Endangered Species Act Section 7 Consultation
Biological Opinion

Activities Considered: Authorization of the Alaska groundfish fisheries under the proposed revised Steller Sea Lion Protection Measures

Agency: National Marine Fisheries Service

Consultation By: National Marine Fisheries Service

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1 BACKGROUND INFORMATION AND CONSULTATION HISTORY

Section 7(a)(2) of the Endangered Species Act (ESA) (16 U.S.C. 1531 *et seq*.) requires that each federal agency insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. If a federal action "may affect" a listed species or critical habitat, section 7 of the ESA requires that the agency consult with NOAA's National Marine Fisheries Service (NMFS) and/or the U.S. Fish and Wildlife Service, depending upon the listed resources that may be affected.

This ESA section 7 consultation considers the action proposed by the NMFS Alaska Region Sustainable Fisheries Division (SFD) to modify the federal groundfish fisheries and State of Alaska parallel groundfish fisheries for Atka mackerel, Pacific cod, and pollock primarily in the Aleutian Islands subarea. This consultation also considers proposed research to better understand the potential effects of these fisheries on Steller sea lions and on the efficacy of conserving prey in areas closed to fishing.

In November 2010, NMFS issued an ESA section 7 biological opinion on the authorization of the groundfish fisheries under the Fishery Management Plan (FMP) for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI), the FMP for Groundfish of the Gulf of Alaska (GOA), and the State of Alaska parallel groundfish fisheries. The 2010 FMP biological opinion (FMP BiOp) found that NMFS could not insure that the authorization of the groundfish fisheries was not likely to jeopardize the continued existence of the western distinct population segment (WDPS) of Steller sea lions or adversely modify or destroy designated critical habitat. In that FMP-level consultation NMFS highlighted concerns about the continued strong decline of the WDPS in the western Aleutian Islands and the lack of recovery in the adjacent central Aleutian Islands. The population trends in these two sub-regions signaled that the WDPS was not recovering in a manner consistent with the abatement of threats to the continued existence of the WDPS per the demographic recovery criteria in the 2008 Steller Sea Lion Recovery Plan (NMFS 2008). NMFS concluded that additional protection from potential competition with the fisheries for prey was necessary given the continued decline of sea lions and the concentrated fishing activity in the sea lion's critical habitat in these sub-regions. NMFS included a reasonable and prudent alternative (RPA) in the FMP BiOp to modify the Atka mackerel and Pacific cod fisheries in the Aleutian Islands subarea to insure jeopardy and adverse modification were not likely. In January 2011, NMFS implemented the RPA by an interim final rule (75 FR 77535, December 13, 2010, and corrected 75 FR 81921, December 29, 2010).

In December 2010, the State of Alaska and several fishing industry groups sued NMFS on the interim final rule, FMP BiOp, and associated analyses. In January 2012, the U.S. District Court for the District of Alaska found that NMFS properly implemented the provisions of the ESA, Administrative Procedure Act, and Magnuson-Stevens Fishery Conservation and Management Act, but did not allow sufficient public participation for the National Environmental Policy Act (NEPA) process for the interim final rule. The Court ruled that NMFS violated NEPA by failing to prepare an Environmental Impact Statement (EIS) and adequately involve the public in the agency's decision-making process. In March 2012 the Court ordered NMFS to prepare an EIS for the interim final rule and provided a schedule for completion of the EIS by March 2, 2014. The schedule was intended to provide for increased participation by the North Pacific Fishery Management Council (NPFMC) and public review and comment. The Court subsequently extended the deadline for the EIS to August 15, 2014.

NMFS, in conjunction with the NPFMC, developed the proposed action, purpose and need, and range of alternatives analyzed in the EIS based on public comments and the work of the NPFMC's Steller Sea Lion Mitigation Committee. The scope of the analysis and the issues to address were informed through the public scoping process and through the NPFMC process. In the draft EIS, NMFS stated its intent to conduct proposed and final rulemaking to implement Steller sea lion protection measures in the groundfish fisheries and to replace the interim final rule. In presentations to the NPFMC and its Steller Sea Lion Mitigation Committee, NMFS's Alaska Region Protected Resources Division (PRD) expressed its intent to complete a new project-level biological opinion if the alternative selected as the proposed action resulted in changes to the action that were not considered in the FMP BiOp.

Meanwhile, several external scientific reviews were conducted on the FMP BiOp. The states of Washington and Oregon commissioned an expert panel to review the FMP BiOp and NMFS commissioned a review with the Center for Independent Experts (CIE). The State-commissioned panel released its findings in October 2011 (Bernard et al. 2011), and the CIE provided its review in the form of separate reports from three independent experts in September 2012 (Bowen 2012, Stewart 2012, Stokes 2012). All of the external scientific reviews were critical of NMFS's treatment and presentation of the science including the assumptions NMFS relied upon to reach the conclusions of the FMP BiOp. Because the four reviews were independent of one another, the points emphasized in the reviews were not unanimous. NMFS carefully considered the reviews and identified areas that warranted further analysis or modification and views that were not supported by the best available science or diverged from provisions of the ESA and NMFS's implementing policies. NMFS PRD and Alaska Fisheries Science Center staff described the analyses to be conducted as a result of the external reviews to the SFD and the NPFMC and its Steller Sea Lion Mitigation Committee in November and December 2012. The results of these new analyses are included in this biological opinion.

Per 50 CFR 402.16, federal agencies are required to reinitiate formal section 7 consultation if (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, (3) the action is modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

NMFS reinitiated consultation on the Alaska groundfish fisheries in the Aleutian Islands on May 10, 2013, due to new information: the external reviews of the FMP BiOp and the new analyses that NMFS intended to conduct in response to those external reviews. Additionally, the research provisions of the proposed action would modify the action in a manner not considered in the FMP BiOp. This consultation considers whether SFD has insured that the proposed Aleutian Islands Atka mackerel, Pacific cod, and pollock fisheries and their supporting research are likely to jeopardize the continued existence of the WDPS of Steller sea lions or destroy or adversely modify designated critical habitat. For all other listed species in the action area, NMFS has determined that consultation need not be reinitiated at this time.

Because the proposed action would modify Steller sea lion protection measures in the BSAI Atka mackerel, Pacific cod, and pollock fisheries, PRD will focus the consultation on this specific project-level action rather than on the FMP-level action. In other words, the FMP BiOp considered the effects of the fisheries as authorized at the plan-level on all listed species under NMFS jurisdiction, and the focus of this analysis will be the effects of the narrower action being evaluated in the EIS on the WDPS of Steller sea lions and designated critical habitat.

The Steller sea lion, *Eumetopias jubatus*, was listed as threatened on November 26, 1990 (55 FR 40204), and Steller sea lion critical habitat was designated on August 27, 1993 (58 FR 45269). In June 1997, the

Steller sea lion stock was divided into eastern and western distinct population segments and the WDPS was listed as endangered (62 FR 30772).

Regulations implementing section 7(a)(2) of the ESA (50 CFR part 402) and associated guidance documents (e.g.,(USFWS and NMFS 1998)) require biological opinions to present (1) a description of the proposed federal action; (2) a summary of the status of the affected listed species and designated critical habitat; (3) a summary of the environmental baseline within the action area; (4) a detailed analysis of the effects of the Proposed Action on the affected species and critical habitat; (5) a description of cumulative effects (future nonfederal actions that are reasonably certain to occur); and (6) a conclusion as to whether it is reasonable to expect the Proposed Action is not likely to jeopardize the listed species or result in the destruction or adverse modification of the species designated critical habitat. By regulation (50 CFR 402.02), the "effects of the action" include the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline. To evaluate whether an action is not likely to result in jeopardy to a listed species or result in the destruction or adverse modification of designated critical habitat, NMFS considers the combination of the status of the species and critical habitat the "effects of the action," and the cumulative effects of reasonably certain to occur future non-federal actions. An action that is not likely to jeopardize the continued existence of the listed species is one that is not likely to appreciably reduce the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution (50 CFR 402.02). This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02 because the Ninth Circuit Court of Appeals determined that definition was facially invalid (*Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service*, 378 F.3d 1059, 9th Cir. 2004). Instead, we rely on the statutory provisions of the ESA to complete the analysis with respect to critical habitat.

Recent court cases have reinforced the direction provided in 50 CFR 402 that NMFS must evaluate the effects of a proposed action within the context of the current condition of the species and critical habitat including other factors affecting the survival and recovery of the species and the functions and value of critical habitat (*National Wildlife Federation v. NMFS*, 524 F.3d 917, 9th Cir. 2008). NMFS considered the guidance provided by recent court decisions in our analytical approach to this consultation.

For this consultation, NMFS uses a conceptual model based on the listed WDPS of Steller sea lions and its designated critical habitat to evaluate the impacts of the proposed action. The conceptual model is based on a hierarchical organization of individual sea lions, population units, and the distinct population segment. The guiding principle behind this conceptual model is that the likelihood of survival and recovery of a species is dependent on the likelihood of survival and recovery of populations that compose the species, and the likelihood of survival and recovery of each population unit is dependent upon the fitness (growth, survival, or reproductive success) of the individuals that compose that population.

NMFS developed this biological opinion after reviewing information provided in the draft EIS (NMFS 2013), previous biological opinions and NEPA documents for SFD and NPFMC actions, the Steller Sea Lion Recovery Plan (NMFS 2008), and the best available data, such as published and unpublished information on the biology and ecology of listed species in the action area, the history of fisheries in the action area, published and unpublished information on fishing efforts and fisheries management, published and unpublished information on the ecosystems in which the action may occur, and published and unpublished information on human activities in the action area, relevant to the environmental baseline and potential cumulative effects. A complete administrative record of this consultation is on file at the NMFS Alaska Regional Office (tracking number: AKR/2013/9294).

1.1 External Reviews of the 2010 FMP BiOp

As mentioned above, external reviews were conducted on the science in the FMP BiOp (NMFS 2010). The States of Alaska and Washington assembled a panel of scientists to conduct a scientific review of the FMP BiOp from April through October 2011 (Bernard et al. 2011) and NMFS commissioned the CIE to conduct a review of the FMP BiOp from April through September, 2012. We describe the results of these reviews in some detail below because the critiques are highly relevant for our analysis in this biological opinion.

States of Alaska and Washington Scientific Review of the FMP BiOp

Due to the lack of consensus about the cause for the sea lion decline, the States of Alaska and Washington were concerned about the credibility of the FMP BiOp and about the impact of conflicting scientific theories on the scientific foundations for ecosystem-based management of North Pacific fisheries (Bernard et al. 2011). Thus, the Alaska Department of Fish and Game (ADFG) and the Washington Department of Fish and Wildlife jointly convened a panel to review the Biological Opinion (Bernard et al. 2011).[1] Each agency selected a co-chair and the two co-chairs selected the other two panel members.[2] The conclusions of the State review were by consensus per the terms of reference. The panel consisted of Dr. David R. Bernard, Mr. Steven J. Jeffries, Dr. Gunnar Knapp, and Dr. Andrew W. Trites. The review panel focused on the conclusions of the FMP BiOp, whether the conclusions were supported by the science in the biological opinion, and whether the conclusions were contradicted by information omitted from the biological opinion. The panel was asked to review whether the FMP BiOp's conclusions represented the most likely explanation for apparent population dynamics of the WDPS of Steller sea lions given current knowledge. The panel was also asked to review whether alternative scientific explanations to the apparent population dynamics of the WDPS of Steller sea lions were thoroughly considered. The panel was asked to review the logical consistency of the RPA with the biological opinion's jeopardy conclusion. The panel was also asked to comment on whether the RPA was sufficient to mitigate jeopardy and whether it was unnecessarily restrictive, whether the RPA was likely to effectively meet recovery goals of the WDPS of Steller sea lions, and to address economic and social aspects of the RPA and whether peer and public comments on economic and scientific issues were considered when developing the biological opinion.

The following is a synopsis of the key assertions in Bernard et al. (2011):

1. The FMP BiOp does not explicitly define its standard for "likely." Implicitly, it uses a standard which is significantly weaker than the scientific standard of preponderance of evidence. The "likely" standard used in the biological opinion should be explicitly defined and the scientific evidence should meet that standard.

2. The FMP BiOp contains an incomplete review of the effort that has been expended over the years to find statistical associations between commercial fishing and Steller sea lion demographics. The panel concludes that a realistic appraisal of the available statistical studies provides strong scientific evidence that fisheries are not having a significant impact on the recovery of the WDPS of Steller sea lions. The panel concludes that without some plausible reason for failing to find any statistical outcomes consistent with negative impacts for the last 10 to 20 years, the statement that, "*it is not possible … to conclude that commercial fisheries are not having a significant impact on the recovery …*" is simply wrong. As such the FMP BiOp should have rejected the scientific hypothesis that a negative relationship exists between fishing and sea lion populations.

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[1] The Terms of Reference are available on the web at: http://wdfw.wa.gov/conservation/steller_sealions/tof.html (accessed November 4, 2013).

[2] NMFS does not consider the review to be "independent" because the agencies had a role in selecting the two co-chairs. Thus, NMFS refers to Bernard et al. (2011) as an external but not independent review.

3. The Alaska Fisheries Science Center (AFSC) fishery footprint analysis appears to be the key document upon which the FMP BiOp based its assessment of competitive interactions between fisheries and Steller sea lions and NMFS's judgment that results of statistical tests have been equivocal.

4. Selecting fisheries for Atka mackerel as potential "fisheries of concern" is relatively easy to accept, but a scientific explanation is needed about how the FMP BiOp concluded that Pacific cod fisheries are "fisheries of concern."

5. The decision points about resource overlap between the commercial fisheries and Steller sea lions was incomplete and biased in the FMP BiOp. Steller sea lion diving depth information was not synthesized with commercial fishery depth information to determine the degree of overlap. The FMP BiOp excluded information on size of prey, even though that information was provided in earlier biological opinions and can be found in other sources. The crude inference from available length data (Ormseth et al. 2008, Zeppelin et al. 2004) is that Steller sea lions ate fish that were only partially recruited to fisheries, thus sea lions take fish from the fishery, not the other way around. Notwithstanding bioenergetics caveats, this should have been discussed—not ignored in the FMP BiOp.

6. The treatment of the spatial and temporal compression of the commercial fisheries was ambiguous in the FMP BiOp. The treatment of the spatial overlap between fisheries and the sea lion prey field was limited to local depletion of prey within critical habitat. A decision of "yes" to spatial overlap between Pacific cod and fisheries and Steller sea lions given in the FMP BiOp is based on a logical fallacy. The FMP BiOp deems the proposition true because it cannot be proven false.

7. The FMP BiOp did not consider the uncertainty in the exploitation rate estimates. The coefficients of variation of the estimated biomass are a crucial part of the best available information; however they were ignored in the FMP BiOp relative to the question of spatial overlap.

8. The ratios of pups to adult females or non-pups are not reliable indicators of reproductive rates because the number of juveniles and adult sea lions onshore are a function of too many variables besides birth rate that are unlikely to stay constant between years or across sites. Thus, the ratios of pups to counts of other age classes as presented in the FMP BiOp are likely meaningless measures.

9. The fishery-driven, nutritional stress hypothesis proffered by NMFS should be scientifically rejected. The available data and analyses indicate that Atka mackerel harvest rates were too low and the reliance on a small population of Pacific cod was too small for the fishery to cause nutritional stress in sea lions under current conditions. Arguments in the FMP BiOp presented in favor of sea lions experiencing nutritional stress caused by a lack of groundfish are not convincing. Forage ratios of groundfish to sea lions present were higher in the western and central Aleutian Islands where sea lions are recovering, thereby indicating a quantity of food area-wide sufficient for sea lions to avoid nutritional stress.

10. Neither the "junk food" hypothesis nor the killer whale predation hypothesis can be scientifically rejected as hypotheses for the reduced numbers of Steller sea lions in the western and central Aleutian Islands. The FMP BiOp inexplicably excluded viable alternate hypotheses, which cannot be rejected at this time, from consideration in the RPA. Instead, Chapter 8 of the FMP BiOp dealt with only one hypothesis— fishery-driven nutritional stress—a hypothesis that is not supported by statistical associations or scientific evidence.

11. NMFS based its choice to rely on single-species models over multi-species models for predicting the efficacy of the RPA on a flawed rationale. By selecting single-species models over multi-species models, NMFS hid rather than reduced uncertainty. This choice required NMFS to assume that restricting fisheries worked in the Gulf of Alaska, and should therefore work to the same degree in the western and

central Aleutian Islands. This assumption is contrary to results from multi-species modeling for the western and central Aleutian Islands and contrary for earlier restrictions in the Gulf of Alaska. NMFS's multi-species modeling also shows that previous restrictions on fisheries from two previous biological opinions were inconsequential to sea lion recovery in the eastern Aleutian Islands and the Gulf of Alaska (Dorn et al. 2005, NMFS 2006). The correct approach to gauging the effectiveness of the RPA in the FMP BiOp would have been to include ecosystem considerations that rely on multi-species, food-web models that directly include sea lions. Multi-species modeling by Aydin (2010) predicted no effect on sea lion biomass from lowering harvest rates in Pacific cod fisheries.

Bernard et al. (2011) also reviewed the economic analysis in the 2010 Environmental Assessment/Regulatory Impact Review for Revisions to the Steller Sea Lion Protection Measures for the Bering Sea and Aleutian Islands Management Area Groundfish Fisheries. However, those comments are not summarized here as economic considerations are specifically barred under section 7(a)(2) of the ESA.

In sum, the panelists were critical of every aspect of the FMP BiOp that they reviewed (see Bernard et al. (2011) pages 95 through 99).

NMFS-Commissioned Review of the FMP BiOp

The CIE provides independent peer reviews of the science on which many of NMFS's management decisions are based, including reviews of stock assessments for fish and marine mammals. The structure and operation of the CIE are designed to ensure the quality, relevance, and independence of the reviews. Independence is maintained by eliminating any role for NMFS in selecting reviewers or in approving the content of reviewers' reports. Reviewers must adhere to a strict conflict of interest policy.

In April 2012, NMFS contracted with the CIE to conduct a peer review of the FMP BiOp. The reviewers were asked to comment on the adequacy of the best available science and of the appropriate interpretation of that science to reach the conclusions presented in the FMP BiOp. They were asked to review the science and interpretation regarding factors, and the role of fisheries in particular, affecting Steller sea lion population status, critical habitat, and recovery. The review panel consisted of Dr. Dan Bowen (Bedford Institute of Oceanography Department of Fisheries and Oceans), Dr. Kevin Stokes (Consultant), and Dr. Brent Stewart (Hubbs-Sea World Research Institute). NMFS received their reviews in three separate reports (Bowen 2012, Stewart 2012, Stokes 2012).

The following summary of the results of the three reviews is organized by perspectives and comments held in common among the reviewers, perspectives held by two of the reviewers, and areas of emphasis from the individual reviews that were not shared by the other reviewers. In some cases the reviewers differed in their perspectives on the treatment and conclusions of the best available data.

The Terms of Reference for the CIE review were intended to provide a framework to focus the reviewers' analysis to questions of science rather than policy and to assist the reviewers in organizing their comments by issue. Stokes' review was organized by the Terms of Reference questions and provided conclusions to each of the questions posed. Bowen and Stewart followed the Terms of Reference guidance to a lesser extent and did not draw conclusions specific to each question in the Terms of Reference. Bowen provided several independent analyses of the available data and literature in reaching his conclusions.

Unanimous Perspectives

While the reviews differed in style, organization, and emphasis, some themes were common among all the reviewers. All reviewers commented on the unwieldy size and organization of the FMP BiOp, stating that it was difficult to identify the key arguments and conclusions given the expansive size and redundant nature of the text. They all thought that the presentation of the information in the FMP BiOp portrayed a bias designed to lead the reader to a conclusion of fishery-induced nutritional stress as the cause for the decline of the WDPS of Steller sea lions by giving unexplained, less thorough treatment to some literature and hypotheses that provide evidence to the contrary. They all commented that there was a lack of critical evaluation of the primary published and unpublished literature and data in the FMP BiOp. They noted that while numerous references were presented (no key omissions were noted) a critical review was not apparent.

All reviewers questioned the reliability of using the ratio of counts of pups to non-pups as proxy for Steller sea lion natality. In general the reviewers concluded that assumptions with this approach need to be explicitly stated and its usefulness as a proxy validated through independent studies. All reviewers suspected that this ratio is a weak proxy for natality given the caveats about Steller sea lion habitat use and movement. The reviewers commented that it is highly important to verify the basis of using pup to non-pup ratios in constructing estimates of survival and natality because these factors provided key support for conclusions about the role of nutritional stress in Steller sea lions population declines.

The reviewers thought that, while the cause of the decline in Steller sea lions is admittedly unknown, the lack of any direct evidence for fisheries-induced nutritional stress in Steller sea lions makes the conclusion of the FMP BiOp unsupportable. They all concluded that the weight-of-evidence suggests that fisheries-induced nutritional stress is unlikely and that NMFS relied on conjecture and hypotheticals rather than evidence to support the conclusions in the FMP BiOp. Given the available evidence, Bowen (2012) concluded that the fisheries-induced nutritional stress hypothesis is unlikely, Stewart (2012) said it is not possible, and Stokes (2012) concluded that it is unknown. All three reviewers emphasized the need to conduct well-designed experiments to test the fisheries-induced nutritional stress hypothesis to draw conclusive results.

The CIE reviewers disagreed with the conclusion in the FMP BiOp that the groundfish fisheries were likely to cause jeopardy to the WDPS of Steller sea lions or result in adverse modification of designated critical habitat.

Common Perspectives

Several views and conclusions were shared by two reviewers. Stokes and Bowen expressed many common views in their respective reports. Both conveyed the need for NMFS to conduct and present critical evaluations of relevant natality studies to understand the degree to which results from region-specific studies are representative of other regions and to critically evaluate the assumptions made in the various studies and the sensitivity of the results to those assumptions. In their view, treatment of this subject in the FMP BiOp was inadequate. They commented that this in an important gap given the reliance of inferred decreases in natality as evidence for nutritional stress in the WDPS of Steller sea lions.

Stokes and Bowen highlighted the need for assumptions and caveats to be more explicitly stated and explained in the FMP BiOp. Both questioned the methods used to delineate the Rookery Cluster Areas and commented on the inability to assess their appropriateness given the lack of detail provided in the FMP BiOp or through the CIE review process. Stokes and Bowen asserted that the exposure analysis, necessary to show spatial and temporal overlap of Steller sea lions and fisheries, was inadequate and not transparent. They both mentioned that the exposure and response analytical framework presented in Figures 4.24 and 4.25 in the FMP BiOp was ambiguous and incomplete, and they question how it was used and how, or if, the framework’s yes/no conclusions were reached, saying this was not evident in the FMP BiOp. They both cited natural, environmental regime change and its potential effects on sea lions and commented that it was poorly treated in the FMP BiOp. They felt that some aspects of the logic in the discussion on environmental change were flawed and contradictory.

Stokes and Bowen both mentioned shortcomings with the FMP BiOp's use of frequency of occurrence (FO) of prey hard parts in scats to infer diet habits; specifically the importance of Atka mackerel, Pacific cod, and pollock in the Steller sea lion diet. They commented that the results are unreliable as presented, as the FMP BiOp did not correct the FO data for known biases and likely overestimated the importance of these prey species in the Steller sea lion's diet.

Stokes and Bowen stated that the FMP BiOp inappropriately relies on "lack of evidence for other causal factors" as evidence in support of the fishery-induced nutritional stress hypothesis. They asserted that the conclusions, as presented, are not well supported by the FMP BiOp and that fine-scale statistical analyses are needed to assess the effects of fishing on Steller sea lions. Lastly, they both concluded that the description of the groundfish fisheries was thorough and accurate.

Bowen and Stewart both said that the FMP BiOp dismisses the possibility of the animals from the WDPS emigrating to the eastern stock without presenting any analysis or evidence in support of the "closed population" conclusions that it drew, even though this conclusion is contradicted by data presented elsewhere in the FMP BiOp on dispersal, emigration, and immigration.

Individual Perspectives

Given their varying backgrounds, the reviewers brought unique perspectives to the review and had views or emphases that were not shared (or at least not conveyed) by the other reviewers. Bowen's review strongly emphasized that the FMP BiOp inappropriately applies results from diet FO studies to infer Steller sea lion diet, and the importance of Atka mackerel, pollock, and Pacific cod specifically. His review said that FO is the least informative estimate of what is consumed. According to Bowen, "without correction for effects of digestion, FO tends to systematically over-estimate prey species with robust hard parts and under-estimate those prey species without or with fragile hard parts. FO will provide a biased view of the diet even if the population has been representatively sampled." Bowen concluded that the estimates of Steller sea lion diet composition reported in the FMP BiOp cannot be considered accurate and that this could be investigated with experimental studies from captive animals. Bowen evaluated several relevant studies referenced in the FMP BiOp to base conclusions on the weight-of-evidence for fisheries-induced nutritional stress and made recommendations for future biological opinions.

Stokes argued that the FMP BiOp should not endeavor to determine the cause of the decline of the WDPS but should focus on factors that are affecting recovery. Beyond the question of the validity of using pup to non-pup ratios as a proxy for natality, Stokes expressed concern with the interpretation of the ratios among sub-regions in the WDPS. He noted that while there is a clear difference (in 2009) between the WDPS and the eastern distinct population segment, and between the western Aleutian Islands and other WDPS sub-regions, there is little difference across the remaining WDPS sub-regions in which population trends diverge. He argued that eastern distinct population segment vs. WDPS comparisons of inferred natality to support an argument of nutritional stress in the western Aleutian Islands does not seem reasonable when the natality and stock trend indicators in the remainder of the WDPS suggest there is no linkage (Stokes 2012).

Stewart alleged that the FMP BiOp disregarded a fundamental constraint imposed by the ESA, that no unit smaller than a distinct population segment is relevant when assessing whether the agency action would likely jeopardize the continued existence of the WDPS. He argued that the two contrasting, leading top-down and bottom-up hypotheses for the decline of Steller sea lions are testable, "to the extent that robust data on the reproductive, physical, and physiological responses of Steller sea lions and their habitats could be collected in their logistically challenging habitats," and to the extent that regulating killer whale abundance would actually be considered and allowed by the public and the courts (Stewart 2012).

Areas of Disagreement

There were some areas where the reviewers disagreed about the interpretation of the available science. For example, the reviewers weighed in from different perspectives on the effects of killer whale predation on Steller sea lions. The Terms of Reference asked, "… does the (FMP) BiOp also adequately address alternate scientific explanations to the apparent population dynamics of the WDPS of Steller sea lion, such as (but not limited to) predation … ?" Stokes said that it would be helpful for the FMP BiOp to note whether killer whale predation was included in Aydin's multi-species models but concluded that, generally, the FMP BiOp contains relevant information and analysis on killer whale predation and does not dismiss killer whale predation as a causal factor in the decline or lack of recovery. Bowen (2012) concluded that, based on new data (e.g., Durban et al. 2010), it is clear that there are sufficient numbers of transient killer whales to exert significant predation mortality on Steller sea lions. Despite the results of several feasibility studies, however, the effects of transient killer whale predation on Steller sea lion dynamics remain unknown. Stewart (2012) concluded, "the apparently leading top-down hypothesis that predation by killer whales can account for the population declines, particularly in the WDPS, lacks persuasive evidentiary support and remains simply hypothetical."

Bowen's assessment of the use of trend sites for monitoring sea lion population trends differed from the conclusions reached by Stokes and Stewart. Bowen described the trends as "uncontroversial" though he said that they need to be presented with a description of the uncertainty about the estimates. Bowen noted that Steller sea lion populations are monitored by conducting counts during the breeding season at a large number of consistently surveyed sites and that similar approaches are commonly used to monitor pinniped population trends elsewhere. Though they cited different reasons, Stokes and Stewart thought that NMFS's Steller sea lion survey design is potentially flawed because it monitors consistently surveyed trend sites instead of sites selected at random from year to year. Stokes described the trends as "tenuous" because the "i) spatial categorizations are not explicitly justified and no sensitivity testing was conducted on their delineation; ii) use of trend sites may introduce bias in trend estimation rendering east to west comparisons invalid; and iii) lack of transparency because of unpublished materials." Stewart questioned the use of trend sites because if the WDPS of Steller sea lion is a metapopulation, as has been argued, then the use of trend sites would seem to be a poor method to assess overall population status and viability.

Bowen and Stokes commented on NMFS's use and interpretation of ratios of sea lion forage requirements to prey biomass in Steller sea lion critical habitat. They agree with one another that the harvest rates of Atka mackerel and pollock appear to be too low to have an adverse effect on the biomass available to foraging Steller sea lions. However, they differ in their view about NMFS's conclusion that the forage to biomass ratios were not useful in evaluating the impacts of the fisheries on the value of critical habitat. Bowen stated that NMFS's conclusions about the forage to biomass ratios seemed problematic because NMFS did not discuss the interpretation that a high forage ratio in an area of decline suggests that food may not be limiting (Bowen 2012). Stokes commented that the FMP BiOp sensibly ignores the forage ratio information (Stokes 2012).

NMFS's Response to the External Reviews

Responses to the external reviews of the FMP BiOp are incorporated throughout this biological opinion. We point out where we agreed with the reviewers and/or conducted new analyses as a result of the external reviews, and we take care to present the information and evidence objectively and transparently. Some issues raised by the external reviews were not consistent with ESA implementing regulations or policy and some of the reviewers' assertions do not comport with NMFS's interpretation of the best available science. In those cases, NMFS explains the reasons and provides the data for supporting an approach of which the external reviewers may have been critical.

1.2 Consultation History

A history of recent, relevant consultations and actions leading up to this biological opinion is presented below.

January 26, 1996, Biological Opinions on the FMPs for the BSAI groundfish fishery and the GOA groundfish fishery, the proposed 1996 total allowable catch (TAC) specifications and their effects on Steller sea lions. These opinions concluded that the BSAI and GOA FMPs, fisheries, and harvests under the proposed 1996 TAC specifications were not likely to jeopardize the continued existence of Steller sea lions or to result in the destruction or adverse modification of their critical habitat. NMFS also concluded that the reasons for the decline of Steller sea lion populations and the possible role of the fisheries in the decline remain poorly understood.

December 3, 1998, Biological Opinion on authorization of the BSAI Atka mackerel fishery, BSAI pollock fishery, and GOA pollock fishery under their respective FMPs for the period 1999 to 2002. The opinion concluded that the Atka mackerel fishery was not likely to jeopardize the western population of Steller sea lion or adversely modify its critical habitat, but that the pollock fisheries were likely to cause jeopardy and adverse modification. These conclusions and RPAs developed for the pollock fisheries were challenged in court; the conclusions were upheld, but the RPAs were found arbitrary and capricious for lack of sufficient information. The court ordered preparation of revised final RPAs, which were issued by NMFS on October 15, 1999, and were implemented for the 2000 fisheries.

December 22, 1998, Biological Opinion on authorization of the BSAI and GOA groundfish fisheries based on TAC specifications recommended by the NPFMC for 1999. The opinion concluded that based on the 1999 TAC specifications, the groundfish fisheries were not likely to cause jeopardy or adverse modification for listed species or their critical habitat. The opinion was challenged in court and subsequently found to be arbitrary and capricious for failing to include a sufficiently comprehensive analysis of the groundfish fisheries and their individual, combined, and cumulative effects. Based on this finding, the court determined that NMFS was out of compliance with the ESA (Greenpeace v. National Marine Fisheries Service, 80 F. Supp. 2d 1137 [WD. Wash. 2000]).

December 23, 1999, Biological Opinion on authorization of the BSAI and GOA groundfish fisheries based on TAC specifications recommended by the NPFMC for 2000, and on authorization of the fisheries based on statutes, regulations, and management measures to implement the American Fisheries Act of 1998 (AFA). The opinion concluded that based on the 2000 TAC specifications and implementation of the AFA, the groundfish fisheries would not jeopardize the continued existence of listed species or result in the adverse modification of designated critical habitat. The opinion was not challenged in court.

November 30, 2000, Biological Opinion (FMP Biological Opinion) on authorization of groundfish fisheries in the BSAI under the FMP for Groundfish of the BSAI Management Area, and the authorization of groundfish fisheries in the GOA under the FMP for Groundfish of the GOA (NMFS 2000). The opinion was comprehensive in scope and considered the fisheries and the overall management framework established by the respective FMPs to determine whether that framework contained necessary measures to ensure the protection of listed species and their critical habitat. The FMP Biological Opinion determined that the BSAI or GOA groundfish fisheries, as implemented under the respective FMPs, were likely to jeopardize the continued existence of the WDPS of Steller sea lions and result in adverse modification of designated critical habitat. The FMP Biological Opinion provided an RPA which was partially implemented in 2001. Full implementation of the RPA was scheduled for 2002; however, the action considered in the 2001 Biological Opinion described below took the place of that RPA.

In January 2001, an RPA committee, composed of members of the fishing community, the conservation community, NMFS, State agencies, and the NPFMC's Scientific and Statistical Committee, was formed by the NPFMC to develop an alternative to the RPA in the 2000 FMP Biological Opinion.

October 19, 2001, Biological Opinion on authorization of the BSAI and GOA groundfish fisheries under their respective FMPs, specifically the Pacific cod, pollock, and Atka mackerel fisheries and the parallel fisheries for Pacific cod, pollock, and Atka mackerel as authorized by the State of Alaska within 3 nm of shore (NMFS 2001). In July 2001, the action agency, SFD, proposed an alternative RPA developed by the RPA committee to replace the components of the original FMP action that had resulted in the jeopardy and adverse modification finding in the 2000 FMP Biological Opinion. In 2001, NMFS prepared the project level Biological Opinion, (NMFS 2001) which reviewed the revised action and determined that it was not likely to jeopardize or adversely modify critical habitat. This 2001 Biological Opinion evaluated the direct and indirect effects of that proposed action on Steller sea lions and designated critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. These effects were considered in the context of an Environmental Baseline and Cumulative Effects. State-waters parallel fisheries were included in the 2001 BiOp due to their intricate connection with the federal action as well as a request by the State of Alaska to formally include the parallel fisheries in the consultation. The 2001 Biological Opinion determined that the action was not likely to jeopardize or adversely modify critical habitat. The court reviewed the 2001 Biological Opinion and found that it was arbitrary and capricious and remanded the opinion back to NMFS for revision.

June 19, 2003, Supplement to the 2001 Biological Opinion on authorization of the BSAI and GOA groundfish fisheries under their respective FMPs, specifically the Pacific cod, pollock, and Atka mackerel fisheries and the parallel fisheries for Pacific cod, pollock, and Atka mackerel as authorized by the State of Alaska within 3 nm of shore (NMFS 2003)**.** In response to the court remand, NMFS prepared a supplement to the 2001 Biological Opinion. The 2003 supplement provided background information on the decision making process in the 2001 Biological Opinion and affirmed NMFS's conclusions that the revised FMP actions were not likely to jeopardize ESA-listed species or adversely modify their critical habitat.

March 9, 2006, Biological Opinion on the issuance of an exempted fishing permit (EFP) to support a feasibility study using commercial fishing vessels for acoustic surveys of pollock in the Aleutian Islands subarea. The opinion evaluated the effects of harvesting pollock inside Steller sea lion designated critical habitat under an EFP. NMFS determined that the action would not jeopardize the continued existence of listed species or result in adverse modification of critical habitat.

November 24, 2010, Biological Opinion (FMP BiOp) on the authorization of groundfish fisheries under the FMP for Groundfish of the BSAI Management Area, authorization of groundfish fisheries under the FMP for Groundfish of the GOA, and State of Alaska parallel groundfish fisheries (NMFS 2010). The 2010 FMP BiOp replaced the 2000 FMP Biological Opinion. The 2010 FMP BiOp was comprehensive in scope and considered the fisheries and the overall management framework established by the respective FMPs to determine whether that framework contained necessary measures to ensure the protection of listed species and their critical habitat. The FMP BiOp determined that the fisheries, as implemented, were likely to jeopardize the continued existence of the WDPS of Steller sea lions and result in adverse modification of designated critical habitat. The FMP BiOp concluded that the fisheries, as implemented, were not likely to jeopardize the continued existence of humpback, sperm or fin whales. The FMP BiOp included an RPA which was implemented in 2011via interim final rule (75 FR 77535, December 13, 2010, and corrected 75 FR 81921, December 29, 2010).

As described above, as a result of a lawsuit filed by the State of Alaska and others in December 2010, the U.S. District Court for the District of Alaska upheld the FMP BiOp and interim final rule but ordered NMFS to prepare an EIS on the interim final rule. The State of Alaska appealed and the Ninth Circuit Court of Appeals upheld the District Court's ruling in July, 2013. SFD worked with the NPFMC and its Steller Sea Lion Mitigation Committee (SSLMC) to develop the range of alternatives in the draft EIS (NMFS 2013). The SSLMC met eight times from May through November 2012 to review recent fishery and sea lion science and develop a range of alternatives for the EIS. The NPFMC combined the SSLMC's alternatives with the regime analyzed as the proposed action in the FMP BiOp, with modifications, for its recommended suite of alternatives to be analyzed in the EIS. The SSLMC met in March 2013 to review the preliminary draft EIS and recommend a preliminary preferred alternative to the NPFMC. At its April 2013 meeting, the NPFMC adopted the SSLMC's preliminary preferred alternative. NMFS analyzed the NPFMC's preliminary preferred alternative and released the draft EIS for public review and comment on May 14, 2013.

Anticipating that the NPFMC was poised to recommend a preferred alternative that differed from the interim final rule, PRD presented the analytical approach for the anticipated ESA consultation to the NPFMC's Scientific and Statistical Committee at its April 2013 meeting. The Scientific and Statistical Committee requested to hear more detailed methods on specific studies described in the analytical approach.

SFD requested reinitiation of consultation on May 10, 2013, on the NPFMC's preliminary preferred alternative in the draft EIS, due to changes to the action that may result in effects not previously analyzed in a formal consultation.

In June 2013, PRD and AFSC staff presented detailed methods and preliminary results of specific studies (AFSC 2013, DeMaster 2013) per the Scientific and Statistical Committee's request. PRD also presented an initial analysis of the NPFMC's preliminary preferred alternative (PRD 2013b, 2013c) to the NPFMC and its Scientific and Statistical Committee. The objective of the analysis was to identify elements of the preliminary preferred alternative that were consistent with the performance standards for Steller sea lion protection measures introduced in the FMP BiOp and incorporated into the draft EIS and elements of the preliminary preferred alternative that were not consistent with those performance standards. Overall, the intent was to provide early feedback to the NPFMC about aspects of the preliminary preferred alternative that were of concern to PRD and to provide the NPFMC an opportunity to recommend adjustments to the proposed action to reduce effects of the proposed action on designated critical habitat in areas where Steller sea lion populations remain in decline. PRD also made the analytical approach document (PRD 2013a) available to the NPFMC in June 2013. The NPFMC did not recommend changes to the preliminary preferred alternative.

PRD responded to SFD's request to reinitiate formal consultation on July 29, 2013. PRD determined upon review of the proposed action that the preliminary preferred alternative was similar to the proposed action analyzed in the FMP BiOp. PRD noted in its response to SFD that the proposed action appeared to have the net effect of increasing fishing for Steller sea lion prey species inside of critical habitat relative to the proposed action analyzed in the FMP BiOp which had resulted in a conclusion of jeopardy and adverse modification. PRD concurred that reinitiation of formal consultation was warranted due to new information likely to result from ongoing analyses in response to the external reviews of the FMP BiOp.

In October 2013, the NPFMC recommended the preliminary preferred alternative in the draft EIS as the preferred alternative for the final EIS. On October 21, 2013, SFD transmitted a memorandum to PRD confirming alternative 5 in the draft EIS (NMFS 2013) as the proposed action for this consultation.

On November 1, 2013, PRD and SFD met to discuss the research component of the proposed action. SFD confirmed that two research elements described in Chapter 11 of the draft EIS (NMFS 2013) are part of the proposed action for this consultation– the Atka mackerel tagging studies and the opportunistic prey field study. Thus, two of the triggers for reinitiation of formal consultation are satisfied, the new information as a result of the external reviews of the FMP BiOp and the change to the proposed action by the addition of a research component.

2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action consists of two main components. The first component is a suite of measures to control the location, gear type, timing, and harvest amount for Atka mackerel, pollock, and Pacific cod fishing in the Aleutian Islands (referred to herein as the fishery component). The purpose of the fishery component of the proposed action is to replace the interim final rule (75 FR 77535, December 23, 2010, and corrected 75 FR 81921, December 29, 2010) with a rule that avoids jeopardizing the continued existence of the WDPS of Steller sea lions or adversely modifying designated critical habitat and simultaneously minimizes, to the extent practicable, economic impacts to the groundfish fisheries. The second component of the proposed action is research on groundfish abundance and distribution, and movement of Atka mackerel (referred to herein as the research component). The purpose of the research component is to learn about local abundance and movement patterns of groundfish in the Aleutian Islands to understand potential impacts of commercial fisheries on Steller sea lion prey species. The proposed research would provide data about the potential for fisheries to cause localized depletion of sea lion prey and about the efficacy of trawl exclusion zones.

2.1 Action Area

The action area means “all areas affected directly or indirectly by the federal action and not merely the immediate area involved in the action” (50 CFR 402.02). As such, the action area for the federally managed Aleutian Islands groundfish fisheries effectively covers all of the Aleutian Islands fishery management areas of the US Exclusive Economic Zone (EEZ) and adjacent state waters. The action area comprises three fishery management districts in the Aleutian Islands (Figure 2-1):

- The Eastern Aleutian District, Area 541. The area south of 55° 00' N latitude, west of 170° 00' W longitude, and east of 177° 00' W longitude and bounded on the south by the limits of the US EEZ as described in the current editions of NOAA chart INT 813 Bering Sea (Southern Part) and NOAA chart 530 (San Diego to Aleutian Islands and Hawaiian Islands).
- The Central Aleutian District, Area 542. The area south of 55° 00' N latitude, west of 177° 00' W longitude, and east of 177° 00' E longitude and bounded on the south by the limits of the US EEZ as described in the current editions of NOAA chart INT 813 Bering Sea (Southern Part) and NOAA chart 530 (San Diego to Aleutian Islands and Hawaiian Islands).
- The Western Aleutian District, Area 543. The area south of 55° 00' N latitude and west of 177° 00' E longitude, and bounded on the south and west by the limits of the US EEZ as described in the current editions of NOAA chart INT 813 Bering Sea (Southern Part) and NOAA chart 530 (San Diego to Aleutian Islands and Hawaiian Islands).

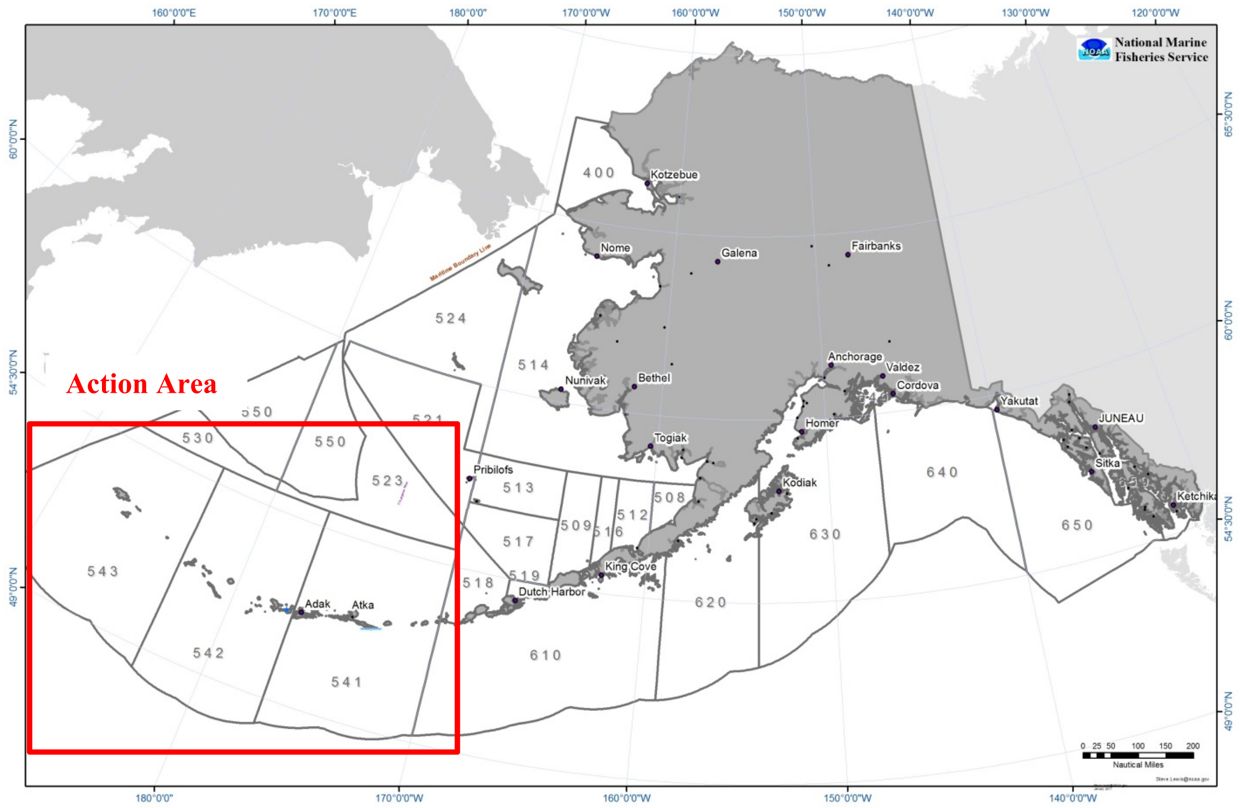

Figure 2-1. **Aleutian Islands Fishery Management Districts (Areas).**

2.2 Description of the Proposed Fishery Component

Readers are referred to Chapter 2 of the FMP BiOp (NMFS 2010) for the plan-level description of the Alaska groundfish fisheries. That biological opinion describes the fisheries management policy, exploitation strategy, annual fisheries assessment, and implementation of the federal groundfish fisheries in the BSAI and GOA and the State parallel groundfish fisheries.[3] Implementation of the groundfish fisheries is described in Section 2.5 of the FMP BiOp. The only changes to the fishery component of the proposed action relative to the action described in the FMP BiOp are changes to the Aleutian Islands Atka mackerel, Pacific cod, and pollock fishing locations, seasons and area-specific catch limits depending on the target species and gear type. This section describes elements of the proposed action that are modified relative to the proposed action analyzed in the FMP BiOp.

Protection for an emerging rookery site

The proposed action would prohibit groundfish fishing from 0 to 3 nm from the Kanaga Island/Ship Rock Steller sea lion rookery in Fishery Management Area 542. Kanaga Island/Ship Rock was classified as a major haulout site when critical habitat was designated in 1993 (58 FR 45269, August 27, 1993). An analysis conducted in 2006 and cited in the FMP BiOp (NMFS 2010) concluded that five new sites in the range of the WDPS of Steller sea lions should be considered as rookeries for conservation purposes due to recent counts indicating high use of these sites by non-pups and pups in the breeding season. The Kanaga Island/Ship Rock site was the only new rookery identified in Table 3.30 in the FMP BiOp in the Aleutian

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[3] Generally, a parallel groundfish fishery is a fishery that occurs in waters of the State of Alaska (from 0 to 3 nm) adjacent to the BSAI or GOA management areas and opens concurrently with federal groundfish fisheries such that groundfish catch is deducted from the federal total allowable catch.

Islands. Waters from 0 to 3 nm around rookeries were closed to directed fishing for groundfish when the 2003 Steller sea lion protection measures were implemented (68 FR 204, January 2, 2003). The 0 to 3 nm zone around the Kanaga Island/Ship Rock site was closed to fishing with trawl gear for Atka mackerel, Pacific cod and pollock under the 2003 protection measures (NMFS 2013). By affording this site rookery status, the proposed action would close the 0 to 3 nm zone to all groundfish harvest, including Pacific cod with nontrawl gear—a closure not included in the proposed action that was analyzed in the FMP BiOp.

Modifications to the Atka mackerel trawl fishery

The proposed action would modify several aspects of the Aleutian Islands Atka mackerel trawl fishery relative to the action analyzed in the FMP BiOp (NMFS 2010).

Remove the Harvest Limit Area Management Structure
First, the proposed action would eliminate the platoon management structure referred to as the Harvest Limit Area (HLA) management in the FMP BiOp. NMFS first implemented HLA management for Atka mackerel trawl fishing inside Steller sea lion critical habitat in Fishery Management Areas 543 and 542 west of 178° W longitude in 2002 (67 FR 956). The objective of HLA management was to spatially and temporally disperse Atka mackerel harvest inside Steller sea lion critical habitat by creating two Atka mackerel directed fishing seasons inside critical habitat in Areas 543 and 542, establishing a critical habitat TAC limit of less than or equal to 60 percent of the seasonal TAC, and randomly assigning vessels to one of the two critical habitat directed fisheries for Atka mackerel. By regulation, the HLA fishery was limited to a maximum duration of 14 days and could only open after the closure of the Area 541 Atka mackerel directed fishery. In general, one to six vessels were assigned to each directed HLA fishery from 2002 through 2010.[4]

The platoon management of Atka mackerel inside the HLA was repealed by the interim final rule (75 FR 77535) because the interim final rule prohibited all retention of Atka mackerel in Area 543 and restricted nearly all directed fishing for Atka mackerel in critical habitat in Area 542. It was also determined that removal of the HLA would allow the fishery to temporally disperse instead of being compressed into a short period, while maintaining the goals of limiting catch inside critical habitat.

The proposed action would allow Atka mackerel fishing inside of Steller sea lion critical habitat in Areas 543 and 542 without reinstating the HLA management structure of the proposed action in the FMP BiOp. Instead, several alternate measures designed for synergy with the current FMP would be implemented to achieve the objectives of HLA management—limiting catch inside critical habitat and spatially and temporally dispersing Atka mackerel harvest in Steller sea lion critical habitat.

As described in the FMP BiOp (NMFS 2010), Amendment 80 to the BSAI Groundfish FMP (72 FR 54219, September 24, 2007) allocated six groundfish species including Atka mackerel and Pacific cod among fishing sectors, facilitated the formation of cooperatives among non-AFA trawl catcher/processors, and established a limited access privilege program (also referred to as a catch share program). The implementation of Amendment 80 in 2008 ended the race for Atka mackerel (since approximately 90 percent of the ITAC is allocated to the Amendment 80 sector) (78 FR 13813, March 1, 2013). Catch share programs allow harvesters to fish slower since they are no longer competing with other harvesters for a shared, total catch limit, and they can use fishing practices that reduce the harvest rate and bycatch. Vessel operators can also consolidate fishing operations on to fewer vessels and coordinate with other operators to avoid areas with high bycatch. Prior to implementation of Amendment 80, harvesters were competing for the Atka mackerel TAC, attempting to maximize their harvest in as little time possible. Participation in the Atka mackerel fishery is now limited as a result of Amendment

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[4] http://alaskafisheries.noaa.gov/cm/info_bulletins/?keyword=harvest%20limit%20area

80, which eliminates the need for the HLA platoon management structure that was implemented in 2002 when harvesters were competing to harvest the TAC. The NPFMC recommended that the proposed action not include the HLA management as it no longer disperses fishing in space and time to the extent realized by fishing practices under Amendment 80. Moreover, the proposed action retains the 50:50 seasonal TAC apportionment and the critical habitat harvest limit of 60 percent of TAC for Areas 543 and 542, west of 178° W longitude that was part of the HLA management structure.

Modify trawl gear season dates
The proposed action would modify the season dates for the Aleutian Islands Atka mackerel trawl fishery relative to the action analyzed in the FMP BiOp. The season dates from the action in the FMP BiOp, the interim final rule (75 FR 77535), and the proposed action are shown in Table 2-1. The interim final rule changed the Atka mackerel trawl season dates to align the Atka mackerel seasons with the Aleutian Islands pollock and Pacific cod trawl fisheries and to temporally disperse catch. The Atka mackerel trawl fishery season dates would be extended even further under the proposed action. The extended seasons (along with the seasonal TAC apportionments) are intended to allow for further dispersion of Atka mackerel harvest over the year (NMFS 2013).

Table 2-1.Atka mackerel trawl fishery season dates in 2010 (FMP BiOp), 2011–2014 (Interim Final Rule), and as proposed.

	A Season		B Season	
	Start	End	Start	End
Action in FMP BiOp	20-Jan	15-Apr	1-Sep	1-Nov
Interim Final Rule	20-Jan	10-Jun	10-Jun	1-Nov
Proposed Action	20-Jan	10-Jun	10-Jun	31-Dec

Prohibit Harvest of Rolled Over TAC Inside Critical Habitat
Under the 2003 Steller sea lion protection measures (68 FR 204, January 2, 2003) unharvested A season TAC could be rolled over for harvest in the B season. Only the unharvested A season TAC inside the HLA was rolled to the B season HLA limit, and the unharvested A season TAC outside the HLA was rolled to the B season outside HLA TAC. The proposed action differs from the 2003 measures in that it would prohibit the increase of B season harvest inside Steller sea lion critical habitat.

Modifications in Area 543
In Area 543, the proposed action would modify the closure to Atka mackerel fishing around the Buldir Island rookery relative to the closure analyzed in the FMP BiOp. The proposed action would modify the closure around Buldir Island from a 0 to 15 nm closure to trawl fishing for Atka mackerel to a 0 to 10 nm closure (Figure 2-3). The 0 to 10 nm closure is consistent with other rookery closures in Area 543 under the 2003 protection measures.

The proposed action would also limit the Area 543 Atka mackerel TAC to less than or equal to 65 percent of the acceptable biological catch (ABC). The action analyzed in the FMP BiOp did not include an Area 543-specific Atka mackerel harvest limit.

Modifications in Area 542
In addition to the Area 542 Atka mackerel area closures that were part of the action in the FMP BiOp, the proposed action would close Steller sea lion critical habitat to Atka mackerel fishing between 178°E and 180° longitude (Figure 2-3). The proposed action would close areas that were open under the 2003 protection measures, would increase 0 to 10 nm closures to 0 to 20 nm closures year-round at five rookeries (Ayugadak Point, Amchitka/Column Rocks, Amchitka Island/East Cape, Semisopochnoi/Petrel,

and Semisopochnoi/Pochnoi) and would increase 0 to 3 nm closures to 0 to 20 nm at six haulouts (Unalga and Dinkum Rocks, Amatignak Island/Nitrof Point, Amchitka Island/Cape Ivakin, Hawadax Island (formerly Rat Island), Little Sitkin Island, and Segula Island). The proposed closed and open areas were designed based on Alaska Fisheries Science Center, Fishery Interaction Team (FIT) research of areas that are more and less susceptible to localized depletion of Atka mackerel (NMFS 2013). The proposed action would provide opportunities to fish for Atka mackerel inside sea lion critical habitat in Area 542 while maintaining nearshore closures for haulouts and rookeries. Fishing for Atka mackerel would be prohibited near Amchitka Island where research has shown that fishing, as it occurred before 2011, could affect sea lion prey inside of 10 nm and abundance of Atka mackerel is low compared to other areas in Area 542 (McDermott and Haist In Review).

Modifications in Area 541

The proposed action would open a portion of sea lion critical habitat to Atka mackerel fishing in Area 541. All of critical habitat in Area 541 was closed to Atka mackerel fishing under the action analyzed in the FMP BiOp. Fishing for Atka mackerel has been prohibited in Steller sea lion critical habitat in Area 541 since 2001 (66 FR 37167, July 17, 2001). The proposed action would open a portion of critical habitat in Area 541 from 12 to 20 nm southeast of Seguam Island. Beyond the 50 percent seasonal apportionments there would be no limit on the amount of the Atka mackerel TAC that could be harvested inside this open area of critical habitat.

This proposed directed fishing for Atka mackerel in critical habitat is based on FIT studies that have shown that there is little exchange between Atka mackerel inside the areas proximate to the islands around Seguam Pass (inside 12 nm) and the outside areas (outside 12 nm) (McDermott and Haist In Review). This new information suggests that Atka mackerel outside of 12 nm follow bathymetric contours extending from outside critical habitat to inside critical habitat to approximately 12 nm from the Steller sea lion sites at Agligadak, Amlia, and Seguam Islands. The proposed action would open this limited area inside critical habitat to Atka mackerel fishing.

Bering Sea Subarea

While the proposed action pertains chiefly to statistical areas in the Aleutian Islands, the management of the Atka mackerel TAC in the Aleutian Islands Statistical Area 541 is combined with the Bering Sea subarea; therefore, the proposed action also would control the Atka mackerel fishery in the Bering Sea subarea. The proposed action would prohibit directed fishing for Atka mackerel with trawl gear in the Bering Sea subarea. Under the action analyzed in the FMP BiOp, trawling for Atka mackerel was prohibited from 0 to 20 nm around all Steller sea lion rookeries and haulouts and in the Bogoslof Foraging Area. The proposed action would retain the provision in the interim final rule (75 FR 77535, December 13, 2010, and corrected 75 FR 81921, December 29, 2010) to close the entire Bering Sea subarea to directed fishing for Atka mackerel with trawl gear. The proposed action would also modify maximum retainable amount (MRA) regulations for Amendment 80 vessels and Western Alaska Community Development Quota (CDQ) entities operating in the Bering Sea subarea.

In general, the harvest of Atka mackerel in the Bering Sea is incidental to harvest of other groundfish target species, occurring in relatively small quantities in critical habitat areas closed to directed fishing for Atka mackerel. Prohibiting directed fishing for Atka mackerel in the Bering Sea subarea allows for the continued harvest of Atka mackerel in a manner similar to historical practices. The TAC for Atka mackerel in Area 541 is combined with the Bering Sea subarea so that this allocation is managed as a unit. Any harvest limit or seasonal apportionment applied to the Atka mackerel fishery management in Area 541 needs to be applied to the Bering Sea subarea to manage the combined allocation. This concurrent change in the Bering Sea subarea is designed to facilitate management.

The effect of these modifications would provide for more of the combined Bering Sea/541 Atka mackerel TAC to be harvested in the Bering Sea subarea rather than the Aleutian Islands. Regulations at 50 CFR 679.20(e) establish MRA percentages for groundfish species. These MRA percentages establish the amount of a species closed to directed fishing that may be retained onboard a vessel, relative to the amounts of other groundfish open to directed fishing retained onboard the vessel. MRA percentages serve as a management tool to slow down the rate of harvest and reduce the incentive for targeting a species closed to directed fishing. MRAs also allow for retention of incidentally caught species instead of requiring regulatory discards of species closed to directed fishing. MRA percentages may not reflect a natural incidental catch rate, but rather, may reflect a balance between the recognized need to slow harvest rates, minimize the potential for discards, and, in this case, provide an increased opportunity to harvest available TAC through limited targeting activity.

By closing the Bering Sea to directed fishing, harvest of Atka mackerel would be limited to the MRA which, for BSAI Atka mackerel, is 20 percent of the amount of each basis species retained at any time during a fishing trip. The proposed action would revise the method for calculating the MRA so that the MRA would be calculated on an offload to offload basis to be consistent with the method used by all non-AFA vessels for pollock, including the Amendment 80 sector. Under status quo, 50 CFR 679.20(e)(3)(iii) requires calculating the maximum retainable amounts for vessels harvesting pollock in the BSAI at the end of each offload and is based on the basis species harvested and retained since the previous offload. Non-AFA catcher vessels and catcher processors under Amendment 80 are currently required to calculate the MRA at any time during each trip (50 CFR 679.20(e)(3)(i) and (ii)), with a new fishing trip being established each time the vessel crosses from an area open to directed fishing to an area that is closed to directed fishing. The proposed action would resolve MRA accounting issues that arise when a vessel moves among areas open and closed to Atka mackerel between offloads.

Aleutian Islands Habitat Protection and Conservation Areas

Amendment 78 to the BSAI Groundfish FMP closed a large portion of the Aleutian Islands subarea to nonpelagic trawling. Nonpelagic trawl gear is used for harvesting Atka mackerel and Pacific cod. The Amendment 78 closures to nonpelagic trawling include the Aleutian Islands Habitat Conservation Area (AIHCA), the Aleutian Islands Coral Habitat Protection Areas, and the Bowers Ridge Habitat Conservation Zone, located in the northern portion of Area 542 and 543 (Figure 2-2). These closures were implemented on July 28, 2006 (71 FR 36694), and revised March 20, 2008 (73 FR 9035). These closures were mentioned in the FMP BiOp (see NMFS (2010) pg. 55), but not mentioned or considered elsewhere in that analysis. The AIHCA closed most of the Aleutian Islands subarea to nonpelagic trawling (279,114 nm^2), and left open most fishing areas that have been repeatedly trawled in the past. The Bowers Ridge Habitat Conservation Zone is closed to mobile bottom contact gear, including nonpelagic trawling. The Aleutian Islands Coral Habitat Protection Areas are relatively small, discrete areas closed to bottom contact gear. These closures are in addition to the Steller sea lion protection measures and, in combination, substantially limit the locations available for nonpelagic trawling in the Aleutian Islands subarea (Figure 2-2). Figure 2-3 shows the proposed action combined with the Aleutian Islands Habitat Protection Measures. As shown in Figure 2-3, only a small portion of the amount of critical habitat open to fishing for Atka mackerel would be open to Atka mackerel fishing with trawl gear. More than 90% of the Atka mackerel TAC is harvested with nonpelagic trawl gear.

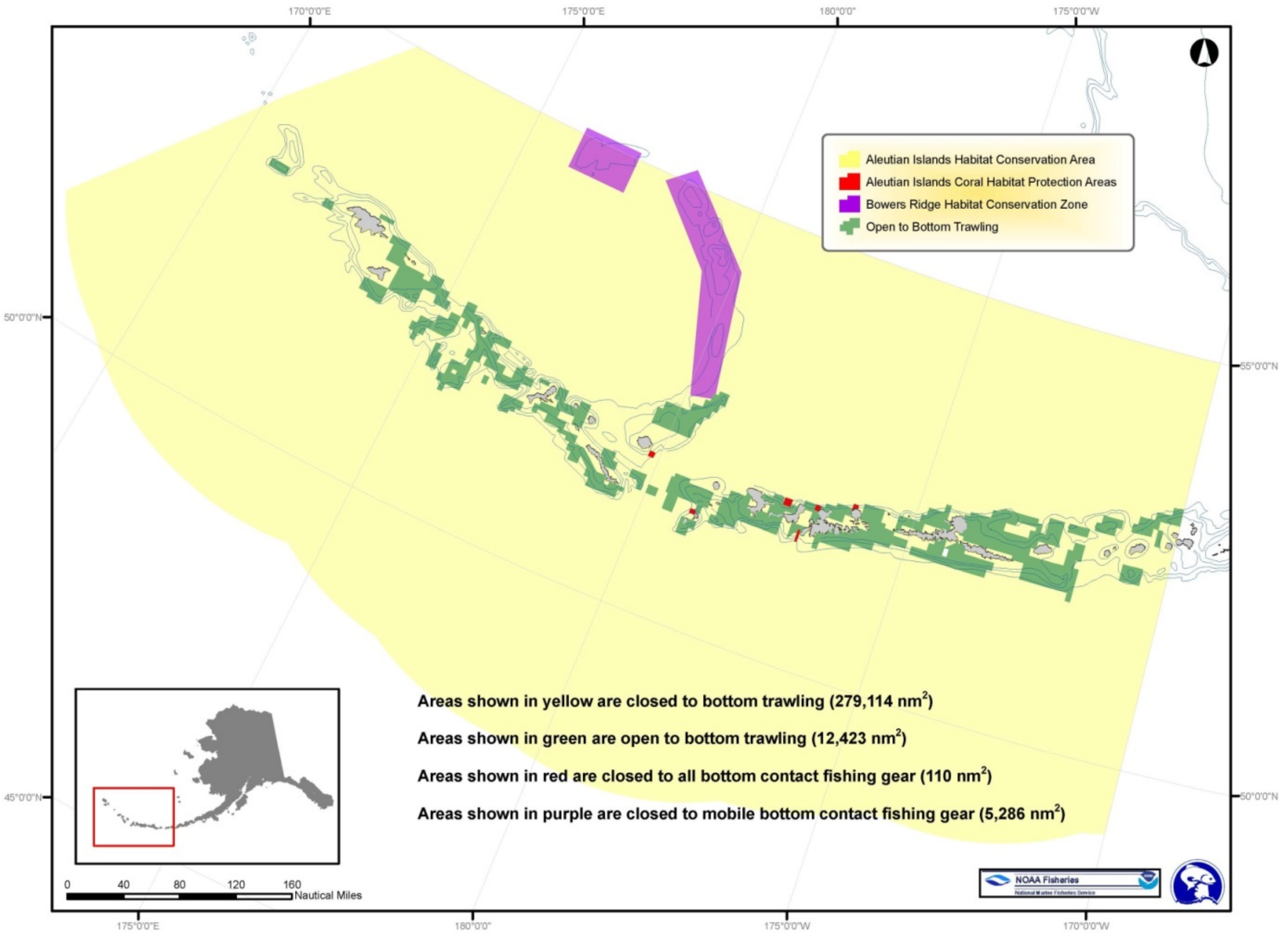

Figure 2-2. Aleutian Islands Essential Fish Habitat Protection Measures implemented via BSAI FMP Amendment 78 (71 FR 36694, June 28, 2006).

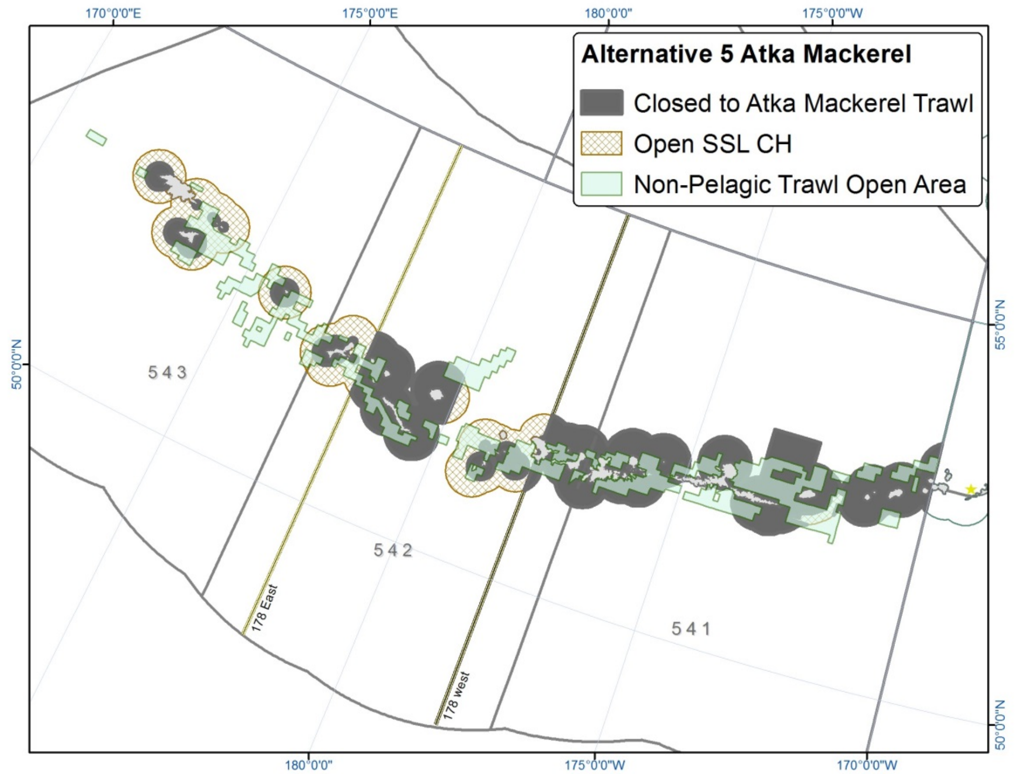

Figure 2-3. Proposed Aleutian Islands Atka mackerel trawl closures (NMFS 2013).

Modifications to Pacific cod fisheries

Aleutian Islands-specific Pacific cod OFL, ABC and TAC

All of the alternatives analyzed in the draft EIS (NMFS 2013) assume that the BSAI Pacific cod overfishing limit (OFL), ABC and TAC will be split into separate Eastern Bering Sea (EBS) and Aleutian Island ABCs and TACs beginning in 2014. Throughout the history of management under the Magnuson-Stevens Fishery and Conservation and Management Act, Pacific cod in the EBS and Aleutian Islands has been managed as a unit. Since at least the mid-1980s, harvest specifications for the combined BSAI unit have been extrapolated from an age-structured model for Pacific cod in the EBS. However, the available science indicates that the Aleutian Islands Pacific cod stock is biologically distinct from the EBS stock (Canino et al. 2010, Canino et al. 2005, Cunningham 2007, Spies 2012). Since at least 2009, the BSAI Pacific cod stock assessment authors have explored the development of a separate Aleutian Islands Pacific cod stock assessment model. As of 2012, the Aleutian Islands stock assessment model remained exploratory, primarily due to the lack of age-structure data for the Aleutian Islands Pacific cod stock. In December 2012, the NPFMC's Scientific and Statistical Committee (SSC) observed that Pacific cod harvest rates in the Aleutian Islands would have exceeded the (exploratory) maximum permissible ABC by more than four times the amount that would have been allowed under split stock management from 2010 through 2012 (SSC 2012). The SSC noted that, "While these models are still exploratory, the range of models examined appears to provide strong evidence for a substantial decline in [Pacific cod] biomass in the Aleutian Islands since the early 1990s. This decline, unlike in the Eastern Bering Sea, has continued in recent years and is consistent with observed declines in fishery CPUE in the Aleutian Islands for both longline and trawl fisheries." The SSC concluded that the approach of setting a single OFL and ABC for the entire BSAI area raised potentially serious conservation concerns for Pacific cod in the Aleutian Islands. Given the heightened conservation concern, the SSC notified the NPFMC that it intended to set separate OFLs and ABCs for EBS Pacific cod and Aleutian Islands Pacific cod for the 2014 fishing season.

The proposed action would split the Pacific cod TAC between the Eastern Bering Sea and Aleutian Islands to improve conservation of the Aleutian Islands Pacific cod stock and better align management with the available science. The 2014/2015 harvest specifications will include an Aleutian Islands Pacific cod OFL, ABC, and TAC. The TAC allocations under Amendment 85 described in the FMP BiOp would continue to apply BSAI-wide (Table 2-2). A CDQ reserve of 10.7% of the TAC is deducted from each of the Bering Sea and Aleutian Islands Pacific cod TACs before the remaining Pacific cod TACs are combined and allocated to the other fishing sectors.

Table 2-2. Percent sector allocations of BSAI Pacific cod TAC (72 FR 50789, September 4, 2007).

Sector	% Allocation
Jig	1.4
Hook-and-line/pot catcher vessel < 60 ft LOA	2.0
Hook-and-line/pot catcher vessel ≥ 60 ft LOA	0.2
Hook-and-line catcher processor	48.7
Pot catcher vessel ≥ 60 ft LOA	8.4
Pot catcher processor	1.5
AFA trawl catcher processor	2.3
Non-AFA trawl catcher processor (Amend 80)	13.4
Trawl catcher vessel	22.1

LOA = length overall

Area 543 Catch Limit

The proposed action would also add a Pacific cod catch limit to Area 543, which is a change relative to the action analyzed in the FMP BiOp. The catch limit would be based on the estimated abundance of Pacific cod in Area 543 as determined by the annual stock assessment process. This annually-set limit would allow the best available information on the estimated stock distribution to be reflected in fishery management, though the extent to which the estimates based on summer surveys reflect winter distribution is unknown. Because the State of Alaska authorizes a separate, guideline harvest level (GHL) Pacific cod fishery in the Aleutian Islands, NMFS would deduct 3 percent of the BSAI Pacific cod ABC for the GHL amount from the Aleutian Islands ABC before establishing federal fishery catch limits in Area 543.[5] After deducting the amount of Pacific cod for the CDQ allocation and the amount estimated to be caught incidental to other fisheries, NMFS would determine if a sufficient amount of Pacific cod TAC remains to support a directed fishery. NMFS apportions the BSAI combined Pacific cod TAC among the sectors according to the CDQ allowance and sector apportionments in Table 2-2. There is no sector limit applied to the Aleutian Islands so a sector may harvest within the Aleutian Islands subarea until they reach their BSAI-wide allocation or until the Aleutian Islands subarea directed fishery is closed. Once a sector reaches its allocation or once the Aleutian Islands subarea TAC is reached, it would be prohibited from directed fishing for Pacific cod in the Aleutian Islands.

Modifications to the Pacific cod trawl fisheries

Modified C Season for Catch Share Fisheries and CDQ

The seasons for the Pacific cod trawl fishery would be the same under the proposed action as the action analyzed in the FMP BiOp with one exception. The proposed action would extend the C season end date for Amendment 80 and CDQ Pacific cod trawl fisheries from November 1 to December 31. Extending the season and date for Amendment 80 and CDQ trawl vessels would reduce regulatory discards of Pacific cod caught by trawlers in November and December that occasionally exceed 20 percent of the MRA. Because Pacific cod catch by Amendment 80 and CDQ trawl vessels is managed under catch share programs it is expected that these fisheries will continue to operate in a way that temporally disperses the

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[5] The majority of the GHL fishery has historically occurred in Areas 541 and 542.

catch. Pacific cod catch by catcher vessels and AFA catcher/processors sectors are not managed under catch share programs, thus, fishing by these sectors cannot be controlled to spread the harvest out over time.

The area closures for Pacific cod trawl fishing are unchanged relative to the action analyzed in the FMP BiOp (Figure 2-4). Figure 2-4 also shows the only areas open to non-pelagic trawl under the Essential Fish Habitat protection measures described above. Directed fishing for Pacific cod with trawl gear would only be permitted where critical habitat open areas and areas open to non-pelagic trawl gear overlap.

Modifications to the Pacific cod non-trawl fisheries

Pacific cod is caught with the following non-trawl gear types in the Aleutian Islands: hook-and-line, pot, and jig. There are no changes to the proposed action relative to the action analyzed in the FMP BiOp for these gear types beyond the TAC split and the Area 543 catch limit that also would apply to trawl fisheries.

The area closures for Pacific cod non-trawl fishing are unchanged relative to the action analyzed in the FMP BiOp (Figure 2-5).

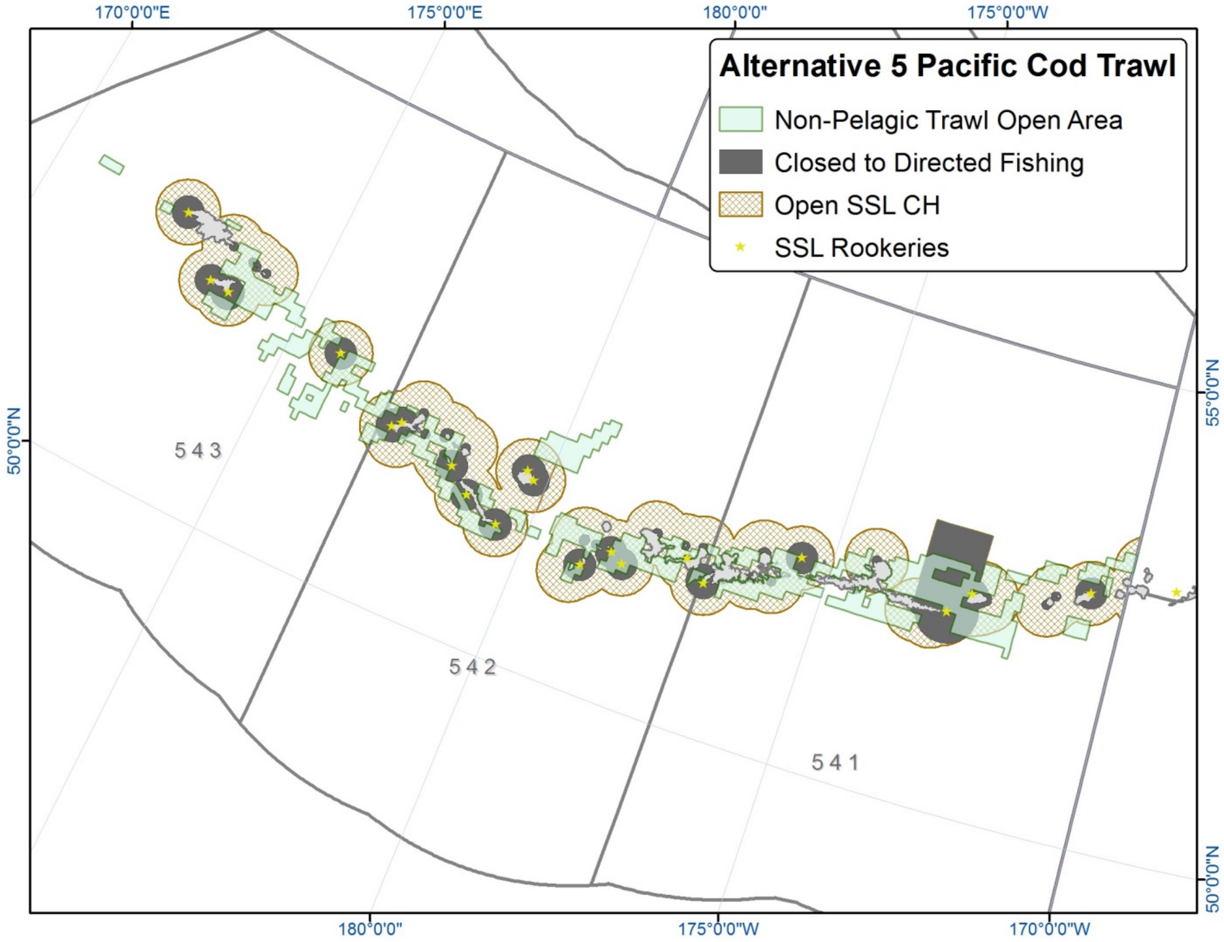

Figure 2-4. Proposed Aleutian Islands Pacific cod trawl closures. These are the 2003 Steller sea lion protection measure closures (68 FR 204, January 2, 2003).

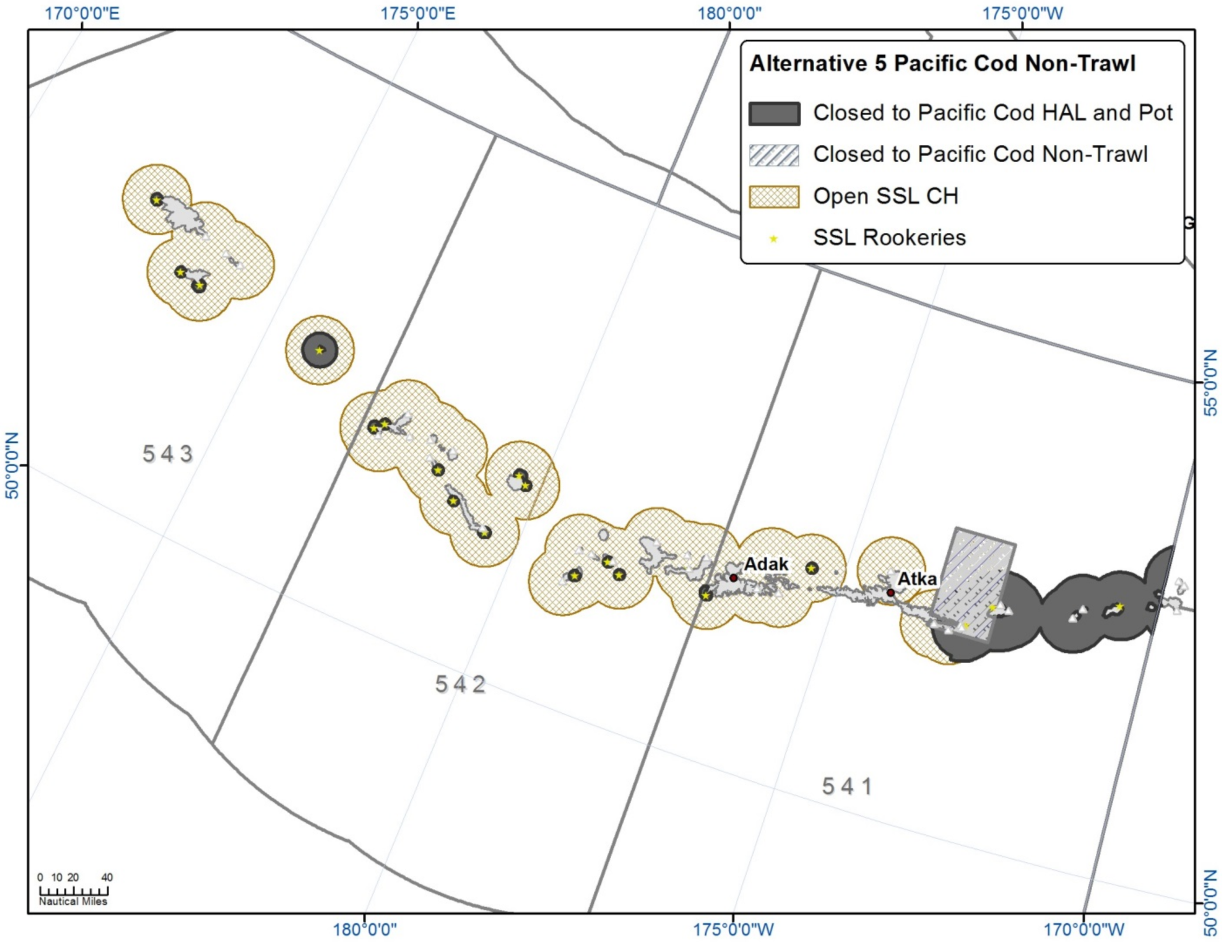

Figure 2-5. Proposed Aleutian Islands Pacific cod non-trawl closures. These closures are the 2003 Steller sea lion protection measure closures (68 FR 204, January 2, 2003).

Modifications to the Pollock fisheries

The Aleutian Islands were closed to directed fishing for pollock in 1999 due to concerns for Steller sea lion recovery (64 FR 3438). In 2005, the directed fishery for Aleutian Islands pollock was re-opened and allocated in its entirety after deduction for an incidental catch allowance to CDQ and the Aleut Corporation pursuant to the requirements of The Consolidated Appropriations Act of 2004 (Public Law 108-199). The law required the Aleut Corporation to select participants in the Aleutian Islands directed pollock fishery and limited participation to AFA qualified entities and vessels 60 ft or less length overall (LOA). The Aleutian Islands pollock fishery is still restricted to areas outside of 20 nm of Steller sea lion rookeries and haulouts, which has limited fishing to two small areas with commercial concentrations of pollock within easy delivery distance to Adak Island (NMFS 2013).

The proposed action would open some areas inside of critical habitat in the Aleutian Islands to directed fishing for pollock that were closed under the action analyzed in the FMP BiOp and would establish separate A season catch limits for Area 543, Area 542 and Area 541.

Area 543

The proposed action would open a portion of the area outside of 3 nm from all three sea lion haulouts in Area 543 to pollock fishing with pelagic trawl gear—Attu Island/Chirikof Point, Alaid Island, and Shemya Island. The four sites designated as rookeries in Area 543—Attu Island/Cape Wrangell, Attu

Island/Cape Sabak, Agattu Island/Gillon Point, and Buldir— would continue to be closed to pollock fishing from 0-20 nm year-round (Figure 2-6). The maximum catch amount in the A season would be limited to 5 percent of the Aleutian Islands subarea ABC.

Area 542
The proposed action would open a portion of critical habitat to pelagic trawling for pollock in Area 542. West of 178° W longitude the proposed action would open a portion of critical habitat outside of—

- 3nm from Tanadak Island, Segula Island, and Krysi Point haulouts; and
- 10 nm from one rookery (Ayugadak Point) and one haulout (Little Sitkin Island) to pollock trawling in the western portion of Area 542 (Figure 2-6).

East of 178° W longitude in Area 542 the proposed action would open a portion of critical habitat outside of—

- 3 nm from three haulouts (Tanaga Island/Bumpy Point, Bobrof Island, and Kanaga Island/North Cape).

The A season catch limit would be 15 percent of the Aleutian Islands pollock ABC.

Area 541
The proposed action would open critical habitat to trawling for pollock outside of 10 nm from rookeries and from 3 to 20 nm from haulouts (Figure 2-6). The Area 541 A season catch limit would be 30 percent of the Aleutian Islands pollock ABC.

Overall the A season apportionment would continue to be limited to a maximum of 40 percent of the Aleutian Islands pollock ABC, so it would not be permissible to reach the maximum area apportionments in all three areas (Area 543 limit = 5%, Area 542 limit = 15%, Area 541 limit = 30%).

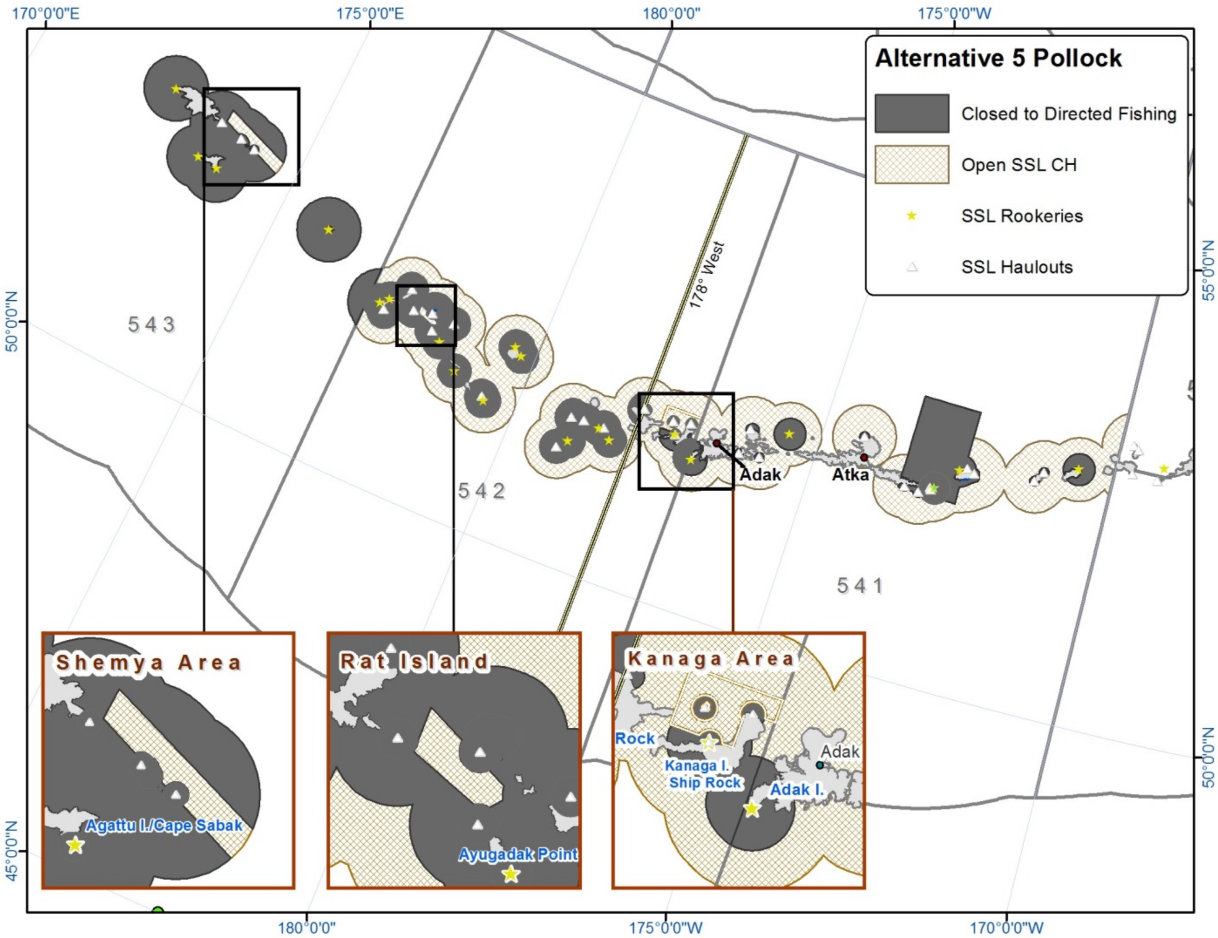

Figure 2-6. Proposed Aleutian Islands pollock closures.

Observer Program Changes

Though not part of the proposed action, observer coverage requirements for the BSAI groundfish fisheries have changed relative to the description of the action in the FMP BiOp. The North Pacific Observer Program (Observer Program) monitors fish and prohibited species catch and bycatch and marine mammal and seabird bycatch in Alaska’s federally managed groundfish fisheries. Many changes to the structure of the Observer Program took effect in January 2013 to improve observer data quality and to more equitably distribute the industry’s observer coverage costs (77 FR 70062, November 21, 2012). These changes increase the statistical reliability of data collected by the program and expand observer coverage to previously unobserved fisheries. The new Observer Program allows NMFS to determine when and where to deploy observers according to management and conservation needs, with funds provided through a system of fees based on the retained value of groundfish and halibut in fisheries covered by the new program. The new program is designed to reduce sources of bias that jeopardized the statistical reliability of catch and bycatch data collected by the Observer Program. All sectors of the groundfish fishery are included in the new Observer Program, including vessels less than 60 feet LOA and the commercial halibut sector, which were not covered under the previous program.

All vessels and processors in the groundfish and halibut fisheries off Alaska are in one of two observer coverage categories: (1) a full coverage category, and (2) a partial coverage category. Vessels in the full coverage category include:

- catcher/processor (with limited exceptions)

- mothership
- catcher vessel while participating in AFA or CDQ pollock fisheries
- catcher vessel while participating in CDQ groundfish fisheries (except: sablefish; and pot or jig gear catcher vessels)
- catcher vessel while participating in the Central Gulf of Alaska Rockfish Program
- inshore processor when receiving or processing Bering Sea pollock

Vessels and processors in the full coverage category obtain observers by contracting directly with observer provider companies. All catcher/processors are now required to have 100 percent observer, coverage which is an increase relative to the program described in the FMP BiOp (NMFS 2010).

Partial coverage vessels include:

- catcher vessel designated on a Federal Fisheries Permit when directed fishing for groundfish in federally managed or parallel fisheries, except those in the full coverage category
- catcher vessel when fishing for halibut individual fishing quota (IFQ) or CDQ
- catcher vessel when fishing for sablefish IFQ or fixed gear sablefish CDQ
- shoreside or stationary floating processor, except those in the full coverage category

In addition, the following catcher/processors may be included in the partial observer coverage category: (1) catcher/processors less than 60 ft. LOA with a history of catcher/processor and catcher vessel activity in a single year from January 1, 2003, through January 1, 2010; (2) any catcher/processor with an average daily groundfish production of less than 5,000 pounds round weight equivalent in the most recent full calendar year of operation from January 1, 2003, to January 1, 2010; or (3) catcher/processors that processed no more than one metric ton (mt) round weight of groundfish on any day (up to a maximum of 365 mt per year) in the previous calendar year.

Vessels and processors in the partial coverage category have a substantial change in how observers are deployed and paid for compared to the previous observer program. Vessels that previously took observers under the old 30 percent coverage rules are only required to take partial observer coverage when selected through the Observer Declare and Deploy System from either a trip selection or vessel selection pool. An annual deployment plan (ADP) is used to assign observers to collect independent information from fishing operations under the groundfish FMPs and the North Pacific Halibut Act of 1982. Details of this annual plan for 2013 are at http://209.112.168.2/sustainablefisheries/observers/ADP_Final_2013.pdf. The ADP focuses on a science driven deployment of observers to reduce potential bias and meet NMFS's data needs. Some aspects of observer deployment can be adjusted through the ADP, including the assignment of vessels to the selection pools or the allocation strategy used to deploy observers in the partial coverage category.

Summary of the Fishery Component of the Proposed Action

Table 2-3 provides a summary of the proposed provisions for managing the Aleutian Islands Atka mackerel, Pacific cod, and pollock fisheries.

Table 2-3. Summary table of the fishery component of the proposed action.

Fishery	Seasons	Area 543		Area 542		Area 541	
		Closures	Catch and Participation limits	Closures	Catch and Participation limits	Closures	Catch and Participation limits
Atka mackerel	Trawl: A season: 1/20-6/10 B season: 6/10-12/31.	Critical habitat closed 0-3 haulouts and 0-10 from rookeries.	Critical habitat harvest limit 60 % of TAC, distribute evenly between seasons.	Critical habitat closed 0-3 from haulouts and 0-10 from rookeries except, close critical habitat between 178°E long. to 180° and east of 178°W long.	Critical habitat harvest limit 60% of TAC west of 178° W long, distribute evenly between seasons.	Critical habitat closed except 12-20 nm portion southeast of Seguam Island.	Amend. 80 and CDQ in BS: revise MRA calculation for Atka mackerel as an incidental catch species.
	50:50 seasonal apportionment including CDQ.						
	Rollover from A to B season, fished outside of critical habitat.		TAC ≤ 65% ABC.			BS subarea closed to directed fishing.	
Pacific cod trawl	Amend 80 and CDQ: A season: 1/20-4/1 B season: 4/1-6/10 C season: 6/10-12/31.	Critical habitat closed 0-3 haulouts and 0-10 from rookeries.	Catch limit in proportion to Area 543 abundance based on annual stock assessment.	Critical habitat closed 0-3 from haulouts and 0-10 from rookeries.	None	Critical habitat closed 0-3 haulouts and 0-10 from rookeries, except a 20 nm closure at Agligadak.	None
	CVs and AFA CPs: A season: 1/20-4/1 B season: 4/1-6/10 C season: 6/10-11/1.						
	Seasonal apportionments based on BSAI wide TAC level under Amend 85.					Seguam Foraging Area closed.	
Pacific cod non-trawl	Hook-and-line: A season: 1/1-6/10 B season: 6/10-12/31.	Hook-and-line and pot: Critical habitat closed 0-3 nm from rookeries and 0-10 from Buldir Island.	Catch limit in proportion to Area 543 abundance based on annual stock assessment.	Hook-and-line and pot: Critical habitat closed 0-3 nm from rookeries.	None	Hook-and-line and pot: Critical habitat closed 0-3 from rookeries west of 172.59° W long.	None
	Pot: A season: 1/1-6/10 B season: 9/1-12/31.					Hook-and-line and pot: Critical habitat closed east of 172.59° W long.	
	Jig: A season: 1/1-4/30 B season: 4/30-8/31 C season: 8/31-12/31.					Hook-and-line, pot, and jig: Seguam Foraging Area closed.	
	Seasonal apportionments based on BSAI wide TACs under Amend 85.						
Pollock	A season: 1/20-6/10 B season: 6/10-11/1	Critical habitat closed, except an area outside of 0-3 nm from Shemya, Alaid, and Chirikof haulouts and outside of 20 nm from rookeries.	Only vessels registered with the Aleut Corporation in directed fishery.	Critical habitat closed 0-20 at rookeries and haulouts west of 178°W long. except open portion of critical habitat at Hawadax Island Area outside of 3 nm from Tanadak, Segula, and Krysi Point and 10 nm from Little Sitkin and Ayugudak	Only vessels registered with the Aleut Corporation in directed fishery.	Critical habitat closed to directed fishing 0-3 nm from haulouts and 0-10 nm from rookeries.	Only vessels registered with the Aleut Corporation in directed fishery.
			50% of Aleut Corp. directed fishery allocation to vessels ≤ 60 ft		50% of Aleut Corp. directed fishery allocation goes to vessels ≤ 60 ft.		50% of Aleut Corp. directed fishery allocation to vessels ≤ 60 ft.
	A season apportionment no more than 40% of ABC for AI subarea.		When AI ABC ≥ 19,000 mt, AI TAC = 19,000 mt. When AI ABC < 19,000 mt, AI TAC ≤ AI ABC.	Critical habitat closed 0-3 nm haulouts and 0-10 nm from rookeries east of 178° W long., except open portions of critical habitat outside of 3 nm from Kanaga and Bobrof Island.	When AI ABC ≥ 19,000 mt, AI TAC = 19,000 mt. When AI ABC < 19,000 mt, AI TAC ≤ AI ABC.	Seguam Foraging Area closed to directed fishing.	When AI ABC ≥ 19,000 mt, AI TAC = 19,000 mt. When AI ABC < 19,000 mt, AI TAC ≤ AI ABC.
			A season catch limit 5% of AI ABC.		A season catch limit 15% of AI ABC.		A season catch limit 30% of AI ABC.

CDQ= Community Development Quota, TAC=total allowable catch, ABC=acceptable biological catch, BSAI=Bering Sea and Aleutian Islands Management Area, CV=catcher vessel, CP=catcher processor, AFA=American Fisheries, AI=Aleutian Islands, BS=Bering Sea

2.3 Description of the Proposed Research Component

As mentioned above, the purpose of the research component of the proposed action is to learn about local abundance and movement patterns of groundfish in the Aleutian Islands to understand potential impacts of commercial fisheries on Steller sea lion prey species. The proposed research would provide data about the potential for fisheries to cause localized depletion of Atka mackerel and about the efficacy of trawl exclusion zones in conserving Atka mackerel. The Atka mackerel tagging studies described in Chapter 11 of the draft EIS (NMFS 2013) primarily compose the proposed research; the project has been funded for the 2014–2015 field season.

The proposed research would involve capturing, tagging, and releasing Atka mackerel in Areas 543, 542, and 541 in the Aleutian Islands and the subsequent recovery of those tags by trawling (with non-pelagic trawl gear) for Atka mackerel inside and outside of Steller sea lion critical habitat. The principal investigators have received funding to conduct tagging work in Areas 541 and 543 in June or July, 2014. Tag Recovery trawls will be conducted in September 2014 and again in March 2015. The anticipated catch amounts for the tag recovery trawls are shown in Table 2-4. The estimated amount of incidental catch of other species during the tagging and recovery cruises is also shown in Table 2-4. Bycatch is based on species composition of previous Atka mackerel tag recovery cruises and fishery catch composition in these areas. If funding is available in future years (beyond 2015), the principal investigators will tag and recover Atka mackerel in other combinations of Areas, such as Areas 542 and 541. In any given year, a reasonable expectation is that Atka mackerel would be caught in the projected amounts in two of the three Areas (Table 2-4).

In recent years the Atka mackerel tagging project has also assessed the distribution and abundance of other groundfish (e.g., Pacific cod, Pacific ocean perch, northern rockfish, and pollock) using catch-per-unit effort (CPUE) abundance indices derived from trawls conducted during the tag recovery cruises (a.k.a. a “prey field study”). For the funded 2014–2015 study this CPUE data will come from trawl tows already planned for recovery of tagged Atka mackerel. However, if funding should become available in future years for additional vessel time, principal investigators would propose conducting opportunistic trawl tows solely for the purpose of assessing the prey field distribution. Table 2-5 shows the anticipated removals for these opportunistic prey field studies.

The anticipated catches of Atka mackerel described above are small compared to ABC and AFSC groundfish trawl survey biomass. To account for high inter-annual variability in Atka mackerel ABC, the research catches were compared to the 2000–2014 mean ABC in each Area. Similarly, research catches were compared to AFSC groundfish trawl data from survey strata in each Area averaged over years 2000–2012. The anticipated catches of Atka mackerel during tag recovery cruises range from 3.9% to 4.6% of the mean ABC, depending on Area. They range from 0.4% to 0.5% of mean AFSC groundfish trawl survey biomass (Table 2-6). Anticipated catches during opportunistic prey field studies range from 4.4% to 1.9% of mean ABC and 0.07% to 0.46% of mean survey biomass (Table 2-6).

Table 2-4. Anticipated survey catches for Atka mackerel tag recovery studies (mt) inside and outside critical habitat (CH) for a given cruise and year (fall or winter/spring).

	NMFS area								
	541			542			543		
Species	Inside CH	Outside CH	Total	Inside CH	Outside CH	Total	Inside CH	Outside CH	Total
Atka mackerel	400	400	800	800	400	1200	600	550	1150
Northern rockfish	69	69	137	137	69	206	77	94	171
Pacific cod	24	24	48	48	24	72	27	33	60
POP	69	69	137	114	48	162	54	66	120
Pollock	9	9	17	17	9	26	10	12	21

POP=Pacific ocean perch

Table 2-5. Anticipated survey catches during opportunistic prey field studies (mt).

	NMFS area				
	541	542	543	518	610
Species	Inside CH	Inside CH	Outside CH	Inside CH	Inside CH
Atka mackerel	910	560	150	140	140
Pacific cod	55	34	9	8	8
POP	156	96	18	24	24
Northern rockfish	156	96	26	24	24
Pollock	20	12	3	3	3

POP=Pacific ocean perch

Table 2-6. Anticipated survey catches of Atka mackerel in relation to allowable biological catch (ABC) and AFSC groundfish trawl survey biomass.

	NMFS area		
	541	542	543
Atka mackerel ABC (mt, mean 2000–2014)	20,624	29,518	24,935
Atka mackerel survey biomass (mt, mean 2000–2012)	198,594	252,884	216,817
Anticipated catch during recovery cruises (mt)	800	1,200	1,150
% of mean ABC	3.88%	4.07%	4.61%
% of mean survey biomass	0.40%	0.47%	0.53%
Anticipated catch during opportunistic prey field studies (mt)	910	560	150
% of mean ABC	4.41%	1.90%	0.60%
% of mean survey biomass	0.46%	0.22%	0.07%
Total anticipated catch (mt)	1,710	1,760	1,300
% of mean ABC	8.29%	5.96%	5.21%
% of mean survey biomass	0.86%	0.70%	0.60%

3 STATUS OF SPECIES AND CRITICAL HABITAT

3.1 Species Description and Listing Status

The Steller sea lion (*Eumetopias jubatus*) is classified within the Order Carnivora, Suborder Pinnipedia, Family Otariidae, and Subfamily Otariinae. The Steller sea lion is the only extant species of the genus *Eumetopias*.

In the 1950s, the worldwide abundance of Steller sea lions was estimated at 240,000 to 300,000 animals, with a range that stretched across the Pacific Rim from southern California, Canada, Alaska, and into Russia and northern Japan. In the 1980s, annual rates of decline in the range of what is now recognized as the western population were as high as 15 percent. The worldwide Steller sea lion population declined by over 50 percent in the 1980s, to approximately 116,000 animals (Loughlin et al. 1992). By 1990, the U.S. portion of the population had declined by about 80 percent relative to the 1950s. On April 5, 1990, NMFS issued an emergency interim rule to list the Steller sea lion as threatened (55 FR 12645). On November 26, 1990, NMFS issued the final rule to list Steller sea lions as a threatened species under the ESA (55 FR 49204).

NMFS reclassified Steller sea lions as two distinct population segments under the ESA in 1997 based on demographic and genetic dissimilarities—the western and eastern stock (62 FR 30772, June 5, 2007). The WDPS, extending from Japan around the Pacific Rim to Cape Suckling in Alaska (144° W), was listed as endangered due to its continued decline and lack of recovery (Figure 3-1). This endangered status listing was supported by a population viability analysis which indicated that a continued decline at the 1985 to 1994 rate would result in extinction of the WDPS in 100 years. The probability of extinction was 65% if the 1989 to 1994 trend continued for 100 years (62 FR 24345).

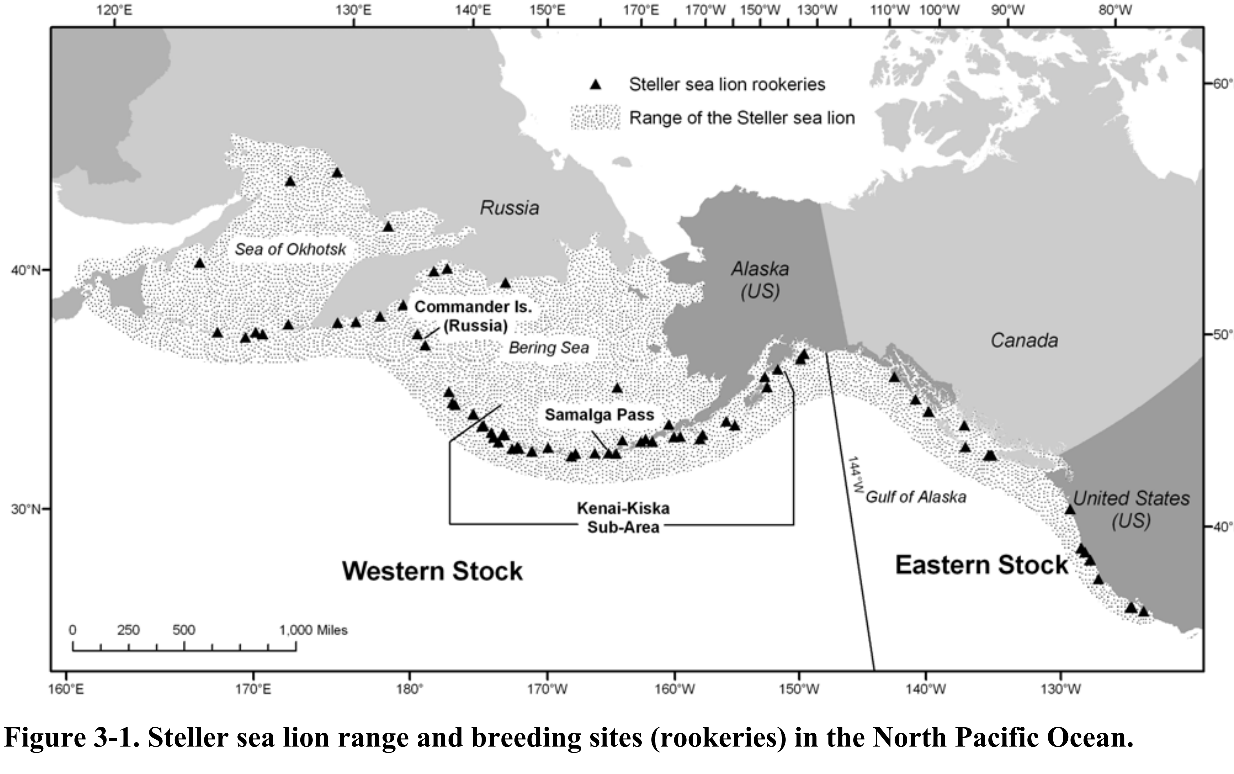

Figure 3-1. Steller sea lion range and breeding sites (rookeries) in the North Pacific Ocean.

The eastern DPS (EDPS), extending from Cape Suckling (144° W) east to British Columbia and south to California, remained on the list as threatened because of concern over WDPS animals ranging into the east, the larger decline overall in the U.S. population, human interactions, and the lack of recovery in California (62 FR 24345). The EDPS continued to recover, and NMFS removed the EDPS from the list of threatened species on November 4, 2013 (78 FR 66140), since the recovery criteria in the Steller Sea Lion Recovery Plan (NMFS 2008) were achieved and the stock no longer met the definition of a threatened species under the ESA. The WDPS remains classified as endangered and NMFS and our partners continue to research why the EDPS has recovered and the WDPS has not.

On August 27, 1993, NMFS designated critical habitat for Steller sea lions based on the location of terrestrial rookery and haulout sites, spatial extent of foraging trips, and availability of prey items (58 FR 45269). Designated critical habitat for Steller sea lions includes terrestrial, air, and aquatic areas containing physical and biological features that support sea lion reproduction, foraging, rest, and refuge that are essential to the conservation of the species. With respect to the terrestrial habitat, NMFS concluded that the suitability of a particular area for Steller sea lions is influenced by substrate, exposure to wind and waves, the extent and type of human activities and disturbance in the region, and proximity to prey. For the aquatic habitat areas, the essential at-sea activity is presumed to be feeding and access to adequate food resources. An in-depth description of critical habitat areas for Steller sea lions is provided in Section 3.12.

3.2 WDPS Distribution

The WDPS of Steller sea lion inhabits an area of Alaska from Prince William Sound (144° W) west through the Aleutian Islands and in Russia on the Kamchatka peninsula, Kuril Islands and the Sea of Okhotsk. In the U.S., the WDPS ranges from 144° W longitude west through 172° E longitude. Steller sea lions use 38 rookeries and hundreds of haulouts within the range of the WDPS in Alaska (Figure 3-1).

3.3 WDPS Status and Trends

The WDPS of Steller sea lions decreased from an estimated 220,000 to 265,000 animals in the late 1970s to less than 50,000 in 2000 (Burkanov and Loughlin 2005, Loughlin et al. 1984, Loughlin and York 2000). The decline began in the 1970s in the eastern Aleutian Islands, western Bering Sea/Kamchatka and the Kuril Islands (Braham et al. 1980, Burkanov and Loughlin 2005, Waite et al. 2005) (Figure 3-1). In Alaska, the decline spread and intensified east and west of the eastern Aleutians in the 1980s. Between 1991 and 2000, overall counts of Steller sea lions at trend sites decreased 40 percent, an average annual decline of 5.4 percent (Loughlin and York 2000). In the 1990s, counts decreased more at the western (western Aleutians; -65%) and eastern edges (eastern and central GOA; -56% and -42%, respectively) of the U.S. range than they did in the center (range of -24% to -6% from the central Aleutians through the western Gulf of Alaska) (Fritz et al. 2008). The decline continued in the WDPS until about 2000.

Overall, there is strong evidence that non-pup counts in the WDPS in Alaska increased at an average rate of 1.67 percent per year (95% credible interval of 1.01% y^{-1} and 2.38% y^{-1}) between 2000 and 2012 (Fritz et al. 2013, Johnson and Fritz In Review). However, there are strong differences in trend across the range in Alaska, with strong evidence of a positive trend east of Samalga Pass (2.89% y^{-1}; 2.07-3.80% y^{-1}) and strong evidence of a decreasing trend to the west (-1.53% y^{-1}; -2.35% y^{-1} to -0.66%y-^{1}) (Fritz et al. 2013, Johnson and Fritz In Review) (Table 3-1). NMFS uses six sub-regions within the WDPS in Alaska for trend and status monitoring, three (eastern, central and western) within both the Aleutian Islands and Gulf of Alaska (NMFS 2008) (Figure 3-2).

It is estimated that the WDPS in Russia declined from about 27,000 sea lions in the 1960s to 13,000 in the 1990s. The Russian portion of the WDPS is estimated to have increased to 16,000 by 2005 (Burkanov and

Loughlin 2005).[6] Data collected through 2012 (V. Burkanov, National Marine Mammal Lab, personal communication) indicate that overall Steller sea lion abundance in Russia has continued to increase and is now similar to the 1960s (27,100 based on a life table multiplier of 4.5 on the most recent total pup count). Between 1995 and 2011/12, pup production increased overall in Russia by 3.1 percent per year (V. Burkanov, National Marine Mammal Lab, personal communication). However, just as in the U.S. portion of the range of the WDPS, there are significant regional differences in population trend in Russia. Sea lion abundance has been increasing in the Kuril Islands, northern Sea of Okhotsk, and Sakhalin Island and is stable at a historically low level of abundance in eastern Kamchatka (Burkanov et al. 2012) (Figure 3-3).

Pup and non-pup abundance increased substantially between 1995/97 and 2011 in the Kuril Islands and the Sea of Okhotsk. However, in eastern Kamchatka, pup production at the single rookery (Kozlova Cape) declined 50 percent between the mid-1980s (~200 pups) and 2012 (101 pups), while non-pup counts were 80 percent lower in 2010 than in the early 1980s. On the Commander Islands, non-pup counts increased between 1930 and the late 1970s, when the rookery became re-established. Pup production on the Commander Islands increased to a maximum of 280 in 1998 and has varied between 180 and 228 since then (through 2012) (V. Burkanov, National Marine Mammal Lab, personal communication). Non-pup counts on the Commander Islands also reached a recent maximum in 1998–99 (mean of 880), and since then have ranged between 581 and 797 (through 2010). The largest decline in Steller sea lions in Russia has been in the western Bering Sea, which has no rookeries, where non-pup counts declined 98 percent between 1982 and 2010 (V. Burkanov, National Marine Mammal Lab, personal communication). The overall increase in the abundance of Steller sea lions in Russia is due entirely to recovery and increases in abundance in the Kuril Islands and Sea of Okhotsk. Regions in Russia that are either stable or declining (eastern Kamchatka, Commander Islands and the western Bering Sea) border regions in the U.S. where sea lion trends are similar (Aleutian Islands west of 170° W). Movement of Steller sea lions between the U.S. and Russia is discussed in Section 5.1.1.4.3 in (NMFS 2013). As of December 2012, 22 of 9,000 sea lions branded as pups in Russia have been observed in the U.S. portion of the WDPS and 19 of 3,500 sea lions branded as pups in the U.S. have been observed in Russia (NMFS 2013). The majority of sea lions observed moving between sites in Russia and the U.S. (33 of 41) were male. The small amount of exchange of females between the Commander Islands in Russia and the Near Islands in the U.S. is consistent with genetic marker indicators of dispersion which group the Commander Islands with the WDPS in Alaska (Baker et al. 2005).

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[6] Baker et al. (2005) hypothesized that, in addition to the western and eastern stock of Steller sea lions, a third discrete population—the Asian stock, including rookeries from the Kamchatka Peninsula, Kuril Islands, and Sea of Okhotsk—may exist just west of the Commander Islands in Russia. However, Hoffman, et al. (2006) found that while evidence for strong female philopatry supported the stock split, there was little evidence to support the separation of an Asian DPS due to potentially extensive male gene flow.

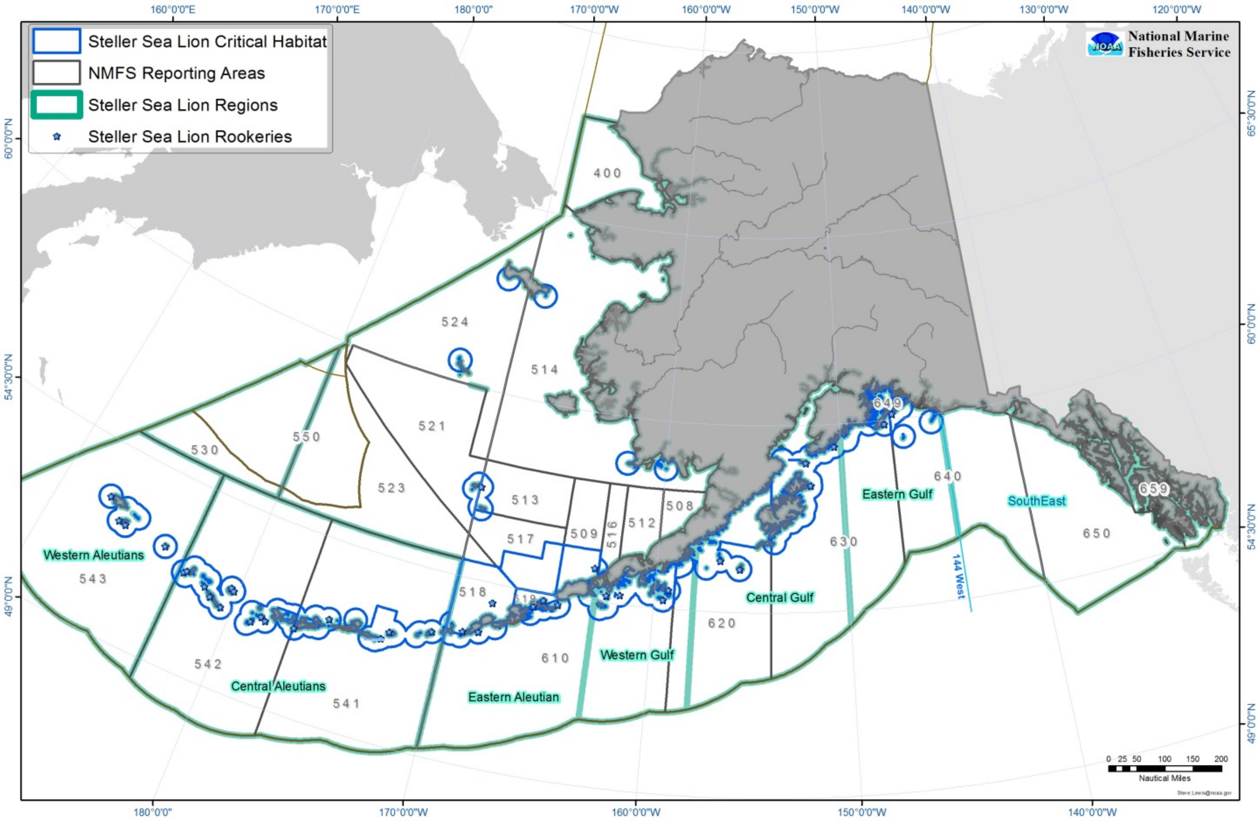

Figure 3-2. Sub-regions used by NMFS to monitor status and trends of the WDPS in Alaska.

Table 3-1. Average annual rates of change in non-pup and pup counts of WDPS Steller sea lion non-pups and pups in Alaska, by Recovery Plan sub-region, from 2000 through 2012 (Source:Fritz et al. (2013). Shaded cells denote delineated Recovery Plan sub-regions from NMFS (2008).

		Non-pups			Pups		
Region	**Longitude Range**	Trend	-95%	+95%	Trend	-95%	+95%
WDPS in Alaska	144°W-172°E	1.67	1.01	2.38	1.45	0.69	2.22
East of Samalga Pass	144-170°W	2.89	2.07	3.8	–	–	–
Eastern Gulf of Alaska	144-150°W	4.51	1.63	7.58	3.97	1.31	6.5
Central Gulf of Alaska	150-158°W	0.87	-0.34	2.18	1.48	-0.56	3.3
E-C Gulf of Alaska	144-158°W	2.4	0.92	3.86	–	–	–
Western Gulf of Alaska	158-163°W	4.01	2.49	5.42	3.03	1.06	5.2
Eastern Aleutian Islands	163-170°W	2.39	0.92	3.94	3.3	1.76	4.83
W Gulf and E Aleutians	158-170°W	3.22	2.19	4.25	–	–	–
West of Samalga Pass	170°W-172°E	-1.53	-2.35	-0.66	–	–	–
Central Aleutian Islands	170°W-177°E	-0.56	-1.45	0.43	-0.46	-1.5	0.72
Western Aleutian Islands	177°E - 172°E	-7.23	-9.04	-5.56	-9.23	-10.93	-7.78

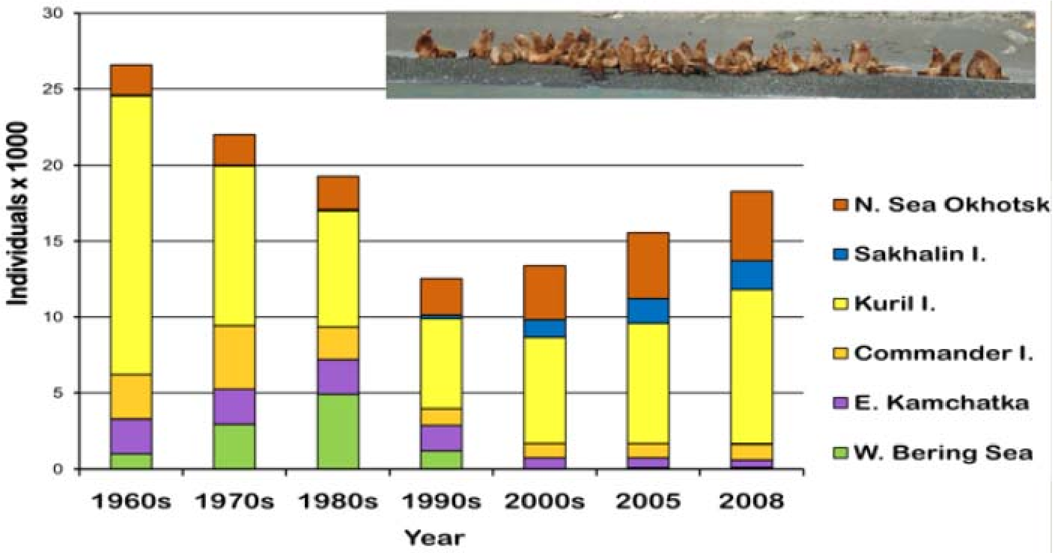

Figure 3-3. Changes in total abundance of the WDPS in Russian waters, by region from the 1960s through 2008. Source: Burkanov et al. (2012).

3.3.1 WDPS Population Size

The most recent comprehensive estimate (pups and non-pups) of abundance of the WDPS of Steller sea lions in Alaska is derived from aerial photographic surveys of non-pups conducted in June–July 2008 through 2012 and aerial photographic and ground-based pup counts conducted in June–July 2009 through 2012 (Fritz et al. 2013). During the 2008–2012 non-pup surveys, 34,056 non-pups were counted at 269 terrestrial rookery and haulout sites; 19,593 in the Gulf of Alaska and 14,463 in the Bering Sea/Aleutian

Islands. The composite pup count of the WDPS in Alaska from 2009–2012 totaled 11,603. Most of the data represented in the aggregate 2009–2012 pup count were collected in 2011 (10,418 pups on 73 sites) and 2012 (200 pups on 5 sites), with the remainder collected in 2009 (273 pups on 6 sites) and 2010 (712 pups on 4 sites). There were 6,034 pups counted in the Gulf of Alaska and 5,569 pups counted in the Bering Sea/Aleutian Islands (Allen and Angliss 2013).

An estimate of the total population size of the WDPS of Steller sea lion in Alaska in 2012 (pups and non-pups) may be obtained by multiplying the best estimate of total pup production (11,603; Fritz et al. (2013)) by 4.5 (Calkins and Pitcher 1982), which yields approximately 52,200. This is not a minimum population estimate per the definition in the Marine Mammal Protection Act (MMPA)[7] since it is an extrapolated total population size from pup counts based on survival and fecundity estimates in the Calkins and Pitcher (1982) life table. The implicit assumption in this multiplier and resulting estimate is that current underlying population vital rates (age-specific fecundity and survival) are the same as an assumed stable, mid-1970s population in the central Gulf of Alaska. Because vital rates of Steller sea lions in the central Gulf of Alaska have changed considerably since the mid-1970s as the population declined through the 1980s and 1990s, and stabilized in the 2000s (Holmes and York 2003, York 1994, Pendleton et al. 2006, Punt and Fay 2006, Winship and Trites 2006, Holmes et al. 2007) it is likely that an updated life table would yield a different multiplier. As explained below, there may be data to update the life table for the central and eastern GOA sub-regions; however vital rate data are not available to update the life table for other sub-regions at this time.

Methods used to survey Steller sea lions in Russia differ from those used in Alaska, with less use of aerial photography and more use of skiff surveys and cliff counts for non-pups, and ground counts for pups. The most recent counts of non-pup Steller sea lions in Russia were conducted in 2007–2011 and totaled approximately 12,700. The most recent estimate of pup production in Russia is available from counts conducted in 2011 and 2012, which totaled 6,021 pups and yields a total population abundance estimate of 27,100 Steller sea lions using the 4.5 multiplier.

An estimate of the abundance of the entire (U.S. and Russia) WDPS of Steller sea lions (pups and non-pups) in 2012 can be made by adding the most recent U.S. and Russian pups counts, and multiplying by 4.5 (11,603 + 6,021 = 17,624 pups × 4.5), which yields 79,300 sea lions.

3.3.2 WDPS Trend in the U.S. (Alaska)

NMFS monitors the status of the WDPS by conducting aerial surveys of Steller sea lion rookery and haulout sites during the breeding season (June through mid-July), extending the series of surveys that began in Alaska in the mid-1970s (Braham et al. 1980, Calkins and Pitcher 1982, Loughlin et al. 1992, Merrick et al. 1987). Trends in sea lion population abundance have been determined by analyzing time series of pup and non-pup counts at “trend” sites that have been consistently surveyed over time since the 1970s, 1990s, and 2000s (Fritz et al. 2013, NMFS 2008). Trend sites include all rookeries and major haulouts in the WDPS and have included a larger number of sites since Steller sea lions were listed under the ESA and the surveys became more comprehensive. A description of the survey methods and number of sites in each trend site grouping is provided in (Fritz et al. 2013).

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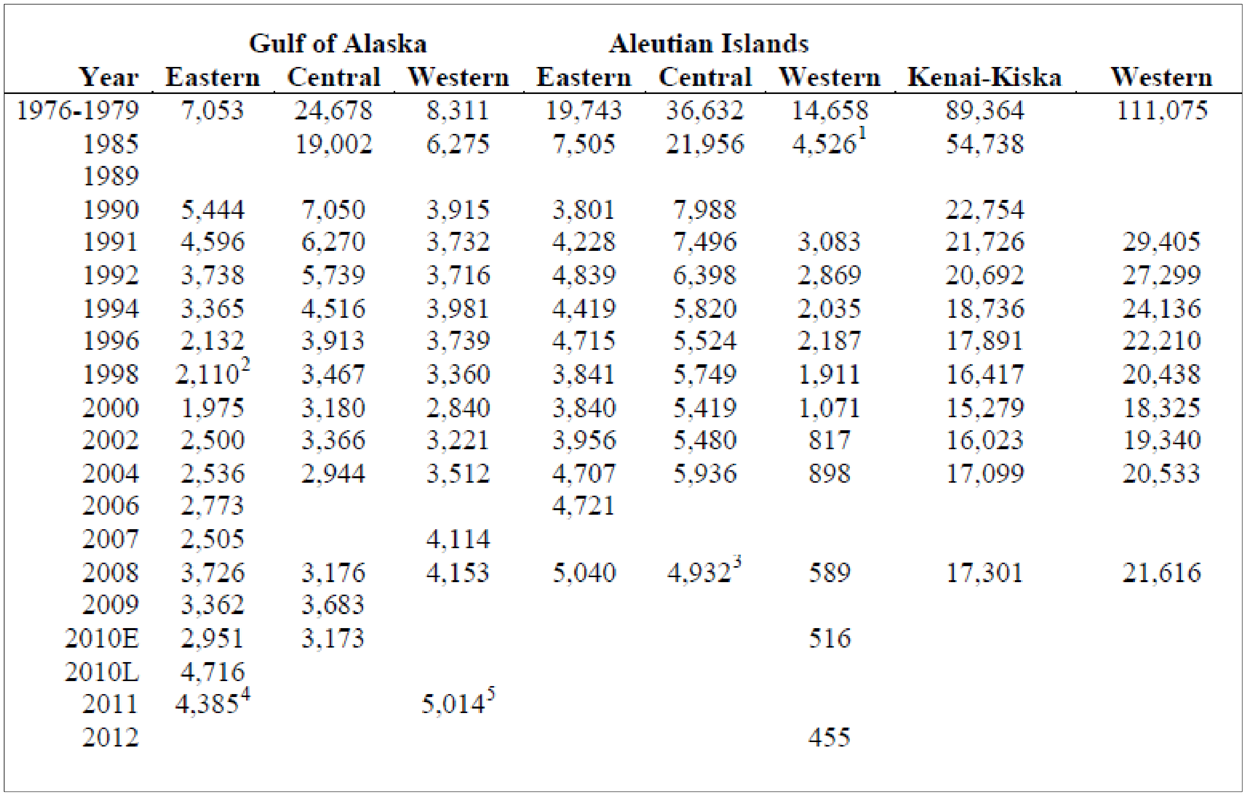
[7] The minimum population estimate, as defined by the MMPA, is an estimate of the number of animals in a stock that is based on the best available scientific information on abundance, incorporating the precision and variability associated with such information, and provides reasonable assurance that the stock size is equal to or greater than the estimate.

Table 3-2 and Figure 3-4 show the results of the survey counts using the 1970s trend site grouping by sub-region from 1976 to 2012. Using the 1970s trend site grouping shows the longest time series, whereas the 2000s trend site grouping now provides the most comprehensive count of the WDPS in Alaska for 2000 through 2012 (Table 3-3).

The most recent, complete, non-pup surveys of the WDPS in Alaska occurred in 2004 and 2008 (Fritz et al. 2013). In 2009, NMFS was able to complete most of the pup survey across the range of the WDPS with the exception of sites in western Aleutian Islands. NMFS counted pups on western Aleutian sites from aerial photos taken in 2008 as a substitute for the 2009 western Aleutian Islands pup counts (Fritz et al. 2013). In 2010 NMFS conducted non-pup surveys in the western Aleutian Islands and large portions of the central Aleutian Islands and western GOA. NMFS was able to survey the sites missed in 2010 in 2011 along with conducting pup surveys. While NMFS surveyed the missed 2010 non-pup sites during the 2011 pup survey, NMFS was unable to survey 40 sites for pup counts in the western half of the central Aleutian Islands, Buldir Island in the western Aleutians and Walrus Island in the EBS. The focus of the 2012 survey was to count pups and non-pups in the western, central, and eastern Aleutian Islands. Due to persistent fog and bad weather only 14 of 175 targeted sites were able to be surveyed.

Table 3-2. Aerial survey counts of adult and juvenile (non-pup) Steller sea lions observed at 1970s trend sites (as described in Fritz et al. (2013)) by sub-region in Alaska in June and July from 1976 to 2012. Counts in 2004 through 2012 were adjusted to account for differences in photograph orientation and resolution relative to those taken in previous years. Respectively, 2010E and 2010L refer to "early" and "late" surveys conducted in 2010. Source: Fritz et al. (2013).



	Gulf of Alaska			Aleutian Islands				
Year	Eastern	Central	Western	Eastern	Central	Western	Kenai-Kiska	Western
1976-1979	7,053	24,678	8,311	19,743	36,632	14,658	89,364	111,075
1985		19,002	6,275	7,505	21,956	4,526[1]	54,738	
1989								
1990	5,444	7,050	3,915	3,801	7,988		22,754	
1991	4,596	6,270	3,732	4,228	7,496	3,083	21,726	29,405
1992	3,738	5,739	3,716	4,839	6,398	2,869	20,692	27,299
1994	3,365	4,516	3,981	4,419	5,820	2,035	18,736	24,136
1996	2,132	3,913	3,739	4,715	5,524	2,187	17,891	22,210
1998	2,110[2]	3,467	3,360	3,841	5,749	1,911	16,417	20,438
2000	1,975	3,180	2,840	3,840	5,419	1,071	15,279	18,325
2002	2,500	3,366	3,221	3,956	5,480	817	16,023	19,340
2004	2,536	2,944	3,512	4,707	5,936	898	17,099	20,533
2006	2,773			4,721				
2007	2,505		4,114					
2008	3,726	3,176	4,153	5,040	4,932[3]	589	17,301	21,616
2009	3,362	3,683						
2010E	2,951	3,173				516		
2010L	4,716							
2011	4,385[4]		5,014[5]					
2012						455		

[1] Includes 1988 count at Buldir

[2] Includes 1999 counts for those sites not surveyed in 1998

[3] Includes 2006 count at Amchitka/East Cape of 99 animals (adjusted)

[4] Includes 2010L counts at Rugged and Seal Rocks (Kenai) (total of 63 animals adjusted)

[5] Includes 2008 count at Castle Rock of 27 animals (adjusted)

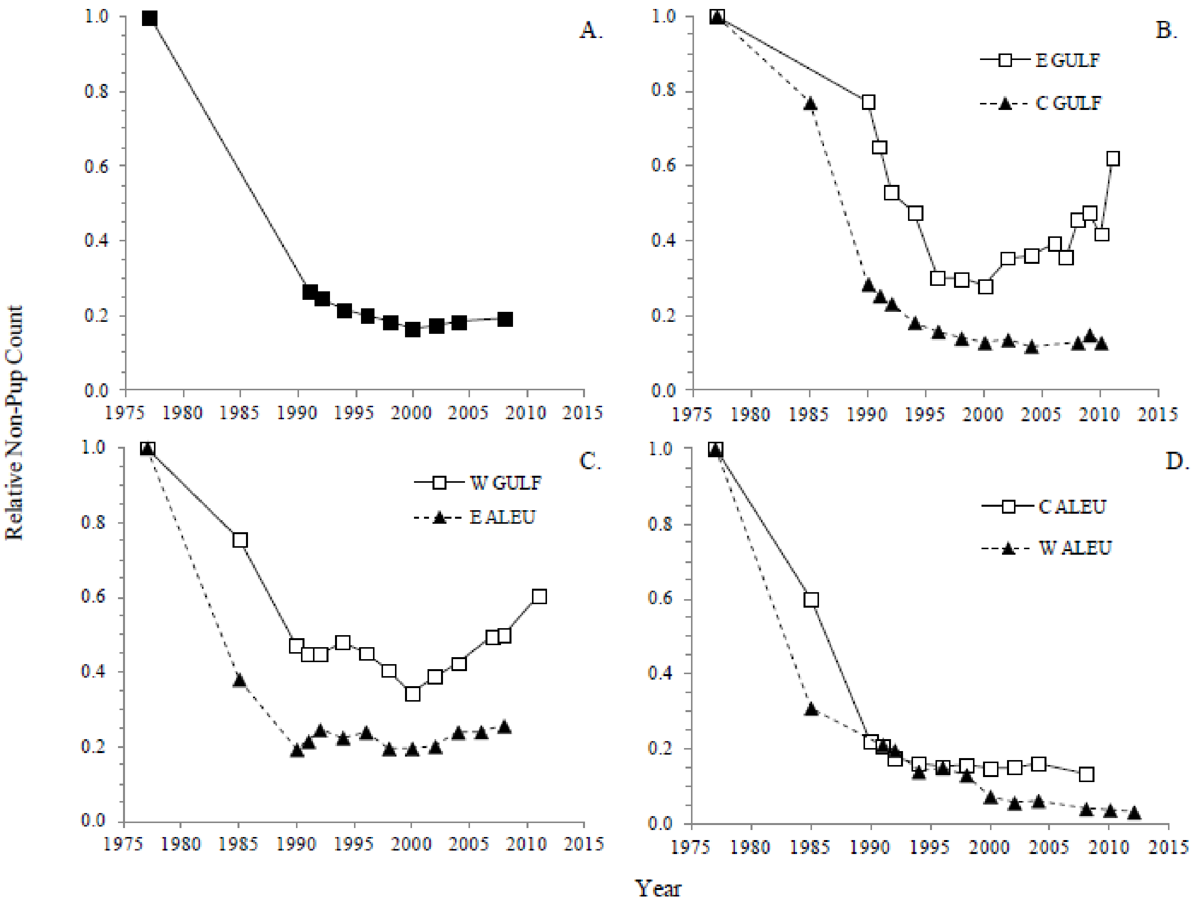
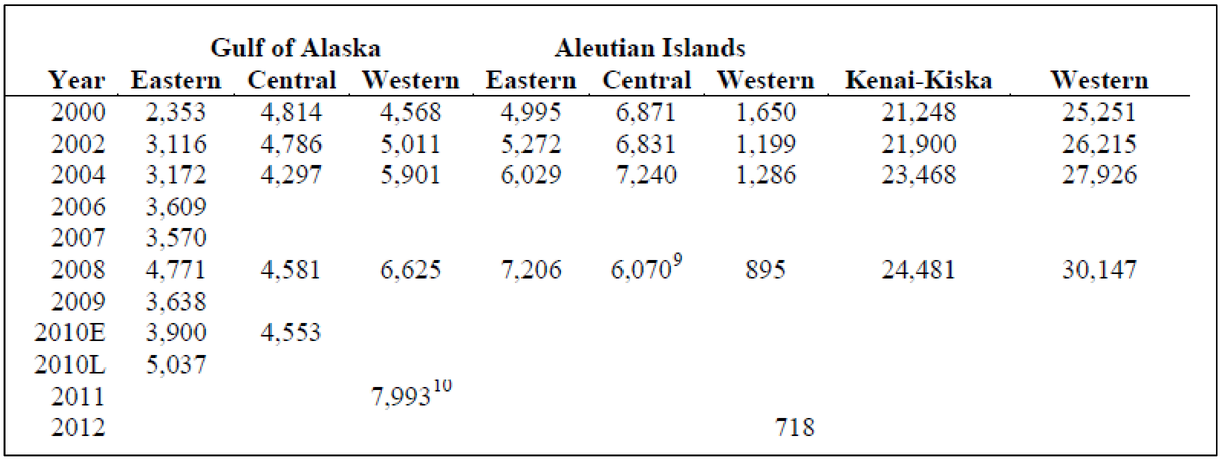


Figure 3-4. Relative counts of adult and juvenile (non-pup) Steller sea lions on consistently surveyed terrestrial haulout and rookery sites in the WDPS in Alaska, 1977–2012 (standardized by sub-region relative to the 1977 count). A. WDPS in Alaska; B. Eastern (E GULF) and central GOA (C GULF); C. Western GOA (W GULF) and eastern Aleutian Islands (E ALEU); D. Central (C ALEU) and western Aleutian Islands (W ALEU).

Table 3-3. Aerial survey counts of adult and juvenile (non-pup) Steller sea lions observed at the 00s trend sites (as described in Fritz et al. (2013)) in seven regions of Alaska in June–July from 2000 through 2011. Kenai-Kiska consists of the combined counts in the central and western Gulf of Alaska and eastern and central Aleutian Islands. Counts in 2004 through 2012 were adjusted to account for differences in photograph orientation and resolution relative to those taken in previous years. Respectively, 2010E and 2010L refer to early and late surveys conducted in 2010. Western refers to the WDPS in Alaska. Source: Fritz et al. (2013).



	Gulf of Alaska			Aleutian Islands				
Year	Eastern	Central	Western	Eastern	Central	Western	Kenai-Kiska	Western
2000	2,353	4,814	4,568	4,995	6,871	1,650	21,248	25,251
2002	3,116	4,786	5,011	5,272	6,831	1,199	21,900	26,215
2004	3,172	4,297	5,901	6,029	7,240	1,286	23,468	27,926
2006	3,609							
2007	3,570							
2008	4,771	4,581	6,625	7,206	6,070[9]	895	24,481	30,147
2009	3,638							
2010E	3,900	4,553						
2010L	5,037							
2011			7,993[10]					
2012						718		

[9] Includes 2006 count at Amchitka/East Cape of 99 animals (adjusted).

[10] Includes 2008 counts at Atkulik, Big Koniuji, Chankliut, Egg (Sand Point), Hague Rock, Nagai/Rk W of Cape Wedge, Omega, Seal Cape, Twins, Kak, Spitz, Castle Rock, The Haystacks, Chermi and Rock totaling 33 animals (adjusted).

Until 2013, NMFS estimated sub-regional and overall WDPS trends in non-pup and pup counts by summing only trend site counts—a subset of the total sites surveyed. Analyses of trend site counts were limited since certain region/period combinations differ across the range as demonstrated in the survey results from 2008 through 2012 (Table 3-3). All three of the CIE reviewers of the FMP BiOp commented on NMFS's methods for monitoring Steller sea lion population trends (Bowen 2012, Stewart 2012, Stokes 2012). Bowen (2012) stated that NMFS's use of trend sites was uncontroversial, but that NMFS needed to describe the uncertainty about the trend estimates. Stokes (2012) cautioned that use of consistently surveyed trend sites to monitor trends may have good statistical justification but it ignores potential bias which might be different between sites and hence defined spatial categories. Stokes (2012) recommended that NMFS use sites selected at random from year to year rather than consistently surveyed trend sites to monitor sea lion trends. Stewart (2012) commented that monitoring individual trend sites is a poor method to assess population viability of metapopulations and that Steller sea lions are hypothesized to be a metapopulation.

In 2013, Johnson and Fritz (In Review) developed a method in response to comments made by the CIE reviewers that uses data from a larger group of sites (all those with at least two counts greater than 0 from 1990 and 2012) to estimate trends and counts for years and sites that were missing. Detailed methods for the count augmentation method are described in Johnson and Fritz (In Review). In general, NMFS disagrees that a survey of randomly selected sites would provide a better population trend estimate since Steller sea lions do not randomly re-distribute between sites from year to year, females have high rookery fidelity (Calkins and Pitcher 1982), an average of 92% of the non-pups counted at all sites in the WDPS in Alaska from 1991 through 2012 were at trend sites. NMFS will continue to monitor abundance of pups and non-pups at all known terrestrial Steller sea lion sites. Combined with the methods to estimate trends from a broader range of sites based on the new aggregation methods described in Johnson and Fritz (In Review), NMFS expects contemporary population trend estimates to be improved relative to prior estimates based solely on counts from trend sites.

Overall, counts of non-pups increased in the WDPS in Alaska between 2000 and 2012 (Table 3-3). However, there were large differences in abundance and trends among sub-regions across Alaska (Table 3-1). In the far western portion of the WDPS in Alaska, the western Aleutian Islands sub-region, the population is declining at approximately 7 percent per year. Meanwhile, the western and eastern GOA sub-regions are increasing at just over 4 percent per year while populations in the central Aleutian Islands and central GOA are stable (Johnson and Fritz In Review). Figure 3-5 shows the dire situation for the western Aleutian Islands sub-region—a population that is declining steadily at over 7 percent per year with the lowest abundance of all the sub-regions.

Regional variation in trends in pup counts from 2000 through 2012 is similar to that of non-pup counts (Johnson and Fritz (In Review); Figure 3-5). Overall, there is strong evidence that pup counts in the entire WDPS in Alaska increased (1.45% y^{-1}; 0.69-2.22% y^{-1}). Pup counts declined steeply in the western Aleutian Islands (-9.36% y^{-1}; -10.93% y^{-1} to -7.78% y^{-1}), but were stable (declining slowly) in the central Aleutian Islands (-0.46 % y^{-1}; -1.50% y^{-1} to 0.72% y^{-1}). As with non-pup counts, there is a west-east cline in pup trends in the central Aleutians, with declining counts in the western central Aleutians and stable (slowly increasing) counts in the eastern central Aleutians. In three of the four sub-regions east of Samalga Pass (eastern Aleutian Islands, and eastern and western GOA), there is strong evidence that pup counts increased (all >3% y^{-1}), but were stable (increasing slowly; 1.48% y^{-1} [-0.56% y^{-1} to 3.30% y^{-1}]) in the central GOA (Fritz et al. 2013, Johnson and Fritz In Review).

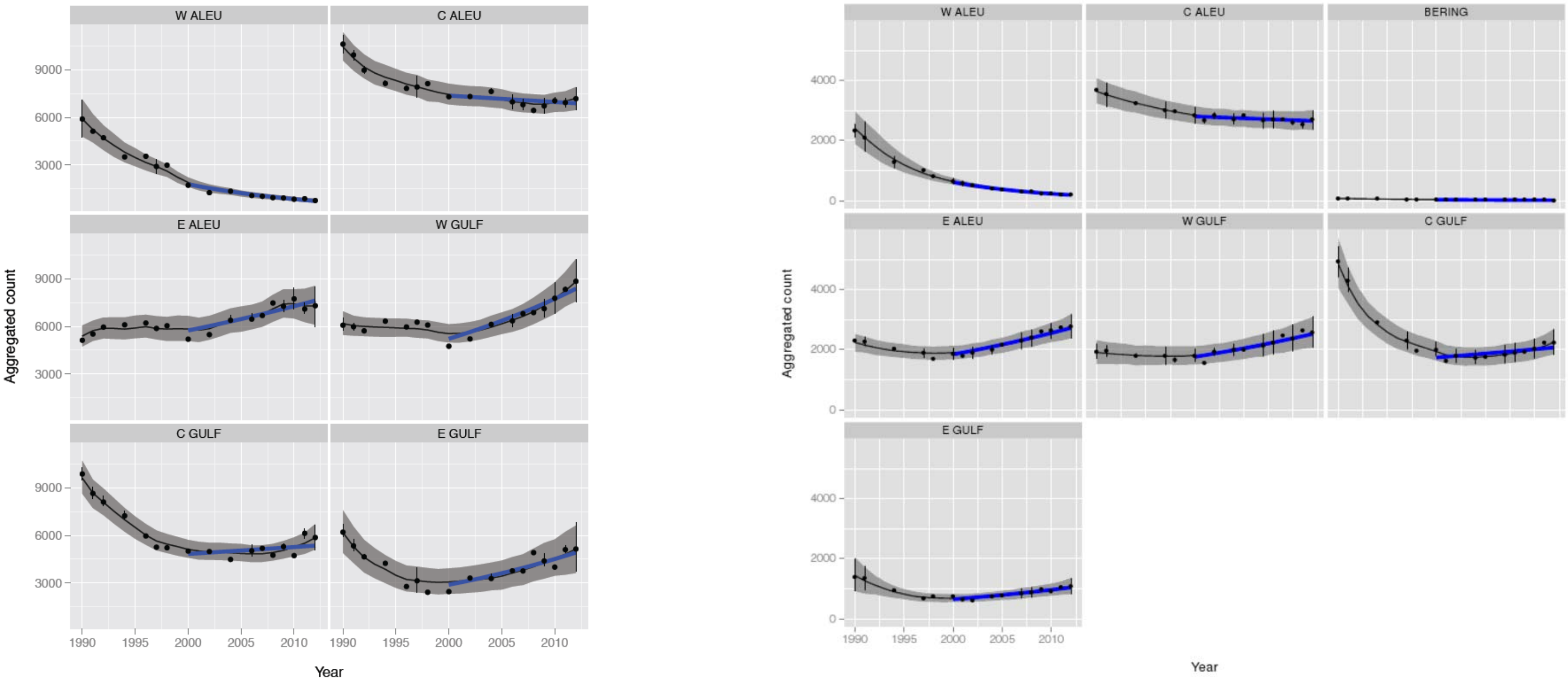


Figure 3-5. Predictive distribution of aggregated non-pup (left) and pup (right) abundance and trends of WDPS Steller sea lions. The grey envelope is the 90 percent highest probability density credible interval of the posterior predictive counts. The points and error bars represent the observed counts with augmented missing values (realized count distribution). The blue lines are the fitted least-squares predictive trend. The black line is the median of the posterior predictive counts. Source: (Johnson and Fritz In Review).

3.4 Movement

Movement of animals between the western and eastern stocks of Steller sea lions may affect population dynamics and patterns of underlying genetic variation. Studies have confirmed movement of animals across the eastern and western stock boundary (Fritz et al. 2013, Gelatt et al. 2007, Jemison et al. 2013, Pitcher et al. 2007, Raum-Suryan et al. 2002). The average estimated net annual movement between stocks is approximately 200 sea lions from southeast Alaska (eastern stock) to the western stock during the breeding season (Fritz et al. 2013). An average net movement of this magnitude represents a very small (<0.5%) percentage of the total count of sea lions in the western stock or southeast Alaska, and has a negligible impact on non-pup trend estimates with a net increase of approximately 400 females in Southeast Alaska (eastern stock) and a net increase of approximately 600 males in the western stock.

Movement of animals among sub-regions within the WDPS may affect population dynamics, including estimated population growth rates. Data are available to estimate movement of animals branded as pups at their natal rookeries in three sub-regions—the eastern GOA (two rookeries), the central GOA (two rookeries), and the eastern Aleutian Islands (one rookery) (Fritz et al. 2013, Jemison et al. 2013). Resightings of branded animals from 2001 through 2011 indicate a net annual movement of sea lions from the central GOA to the eastern GOA, which could have depressed trend estimates in the former and increased trend estimates in the latter region (Fritz et al. 2013). The effect of the estimated regional movements is a net increase of 1,702 sea lions in the eastern GOA and a net decrease of 1,526 in the central GOA.

The percentage of brand re-sightings within each sub-region is shown in Figure 3-6. There were sub-regional differences in natal region fidelity ranging from a low of 64 percent in the central GOA to a high of 79 percent in the eastern Aleutian Islands. There were also differences in the direction of movement between sub-regions. Central and eastern GOA animals were more likely to be observed in sub-regions to the east (eastern GOA and southeast Alaska, respectively). Eastern Aleutian Island animals were more likely to be observed to the north (in the EBS) and to a lesser extent in the western GOA (Figure 3-6) (Fritz et al. 2013). An important caveat to these data is that re-sighting effort was not equally distributed among sub-regions. Effort was relatively high in Russia, the eastern Aleutians, the central and eastern GOA, and southeast Alaska and Washington. Effort was lower in the western and Central Aleutian Islands, the western GOA, and British Columbia. Thus, movement of animals from the eastern Aleutian Islands to the west, central GOA animals to the west, and WDPS animals to the eastern stock may be underestimated in Figure 3-6 (Fritz et al. 2013).

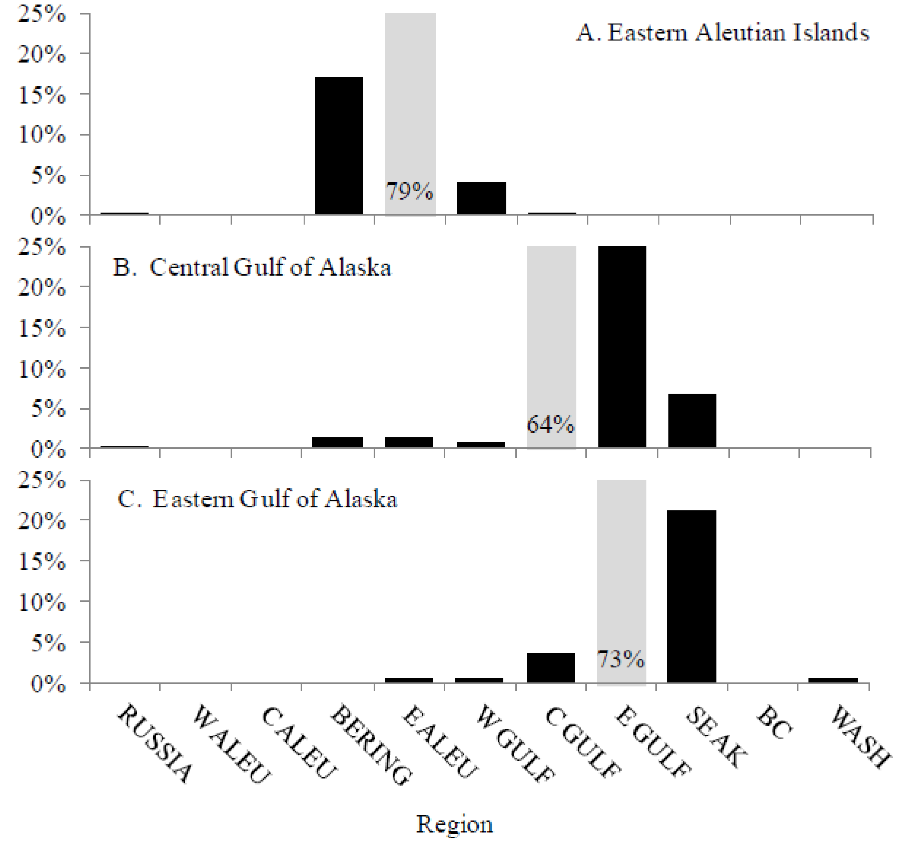


Figure 3-6. Distribution of sightings of individual branded western DPS Steller sea lions by natal rookery region in May–July 2001–2011. Steller sea lions were branded as pups in 2000–2010 on rookeries in the eastern Aleutian Islands (A. Ugamak; 714 non-pups), central Gulf of Alaska (B. Marmot and Sugarloaf; 993), and eastern Gulf of Alaska (C. Wooded [Fish] and Seal Rocks; 287). The data are the average number of individually branded sea lions observed in each region per year, standardized to a total of 100 per natal region, and displayed as a percent. The percent observed within each natal region is shown at the bottom of the gray bar which extends vertically off each chart. Source: (Fritz et al. 2013).

NMFS branded 54 pups at Agattu Island in the western Aleutian Islands in June 2011. Of those pups that have been re-sighted at least once, most were seen on islands within the western Aleutian Islands (82% on Attu, Agattu, and Alaid). However, one was sighted on Ulak Island (179° W in the central Aleutian Islands) in November 2011 and again on St Paul Island (Pribilof Islands; 170° W in the eastern Bering Sea, 1200 km northeast of Agattu) in August 2012, and four were sighted on the Commander Islands (Russia; 500 km northwest of Agattu) in November 2011 and June–August 2012. Three of the four Agattu animals sighted on the Commander Islands have been seen in analyses of digital images collected between October 2012 and May 2013 by remote cameras installed at Agattu Island/Gillon Point and Attu Island/Cape Wrangell (Brian Fadely, National Marine Mammal Lab, personal communication, January 15, 2014).

3.5 Recovery Criteria

Recovery criteria in the Steller sea lion Recovery Plan (NMFS 2008) form the basis from which to gauge the risk of extinction for the WDPS and compose the core standards upon which a decision to remove the WDPS for the Endangered Species List will be based. The recovery criteria include measures of demographic health (biological criteria) as well as measures that indicate the elimination of threats to the species (recovery factor criteria). The biological and the recovery factor criteria must be met for the WDPS of Steller sea lion to be reclassified as threatened or delisted. The biological criteria require evidence that the population status has improved in response to the reduction of threats, while the recovery factor criteria require evidence that the threats have been eliminated or controlled and are not likely to recur. The Recovery Plan noted the limits in our ability to understand the extinction risk of Steller sea lions due to the vast uncertainty about the threats to the species. Thus, NMFS concluded that population growth over an extended period was the only way for the WDPS to demonstrate a reduction in threats (NMFS 2008).

The biological (demographic) criteria in the Recovery Plan (NMFS 2008) are intended to maintain sea lion populations throughout the range of the WDPS. Currently there are no geographic gaps in the range of the WDPS and the Recovery Team determined, and NMFS concurred, that it is important to the species' viability to maintain populations in all sub-regions of the WDPS (NMFS 2008). Significant declines over large areas (two sub-regions or more) could indicate that extinction risk may still be high and that further research would be needed to understand the threats before delisting.

The demographic down-listing criteria (from endangered to threatened) for the WDPS are—

1) The population for the U.S. region [in Alaska] has increased (statistically significant) for 15 years on average, based on counts of non-pups, and

2) The trends in non-pups in at least five of the seven sub-regions are consistent with the trend observed under criterion #1. The population trend in any two adjacent sub-regions cannot be declining significantly. The seven sub-regions are as follows (Figure 3-2): eastern GOA; central GOA; western GOA; eastern Aleutian Islands (including the EBS); central Aleutian Islands; western Aleutian Islands, and Russia/Asia.

The WDPS population in Alaska is increasing at a statistically significant rate; however the increase is due to significant increases in population growth in three of the six sub-regions (the Eastern Aleutian Islands, and the western and eastern GOA). The WDPS continues to decline in the central (non-significant) and western Aleutian Islands (significant) and to increase at an uncertain rate in the central GOA. Thus, the WDPS is not on track to reach the recovery criteria to be down-listed from endangered to threatened by 2015.[8]

The demographic criteria to remove the WDPS of Steller sea lions from the Endangered Species List require 1) statistically significant increases in sea lion abundance for 30 years, 2) no statistically significant population declines in two adjacent sub-areas, and 3) no decline in abundance[9] of more than 50 percent in any sub-region relative to the 2000 base year (NMFS 2008). Significant population increases need to occur for another 17 years to achieve the first demographic de-listing criterion. Given current population trends (significant increases in only 3 of 6 sub-regions in Alaska), the second criterion is not being met and substantial increases in western Aleutian Islands population abundance need to occur to satisfy the third criterion. Non-pup counts on all western Aleutian Islands

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[8] The Recovery Plan uses a "base year" of 2000 for assessing the recovery criteria. Thus, 2015 is the earliest the population could be re-classified as threatened per these criteria.

[9] The Recovery Plan says the "trend" cannot have declined by more than 50 percent. The observation by CIE reviewer Stokes (2012) is correct that NMFS intended for this criterion to pertain to the population abundance and not the trend.

trend sites declined by 7.23% y^{-1} (95% confidence interval of -9.04 y^{-1} to -5.56) between 2000 and 2012,a -60 percent change in abundance (Fritz et al. 2013).

As NMFS learns more about the population structure of the WDPS in Alaska, including information such as the distribution and movement of animals between sub-regions, NMFS may revisit the Recovery Plan criteria.

3.6 Extinction Risk of the WDPS in Alaska

In addition to reviewing past and current trends in abundance, NMFS used the available count data to predict the status of the WDPS including the predicted status of each sub-region 50 and 100 years in the future (Johnson 2013). Population viability analyses (PVAs) aim to assign concrete numbers to measures of a population's future status, where future status means the likelihood the population will be above a minimum size at some point in the future (Morris and Doak 2002). There are many types of PVAs and the choice of which model to use in a particular case is determined by the information available for the population and the objective of the model. As described in the Steller Sea Lion Recovery Plan (NMFS 2008) numerous PVAs have been conducted for the WDPS. The last formal PVA included Steller sea lion survey data collected through 2006 (Boyd 2010). To generate an assessment using all the information currently available, NMFS conducted new analyses of future WDPS population status for this biological opinion using the count data through 2012 (Johnson 2013).

Generally, PVAs predict future population size and the likelihood of the population crossing a pre-defined abundance threshold based on historically observed abundance trends and, if known, population birth, death, and immigration and emigration rates. If population processes such as birth and death rate are regulated by the density of the population (density dependence), then the PVA can be designed to constrain population growth according to population density. Thus, depending on the available data, the complexity of PVAs varies considerably. While more complex models may appear to yield more accurate results because they include more biological detail, this gain in accuracy is undermined if the use of a more complex model requires analysts to guess at critical components for which there are no data. Thus, simpler approaches with empirical data are better gauges of future population status than complex structures that rely on numbers with no empirical justification (Morris and Doak 2002).

NMFS constructed two, simple, count-based predictions of future population size and of the probability that the WDPS of Steller sea lions in Alaska will reach a threshold, referred to as the quasi-extinction threshold, in 50 and 100 years (Johnson 2013). The only data requirement for these models was the time series of WDPS counts and the specification of a quasi-extinction threshold.

A quasi-extinction threshold is a population size greater than zero (ultimate extinction) that represents a minimum viable population size. Theoretically, when a population falls below the quasi-extinction threshold, Allee effects (e.g., predation risk, mating failure, genetic bottlenecks) doom the population to ultimate extinction. The two models developed for this biological opinion (Johnson 2013) used the quasi-extinction threshold from the PVA developed for the Steller Sea Lion Recovery Plan (NMFS 2008). It is based on a minimum viable breeding population of $N = 1{,}000$ and takes into account the juvenile proportion of the total population and the sex ratio of reproductively active animals. Thus, the abundance quasi-extinction threshold for the WDPS in Alaska was estimated to be $N = 4{,}743$ non-pups. Based on past experience, NMFS assumes that 50% of the total non-pup portion of the population is hauled-out and available to the summer survey at any time. Therefore, the survey quasi-extinction threshold would be reached when the WDPS survey count in Alaska was less than $n = 2{,}372$. NMFS allocated the quasi-extinction threshold among the sub-regions based on the number of rookeries in each sub-region to derive a sub-region-specific threshold. NMFS assumed the quasi-extinction threshold would be the same for each rookery and divided the survey threshold by the number of rookeries in Alaska for a rookery-specific survey quasi-extinction threshold (survey QE) of 64 animals (abundance QE threshold = 124 animals per rookery and associated sub-region haul outs). Table 3-4 shows the quasi-extinction thresholds for each sub-region.

Table 3-4. WDPS and sub-region specific abundance and survey quasi-extinction thresholds. Source: Johnson (2013).

Region	Rookeries	Abundance QE	Survey QE
W ALEU	4	513	256
C ALEU	12	1538	769
E ALEU	7	897	449
W GULF	5	641	320
C GULF	6	769	385
E GULF	3	385	192

To assess the probability of quasi-extinction in the future for each WDPS sub-region and the entire WDPS in Alaska, NMFS employed two models for comparison and assessment of qualitative inference. One model was based on the count-based PVA methods for density-independent population growth described in Morris and Doak (2002). The other method was based on direct sampling of future abundance values estimated via the new population trend estimation methods described in Johnson and Fritz (In Review). Initially, NMFS intended to assess future WDPS population status by forecasting the abundance and trend estimates generated by Johnson and Fritz (In Review) (referred to as agTrend). Recognizing that agTrend was a novel method and because the NPFMC's SSC had provided substantial input into the PVA developed for the Steller Sea Lion Recovery Plan (NMFS 2008), NMFS presented the methods and initial results of the agTrend forecast (Johnson and Fritz In Review) to the SSC for review and comment in June 2013. The SSC did not express concerns with the population forecast based on Johnson and Fritz (In Review). Subsequently, NMFS applied published and commonly-used count-based PVA methods (Morris and Doak 2002) to the WDPS count data for comparison with the Johnson and Fritz (In Review) method.

The method based on Morris and Doak (2002) assumes that the population growth rate and variability about that rate will resemble historically observed values and models a constant mean annual population growth rate. The agTrend method allows the population growth rate to increase over time according to the trends in the preceding years (Johnson 2013). The agTrend model also allows for declining growth rates, but, the observed counts show a positive change in growth rate from the 1990s through the 2000s; so, it weights a continued positive change in growth over a declining change. Additional assumptions differed between the two methods as discussed in (Johnson 2013). Given differences in the method and underlying assumptions, count data from 2000 through 2012 were included in the model based on Morris and Doak (2002) and data from 1990 through 2012 were included in the model based on Johnson and Fritz (In Review). NMFS generated two sets of estimates of probability of quasi-extinction with the agTrend method. One set of estimates (restricted) constrains population growth to a maximum of 5 percent per year for 50 years while the other allows population growth to increase exponentially without constraint (unrestricted, which may be biologically unrealistic) (Johnson 2013).

Qualitatively, the results for each method are the same. With the exception of the western Aleutian Islands, the models predict a virtually nil probability that the WDPS of Steller sea lions in Alaska will cross the quasi-extinction threshold in the next 100 years given current trends in population growth rate and abundance (Table 3-5). Both models predict a high probability of quasi-extinction of Steller sea lions in the western Aleutian Islands sub-region in 50 years and a near certain probability of reaching quasi-extinction in the next 100 years (Table 3-5). The results from the Morris and Doak (2002) method are slightly more pessimistic than the agTrend method because the former does not allow the mean annual population growth rate to change and the latter does. Thus, the status quo negative population growth rate in the western Aleutian Islands is continued forever into the future with no hope of recovery under the Morris and Doak (2002) method. Besides the western Aleutian Islands, the eastern GOA is the only other sub-region with the slightest probability (1%, 95% credible interval 0 – 2%) of reaching quasi-extinction in the next 50 years based on the Morris and Doak (2002) method. No other sub-regions other than the western Aleutian Islands have the slightest probability of reaching the quasi-extinction threshold in 50 or 100 years according to the agTrend forecast results (Table 3-5). Though the posterior mean probability of quasi-extinction is greater than zero over 100 years for some sub-regions, the mean and the mode of the cumulative frequency distribution are equal to zero for all sub-regions (Johnson 2013). This implies that there is virtually a zero probability of the other sub-regions or WDPS reaching quasi-extinction in 50 or 100 years, with the exception being the western Aleutian Islands sub-region.

Table 3-5. The probability that Steller sea lions will cross the quasi-extinction threshold in each sub-region in the WDPS in Alaska and in the WDPS in Alaska as a whole in the next 50 and 100 years. MD refers to the method based on Morris and Doak (2002) and agTrend refers to the method based on Johnson and Fritz (In Review). Source:(Johnson 2013).

Sub-Region	P[QE ≤ 50 yrs]			P[QE ≤ 100 yrs]		
	MD	*agTrend (restricted)*	*agTrend (unrestricted)*	*MD*	*agTrend (restricted)*	*agTrend (unrestricted)*
W ALEU	0.99 (0.97-1.0)	0.75	0.46	1	0.89	0.46
C ALEU	0	0	0	0.03 (0.0-0.08)	0	0
E ALEU	0	0	0	0 (0.0-0.01)	0	0
W GULF	0	0	0	0	0	0
C GULF	0	0	0	0 (0.0-0.01)	0	0
E GULF	0.01 (0.0-0.02)	0	0	0.02 (0.0-0.05)	0	0
Total	0	0	0	0	0	0

3.7 Vital Rates

Changes in the size of a population are ultimately due to changes in one or more of its vital demographic rates. Inputs to the population are provided by reproduction of adults (e.g., birth rates, natality, fecundity; probability that a female of a given age will give birth to a pup each year) and immigration. Outputs from the population include those that leave the population through emigration or death, which can also be inversely described by rates of adult and juvenile survivorship (the proportion of individuals surviving at each age). Estimates of vital rates are best determined in longitudinal studies of marked animals, but can also be estimated through population models fit to time series of counts of sea lions at different ages or stages (e.g., pups, non-pups).

3.7.1 Survival

Causes of pup mortality include drowning, starvation caused by separation from the mother, disease, parasitism, predation, crushing by larger animals, biting by other Steller sea lions, and complications during parturition (Orr and Poulter 1967; Edie 1977; Maniscalco et al. 2005; Maniscalco et al. 2007; and Allen and Angliss 2011). Older animals may die from disease, predation, starvation, injuries, intra-specific interactions (e.g., bulls can kill females during copulation), intentional shooting by humans, entanglement in marine debris, and fishery interactions (Merrick et al.1987, Altukhov et al. 2012). Research handling and disturbance has also been listed as a possible contributor to pup mortality (Dalton 2005), but recent studies (e.g., Chelnokov 2004, Hastings et al. 2009, Wilson et al. 2012) have shown research impacts to be minimal.

Early estimates of survivorship in WDPS sea lions were generated by Calkins and Pitcher (1982) using life tables constructed from a sample of animals collected in the central GOA from 1975 to 1978. Pendleton et al. (2006) estimated survivorship with mark (branded pups) and resighting techniques starting in the late 1980s when the WDPS was in steep decline throughout its range. The most recent estimates of survivorship in the WDPS in Alaska were generated by Fritz et al. (In Review) based on re-sightings of branded animals in the 2000s. All three of these studies included animals from the Marmot Island rookery in the central GOA which provides for comparison in survival over time.

For the first time, this biological opinion includes data on survivorship in the eastern and central GOA and eastern Aleutian Islands. Horning and Mellish (2012) estimated survivorship of Steller sea lions based on data from juvenile animals tagged with life history tags in the eastern GOA. Fritz et al. (In Review) also includes data from the eastern GOA for comparison of estimates of survivorship from the same sub-region over the same period. Survivorship data for the eastern Aleutian Islands are also included in Fritz et al. (In Review).

In addition to the empirical studies listed in Table 3-6, several modeling studies have estimated survivorship in the WDPS of Steller sea lions (Pascual and Adkison 1994, York 1994, Holmes and York 2003, Fay and Punt 2006, Winship and Trites 2006, Holmes et al. 2007).

Table 3-6. Empirical studies to estimate survival, by sub-region in the WDPS of Steller sea lions.

	Region	Years marked/tagged	Re-sighting Years	Sample Size	
Collection				Females	Males
Calkins and Pitcher (1982)	Central GOA	1975-1978	n/a	141	99
Branded Animals					
Pendleton et al. (2006)	Central GOA	1987-1988	1987-2003	389	362
Fritz et al. (In Review)	Eastern GOA	2001-2005	2002-2011	129	158
Fritz et al. (In Review)	Central GOA	2000-2004	2001-2011	307	330
Fritz et al. (In Review)	Eastern AI	2001-2005	2002-2011	239	286
LHX Tags					
Horning and Mellish (2012)	Eastern GOA	2005-2011	2005-2011	8	28

Estimates of survivorship in the central GOA were similar among study periods with the exception of ages 0 to 3 years. These results corroborate the demographic modeling studies, which also found that the steep decline in abundance observed in the 1980s and early 1990s in the central GOA was associated with a large drop in the survival rate of juvenile sea lions (Pascual and Adkison 1994, York 1994, Holmes and York 2003, Fay and Punt 2006, Winship and Trites 2006, Holmes et al. 2007). Holmes et al. (2007) estimated that the survival rate of juvenile females in the central GOA in the late 1980s to early 1990s was 27 percent lower than in the mid-1970s. The WDPS Steller sea lion population east of Samalga Pass (eastern Aleutian Islands, and the western, central, and eastern Gulf of Alaska) reached its lowest level of abundance in 2000. As the population stabilized in the late 1990s and early 2000s, juvenile survivorship improved to rates similar to those observed prior to the decline (Table 3-8).

Annual survival rates increased with age for both sexes over all time periods in the central GOA, such that by age 7 years, average annual survival rates were estimated to range from 0.86 to 0.91 over all time periods (Table 3-8). Females may live to approximately 30 years and males to approximately 20 years (Calkins and Pitcher 1982).

Table 3-7. Comparison of estimated survival of male (M) and female (F) Steller sea lions in the central GOA over time. The survival probability is the proportion that survived between the former age to the later age. The provided survival probabilities are annual unless noted.

Study	Age 0 to 3		Age 1		Age 2		Age 3		Age 4+		Age 7	
	M	F	M	F	M	F	M	F	M	F	M	F
Calkins and Pitcher (1982)	0.26[a]	0.47[a]	--	--	--	--	--	--	0.86	0.87	--	.89
Pendleton et al. (2006)			0.73[b]		0.58[b]		0.58[b]		0.86[b]		0.86 [b]	
Fritz et al. (In Review)			0.79	0.78	0.69	0.76	0.73	0.79	0.87[c]	0.94[c]		

[a] Cumulative survival

[b] Results from the Cormack-Jolly-Seber model for Marmot Island.

[c] Ages 4 to 11

Table 3-8. Comparison of combined male and female survival probabilities of Steller sea lions from age 0 to 3 years and for animals over 7 years in age in the Central GOA.

	Cumulative Survival 0 – 3 years	Annual Survival for Age 7+
Calkins and Pitcher (1982)	0.37	0.89
Pendleton et al. (2006)	0.24	0.86
Fritz et al. (In Review)	0.43	0.91

Horning and Mellish (2012) estimated survivorship from age 1 to 3 years to be 0.53 (95% CI: 0.40-0.63) for Steller sea lions in the eastern GOA, based on mortality detections from life history transmitter (LHX) tags implanted in 8 female and 28 male juveniles in the early 2000s. This is lower than, but not significantly different from NMFS's estimate (0.62: 0.50-0.73) for sea lions branded as pups in the eastern Gulf in 2001–2005 for the same age range and for a population with the same sex ratio (Fritz et al. In Review).

In the eastern Aleutian Islands where sea lion populations increased at approximately 3–4% y^{-1} between 2000 and 2012, survivorship to age 3 years has been relatively high: 0.55 for females and 0.45 for males branded as pups between 2001 and 2005 on Ugamak Island (Fritz et al. In Review). Similarly, preliminary estimates based on sea lions branded as pups in eastern Russia (Medny Island in the Commander Islands and Kozlova Cape in eastern Kamchatka) also indicate relatively high juvenile survival in populations that are stable or declining in the 2000s and have declined considerably since the 1970s (Burkanov and Loughlin 2005).

Hastings et al. (2011) estimated survival of eastern Steller sea lions based on sightings (through 2009) of animals branded as pups in 2001–2005 on four rookeries in southeast Alaska. Juvenile survivorship (to age 3 y) ranged between 0.36–0.63 for females (overall mean: 0.39) and 0.28–0.55 for males (overall mean: 0.31), and was greater at the smaller, younger rookeries in northern southeast Alaska (Graves Rock and White Sisters) than at the larger, older rookeries to the south (Hazy and Forrester) (Gelatt et al. 2007, Hastings et al. 2011, Fritz et al. In Review). Overall (pooled females and males, and weighted by pup production in 2009 at the rookeries where pups were branded) survivorship of Steller sea lions to age 3 years is 0.35 for the eastern DPS in southeast Alaska (Hastings et al. 2011, Fritz et al. In Review) but 0.46 for the combined WDPS in the central GOA, eastern GOA, and eastern Aleutian Islands (Fritz et al. In Review). Steller sea lion populations in both of these areas increased at rates of approximately 3% y^{-1} in the 2000s (Pitcher et al. 2007, Fritz et al. 2013). This suggests that there are other demographic differences (adult survival, natality, age structure, or movement) between the eastern and western stocks.

There are no data to inform how juvenile survivorship has changed over the last 30 years in the western and central Aleutian Islands where populations continue to decline (western and western-central Aleutians) or are relatively stable (eastern-central Aleutians). In June 2011, NMFS branded 54 Steller sea lion pups at Gillon Point rookery on Agattu Island (173° E) in the western Aleutians. Between June and November 2012, 48 percent of these branded animals were observed. Thus, at a minimum, 48 percent survived at least one year. This is greater than the average first year minimum survival rate (39%) for all rookery cohorts branded in 2000–2005 in the eastern Aleutians through the eastern Gulf (range of 9–60%; Fritz et al. In Review). Adding 9 or 10 more years of sightings improved the estimated survival to age 1 year of branded WDPS sea lions (females and males) east of Samalga Pass to between 55 percent and 87 percent (Fritz et al. In Review). Thus, sightings in subsequent years are expected to improve estimates of survival to age 1 y in the western Aleutians. While very preliminary, these first year sightings of Agattu brands suggest that first year survival is not compromised in the western Aleutians, where Steller sea lion populations are declining.

Adult survival: Temporal changes in adult (ages 4+ y) survivorship from both branding and demographic modeling studies were similar to those described above for juveniles, except that the magnitudes of the changes were smaller. During the steep population decline in the 1980s, adult survivorship dropped 3 to 8 percent relative to the 1970s, and as the population stabilized in the late 1990s and through the early 2000s, adult survivorship improved to rates similar to or greater than pre-decline rates (Pascual and Adkison 1994, York 1994, Holmes and York 2003, Winship and Trites 2006, Fay and Punt 2006, Pendleton et al. 2006, Holmes et al. 2007). Compared to the mid-1970s (Calkins and Pitcher 1982), Holmes et al. (2007) estimated that annual survival of females was 7 percent lower in the late 1980s to early 1990s using a demographic model, while Pendleton et al. (2006) estimated that annual adult survival of pooled females and males (0.86) was 4 percent lower based on sightings of the 1987–1988 cohorts branded at Marmot Island. As the WDPS east of Samalga Pass stabilized and increased in the 1990s and 2000s, adult survivorship also increased, potentially to rates greater than those estimated for the pre-decline population. Holmes et al. (2007) estimated that survivorship of adult females in 1998–2004 had improved by approximately 7 percent relative to the mid-1970s. Annual survival of adults between 4 and 11 years old based on sightings of animals branded as pups in 2000–2005 in the eastern Aleutians, and central and eastern Gulf of Alaska (n =1,449) ranged between 0.90 and 0.95 for females and between 0.87 and 0.91 for males (Fritz et al. In Review), or up to 6 percent and 2 percent greater, respectively, than the mid-1970s, and 9 percent greater than the late 1980s to early 1990s.

There are no data to inform how adult survivorship has changed over the last 30 years in the western Aleutian Islands where populations continue to decline or in the central Aleutian Islands where populations are relatively stable at low levels. NMFS expects to collect this information through subsequent resightings of animals branded as pups at Agattu in the western Aleutian Islands and by branding and following additional cohorts in the central and western Aleutian Islands in the future, though the sample size is expected to be small based on the number of animals expected to survive to adulthood.

3.7.2 Reproduction

Birth rate (natality), defined as the probability that a reproductively mature female will give birth to a pup each year, is one of the key parameters governing Steller sea lion population growth. Steller sea lion birth rates may be affected by age, body condition and lactation status, as well as availability of food resources, disease, contaminants, and other factors (Pitcher et al. 1998, Pitcher et al. 2001). The annual reproductive ecology of Steller sea lions is seasonal and synchronous which is consistent with a strategy dependent on seasonal food availability. Steller sea lions are in the Otariidae family. Otariid breeding patterns are energetically expensive (Costa 1993). Female otariids have long lactation periods and rely on food resources adjacent to the rookery or haulout where their offspring are located to meet their energy demands. This reproductive strategy is optimal where prey resources are concentrated and predictable near rookeries and haulouts but can render otariid populations susceptible to localized prey depletion. Because fisheries have the potential to reduce the availability of food to Steller sea lions, and thus the potential to indirectly affect the birth rate of Steller sea lions, it is relevant to consider the reproductive ecology and birth rate of Steller sea lions when assessing the potential impacts of fishing on Steller sea lion populations.

Female Steller sea lions reach sexual maturity at 3 to 6 years of age and may produce young into their early 20s (Mathisen et al. 1962, Pitcher and Calkins 1981). The reproductive cycle for reproductively mature females includes mating, gestation, parturition, and lactation or post-natal care. Annually, reproductively mature females arrive at rookeries in late May and early June and pregnant females give birth to a single pup. Across the range, Steller sea lion births occur from May 15 to July 15 (Pitcher et al. 2001). Pupping tends to be synchronous within individual rookeries with 90 percent of pups born within a 25-day period (Pitcher et al. 2001).

Steller sea lions are polygynous; a single male may mate with multiple females. Males establish territories in May in anticipation of female arrival. Males first attain the ability to hold territories by the age of 10 or 11 (Thorsteinson and Lensink 1962, Raum-Suryan et al. 2002). Adult females normally ovulate once each year, and most mate annually (Pitcher and Calkins 1981). Females typically mate about 11 days after giving birth (Calkins and Pitcher 1982). Although mating occurs during mid-summer, embryo implantation is delayed and occurs in late September or October resulting in an active gestation of about 9 months (Pitcher and Calkins 1981). Female Steller sea lions may nurse their pups for a period ranging from approximately 9 months to up to 3 years, though the majority wean after 9 to 12 months of age (Pitcher and Calkins 1981, Loughlin et al. 2003, Fadely et al. 2005).

Given this annual cycle, it would not be uncommon for adult female Steller sea lions will be in a simultaneous phase of lactation and gestation. Adult females in a phase of simultaneous lactation and gestation have the highest proportional energy requirements of all Steller sea lion life history stages, especially in the spring (March 1 through May 31) and winter (December 1 through February 28) (Winship et al. 2002). Energy requirements for gestation are nominal compared to the increased energy requirements associated with lactation and more energy is required to nurse male pups compared to female pups (Winship et al. 2002). Adult females less than 10 years in age have energetic requirements for growth in addition to maintenance and reproduction.

Birth rate is an important parameter for understanding the forces governing the population dynamics of Steller sea lions. Signals of a reduced birth rate are consistent with responses expected when bottom-up drivers are affecting a population’s growth rate. Bottom-up drivers are factors that affect the physical condition of sea lions (e.g., changes in the environment affecting resource availability or non-lethal disease). While birth rate estimates may provide insight into the direction of the forcing, additional information is needed to ascribe specific drivers. Nonetheless, reliable estimates of birth rate in the WDPS would provide valuable insight as to whether top-down (e.g., predation and other direct mortality), bottom-up, or a combination of forcing is affecting dynamics in this population.

Despite the importance, attempts to directly measure birth rate in the WDPS of Steller sea lions have been limited, largely due to the logistical difficulty of measuring this vital rate in wild Steller sea lions. Studies with empirical estimates of WDPS Steller sea lion birth rates are shown in Table 3-9. The most informative estimates of birth rate in Steller sea lions came from the examination of reproductive tracts from animals collected in 1975–1976 (Calkins and Pitcher 1982) and 1985–1986 (Calkins and Goodwin 1988). From these studies, estimates of near-term birth rates of all adult females were 67 percent from the collection of females taken from 1975–1978 and 55 percent from the collection taken from 1985–1986 (Pitcher et al. 1998). The difference in birth rate was not significant between periods ($p = 0.34$), yet the statistical power to detect the difference was low (less than 0.50). However, the difference in pregnancy rates of the lactating females between the 1970s (63%) and 1980s (30%) was significant ($p = 0.059$).

It is not feasible to sacrifice Steller sea lions to collect reproductive tracts at present, so alternate methods such as mark-resight estimation, analysis of reproductive hormone levels in feces or tissue samples, or population modeling must be employed to estimate birth rates in the WDPS of Steller sea lion. As with estimates of survival, the best estimates of reproductive performance in pinnipeds derive from the study of known individuals over time. These studies are referred to as longitudinal studies and include mark-resight techniques. The most common method of marking Steller sea lions is hot branding and individuals are marked with a unique symbol and number. Thousands of Steller sea lions have been marked in the WDPS since the late 1980s (ADFG and NMFS 2013, Burkanov et al. 2012, Chumbley et al. 1997). To date, the only available analysis of birth rate from branded animals in the WDPS is from Trukhin and Burkanov (2004). Trukhin and Burkanov summarized Steller sea lion breeding patterns at Raykoke Island, Kuril Islands, during 2001–2003. Based on resights of marked individuals, they reported that 12 percent of 4 year old females gave birth, 64 percent of 5 year olds gave birth, and 75 percent of 7 year olds gave birth. An analysis is under development to expand these initial estimates of birth rate in the Russian portion of the WDPS based on resights of branded animals (V. Burkanov, National Marine Mammal Lab, personal communication, January 30, 2013). Taylor (2009) estimated birth rates of Steller sea lions based on encounter histories of branded females sighted with and without pups in the range of the eastern stock of Steller sea lions.

Using animals without brands of known age, Maniscalco et al. (2005) and Maniscalco et al. (2010) analyzed resight data of females with distinct natural markings (fungal patches, scars, or other) from Chiswell Island rookery in the eastern GOA range of the WDPS. Chiswell Island is continually observed by remotely-operated cameras, so it is known whether or not a marked female gives birth on the island. Based on continual observations during the breeding season from 2001 through 2008, Maniscalco et al. (2010) estimated the birth rate to be 69.2 percent (± 2.5 S.E.) for all years combined and found that females that gave birth in one year were more likely to give birth the following year. Over the 7-year study period, they resighted 151 mature females in at least two years. Of these, six were females of a known age. Known-age females produced their first pup at an average age of 5.3 years (Maniscalco et al. 2010). Age at reproduction and the estimated birth rate were similar to the birth rate reported in Calkins and Pitcher (1981). Maniscalco et al. (2010) note that the birth rate estimate in their study may be an underestimate as two females of unknown age never gave birth over the 4 years they were observed and may have been post-reproductive.

Table 3-9. Empirical studies conducted to estimate birth rate in WDPS Steller sea lion populations.

	Region	Years Sampled	Sample Size	Life Stage	Estimated Birth Rate
Collections					
Calkins and Pitcher (1981)	Central GOA	1975-1976	46	Adult females	63%
Calkins and Goodwin (1988)	Central GOA	1985-1986	89	Adult females	55%
Longitudinal Studies					
Trukhin and Burkanov (2004)	Kuril Islands, Russia	2001-2003	?	Adult females	12 – 75%[1]
Maniscalco et al. (2010)	Eastern GOA	2003-2009	151	Adult females	69% (±2.5% S.E.)

[1] Provided age-specific birth rate estimates that varied from 12% for 4 year-old females to 75% for 7 year-old females.

As an alternative to longitudinal studies, retrospective age-structured population models have been developed to estimate changes in vital rates that might have caused the WDPS population decline. These models are based primarily on the vital rate estimates from the central and eastern GOA in the 1970s and 1980s (Calkins and Pitcher 1981; Calkins and Goodwin 1988) and contemporary counts of pups and non-pups across the range of the WDPS of Steller sea lion. These studies are referred to here as inferential studies since they model data collected from other studies. Inferential studies with birth rate estimates for the WDPS of Steller sea lion are listed in Table 3-10.

Table 3-10. Inferential studies conducted to estimate birth rate in WDPS Steller sea lion populations.

	Region	Years Modeled	Estimated Birth Rate (or effect of birth rate on observed trend)
York (1994)	Central GOA	1975 - 1985	63%[1]
Pascual and Adkison (1994)	Central AI, Eastern AI, Central GOA	1976 - 1991	Appreciable reductions over time[1]
Holmes and York (2003)	Central GOA	1976 - 1998	Varied over time
Fay (2004); Fay and Punt (2006)	Eastern, Central, and Western AI; Eastern, Central and Western GOA	1976 - 2001	Varied by region
Winship and Trites (2006)	GOA, AI	1978 - 2002	Varied by region and over time
Holmes et al. (2007)	Central GOA	1976 - 2004	Steadily decreased over time

[1] Used birth rate from Calkins and Pitcher (1981 and 1982) to parameterize age-structured models.

Pascual and Adkison (1994) used survival and fecundity rates estimated by Calkins and Pitcher (1982) to simulate Steller sea lion population trajectories at six Steller sea lion rookeries (Seguam Island, central Aleutian Islands; Bogoslof and Ugamak Islands, eastern Aleutian Islands; and Chowiet, Chirikof and Marmot Islands, central GOA) based on annual abundance estimates at these sites. A 30 to 60 percent reduction in juvenile survival or a 70 to 100 percent reduction in female fecundity (the probability that an adult female will give birth to a female each year) was necessary to simulate the observed decline in abundance in the WDPS of Steller sea lions from 1976–1991. Pascual and Adkison (1994) concluded that sea lion declines in the WDPS were probably caused by a long-term or catastrophic change in conditions. Different rookeries showed different declines, indicating that conditions may be worse in some broad areas than in others. This study does not establish the relative contribution of reduced fecundity and reduced juvenile survival to the decline.

Holmes and York (2003) used a life-table developed by York (1994), for the period prior to the decline of the WDPS of Steller sea lions, to fit an age-structured model with time varying survival and fecundity to the pup, non-pup and juvenile fraction of the WDPS from 1976 through 1998. The objective of Holmes and York (2003) was to estimate the survival and fecundity rates associated with the decline of the WDPS in the 1980s and 1990s. This study indicated that there were three relatively abrupt changes in vital rates in the WDPS in the 1980s and 1990s, suggesting different causes for the decline at different times. Holmes and York (2003) found that declines in the 1980s may be attributed to slight (if any) declines in fecundity but were likely associated with a severe drop in juvenile survivorship relative to 1976. Overall, their results indicate low juvenile survivorship during the early declines, low adult survivorship during the declines of the late 1980s to early 1990s, and low fecundity during declines through the 1990s. Holmes and York (2003) did not detect a significant change in fecundity relative to 1976 levels (from Calkins and Pitcher 1982) until the early 1990s. Holmes and York (2003) also highlighted the importance of including data on the juvenile fraction of the population (in addition to counts of pups and non-pups) to increase certainty and speed about which changes in vital rates in the WDPS Steller sea lion population can be detected. The juvenile fraction information allowed Holmes and York to determine which vital rates were changing through the 1980s and 1990s.

Fay (2004) and Fay and Punt (2006) constructed a population dynamics model for the WDPS of Steller sea lion which allowed for geographical differences in factors affecting sea lion vital rates. In this study, scenarios were analyzed to determine the likely changes in vital rates in each sub-region in the WDPS metapopulation during the decline. This approach allowed for examination of spatially-distinct impacts on population trend which mimicked observed trends in WDPS Steller sea lion abundance better than approaches which consider the WDPS as a single entity (Fay 2004, Fay and Punt 2006). The extent to which survival and birth rate affected the Steller sea lion trend varied among regions. This suggests that different processes are responsible for the population trends among regions. As well, the input data selected to parameterize the initial model affected the importance of birth rate, survival and combinations of birth rate and survival in explaining the trend. Fay (2004) cautioned that because these models assume density-independence, they may best be suited for modeling top-down hypotheses for the decline in the WDPS of Steller sea lion. Fay and Punt (2006) further conclude that steep trends in the historic non-pup count data indicate that declines in Steller sea lion abundance were likely due to reductions in survival rather than due solely to reductions in birth rate. However, the current abundance data for Steller sea lions are insufficient to enable such distinctions between survival and birth rate.

Winship and Trites (2006) estimated birth and survival rates operating during the WDPS Steller sea lion decline (1978–2002) by fitting age-structured models to pup and non-pup counts from 33 rookeries (each rookery was considered to be a subpopulation) and then simulating the subpopulations forward in time. The initial model was parameterized with several survival and birth rate estimates from Calkins and Pitcher (1982) and York (1994). Winship and Trites (2006) modeled one density independent and two density dependent scenarios. Changes in vital rates responsible for the decline likely varied among subpopulations and varied with time. Winship and Trites (2006) drew similar conclusions to Holmes et al. (2003) regarding changes in vital rates driving the decline of the WDPS. Their results, based on only counts of pups and non-pups, were consistent with decrease in juvenile survival in the early part of the decline at Marmot Island and a decrease in birth rate during the 1990s. Winship and Trites (2006) corroborated the importance of additional data on the ratio of juveniles to adults for improving the precision of estimated changes in vital rates.

Holmes et al. (2007) measured Steller sea lions in aerial photographs taken during population surveys in the central GOA since 1985 to estimate changes in Steller sea lion age structure. They then fit an age-structured model to the age-structure data and to total population and pup counts. Using the aerial photograph data allowed them to estimate the juvenile fraction of the non-pup count data. Unlike earlier studies that contrasted between low juvenile survival in the 1980s and reduced birth rate in the 1990s, Holmes et al. (2007) conclude that birth rate declined steadily in the central GOA from 1976 to 2004. Their results indicate a steep decline in survival in the early 1980s and then a steady recovery in survival. This pattern was consistent across four pre-decline matrices and all time-varying vital rate scenarios. Their best-fitting model indicates that birth rate in the central GOA was 36 percent lower than in the 1970s, while adult and juvenile survival was at or above 1970 levels (Holmes et al. 2007).

Ratios of pup counts to non-pup counts to infer birth rate

In the FMP BiOp (NMFS 2010), NMFS used rookery-specific counts of pups divided by adult-females as an index for natality. NMFS (2010) estimated the ratio of pups to adult females for each sub-region in the WDPS and in the eastern stock from non-pup surveys conducted in 2008 and pup surveys conducted in 2009 per DeMaster (2009).

NMFS (2010) concluded that the ratios indicated that natality was lower overall in the WDPS than in the eastern stock and that natality was lower in the western Aleutian Islands compared to the other sub-regions in the WDPS (FMP BiOp Section 7.4.3.). As discussed in Chapter 1, all three independent reviewers of the FMP BiOp (Bowen 2012, Stewart 2012, Stokes 2012) and the panel convened by the States of Alaska and Washington (Bernard et al. 2011) questioned the reliability of using the ratio of counts of pups to non-pups as proxy for Steller sea lion natality. The reviewers concluded that assumptions with this approach need to be explicitly stated and its usefulness as a proxy for natality validated through independent studies. NMFS conducted an analysis of the utility of pup to non-pup ratios in response to the critiques (Johnson and Fritz 2013).

NMFS simulated an aerial survey of a virtual sea lion population with known survival and natality to determine if general patterns or problems with using pup to non-pup ratios as an index for natality could be detected. Specifically, NMFS was interested in instances where the pup to non-pup ratio declined over time when natality remained unchanged as those instances would result in type 1 statistical error, or a “false positive” (Johnson and Fritz 2013). NMFS evaluated 18 scenarios with varying treatments for survival and natality via computer simulation. NMFS also analyzed data from real surveys of the WDPS of Steller sea lions in Alaska, aggregated by sub-region, to evaluate the linear trend in the log of estimated pup to non-pup ratios from 2000 through 2012 and the average ratio for the same period. For this analysis, NMFS assumed that 50 percent of the non-pups were hauled-out and available for sampling per Holmes et al. (2007) (Johnson and Fritz 2013).

The results of the simulation analysis show that the trend in the pup to non-pup ratio (R_t) is an imperfect and in some cases erroneous proxy for changes in natality (Johnson and Fritz 2013). The power in R_t as a proxy for natality depends on the magnitude and direction of the population’s underlying natality and survival rates. For example, if the population’s juvenile survival is constant then R_t is a fairly powerful proxy for natality. However, if there are mild decreases in the population’s natality or if the population’s juvenile survival and natality are declining in unison, then R_t has lower power to detect the decrease in natality. If juvenile survival is increasing and natality is constant, there is a high probability that R_t will erroneously indicate decreasing natality (Johnson and Fritz 2013).

R_t is a powerful proxy for declining natality in scenarios with relatively steep declines in natality. Of seven scenarios with stable natality, error rates were low in four and high in three. Of the three with high error rates only one was of concern since it was the only scenario that resulted in a declining population (Johnson and Fritz 2013).

Johnson and Fritz (2013) examined the seven scenarios in the simulation experiment that had the potential to describe the population dynamics in the western Aleutian Islands—declining pup and non-pup counts ($p < 0.05$) and declining pup to non-pup ratios. Of these seven scenarios, six (86%) involve a declining natality process, with only scenario 2 being the exception. Scenario 2 is the survivorship sequence estimated in Holmes et al. (2007) with constant natality. Scenario 2 illustrates that a large initial decline in juvenile survival followed by a gradual return to higher survival will produce a spike in R_t that reduces as juveniles continue to survive at a higher rate. Thus, a decline in natality is not always necessary to produce a decline in pup to non-pup ratios, but it was in 6 of the 7 scenarios tested. For pup to non-pup ratios to produce erroneous inference on the natality process, the number of non-pups that are not associated with pups must initially decline then regain relative abundance later, while the population as a whole declines and natality remains constant.

Figure 3-7 shows the estimated pup to non-pup ratios from the real 1990 through 2012 survey data. The median rate of change in the pup to non-pup ratios is negative for the western Aleutian Islands and the western GOA but neither rate is significantly different from 0 ($p < 0.10$). These two sub-regions have markedly divergent rates of population growth. Non-pups and pups are declining approximately 7% yr^{-1} and approximately 9% yr^{-1}, respectively, in the western Aleutian Islands while non-pups and pups are increasing by approximately 3 yr^{-1} in the western GOA (Fritz et al. 2013). However, the estimates of R_t are highly uncertain as shown in Figure 3-7.

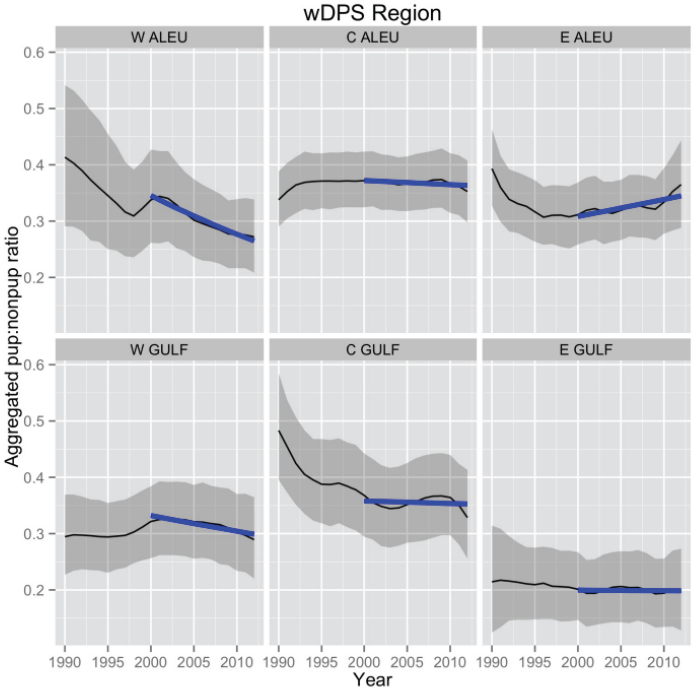
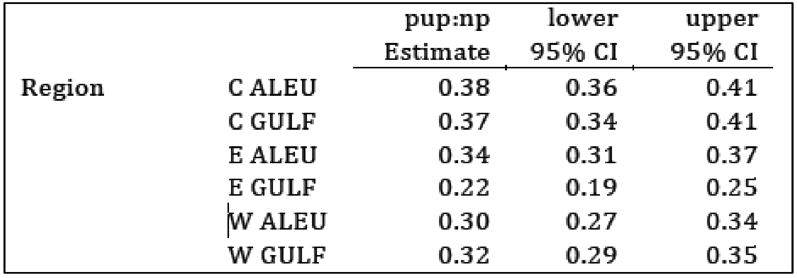


Figure 3-7. Estimated pup to non-pup ratios from 1990 through 2012, by region in the WDPS in Alaska. Blue line is the average rate of change for the 2000 through 2012 period. The black line is the median estimate and the gray zone is the 90 percent credible interval. Source: (Johnson and Fritz 2013).

Johnson and Fritz (2013) caution against direct comparisons of absolute pup to non-pup ratios among sub-regions for natality inference as was done in the FMP BiOp. The average pup to non-pup ratios for each sub-region from 2000 through 2012 are shown in Table 3-11. Johnson and Fritz (2013) describe the variables (e.g., movement, number of haulouts in a sub-region, proportion of animals available to the survey) that confound direct interpretation of the ratio point estimates on natality. Therefore, while NMFS used the pup to non-pup ratios as a proxy for natality in the FMP BiOp, NMFS no longer relies on these ratios to infer natality in the absence of data on the confounding variables.

Table 3-11. Average pup to non-pup ratios aggregated by sub-region in the WDPS Steller sea lion range in Alaska for the years 2000 through 2012. Source:Johnson and Fritz (2013).



		pup:np Estimate	lower 95% CI	upper 95% CI
Region	C ALEU	0.38	0.36	0.41
	C GULF	0.37	0.34	0.41
	E ALEU	0.34	0.31	0.37
	E GULF	0.22	0.19	0.25
	W ALEU	0.30	0.27	0.34
	W GULF	0.32	0.29	0.35

Reproduction Summary

In summary, detectable changes in a population's birth rate may provide insight into the nature of the factors controlling Steller sea lion population dynamics. While this has been broadly recognized and the focus of many studies, few empirical data exist to directly infer birth rate in wild Steller sea lions and no empirical data exist for the western and central Aleutian Island subpopulations. The best data for inferring WDPS Steller sea lion birth rate are available for the central GOA where collections from the 1970s and 1980s provide direct measurements and a basis for comparing birth rates in the central GOA over time. The numerous models developed from these historic collections yield generally consistent results; the decline of Steller sea lions in the central GOA in the 1980s was driven by low juvenile survival and that the continued decline in the 1990s was likely driven by reduced birth rate.

Several models have demonstrated the relevance of spatial heterogeneity in vital rates among subpopulations in the WDPS of Steller sea lion. As such, vital rates from one Steller sea lion subpopulation may not be applicable to another, especially where the rate and direction of population growth diverge. Another common conclusion from the age-structured modeling studies is that the fraction of juveniles in the non-pup counts is an important variable for inferring changes in vital rates over time. Many studies concluded that the available count data do not provide insight into the relative contribution of survival and birth rate in current Steller sea lion population trends. However, Holmes et al. (2007) included information on changes in the juvenile fraction of the population to help estimate vital rate changes in the central GOA sea lion population. This information improves the ability to estimate vital rate changes in the absence of sightings of known–age individuals.

The best available data from the eastern GOA suggest that birth rate is similar to pre-decline birth rates, while the best available data from the central GOA suggest that the birth rate continues to decline steadily relative to 1976 levels. Thus, while longitudinal studies or population models may provide an insight into the likely birth rate for a particular time and area, the extent to which these estimates apply to areas of the WDPS range lacking age-structured information is unknown.

3.8 Anthropogenic Effects on WDPS Steller Sea Lion Populations

3.8.1 Direct Effects

The MMPA defines a stock's potential biological removal (PBR) as the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Based on available data, the estimated annual level of total human-caused mortality and serious injury (33.8 + 198 = 231.8) for the WDPS of Steller sea lions in Alaska is below the PBR (275) for this stock. The WDPS in Alaska declined in the

1980s and 1990s and continues to decline in the western Aleutian Islands for unknown reasons that are not explained by the level of direct human-caused mortality.

Fisheries interactions including entanglement

The minimum estimated mortality rate of western Steller sea lions incidental to all U.S. commercial fisheries is 33.8 sea lions per year, based on observer data (32.8) and stranding data (1.0) where observer data were not available. Several fisheries that are known to interact with the WDPS have not been observed making the estimated mortality a minimum estimate (Allen and Angliss 2013).

The Russian herring trawl fishery in the western Bering Sea was observed in 2002. The estimated take of Steller sea lions from observed vessels was 50 (26–74, 95% CI) with a mortality rate of 83% (Burkanov et al. 2006). All of the animals captured in the fishery were males. Burkanov et al. (2006) note that this level of mortality would be negligible if animals from all Russian populations were taken in the fishery but could have a substantial impact on the Commander Islands population if a disproportionately high number of animals taken in the fishery were from the Commander Islands population.

Subsistence/Native harvest

The most recent subsistence harvest data were collected by the Alaska Department of Fish and Game through 2008 and by the Ecosystem Conservation Office of the Aleut Community of St. Paul through 2009. The mean annual subsistence take from the WDPS in Alaska over the 5-year period from 2004 through 2008, combined with the mean take over the 2005–2009 period from St. Paul, was 198 Steller sea lions/year (Allen and Angliss 2013).

Illegal shooting

Illegal shooting of sea lions was thought to be a potentially significant source of mortality prior to the listing of sea lions as threatened under the ESA in 1990. There have been no cases of illegal shooting successfully prosecuted since 1998 (NMFS, Alaska Enforcement Division).

Mortality incidental to research

Mortalities may occasionally occur incidental to marine mammal research activities authorized under ESA and MMPA permits issued to a variety of government, academic, and other research organizations. Between 2006 and 2010, there were no mortalities resulting from research on the western stock of Steller sea lions (Allen and Angliss 2013).

3.8.2 Indirect Effects

Fishing for Steller sea lion prey species

The Steller Sea Lion Recovery Plan (NMFS 2008) ranked competition with fisheries for prey as a potentially high threat to recovery of the WDPS. Substantial scientific debate surrounds the question about the impact of potential competition between fisheries and sea lions. It is generally well accepted that fisheries target several important Steller sea lion prey species (NRC 2003). The primary issue of contention is whether fisheries reduce sea lion prey biomass and quality at regional and/or local spatial and temporal scales such that sea lion survival and reproduction are reduced. As mentioned in the consultation history in Chapter 1, the 2000 Biological Opinion and 2010 FMP BiOp (NMFS 2000, 2010) found that the Alaska groundfish fisheries, as proposed, were likely to jeopardize the continued existence of the WDPS of Steller sea lions and adversely modify designated critical habitat. Chapter 4 of the FMP BiOp (NMFS 2010) explains the amount and location of catch of Steller sea lion prey species in the federal and parallel groundfish fisheries off Alaska and the Alaska state groundfish, salmon, and herring fisheries. The extent to which fisheries for sea lion prey contributed to sea lion population declines in the

1980s and 1990s and the extent to which fisheries affect current population growth rates in the WDPS is unknown. Chapter 5 of this biological opinion provides a contemporary assessment of the potential effects of the Alaska groundfish fisheries on the recovery of the WDPS.

Disturbance

Vessel traffic, sea lion research and tourism may disrupt sea lion feeding, breeding, or aspects of sea lion behavior. The Steller Sea Lion Recovery Plan (NMFS 2008) ranked disturbance from these sources as a low threat to the recovery of the WDPS. Disturbance from these sources are not likely affecting population dynamics in the WDPS.

Contaminants

The Steller Sea Lion Recovery Plan ranked the threat of toxic substances as medium (NMFS 2008). Studies published since the completion of the Recovery Plan indicate that contaminants may pose a greater threat to the recovery of the WDPS, particularly for animals in the western portion of the WDPS, than indicated in NMFS (2008). Myers et al. (2008) analyzed organochlorine contaminant (OC) levels in blood samples from Steller sea lion pups from Russia and western Alaska. Exposure to OCs in marine mammals and other wildlife has been associated with reproductive failures (Helle et al. 1976, Reijnders 1986) population declines (Martineau et al. 1987), carcinomas (Martineau et al. 1999) (Ylitalo et al. 2005), and immune suppression (Beckmen et al. 2003, DeSwart et al. 1994, Ross et al. 1996). OCs include synthetic chemicals such as polychlorinated biphenyl (PCB) and dichlorodiphenyltrichloroethane (DDT). Average OC concentrations were significantly higher in the blood of Russian animals compared to western Alaska (for PCBs and DDTs, $p<0.001$) and females had higher concentrations than males in both areas (Myers et al. 2008). OC data indicate that WDPS Steller sea lion pups in Russia and the western Aleutian Islands have measurable concentrations of these synthetic chemicals. However, more research is needed to understand any physiological effect and the specific role these chemicals may have in the failure of the WDPS to recover. In contrast to Russia and the western Aleutian Islands, PCB levels were below immunotoxic and physiological toxic thresholds in Steller sea lion tissue samples from the Bering Sea and Prince William Sound (Hong et al. 2005). Kubo et al. (2013) found lower levels of PCBs in a small sample of opportunistically collected Steller sea lions from Hokkaido Japan in 2008 through 2010 than from small samples of sea lions in the Bering Sea and Alaska in the 1990s.

Mercury is a ubiquitous environmental pollutant that bioaccumulates and biomagnifies in food webs. Mercury enters ecosystems through natural sources (e.g., volcanism) and a variety of anthropogenic activities (e.g., mining and the burning of coal) and is converted by bacteria into the more toxic methylmercury (Kenney et al. 2012). Methylmercury in wildlife and humans can impair or suppress the nervous, cardiovascular, and endocrine systems, decrease reproductive success, and disrupt development (Scheuhammer et al. 2007). Elevated levels of mercury have been found in arctic ecosystems despite the paucity of local anthropogenic sources. Some studies indicate that heavy metals are unlikely to have been a significant factor in the decline of the WDPS of Steller sea lion. (Castellini 1999) found that zinc, copper, and metallothionien levels were comparable between sea lion pups sampled from both the western and eastern DPS, and were lower than for captive Steller sea lions. Mercury levels in the hair of young Steller sea lions from both the western and eastern DPSs were lower than for northern fur seals (Beckmen et al. 2002), yet concerns remained about possible effects on fetal development and interactive effects with other contaminants. Holmes et al. (2008) presented baseline information on concentration burdens of seven metals in nine Steller sea lion organs. Their sample comprised nine female and eighteen male opportunistically-collected dead pups from the Sea of Okhotsk through southeast Alaska, thus their results may not be representative of the total population and have low statistical power to draw meaningful conclusions of heavy metal loads between populations. Their results indicated that of the seven metals tested, mercury appears to be of highest concern. The upper concentration limit in their study was 9.38 µg/g in pups—nine times the action level for mercury in fish for human consumption.

Recent studies indicate that exposure to contaminants such as methylmercury cannot be dismissed as a threat to the WPDS (Rea et al. 2013). Young Steller sea lions from western populations (Aleutians, Kodiak, Prince William Sound) were found to have higher levels of mercury exposure than those from the eastern population (Southeast Alaska) (Castellini et al. 2012). For pup through juvenile (<38.5 months old) age classes, very young pups had the highest and most variable exposure to mercury which likely occurs in utero (Castellini et al. 2012). Castellini et al. (2012) found that mercury concentrations decreased with age, with older pups, young of the year, and yearlings showing significantly lower levels of total mercury than young pups.

Total mercury concentrations in the hair of some young pups from Agattu Island in the western Aleutian Islands were the highest ever documented, and were related to the foraging trophic level of their dams (Rea et al. 2013). Rea et al. (2013) found that hair and blood mercury concentrations were highly correlated and that 20 percent of pups sampled in the western Aleutian Islands had methylmercury levels that exceed mammalian risk thresholds established for each of these tissues. Methylmercury levels in Steller sea lion pups increased across Alaska from east to west and also appear to have increased over time (Rea et al. 2013).

The extent to which these levels of mercury impair Steller sea lion physiology is unknown. It is theorized that pinnipeds produce higher levels of selenium than other mammals which may detoxify the mercury in Steller sea lion organs (Holmes et al. 2008). The level of our understanding about the effects of chronic exposure to environmental toxins is not well enough understood to relate observed toxin levels to population effects in the WDPS of Steller sea lion. More research is needed to understand the potential physiological effects of environmental pollutants especially as the evidence indicates concentrations are higher in areas with slower to negative sea lion population growth, appear to be increasing over time (Castellini et al. 2012, Rea et al. 2013), and are likely to be biomagnified with warmer temperatures linked with climate change (Burek et al. 2008).

Climate change and ocean acidification

Marine ecosystems are susceptible to impacts from climate change and ocean acidification linked to increasing CO_2 emissions including increasing global anthropogenic CO_2 emissions. Climate change and ocean acidification effects that may affect the WDPS of Steller sea lions are discussed in the FMP BiOp (NMFS 2010). As discussed in the FMP BiOp, there is strong evidence that ocean pH is decreasing and that ocean temperatures are increasing and that this warming is accentuated in the Arctic. Scientists are working to understand the impacts of these changes to marine ecosystems, however the extent and timescale over which the WDPS of Steller sea lions may be affected by these changes is unknown. Readers are referred to the discussion on climate change in Section 4.1.6 of the FMP BiOp (NMFS 2010) and to the discussion on ocean acidification in Section 7.3 of the Draft Environmental Impact Statement (NMFS 2013).

3.9 Natural Effects on WDPS Steller Sea Lions

Killer Whale Predation

Steller sea lions in both the eastern and western stocks are eaten by killer whales (Dahlheim and White 2010, Ford et al. 1998, Heise et al. 2003, Horning and Mellish 2012, Maniscalco et al. 2007, Matkin et al. 2007, Springer et al. 2008, Williams et al. 2004). The Steller Sea Lion Recovery Plan ranked killer whale predation as a potentially high threat to the recovery of the WDPS (NMFS 2008).

Three divergent yet sympatric ecotypes of killer whales– residents, offshores, and transients– inhabit North Pacific waters (Bigg 1982, Ford et al. 1998). There is no evidence that resident-type or offshore-type killer whales eat marine mammals (Ford et al. 1998, Ford et al. 2011, Krahn et al. 2007), so this discussion focuses solely on transient-type killer whales. Transients have also recently been referred to as Bigg's killer whales, in tribute to the late Dr. Michael Bigg (Ford et al. 2011, Riesch et al. 2012). Readers are referred to the Steller Sea Lion Protection Measures EIS (NMFS 2013) for a discussion of killer whale research predating the Recovery Plan (NMFS 2008) and transient killer whale abundance and distribution information across the range of the WDPS.

The available data for assessing the effect of killer whale predation on WDPS Steller sea lions consist of: abundance estimates of transient killer whales from line transect (Zerbini et al. 2007) and mark-recapture (Durban et al. 2010, Matkin et al. 2012, Wade and Durban 2010) surveys; direct observation of killer whales preying on Steller sea lions (Barrett-Lennard et al. 1995, Maniscalco et al. 2008, Maniscalco et al. 2007, Matkin et al. 2007, Matkin and Saulitis 1994, Wade unpublished data); Steller sea lion tissues and tags found in stomachs of deceased killer whales (Heise et al. 2003, Matkin and Saulitis 1994); Steller sea lion life history tag data indicating death by predation (Horning and Mellish 2009, 2010, 2012); and stable isotope analysis from killer whale tissue biopsies (Wade unpublished data, Wade et al. 2006).[10]

Abundance estimates for transient-type killer whales throughout the range of the WDPS in Alaska are summarized in Table 3-12.

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[10] Note, Matkin and Saulitis (1994) is not the original source, but contains a list of documented Steller sea lion/killer whale predation events or stomach samples from the 1950s to the 1990s with citations for the original sources.

Table 3-12. Abundance estimates of transient killer whales across the range of the WDPS of Steller sea lions.

		Line transect	Mark-recapture	Mark-recapture	Mark-recapture
		2001-2003	2001-2003	2004-2010	1985-2010
SSL Area	Geographic Description	Zerbini et al (2007)	Durban et al (2010)	Wade and Durban (2010)	Matkin et al. (2012)
EGOA	Kenai Fjords and Prince William Sound	0[1]			18[2]
CGOA	Kodiak Island area	27 (4-179)			
WGOA	False Pass to Shumagins	51 (12-227)			
EAI	Unimak Island to Samalga Pass	88 (20-373)		176 (130-252)	
CAI	Samalga Pass to Kiska	87 (19-391)		90(48-184)	
WAI	Kiska to Attu			0[3]	
Total (EGOA to CAI)	Kenai to the Delarof Islands	251 (97-644)	345 (265-487)		
Total (EAI+CAI)	False Pass to Delarofs or Kiska	175 (39-764)		266 (178-436)	

[1] Only Kenai Fjords was surveyed.
[2] 7 AT1 transients and approximately 11 GOA transients during last years of study (2006–2010) (Matkin et al. 2012).
[3] No transient killer whales were seen west of Kiska during National Marine Mammal Lab killer whale surveys in 2006 and 2010, so the abundance estimate is zero. However, one group of transient killer whales were seen approximately 100 nm west of Attu during a humpback whale survey in 2004, and transient killer whales occur in the Commander Islands in Russia, so transient killer whales likely occur in the western Aleutians at least some of the time.

Eastern GOA

Relative to other WDPS sub-regions, transient killer whale abundance and predation on Steller sea lions has been well studied in the Prince William Sound and Kenai Fjords portion of the eastern GOA. Steller sea lions represented 33% (Heise et al. 2003) and 5% (NMFS 2013) of the remains found in deceased killer whale stomachs in the GOA. Matkin et al. (2012) estimated the abundance of transient killer whales in the eastern GOA to be 18. Maniscalco et al. (2007) identified 19 transient killer whales in Kenai Fjords from 2000 through 2005 and observed killer whale predation on 6 pup and three juvenile Steller sea lions. Maniscalco et al. (2007) estimated that 11 percent of the Steller sea lion pups born at the Chiswell Island rookery were preyed upon by killer whales from 2000 through 2005 and concluded that GOA transient killer whales were having a minor impact on the recovery of the sea lions in the area. Maniscalco et al. (2008) further studied Steller sea lion pup mortality using remote video at Chiswell Island. Pup mortality up to 2.5 months postpartum averaged 15.4 percent, with causes varying greatly across years (2001–2007). They noted that high surf conditions and killer whale predation accounted for over half the mortalities. Even at this level of pup mortality, the Chiswell Island Steller sea lion population has increased.

Other studies in the Kenai Fjords/Prince William Sound region have also found evidence for high levels of juvenile Steller sea lion mortality, presumably from killer whales. Based on data collected post-mortem from juvenile Steller sea lions implanted with life history tags, 12 of 36 juvenile Steller sea lions were confirmed dead, at least 11 of which were killed by predators (Horning and Mellish 2012). Horning and Mellish (2012) estimated that over half of juvenile Steller sea lions in this region are consumed by predators before age 4 yr. They suggested that low juvenile survival due to predation, rather than low natality, may be the primary impediment to recovery of the WDPS of Steller sea lions in the Kenai Fjords/Prince William Sound region.

Eastern Aleutian Islands

Transient killer whale abundance estimates are much higher in the eastern Aleutian Islands relative to the eastern GOA (Table 3-12). Most observed transient killer whale predation events have been on gray whales in the eastern Aleutian Islands (Matkin et al. 2007). Gray whales are not present in the Aleutian Islands in the summer, so the transient killer whales either leave the area or switch to other prey in summer. In recent years, on two separate occasions, predation of one Steller sea lion (in each event) was observed in the eastern Aleutian Islands (Matkin et al. 2007, Wade unpublished data). Estimates from two observation studies and two stable isotope analyses estimate predation on Steller sea lions as 13% to 14% of the total killer whale predation in the Aleutian Islands (Herman et al. 2005, Krahn et al. 2007, Matkin et al. 2007, Wade unpublished data).

Central Aleutian Islands

The current estimate of transient killer whale abundance in the central Aleutian Islands is 90 (95% CI 48, 184) (Wade and Durban 2010) similar to the line-transect estimate from Zerbini et al. (2007) (Table 3-12). Transient killer whales have frequently been seen in the Delarof Islands and Tanaga Island area and in the Kiska and Rat Islands area (Wade unpublished data) and appear to be concentrated in these two areas in the central Aleutian Islands. Predation events have been observed on other marine mammal species but not on Steller sea lions in the central Aleutian Islands (Hatfield et al. 1998, Wade unpublished data) though survey and observation effort has been lower in the central and western Aleutian Islands relative to the eastern Aleutian Islands. Nitrogen values from transient killer whale tissues in the central Aleutians show dramatically different patterns. Levels from some samples were lower than any levels measured in marine mammals (indicating that Steller sea lions may not be the primary prey of most killer whales in the central Aleutian Islands) and some were consistent with the higher nitrogen levels in eastern Aleutian Islands transient killer whales (Wade unpublished data, Wade et al. 2006). More research is needed to confirm diet habits of transient killer whales in the central Aleutian Islands.

Western Aleutian Islands

No transient killer whales were seen during the National Marine Mammal Lab's killer whale surveys in the western Aleutian Islands (west of Kiska Island) in 2006 and 2010, so the abundance estimate for the western Aleutians is zero (Wade and Durban 2010), though many resident-type killer whales are seen in this region (P. Wade, unpublished data). Transient killer whales were documented incidental to humpback whale surveys in offshore waters south and west of the Aleutian Islands in 2004, but none of these killer whales have been seen in the Aleutian Islands chain (Wade and Durban 2010). Transient type killer whales are also found in the Commander Islands and Kamchatka, Russia, so there likely are transient killer whales in the western Aleutian Islands, but perhaps at lower densities than other areas.

Commander Islands, Russia

Between 2002 and 2007, Permyakov and Burkanov (2009) observed 105 killer whale (ecotype uncertain) approaches to a Russian Steller sea lion rookery and noted that predation events were rare. Killer whales seemed to show little interest in Steller sea lions at this rookery during the breeding season though substantial predation by killer whales on northern fur seals has been seen in the Commander Islands.

Summary of killer whale predation on the WDPS of Steller sea lions

The available data show that transient killer whales prey on Steller sea lions in the WDPS. Abundance and diet habits of transient killer whales appear to vary by region and killer whale predation may affect sea lion population dynamics differently among WDPS sub-regions. Diet habits of transient killer whales may also vary within sub-regions (e.g., the central Aleutian Islands) though more data are needed to verify these habits (Wade et al. 2006).

Juvenile and pup Steller sea lions appear to be the most vulnerable age classes to killer whale predation. The relatively small numbers of transient killer whales in the eastern GOA are estimated to kill 11 percent of the pups born at Chiswell Island rookery (Maniscalco et al. 2007) and up to 50 percent of Steller sea lions ages 0 to 4 years (Horning and Mellish 2012). The Steller sea lion population in the eastern GOA is estimated to be increasing at 4.51%y^{-1} [95% CI 1.63, 7.58%y^{-1}] (Fritz et al. 2013) and survival from age 1 to 3 years is estimated to be 0.62 [95% CI 0.5, 0.73] (Fritz et al. In Review), which is high relative to the central GOA and eastern Aleutian Islands (sub-regions with available survival rate estimates). Horning and Mellish (2012) and (Maniscalco et al. 2007) appear to reach different conclusions about the effect of killer whale predation on the recovery of sea lion populations in the eastern GOA from their respective research—the former conclude that killer whale predation may be the primary impediment to the recovery of sea lions in the Kenai Fjords/PWS region while the latter concluded that killer whales are having a minor impact on recovery of sea lions near the Chiswell Island rookery.

In 2003, the National Research Council (NRC) concluded that the available evidence for the decline of the WDPS of Steller sea lions was most consistent with top-down forcing from mortality sources such as killer whale predation(NRC 2003). (Adams et al. 2009) and (Williams et al. 2004) corroborate the NRC's conclusions. The available evidence about the abundance and diet habits of transient killer whales in the WDPS presented in (NMFS 2013) and summarized here is not consistent with the regional variation seen in Steller sea lion population trends. For example, the sub-regions with the highest documented predation of killer whales on Steller sea lions (e.g., the eastern GOA) have some of the highest rates of sea lion population increase. The central and eastern Aleutian Islands have relatively high abundance of transient killer whales and while the extent to which they prey on Steller sea lions is unknown, the available data indicate that sea lions may be a minor component of the killer whale diet in these sub-regions. The available data also indicate that transient killer whale abundance may be relatively low in the western Aleutian Islands as there have never been sightings of transient killer whales during killer whale sighting surveys in this sub-region. It is important to note that the survey effort has been lowest in the central and western Aleutian Islands sub-regions, however, which reduces the certainty about the abundance and diet inferences for these areas. Moreover, a small number of killer whales specializing on Steller sea lions may have the potential to limit recovery of sea lion populations in the central and western Aleutians Islands given the reduced abundance in these regions (Durban et al. 2010, Guenette et al. 2007, Springer et al. 2008, Williams et al. 2004). Therefore, the threat of killer whale predation to the recovery of sea lions in the central and western Aleutian Islands cannot be assessed with confidence with the available data.

Shark Predation

Steller sea lions may also be attacked by sharks, though little evidence exists to indicate that sharks prey on Steller sea lions. The Steller Sea Lion Recovery Plan did not rank shark predation as a threat to the recovery of the WDPS (NMFS 2008). Sleeper shark and sea lion home ranges overlap (Hulbert et al. 2006) and one study suggested that predation on Steller sea lions by sleeper sharks may be occurring (Horning and Mellish 2012). A significant increase in the relative abundance of sleeper sharks occurred during 1989–2000 in the central Gulf of Alaska; however, samples of 198 sleeper shark stomachs found no evidence of Steller sea lion predation (Sigler et al. 2006). Sigler et al. (2006) sampled sleeper shark stomachs collected in the GOA near sea lion rookeries when pups may be most vulnerable to predation (i.e., first water entrance and weaning) and found that fish and cephalopods were the dominant prey. Tissues of marine mammals were found in 15 percent of the shark stomachs, but no Steller sea lion tissues were detected. Overall, Steller sea lions are unlikely prey for sleeper sharks (Sigler et al. 2006).

Disease

The Steller Sea Lion Recovery Plan (NMFS 2008) ranked diseases and parasites as a low threat to the recovery of the WPDS. There is no new information on disease in the WDPS relative to the information in the FMP BiOp (NMFS 2010).

Environmental Variability and Drivers in the Bering Sea and Gulf of Alaska/North Pacific

The Steller Sea Lion Recovery Plan ranks environmental variability as a potentially high threat to recovery of the WDPS (NMFS 2008b). The Bering Sea and Gulf of Alaska are subjected to large-scale forcing mechanisms that can lead to basin-wide shifts in the marine ecosystem resulting in significant changes to physical and biological characteristics, including sea surface temperature, salinity, sea ice extent and amount. Physical forcing affects food availability and can change the structure of trophic relationships by impacting climate conditions that influence reproduction, survival, distribution, and predator-prey relationships at all trophic levels (Wiese et al. 2012). Populations in the Gulf of Alaska and Bering Sea have experienced large fluctuations due to environmental and anthropogenic forcing (Mueter et al. 2009). As we work to understand how these mechanisms affect various trophic levels in the marine ecosystem, we must consider the additional effects of global warming, which are expected to be most significant at northern latitudes (IPCC 2013, Mueter et al. 2009).

Ocean Currents: Large-Scale Circulation

Ocean currents are capable of regulating climate through transportation of large amounts of heat, fresh water, oxygen, and nutrients (Ganachaud and Wunsch 2000). A number of large-scale oceanic currents occur within and between the Bering Sea, Gulf of Alaska (GOA), and surrounding oceans. The primary current in the northern GOA is the Alaska Coastal Current (ACC), a wind- and buoyancy-forced current that follows the inner GOA shelf for 2500 km from British Columbia to the Bering Sea with numerous eddies and meanders (Drinkwater et al. 2009). Farther offshore, the Alaska Current flows to the west, advecting warm, lower-latitude water into the northern GOA, and becoming the Alaska Stream to the west of Kodiak Island (Drinkwater et al. 2009). The Alaskan Stream is a relatively strong current (reaches average speeds over 35 cm/s) along the south side of the Aleutian Chain, with significant through-flow, primarily northward into the Bering Sea, occurring through Unimak Pass and Amukta Pass (Clement Kinney et al. 2009). This northward flow through the Aleutian Chain initiates the Aleutian North Slope Current (ANSC) (Stabeno et al. 2009).

The ANSC is a narrow, fast-moving current that flows east along the north side of the Aleutian Chain, turning to the northwest in the southeast corner of the basin to join the Bering Sea Current (Stabeno et al. 2009). The Bering Slope Current (BSC) starts north of the base of the Aleutian Chain and flows northwest along the shelf break with long term average speeds of approximately 12 cm/s (Clement et al. 2005, Clement Kinney et al. 2009).

Due to a ~0.5 m difference in sea surface height between the North Pacific and Arctic Oceans, shelf flow north of St. Lawrence Island is primarily north through the Bering Strait (Danielson et al. 2012). Average northerly winter winds (blowing toward the south) reduce the northerly current, so the October-November flow north through the Bering Strait is typically one-half to two-thirds of the April-August flow (Danielson et al. 2012).

Ocean circulation in the Bering Sea varies by season, year, decade, and is also responsive to short-term atmospheric forcing (Clement et al. 2005, Danielson et al. 2012). North or northwesterly winds cause the BSC to flow to the central shelf from the north and northwest, replacing coastal waters that are carried south and west (Danielson et al. 2012).

Climate patterns and regime shifts

Atmospheric circulations and wind-driven patterns are capable of creating basin-scale variations in upwelling and driving large-scale oscillations (Anderson et al. 2013, Di Lorenzo et al. 2008, Drinkwater et al. 2009). It is the interaction between the atmosphere, ocean, and other climate-related factors that leads to significant climate variations, including triggering various oscillations (Trenberth and Hurrell 1994). Decadal or multi-decadal fluctuations (i.e., oscillations) of atmospheric and oceanic conditions have the potential to cause abrupt transitions between different regimes in marine ecosystems (Di Lorenzo et al. 2010). A number of climate indices have been developed to capture the triggers and relationships between oscillations and associated regime shifts.

The Pacific Decadal Oscillation (PDO) affects the pattern of sea surface temperatures (SST) throughout the Pacific Ocean north of 20º N (NRC 2003). The warm phases of the PDO are characterized by cool SST in the central North Pacific and warm SST along the west coast of the Americas (Mantua and Hare 2002). On average, from November-March, warm-phase PDO sea level pressure events have low pressures over the North Pacific which cause increased counterclockwise winds, and high pressure over the northern subtropical Pacific which cause increased clockwise winds (Mantua and Hare 2002). In the Northern Hemisphere, PDO circulation events extend through the troposphere, and are reflected as persistence in the Pacific-North American Pattern (PNA) (Mantua and Hare 2002). Climate patterns associated with cool phases of the PDO are opposites of warm phases, but the physical mechanisms that cause the PDO are unknown (Mantua and Hare 2002).

The El Niño-Southern Oscillation (ENSO) is a pattern of pressure, temperature, and rainfall fluctuations that can have a global climate impact (Rasmusson and Wallace 1983). The development of an ENSO is initiated by boreal winter near-surface atmospheric circulations over the Hawaiian region (Anderson et al. 2013). These same near-surface atmospheric circulations can also change the positioning of the ENSO pattern, resulting in modifications to climate responses (Anderson et al. 2013). The changes in SST over the equatorial Pacific associated with the ENSO results in significant shifts in global and regional climates (Anderson et al. 2013).

The Arctic Oscillation (AO) is a dominant atmospheric occurrence in the Northern Hemisphere (Nagato and Tanaka 2012). The AO is an atmospheric circulation index often associated with change in the Arctic, and was in a positive phase from 1989-1995 and a near-neutral or negative phase from 1996-2004 (Overland and Wang 2005). The AO covaries with the Aleutian low pressure system, which is thought to be a better predictor of zooplankton and salmon abundance than the PDO (Halfar et al. 2011). However, the ecological regime shifts observed in the Bering Sea between 1970-2008 were coincident with significant changes in sea ice, sea surface temperature, and surface air temperature, which are correlated with the PDO, but not other climate indices (Arctic Oscillation, North Pacific Index, and ENSO), suggesting that the PDO may best explain regime shifts in the Bering Sea (Zhang et al. 2010).

The North Pacific Index (NPI) describes changes in the Aleutian low pressure system and is defined to quantify the decadal, interannual, and annual variation in North Pacific climate conditions (Ceballos et al. 2009, Trenberth and Hurrell 1994) which can affect chlorophyll, phytoplankton, and zooplankton, as well as migratory pathways and abundance of many fish species (Trenberth and Hurrell 1994). Although oscillations have the potential to indicate climate variability in an ocean basin on a multidecadal scale, it should not be expected that a single indicator (such as the PDO) can serve to characterize the climate of an ocean basin (Bond et al. 2003). Various modelling efforts have found that different oscillations and indices better describe the changes in climate variables over the past century. Some modelling efforts have found that very different drivers can explain the level of variation observed in an ocean basin (Gaichas et al. 2011).

Regime shifts and marine ecosystems

Bering Sea

Each winter, seasonal sea ice creates a cold pool of water on the seafloor on the eastern Bering Sea shelf (Mueter and Litzow 2008). The southern edge of this cold pool retreated ~230 km northward from the 1980s to 2006 concurrent with a reorganization in the biological community composition and distribution in the southeastern Bering Sea (Mueter and Litzow 2008). Fish species have expanded their ranges north in the southeastern Bering Sea over the past 30 years in response to warming conditions (Mueter et al. 2009), and continue to do so despite the recent (2006-2010) cooling trend (Kotwicki and Lauth 2013). Several community distribution measures suggest a warming climate is the primary cause of changing biogeography, but variability in distribution not explained by climate suggests that other factors (perhaps internal community dynamics) also contribute (Mueter and Litzow 2008).

Since 1915 there was a short warm event in the Bering Sea from 1935-1937, a cold event from 1971-1976, followed by a warm event from 1978-1983, another warm event from 2000-2005, and a cold event from 2007-2011 (Heintz et al. 2013, Hunt et al. 2011, Overland et al. 2012, Stabeno et al. 2012). The two events in the 1970s appear to have an El Niño-Southern Oscillation (ENSO) influence, while the two events in the 2000s are likely linked to Arctic-wide warming (Overland et al. 2012). From 1972-2012 the middle shelf of the Bering Sea was characterized by extreme variability in sea ice extent and temperature (Stabeno et al. 2012). There was high interannual variability of sea ice extent in the spring (March-April) from 1972-2000, which shifted to a period of low sea ice extent (2001-2005), and transitioned to a period of extensive sea ice (2007-2010) (Stabeno et al. 2012). Low spring sea ice extent levels were associated with relatively warm water temperatures for the following 6-7 months, and vice versa (Stabeno et al. 2012). Ocean currents changed during these different events, flowing largely westward on average during cold years, while in warm years flowing northward from December-February, and flowing relatively weakly during the rest of the year (Stabeno et al. 2012).

Fish and zooplankton abundance on the middle shelf of the Bering Sea differed significantly between warm and cold years (Stabeno et al. 2012). The warm period was characterized by a lack of large copepods and euphausiids over the shelf, but their numbers rebounded during the cold period (Stabeno et al. 2012). Recruitment of walleye pollock and Pacific cod was low during the prolonged warm event, but increased during the following cold period (Stabeno et al. 2012). However, small crustacean zooplankton taxa and recruitment of arrowtooth flounder apparently were not influenced by warm versus cold events (Stabeno et al. 2012).

The Oscillating Control Hypothesis (OCH) was developed to describe how walleye pollock recruitment in the Bering Sea might be affected by environmental variability and how a succession of good years could lead to a shift of this mostly bottom-up system to top-down control (Hunt et al. 2011). The OCH explains why cold, icy winters often are associated with strong year classes of pollock and warm winters with less sea ice are not (Hunt et al. 2011, Mueter et al. 2011).

Gulf of Alaska/North Pacific

The Gulf of Alaska and Bering Sea are strongly affected by drivers of global climate variability including the ENSO, PDO, and NPGO (Litzow et al. 2014). However, when taken together, modelling of 6 most important climate indices (PDO, NPGO, AO, PNA, NPI, ENSO) can explain a significant portion, but not all, of the biological variability in the North Pacific (Litzow et al. 2014).

The North Pacific experienced a climate regime shift during the winter of 1976/77 (Yeh et al. 2011), that led to a decade-long change in the North Pacific atmosphere and ocean (Trenberth and Hurrell 1994). During the abrupt shift in the atmosphere-ocean climate over the North Pacific in the winter of 1976/77, the Aleutian low pressure system deepened significantly, the PNA teleconnection pattern changed, and the observed SST prior to and following that winter is characterized by a cooling over the western and central North Pacific, concurrent with a warming of the coastal northeastern Pacific (Yeh et al. 2011). A second climate regime shift occurred in the North Pacific during the winter of 1988/89 (Yeh et al. 2011). While the 1976/77 regime shift appears to be related to changes in SST in the tropics, the 1988/89 shift appears to be restricted to changes (i.e., warming) in the North Pacific (Yeh et al. 2011). The three regime shifts (1976/77, 1988/89, and 2007/08) all involved PDO/NPGO variability of similar magnitude, but while the 1976/77 shift was followed by a period of stability, the 1988/89 shift was not (Litzow and Mueter 2014). Data through 2013 suggest that the 2007/08 shift was more similar to the 1976/77 shift, and therefore may be more ecologically significant than the 1988/89 shift (Litzow and Mueter 2014).

Climatic shifts in the Gulf of Alaska in the twentieth century are often correlated with significant changes in species distribution and abundance, which can affect fisheries and industry and other species that depend on fish (Hollowed et al. 2013, Overland and Wang 2007). Fish species have expanded their ranges north in the Gulf of Alaska in response to warming conditions (Mueter et al. 2009). Ecosystem modelling of the relative effects of fishing, climate conditions, and predator-prey interactions on species in different trophic levels has not led to clear determination of the relative impacts of drivers on species abundance (Gaichas et al. 2011). No single forcing mechanism (fishing history, climate conditions, or predator-prey interactions) explains all species dynamics simultaneously, suggesting that there is no single primary driver of the ecosystem (Gaichas et al. 2011).

Walleye Pollock (*Gadus chalcogrammus*)

Forage fish support fisheries and many predator populations directly and indirectly worldwide (Pikitch et al. 2014). In Alaska, walleye pollock is central to the foodweb in the Bering Sea, Gulf of Alaska, and Aleutian Islands, and juveniles serve as a primary forage fish species for many higher trophic levels, including Steller sea lions (Aydin et al. 2007). Recruitment of walleye pollock is affected by ice and temperature conditions at the time of hatching, marine stratification over the shelf during the first summer (age 0), and the distribution and abundance of predators (Mueter et al. 2011).

Changes in temperature, nutrient supply, stratification, salinity, oxygen, and pH are expected to lead to changes in the ecological structure of the oceans, including the abundance and distribution of forage fish (Doney et al. 2012, Hollowed et al. 2013, Salinger et al. 2013). Warm spring conditions in the Bering Sea increase the survival of larval walleye pollock, but high temperatures in late summer and fall lead to poor feeding conditions for young-of-year pollock and decreased recruitment the following year, suggesting that projected climate warming will lead to significant declines in walleye pollock recruitment (Hunt et al. 2011, Mueter et al. 2011).

Early ice retreat in the Bering Sea in warm years favors populations of small zooplankton, whereas large zooplankton are absent; the reverse is true in cold years (Heintz et al. 2013). The zooplankton composition in cold years leads to increased recruitment of zooplanktivorous fishes, such as walleye pollock (Heintz et al. 2013, Hunt et al. 2011, Siddon et al. 2013).

Anthropogenic Climate Change

Since the 1950s the atmosphere and oceans have warmed, snow and sea ice have diminished, sea level has risen, and concentrations of greenhouse gases have increased (IPCC 2013). The time period 1983-2012 was likely the warmest 30-year period in the Northern Hemisphere in the last 1400 years (IPCC 2013). This warming is thought to lead to increased decadal and inter-annual variability, and increases in extreme weather events (IPCC 2013). The likelihood of further global-scale changes in weather and climate events is virtually certain (IPCC 2013, Overland and Wang 2007, Salinger et al. 2013).

Effects to marine ecosystems from increased atmospheric CO_2 and climate change include ocean acidification, expanded oligotrophic gyres, shifts in temperature, circulation, stratification, and nutrient input (Doney et al. 2012). Altered oceanic circulation and warming cause reduced subsurface oxygen (O_2)

concentrations (Keeling et al. 2010). These large-scale shifts have the potential to disrupt existing trophic pathways as change cascades from primary producers to top level predators (Doney et al. 2012, Salinger et al. 2013).

Environmental Variability Summary
Multiple forcing mechanisms are functioning simultaneously in the Bering Sea and Gulf of Alaska, and many are interrelated and interdependent. Currently there are several competing hypotheses regarding the contribution that climate change and fisheries have on oceanic processes in Alaska. Over time, more comprehensive studies that incorporate longer, multi-species, multi-driver data sets will increase our ability to predict changes in regional climates and more quickly identify regime shifts and associated consequences for Steller sea lions and other components of the ecosystem.

3.10 Nutritional Stress

Nutritional stress results when a species is unable to acquire adequate energy and nutrients from prey resources. Nutritional stress could result from changes in prey quality, distribution, or abundance. The composition and abundance of Steller sea lion prey may be affected by natural environmental variability, interspecific competition, and/or anthropogenic factors (e.g., fishing). Nutritional stress in Steller sea lions manifests as physiological and behavioral responses that directly (e.g., reduced growth, reproduction, or survival) or indirectly (e.g., increased susceptibility to predators or disease) reduce their population growth. Nutritional stress may be acute (e.g., starvation occurring over a period of weeks) or chronic (e.g., suboptimal consumption over a period of months or years).

WDPS Steller sea lions exhibited symptoms of nutritional stress during the rapid population decline in the 1980s. In 1985, sea lions were smaller on average, slower to reach sexual maturity, and had a lower birth rate than in the 1970s (Calkins et al. 1998, Calkins and Goodwin 1988, Pitcher et al. 1998, York 1994). The Steller Sea Lion Recovery Plan (NMFS 2008) determined that nutritional stress is a leading hypothesis for the steep population decline in the 1980s, but models indicate that reduced prey availability alone does not account for the dramatic decline in the population (NRC 2003). In the 1990s, studies compared indicators of nutritional stress between Steller sea lions in the increasing eastern stock and the decreasing western stock. These studies were limited to adult females and young of the year animals in the breeding season and young of the year in the winter. These mid-1990s studies found that, for the indicators measured, Steller sea lions in the western stock were in similar to better condition than animals in the eastern stock (see Chapter 3 of the FMP BiOp). Around the world, several pinniped populations have shown symptoms consistent with severe, acute nutritional stress events (Trites and Donnelly 2003), however no sightings of emaciated pup or adult Steller sea lions, reduced pup size, or large strandings of Steller sea lion pups have ever been documented. Because the available evidence was inconsistent with acute nutritional stress responses, the Steller Sea Lion Recovery Plan (NMFS 2008) and the FMP BiOp (NMFS 2010) concluded that chronic nutritional stress was the only reasonable pathway through which nutritional stress may have acted on the WDPS in the 1990s and early 2000s. This conclusion remains valid as no new evidence for acute nutritional stress has been documented in the WDPS since the completion of those documents.

Many indicators for chronic nutritional stress have multiple potential causes. For example, altered reproductive rates may be a function of toxicity, disease, or nutrition, among other factors. Trites and Donnelly (2003) recommend measuring less ambiguous indicators for nutritional stress such as reduced body size, altered tissue composition (such as reduced blubber), and changes in blood chemistry. A critical factor in the study of nutrition in pinnipeds is that they are well adapted to fasting as a routine part of their annual breeding cycle (NRC 2003). Adult male Steller sea lions will fast for the whole breeding season if they are holding a territory and adult females will fast for about two weeks when they come ashore to pup and breed. The difficulty in capturing animals in the non-breeding season impedes the ability to measure the indicators of nutritional stress recommended by Trites and Donnelly (2003) when indications of nutritional stress in tissue composition and blood chemistry may reflect limited food quality or quantity rather than fasting.

The most recent studies on individual growth rates of WDPS Steller sea lions are limited to a model developed from the collections from the central GOA in the 1970s and 1980s (Winship et al. 2001); a study of neonatal growth rates of pups in the GOA, Aleutian Islands, and southeast Alaska from 1990 through 1997 (Brandon et al. 2005); and a study of 1–40-month-old sea lions in all WDPS sub-regions and in southeast Alaska from 2000 through 2003 (Fadely et al. 2004). Brandon et al. (2005) found that pups up to six weeks in age grew faster in the GOA and central Aleutian Islands than in southeast Alaska in the 1990s. Fadely et al. (2004) found that pup mass declined regionally from the western Aleutians (males 35.8 ± 1.0 kg, females 29.9 ± 0.9 kg) to southeast Alaska (males 29.9 ± 0.2 kg, females 25.8 ± 0.2 kg) and that growth rates of 29 sea lions captured from 5 months through 1.9 years after initial capture also suggest that growth rates were slower in southeast Alaska than the WDPS. The results from these studies, as well as other studies cited in the FMP BiOp, were factored into the conclusions in the Recovery Plan and FMP BiOp (NMFS 2008, 2010); there was evidence for nutritional stress in the early part of the decline, but no such comparable evidence during the continued decline in the 1990s and the current period of overall recovery (recognizing continued declines in the western Aleutian Islands). Below we describe new data related to nutritional stress since completion of the FMP BiOp (NMFS 2010).

Pinnipeds appear to reduce their metabolism and become less active on shore when food intake is restricted (Trites and Donnelly 2003). A recent paper by Hoopes et al. (2014) measured resting metabolic rate and body composition in free-ranging juvenile Steller sea lions (n = 91) collected between 2003 and 2005 in southeast Alaska, Prince William Sound, and the central Aleutian Islands. This is the first study to measure resting metabolic rate in free-ranging juvenile Steller sea lions. Accounting for differences in age among areas; they found that sea lion pups in the central Aleutian Islands were larger and fatter than pups from Prince William Sound (eastern GOA) and southeast Alaska (eastern stock). Under chronic conditions of reduced food intake sea lions should conserve energy by limiting energy expenditures through lowering of metabolic rate. Body condition was robust in Aleutian Islands pups 10.5 months in age (n=16) and differences measured in the resting metabolic rate between the eastern and western stocks could be accounted for by higher percent of total body lipid content in the WDPS sea lions (Hoopes et al. 2014). This suggests that at the time of their study, Steller sea lions were not experiencing metabolic depression in the locations studied (Hoopes et al. 2014). Several aspects of the study design prevented comparisons of resting metabolic rate by season. Captive Steller sea lions were shown to have increasing body fat stores in the spring and decreasing body fat stores into fall (Kumagai et al. 2006). Because this study was conducted on central Aleutian Islands pups in the spring (which may or may not have been weaned) additional study of sea lions of varying ages from the central Aleutian Islands are needed to understand the seasonal effect of changes in sea lion body fat stores on metabolic rate in free-ranging animals (Hoopes et al. 2014).

In another preliminary study, Rea et al. (2011) used vibrissae (whiskers) collected from 1998 to 2009 to determine the proportion of Steller sea lions weaned during their first and second years of life; the first step to comparing the mean age at weaning among sub-regions in the western and eastern stocks of Steller sea lions. At this time the sample sizes are too small to meaningfully compare results among sub-regions for age-classes other than pups less than 12 months of age. No confidence intervals are provided for the proportion of animals weaned by age and sub-region so results should be interpreted with caution and considered preliminary. Only two of 239 pups in the combined sample were weaned before age 1; one in the GOA and one in Prince William Sound. A greater proportion of animals were weaned between 12 and 23 months of age (yearlings) in the Aleutian Islands and Prince William Sound than in Southeast Alaska (Table 3-13). Though only one age 2 animal was sampled in the Aleutian Islands and only one age 2 animal was sampled in the GOA, they both appeared to be fully weaned. Two of 7 juvenile sea lions (greater than 24 months of age) sampled in Prince William Sound appeared to still be fully dependent upon maternal resources as did three of the 14 juveniles sampled in Southeast Alaska.

Table 3-13. Sample size and proportion of Steller sea lions weaned by age-class and sub-region. Source: Rea et al. (2011).

Age Class	Aleutian Islands		Gulf of Alaska		PWS		Southeast Alaska	
	n	%	n	%	n	%	n	%
Pup	60	0%	31	3%	88	1%	60	0%
Yearling	6	67%	1	0%	29	62%	54	41%
Juvenile	1	100%	1	100%	7	71%	14	79%

York et al. (2008) analyzed stable isotopes in teeth from juvenile female Steller sea lions killed incidental to commercial fisheries in the Gulf of Alaska from the 1960s through 1980s to investigate age at weaning. They found that 60% of animals were weaned by one year of age, 30% were weaned in their second year, and 8% of the females studied were not weaned until the third year (n = 101). The percent weaned by age 1 appears to be substantially lower in animals from all regions sampled between1998 through 2009 by Rea et al. (2011) compared to those sampled in the GOA in the 1980s (York et al. 2008). The proportion of animals nursing into the second year appeared to have increased significantly from the 1960s to the 1980s (from 0.32 to 0.52, p=0.02) (York et al. 2008) and this new information is consistent with a greater proportion of animals weaning in the second year than in the first. It is unknown whether a shortage of food results in more or less maternal investment in Steller sea lions, however other otariids have been found to increase maternal investment during food shortages (York et al. 2008).

As discussed in the Recovery Plan (NMFS 2008) and FMP BiOp (NMFS 2010), a lot of research and debate surrounding the nutritional stress hypothesis in the WDPS has centered on whether the cause is linked to reduced quality or quantity of prey or both. As explained in those documents, the available evidence does not clearly support one potential cause over the other and some evidence (since the 1980s) is counter to the nutritional stress hypothesis. Studies contrasting body condition, pup growth, blood chemistry, foraging trip duration, etc. between the eastern and western stocks in the 1990s are summarized in the FMP BiOp (NMFS 2010). As discussed in the FMP BiOp, none of the comparative studies based on data collected in the 1990s—a period of intensive study—found direct evidence for nutritional stress in the WDPS. Given the continued decline in the western Aleutian Islands, the lack of a robust recovery in several WDPS sub-regions, and the limited direct data for drawing inferences, research continues into the role of nutritional stress in WDPS Steller sea lion population dynamics.

Here we summarize the available information to evaluate the chronic nutritional stress hypothesis in terms of evidence that is consistent-with and counter-to a reduction in prey quality, evidence that is consistent-with and counter-to a reduction in prey quantity, and evidence that is consistent-with and counter-to the prevalence of nutritional stress in the WDPS today. The risk in presenting a voluminous amount of research in such a summarized format is that important nuances, details, assumptions, etc. will be oversimplified and some relevant research may inadvertently be omitted. However, the cost of not doing so would be a lack of a transparent and systematic weighing of the available information. Importantly, the CIE reviewers did not identify relevant studies that were omitted from the FMP BiOp. We have taken care to include new, relevant information that may provide insight into the occurrence or absence of chronic nutritional stress since the completion of the FMP BiOp (NMFS 2010) and to review primary studies cited in the FMP BiOp with the goal of illuminating the likelihood of ongoing chronic nutritional stress in the WDPS given the available evidence.

It is important to distinguish between direct/scientific evidence and circumstantial evidence. Evidence is factual information in support of an assertion and spans a continuum from strong to weak. The strongest evidence consists of direct observations and experimental results that support, refute, or modify a scientific hypothesis when collected and interpreted in accordance with the scientific method. Circumstantial evidence is information that is consistent with an assertion but requires inference and does not rule out alternate explanations.

With respect to the hypothesis that inadequate prey quantity is affecting the population dynamics of the WDPS, NMFS did not find any direct evidence that is consistent with this hypothesis. The consistent circumstantial evidence is that the commercial groundfish fisheries have reduced the spawning biomass of some Steller sea lion prey species by approximately 40 – 60% of the theoretical, unfished spawning biomass (NPFMC 2013a, NPFMC 2013b). The observation that is inconsistent with the hypothesis that inadequate prey quantity is affecting the population dynamics of the WDPS is that in the 1990s the overall groundfish biomass levels were large relative to the reduced number of sea lions and yet the WDPS population growth was much lower than expected for a population well below carrying capacity (Goodman 2008 in NMFS 2008 and NRC 2003).

The evidence is also equivocal as to whether reduced prey quality is affecting the population dynamics of the WDPS. Seemingly consistent direct evidence − that Steller sea lion diet diversity is significantly correlated with WDPS sub-region population growth rates (Merrick et al. 1997, Sinclair and Zeppelin 2002, Sinclair et al. 2013) – has been used to support contrasting theories about prey availability and quality. For example, Winship and Trites (2003) and Trites and Donnelly (2003) cited the apparent relationship between diet diversity and population growth as evidence that sub-populations with the lowest diet diversity had the highest consumption requirements because they were consuming the highly abundant low energy prey (e.g., gadids) rather than bypassing these abundant species for less abundant but higher quality prey (e.g., herring). The NRC (2003) surmised that the inverse relationship between diet diversity and the degree to which food resources are limiting to sub-populations of consumers could indicate that diet diversity in Steller sea lions decreases when prey resources are not limiting. They cited foraging models that predict that when prey resources are abundant, consumers will specialize on the most beneficial of these. As consumer populations increase and the most beneficial or valuable prey are depleted, increasing less valuable prey are added to the diet, thus increasing dietary diversity (NRC 2003). In the former example, Trites and Donnelly (2003), reduced diet diversity would be a cause of population decline whereas in the second, NRC (2003), increased population growth would cause higher diet diversity. Direct evidence that appears to be inconsistent with the reduced prey quality hypothesis is that Atka mackerel were found to have higher energy content than pollock (Logerwell and Schaufler 2005) and Atka mackerel is the dominant prey in the western Aleutian Islands where the WDPS is still in decline and pollock is the dominant prey in the east where the WDPS is doing better.

Circumstantial evidence that WDPS abundance declined concurrent with changes in their diet in the 1990s and 2000s relative to the 1950s (Anderson et al. 1997, Trites et al. 1999, Benson and Trites 2002, Trites et al. 2007, Winship and Trites 2003) appears to be consistent with the reduced prey quality nutritional stress hypothesis. However, the observation that Steller sea lion population growth rates vary among regions where gadids compose a large component of the sea lion diet appears to be inconsistent with the reduced prey quality nutritional stress hypothesis.

Consistent and inconsistent evidence from the 1990s and 2000s for the chronic nutritional stress hypothesis that is ambiguous as to whether it fits with the reduced prey quantity or quality hypothesis is shown in Table 3-14.

Table 3-14. Summary of direct (white cells) and circumstantial (shaded cells) evidence relevant to free-ranging WDPS Steller sea lions that appears to be consistent and inconsistent with the chronic nutritional stress hypothesis via either reduced prey quantity, quality, or both.

Chronic Nutritional Stress (from Inadequate Quantity or Quality of Prey or Both) Is Affecting WDPS Population Dynamics			
Consistent Evidence	**Source**	**Inconsistent Evidence**	**Source**
Age of weaning appears to have increased over time.	(York et al. 2008, Trites et al. 2006, Hebert et al. 2011)	Body condition in WDPS juvenile Steller sea lions has been good.	(Fadely et al. 2005, NMML unpublished)
The WDPS is increasing below the theoretical R_{max}.*	(Allen and Angliss 2013)	Individual growth of pup and juvenile Steller sea lions was higher in the west than in the east, opposite of population growth rates.	(Fadely et al. 2004, Fritz et al. 2013, Brandon et al. 2005)
Steller sea lion birth rates in the central GOA from 1998 through 2004 appear to have declined 36% from those estimated in the mid-1970s.*	(Holmes et al. 2007)	Pups in the central Aleutian Islands had significantly greater body mass and total body lipid stores when compared to pups from Prince William Sound and Southeast Alaska. At the time of this study, sea lions did not appear to be experiencing metabolic depression in the locations studied.	(Hoopes et al. 2014)
		Birth rates in the eastern GOA appear to be similar to those estimated in the mid-1970s.	(Maniscalco et al. 2010)

* Drivers other than nutritional stress may produce same response, may be an ambiguous indicator.

As explained in prior groundfish fishery biological opinions (NMFS 2000, 2001, 2010) and by the (NRC 2003), global biomass data and density dependent inferences do not inform us about local prey availability. The NRC (2003) review compared decades of data to draw conclusions about the lack of evidence for effects of broad-scale depletion on sea lion population trends. Based on a review of trends in pollock, Pacific cod, and Atka mackerel biomass and sea lion populations from the 1960s, 70s, 80s, and 90s the NRC (2003) found no clear patterns in overall groundfish biomass with sea lion population trends. Based on data derived from fish stock assessments and the commercial fisheries, the NRC (2003) concluded that the broad-scale fishery depletion hypothesis lacked evidential support. However, they concluded that the evidence for localized depletion was insufficient to resolve the question of whether the fisheries deplete prey on finer spatial and temporal scales important for foraging sea lions and recommended additional research to draw more definitive conclusions about localized depletion.

Numerous captive feeding studies have been conducted on Steller sea lions and closely-related species to determine the effect of diets of varying energy content on body condition and growth. With the exception of Calkins et al. (2013), all of these studies were discussed in the FMP BiOp (NMFS 2010). Rosen (2009) evaluated data from laboratory studies of nutritional stress in pinnipeds to test if the nutritional stress hypothesis could explain the decline of Steller sea lions. He concluded that there is strong evidence for biologically meaningful differences in the nutritional quality of major prey species, and that Steller sea lions can partly compensate for low-quality prey by increasing consumption. Rosen (2009) observed that the ability to increase consumption is physiologically limited in young animals such that they may not be able to compensate for low-quality prey. Calkins et al. (2013) found that juvenile Steller sea lions were able to consume enough pollock to maintain body condition, thus their results do not corroborate the results from Rosen and Trites (2004) or Rosen (2009).

The prevalence of nutritional stress in the WDPS today is unknown. Most of the available evidence is either counter to or non-supportive of a nutritional stress mechanism to explain the apparent population dynamics for the WDPS. There is evidence for potential bottom-up drivers in the population including potentially later age of weaning and potentially lower reproductive rates, at least in some areas. However, these indicators may be responses to other phenomena. The data on individual growth rates in juveniles in the 2000s are limited to the Fadely et al. (2004) study, and comparison of body condition and resting metabolic rate among the central Aleutian Islands (WDPS), Prince William Sound (WDPS), and southeast Alaska (eastern stock) from 2003 through 2005 are provided in Hoopes et al. (2014). Most of the available information is inconsistent with the nutritional stress hypothesis and particularly with the prey quality hypothesis (at least as far as individual prey species are concerned) and with the global prey availability hypothesis. Data on body condition and resting metabolic rate of juvenile sea lions in the central Aleutian Islands from 2003 through 2005 indicate that juveniles up to 10.5 months in age are acquiring adequate nutrition from their mothers (Hoopes et al. 2014). Data from juveniles branded as pups in the western Aleutian Islands in 2011 also indicate high survival to year 1 (Fritz et al. 2013.)

The role of nutritional stress in limiting recovery of the WDPS remains uncertain and the subject of intense scientific debate. The ability to test the nutritional stress hypothesis is complicated by several factors including the logistical difficulties of attaining large sample sizes across all sub-regions and difficulties with isolating a single effect from a complex, dynamic ecosystem (Trites and Donnelly 2003). Based on the available evidence presented above, NMFS concludes that if nutritional stress is acting on the WDPS it is likely due to a localized limitation of important prey resources or low diet diversity or a combination of the two. The evidence also indicates that this mechanism, if it is occurring, would be chronic nutritional stress through a switch from a “live-fast” to a “live-slow” response (Promislow and Harvey 1990, York et al. 2008) where reduced food resources result in increased maternal investment into juveniles at the expense of high reproduction.

3.11 Summary of the Species Status

There is strong evidence that abundance of WDPS Steller sea lions in Alaska increased at an average rate of 1.67% y^{-1} (95% CI 1.01, 2.38% y^{-1}) between 2000 and 2012 (Fritz et al. 2013). Evidence also suggests that the abundance of WDPS Steller sea lions is increasing overall in Russia. However, there are strong regional differences in population trends across the WDPS range. In Alaska, sea lion population trends are increasing east of Samalga Pass and decreasing west of Samalga Pass. In Russia, regions with population trends that are either stable or declining (eastern Kamchatka, Commander Islands and the western Bering Sea) border regions in Alaska where sea lion trends are similar (Aleutian Islands west of 170° W).

In the far western portion of the WDPS in Alaska, Steller sea lions are decreasing at an average rate of -7.23% y^{-1} (95% CI -9.04, -5.56% y^{-1}) from a low level of abundance (Fritz et al. 2013). Populations in the western and eastern GOA are estimated to be increasing at over 4% y^{-1} (Table 3-1). Models predict a high probability of quasi-extinction of the western Aleutian Islands sub-region in less than 50 years and a nil probability of quasi-extinction over 50 and 100 years for all other sub-regions in the WDPS in Alaska (Johnson 2013). Overall, the current WDPS population size in the U.S. and Russia combined is estimated to be 79,300.

Evidence suggests that movement across eastern and western Steller sea lion stocks has negligible effects on the respective population trends though movement among sub-regions within the WDPS may affect sub-region population trend estimates (Fritz et al. 2013). While the majority of Steller sea lions appear to remain within their natal region (Figure 3-6) a large proportion of sea lions branded in the central GOA moved to the eastern GOA which likely affects population trends in these two sub-regions. Most pups branded at Agattu rookery in the western Aleutian Islands have remained within the western Aleutian Islands though a few animals have been seen in the Pribilof Islands, the central Aleutian Islands and the Commander Islands (Fritz et al. 2013).

The WDPS of Steller sea lions is not on track to meet the down listing recovery criteria by 2015 (the soonest the population could be re-classified as threatened per the criteria in the Recovery Plan) as population growth rates are not increasing significantly in five of the seven sub-regions. Likewise, the WDPS is not achieving the de-listing criterion that the abundance in any sub-region cannot have declined by 50% relative to the 2000 base year population due to strong, continued declines in the western Aleutian Islands.

The only sub-region with empirical data to estimate survival in the 1970s, 1980s, and 2000s is the central GOA. While adult survival appears to have been relatively consistent over those decades, juvenile survival appears to have dropped in the 1980s relative to the 1970s but appears to now be at levels observed in the 1970s. Preliminary data indicate that juvenile survival is currently high in the eastern Aleutian Islands. Overall, juvenile survival in the western stock appears to be higher than juvenile survival rates in the eastern stock.

The empirical data to infer WDPS reproductive rates are also limited. Empirical data on reproductive rates are available for the eastern and central GOA and imply different birth rates in the eastern and central GOA sub-regions—birth rates in the central GOA appear to be in continual decline relative to the 1970s whereas birth rates in the eastern GOA appear to be similar to pre-decline rates. The extent to which these estimates apply to areas of the WDPS range where age structured information is lacking is unknown.

Geographic variation in environmental conditions across the range may mean that different factors are responsible for local population dynamics to varying degrees. Observations at one site may not apply to others or even to nearby rookeries (NRC 2003). The available data do not indicate that direct anthropogenic sources of mortality are limiting population growth in the WDPS. Indirect anthropogenic threats such as contaminants and commercial fishing for Steller sea lion prey may be limiting population growth in the WDPS today and ocean acidification may pose threats to the population in the future. Direct killer whale predation or indirect effects of climate change/environmental variability may also be limiting WDPS population growth. The extent to which these drivers are influencing population dynamics in each sub-region is not well understood, though the evidence suggests that the occurrence and intensity of these threats likely varies among sub-regions.

The occurrence and extent of nutritional stress in the WDPS is unknown. The bulk of the available evidence is inconsistent with a nutritional deficit in WDPS Steller sea lions, though diet diversity appears to be correlated with population growth. The limited available data on individual growth rates do not support the nutritional stress hypothesis. If nutritional stress is occurring in the WDPS it is likely chronic, rather than acute, and due to localized prey depletion rather than a large spatial scale reduction in prey.

3.12 Designated Critical Habitat

Steller sea lion critical habitat is listed in 50 CFR 226.202. Designated critical habitat for Steller sea lions includes 1) a terrestrial zone that extends 3,000 ft (0.9 km) landward from the baseline or base point of each major rookery and major haulout; 2) an air zone that extends 3,000 ft (0.9 km) above the terrestrial zone, measured vertically from sea level; 3) an aquatic zone that extends 3,000 ft (0.9 km) seaward in State and federally managed waters from the baseline or basepoint of each major haulout in Alaska that is east of 144° W longitude; 4) an aquatic zone that extends 20 nm (37 km) seaward in State and federally managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144° W longitude; and 5) three special aquatic foraging areas in Alaska; the Shelikof Strait area, the Bogoslof area, and the Seguam Pass area.

Steller sea lions require both terrestrial and aquatic habitats for survival in the wild. Land sites used by Steller sea lions are referred to as rookeries and haulouts. Rookeries are used by adult males and females for pupping, nursing, and mating during the reproductive season (late May to early July). Haulouts are used by all size and sex classes but are generally not sites of reproductive activity. The continued use of particular sites may be due to site fidelity, or the tendency of Steller sea lions to return repeatedly to the same site, often the site of their birth. Presumably, these sites were chosen by Steller sea lions because of their substrate and terrain, the protection they offer from terrestrial and marine predators, protection from severe climate or sea surface conditions, and the availability of prey resources.

Marine components of critical habitat were designated around rookeries and haulouts because those areas provided foraging habitats, prey resources, and refuge considered essential to the conservation of Steller sea lions (58 FR 45269). Marine critical habitat was designated 20 nm seaward of each major rookery and major haulout west of 144° W longitude. As noted in the final rule designating critical habitat for Steller sea lions, “The critical habitat surrounding each BSAI and GOA rookery and major haulout site includes not only the aquatic areas adjacent to rookeries that are essential to lactating females and juveniles, but also encompasses aquatic zones around major haulouts, which provide foraging and refuge habitat for non-breeding animals year-round and for reproductively mature animals during the non-breeding season. These areas are considered critical to the continued existence of the species throughout their range since they are essential for reproduction, rest, and refuge from predators and human-related disturbance” (58 FR 45273; August 27, 1993). All major Steller sea lion rookeries and haulouts are identified in the FMP BiOp Table 3.18 and Table 3.19 (NMFS 2010). The three large aquatic foraging areas were identified through foraging studies, historical observations of Steller sea lions, and observations of distribution of sea lion prey. Seguam Pass was identified as an important area to conserve Atka mackerel; Shelikof Strait and the Bogoslof area, including the Unimak Pass and eastern Bering Shelf, were identified as important areas to conserve dense aggregations of spawning pollock. The final rule designating critical habitat noted that "These sites were selected because of their geographic location relative to Steller sea lion abundance centers, their importance as Steller sea lion foraging areas, their present or historical importance as habitat for large concentrations of Steller sea lion prey items that are essential to the species' survival, and because of the need for special consideration of Steller sea lion prey and foraging requirements in the management of the large commercial fisheries that occur in these areas" (58 FR 45273; August 27, 1993).

Many foraging trips by lactating adult females in summer may be relatively short (20 km or less; Merrick and Loughlin 1997). Also, mean distances for young of the year foraging in winter may be relatively short (about 30 km; Merrick and Loughlin 1997, Loughlin et al. 2003). These young animals are just learning to feed on their own, and the availability of prey in the vicinity of rookeries and haulout sites must be crucial to their transition to independent feeding after weaning. Similarly, haulouts around rookeries are important for juveniles, because most juveniles are found at haulouts not rookeries. Young animals are almost certainly less efficient foragers and may have relatively greater food requirements, which suggests that they may be more easily limited or affected by reduced prey resources or greater energetic requirements associated with foraging at distant locations. Therefore, the areas around rookeries and haulout sites must contain essential prey resources for at least lactating adult females, young of the year animals, and juveniles.

3.12.1 Essential Features of Marine Critical Habitat

The regulations at 50 CFR 424.12(b) outline the physical and biological features that should be considered when designating critical habitat for listed species, which include space for individual and population growth; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

In general, the physical and biological features of critical habitat essential to the conservation of Steller sea lions are those items that support successful foraging, rest, refuge, and reproduction. The final rule to designate critical habitat for the Steller sea lion (58 FR 45269, August 27, 1993) describes essential aquatic (foraging areas) and terrestrial features (rookeries and haulouts) of critical habitat and the rationale behind the regulatory definition of critical habitat.

Prey resources are the most essential feature of marine critical habitat for Steller sea lions (see 58 FR 45269, August 27, 1993). Marine areas may be used for a variety of other reasons (e.g., social interaction, rafting, or resting), but foraging is the most important Steller sea lion activity that occurs when the animals are at sea. A discussion of Steller sea lion foraging patterns and prey use is found in Sections 3.1.6 through 3.1.10 of the FMP BiOp (NMFS 2010).

Due to the dynamic nature of aquatic ecosystems and fish, NMFS was unable to describe the specific attributes of prey within critical habitat at the time of designating critical habitat. Thus, prey resources were described in general, and are constantly re-assessed to determine their conservation value to Steller sea lions. Understanding the status and trends of fish species known to be important Steller sea lion prey is a crucial aspect in understanding the quality of critical habitat and potential impacts to critical habitat on Steller sea lions.

Most analyses of free-ranging Steller sea lion diets are based on the frequency of occurrence (FO) of prey determined from hard part remains in stomachs and scats. FO is a measure of the presence or absence of specific taxa of prey in an individual predator sample. Percent FO (% FO) indicates the percentage of the sampled predator population that consumed a particular prey species or type. In most recent studies that evaluate diet across large study areas prey occurring at a level of ≥5% FO in all samples combined are considered primary (Waite et al. 2012, Sinclair and Zeppelin 2002, Sinclair et al. 2013). The threshold of ≥ 5% FO across a large study area successfully captures prey signals that may appear unimportant across the range, but otherwise occur in high frequency in certain areas or seasons. For our ESA section 7 consultations on the groundfish fisheries NMFS consistently uses a % FO of ≥10% as a basis for which fisheries may be likely to adversely affect Steller sea lions (NMFS 2000, 2001, 2003, 2010). Prey species meeting the threshold for our groundfish fishery biological opinions (occurring in at least 10% of Steller sea lion scats) by WDPS sub-region and season are shown in Table 3-15.

Two of the CIE reviewers mentioned shortcomings with the use of FO of prey hard parts in scats to infer the importance of Atka mackerel, Pacific cod, and pollock in the Steller sea lion diet in the FMP BiOP (Bowen 2012, Stokes 2012).They commented that the results are unreliable as presented, as the FMP BiOp did not correct the FO data for known biases and likely overestimated the importance of these prey species in the Steller sea lion's diet. The FO calculation of prey remains in scat is widely used and well accepted in studies of free ranging pinniped diet (Sinclair et al. 2013, Tollit et al. 2006, Tollit et al. 2007). Biases inherent in diet composition sampling based on prey remains in scats are well described (Jobling and Breiby 1986, Tollit et al. 2006, Bowen and Iverson 2012, Rosen and Tollit 2012). Bowen (2012) recommended that NMFS use alternative methods to analyze Steller sea lion diet and referred to two general categories of research (fatty acids, prey genetics) and two specific research studies (Tollit et al. 2003 and Tollit et al. 2007) for consideration. An objective review of the conclusions reached in those studies confirms that FO remains among the best tools currently available when appropriately applied to wild diets and that other methods and correction factors remain developmental. Tollit et al. (2006) cited NMML's evaluation of the wild diet of Steller sea lions as an example of an appropriate application of the FO metric. Moreover, Bowen and Iverson (2012) determined FO to be reasonably accurate for inferring diet of wild marine mammals when number correction factors were applied. Bowen and Iverson (2012) conclude that the analysis of hard parts recovered from feces and the chemical and statistical analysis of fatty acids of predator and prey are informative of diets in pinnipeds. Other emerging methods are promising and NMFS is committed to supporting their development. However, these methods are not currently standalone options for detailing Steller sea lion prey consumption patterns at the scale described in this biological opinion or the FMP BiOp (NMFS 2010).

The FO metric allows for a broad brush interpretation of prey absence or presence in population-wide diets over time and has proven informative in deciphering system-wide changes in prey distributions and consumption patterns for a wide variety of terrestrial and marine predators including birds, fish and mammals (Stobberup et al. 2009). Sea lion scats are collected from rookeries and haul-outs and since adult males and older juveniles fast during summer months and disperse during winter, scats are most representative of the diet of adult females and young juveniles.

Atka mackerel, pollock, and salmon are the most frequently occurring prey species in scats collected during summer in the Russian Far-East and in winter and summer collections combined across the U.S range of the western stock, (Sinclair and Zeppelin 2002, Waite and Burkanov 2006, Waite et al. 2012, Sinclair et al. 2013). In the U.S. WDPS, Atka mackerel (50% FO) dominates the diet overall but, primarily occurs in scats collected west of Samalga Pass (170° W long.) in the western and central Aleutian Islands. Pollock (36% FO) dominates diets east of Samalga Pass in the eastern Aleutian Islands and GOA (Sinclair et al. 2013). Salmon are the third most frequently occurring prey (28% FO) when collections from all areas and seasons across the WDPS are combined, with highest frequencies in the eastern Aleutian Islands and western GOA.

Seasonal and geographic variation in diet is marked and highlights prey species that may be important to local populations and varying age groups of Steller sea lions. For instance, snailfish (*Liparididae sp*) occur in only 6% of all scats combined across the WDPS range and have a trace presence in summer samples (May through September), but occur in 15% of scats collected in winter (November through

April) in the eastern Aleutian Islands. Likewise, prey types that dominate overall FO rankings are sometimes insignificantly represented outside of a single region or season. For example, Atka mackerel occurs in 93% of scats collected during summer on rookeries in the central and western Aleutian Islands, yet is present in only 4% of scats collected during winter on haulouts across the GOA (Sinclair et al. 2013). Salmon occur more frequently in summer diets (34.9% FO) than in winter (19.6% FO). Arrowtooth flounder and Pacific cod are more important in Steller sea lion diets in winter (15% FO and 37% FO, respectively) compared to summer (8% FO and 16% FO). Seasonal variation in prey FO is even more pronounced when considered by location. For example, in winter in the eastern Aleutian Islands, arrowtooth flounder and Pacific cod are 22% FO and 41% FO, respectively, compared to summer values of 5% FO and 8% FO in the same area. Cephalopods continue to rank as important prey in the summer in the western Aleutian Islands, although they have declined in FO in this area over the past decade (Sinclair et al. 2013).

A decadal comparison of Steller sea lion diets across the range of the U.S. western stock demonstrated that prey taxa identified in scat collected during 1999-2009 were analogous to those reported during 1990-1998, except that FO increased significantly for 7 of 13 primary prey during the latter decade(Sinclair et al. 2013, Sinclair and Zeppelin 2002). Only celphalopods and pollock decreased in FO between decades. Rockfish (*Sebastes spp*.), arrowtooth, rock sole (*Lepidopsetta sp*.), Pacific cod, Irish lord (*Hemilepidotus sp*.), and Atka mackerel increased significantly ($p \leq 0.05$) during either summer or winter in one or more of three described diet regions between the GOA and eastern Aleutian Islands. Pacific sandlance increased ($p \leq 0.05$) in both summer and winter in every diet region between the GOA and eastern Aleutian Islands during the second decade of study. Regions with the greatest increases in FO of primary prey and strongest prey diversity since 2000 are coincident with Steller sea lion population increases (Sinclair et al. 2013).

Four definitive regions of diet across the range of the U.S. WDPS were first described from prey composition patterns in the 1990-1998 dataset and confirmed by comparative analysis with diet data from 1999-2009 (Sinclair et al. 2013, Sinclair and Zeppelin 2002). These diet regions fall within metapopulation boundaries first described by York et al. (1996) and demonstrate similar population trends (Call and Loughlin 2005, Sinclair and Zeppelin 2002, York et al. 1996). It has since been confirmed by mtDNA analysis that Steller sea lions located on regional clusters of islands in close proximity to one another within these diet regions not only have similar diets and population trends, but are genetically related (O'Corry-Crowe et al. 2006). The consistent regional overlay of diet, genetics, and population growth between decades supports suggestions that the boundaries of foraging regions are dictated by proximity to natal rookeries, and that Steller sea lions may develop foraging skills specific to the regions of their birth (Sinclair and Zepplin 2002; O’Corry-Crowe et al. 2006).

Based on recent diet information presented in Sinclair et al. (2013) the following species are considered to be primary prey species for Steller sea lions in the WDPS: Atka mackerel, pollock, Pacific cod, rock sole, rockfish, Irish Lord, arrowtooth flounder, cephalopods, sandlance and snailfish. This determination results from species occurring rangewide (total scats) in at least 5% of Steller sea lion scats (Sinclair and Zeppelin 2002, Sinclair et al. 2013).

Table 3-15. Principal (FO ≥ 10%) prey species by WDPS Steller sea lion sub-region and season. Source:(Sinclair et al. 2013).

	Summer	Winter
Central GOA	arrowtooth flounder, salmon, pollock, sandlance	arrowtooth flounder, salmon, pollock, herring, sandlance, Irish lords, Pacific cod, sandfish
Western GOA	arrowtooth flounder, salmon, pollock, herring, sandlance, Irish lords, Pacific cod, Atka mackerel, rock sole, sand fish	arrowtooth flounder, salmon, pollock, sandlance, Pacific cod
Eastern AI	salmon, pollock, herring, sandlance, Atka mackerel	arrowtooth flounder, salmon, pollock, sandlance, Irish lords, Pacific cod, Atka mackerel, rock sole, sand fish, sandlance
Central and Western AI	salmon, Atka mackerel, cephalopods	pollock, Irish lords, Pacific cod, Atka mackerel, rockfish, sandlance

3.12.2 Status of Essential Prey Features

3.12.2.1 Atka Mackerel

Overall, Atka mackerel is the most prevalent species found in the diet of Steller sea lions in the western and central Aleutian Islands region, during summer 1999-2009 in the eastern Aleutian Islands (Sinclair and Zeppelin 2002, Sinclair et al. 2013) and in the Russian subpopulation (Waite et al. 2005). During winter, 1999-2009, Pacific cod and pollock frequency of occurrence respectively matched and exceeded that of Atka mackerel in the eastern Aleutian Islands (Sinclair et al. 2013). The species is widely distributed along the continental shelf across the North Pacific Ocean and Bering Sea from Asia to North America. On the Asian side they extend from the Kuril Islands to Provideniya Bay (Rutenberg 1962); moving eastward, they are distributed throughout the Commander and Aleutian Islands, north along the eastern Bering Sea shelf, and through the Gulf of Alaska to southeast Alaska. During periods of high recruitment in the Aleutian Islands, juvenile Atka mackerel may move into the GOA under favorable conditions (Lowe et al. 2005). Recently, Atka mackerel have been detected by the summer trawl surveys primarily in the Shumagin (western) area of the Gulf of Alaska.

Atka mackerel stock assessments use multiple data sources. A key source of data is the Bering Sea shelf and Aleutian Islands bottom trawl surveys. From those bottom trawl surveys a biomass estimate can be calculated. This estimate differs from the stock assessment total biomass estimate as it does not include other sources of data.

The most recent Aleutian Islands biomass estimate from the 2012 Aleutian Islands bottom trawl survey is 276,877 mt, down 70% relative to the 2010 survey estimate. The decrease in biomass in the 2012 survey is largely a result of decreases in biomass found in the Eastern and Southern Bering Sea areas (down 91 and 99%, respectively), but all areas showed large declines. Relative to the 2010 survey, the 2012 biomass estimates are down 48% in Area 543, down 45% in Area 542, and down 99% in Area 541 (Lowe et al. 2013)

The variation in the survey biomass and low estimates for 2012 may be affected by colder than average temperature. Previous studies suggest that Atka mackerel behavior can be affected by temperature (Lowe et al. 2013). However, whether temperature affected the 2012 trawl survey is largely unknown and is likely to be examined in future research. The declining trend in biomass indicated by the 2012 survey is consistent with the population age composition. Population biomass would be expected to decline as the most recent strong year class (2006 year class) is aging and past peak cohort biomass (Lowe et al. 2013).

Atka mackerel are a strongly schooling species and use a very narrow range of habitats. Atka mackerel prefer areas with rocky substrates and high current velocity as indicated by examination of survey tows and underwater video. Fine scale location of Atka mackerel is consistent in a sense that both survey and fishery information indicate that large catches of Atka mackerel are encountered in the same locations over multiple years (Conners et al. 2013b).

Most of the scientific data about groundfish in the Aleutian Islands comes from summer trawl surveys. Therefore, there is very little data on seasonal distribution of Atka mackerel during winter months, when Atka mackerel is most critical to Steller sea lions. The 2014 estimated age 1+ biomass is 456,620 mt, with the maximum permissible ABC for 2014 of 64,131 mt (Lowe et al. 2013). The ABC is further apportioned based on the most recent 4-survey weighted average. The 2014 ABCs for Area 541, 542, and 543 are 21,652 mt, 20,574 mt, and 21,905 mt, respectively.

GOA Atka Mackerel Stock Status

Atka mackerel have been inconsistently caught in the GOA surveys, appearing in 29%, 20%, 24%, 24%, and 16% of the hauls in the Shumagin area in the 2005, 2007, 2009, 2011, and 2013 GOA surveys, respectively. Most of the GOA Atka mackerel biomass (96%, 98%, 99.6%, 90%, and 69% in 2005, 2007, 2009, 2011, and 2013, respectively) is distributed within the Shumagin area of the western GOA. Atka mackerel were encountered in two hauls off Unimak and Sanak Islands in 2011 and a large haul off Sanak Island in 2013. The 2013 estimate of GOA Atka mackerel biomass is 105,411 mt with a large coefficient of variation (Lowe et al. 2013).

In the GOA, from 1977 to 1984 and in 1990, a maximum of 11% of the annual Atka mackerel harvest was caught within 20 nm of Steller sea lion rookeries and major haulouts, reflecting the offshore distribution of the fishery. From 1991to 1993, however, the fishery moved closer to shore, and 82% to 98% percent of the annual Atka mackerel harvest was caught between 10–20 nm of Steller sea lion rookeries on Ogchul and Adugak Islands (near Umnak Island), and Atkins and Chernabura Islands in the Shumagin Islands. Currently, Steller sea lion protection measures prohibit directed fishing for Atka mackerel in the GOA; there has not been a GOA Atka mackerel directed fishery since 1996 (NMFS 2010).

3.12.2.2 Pollock

Pollock (*Gadus chalcogramma*) is a semi-pelagic schooling fish widely distributed in the North Pacific Ocean. Concentrations in areas and depths are dependent on season. In the U.S. portion of the Bering Sea three stocks of pollock are identified for management purposes. These are: Eastern Bering Sea which consists of pollock occurring on the Eastern Bering Sea shelf from Unimak Pass to the U.S.-Russia Convention line; the Aleutian Islands Region encompassing the Aleutian Islands shelf region from 170° W longitude to the U.S.-Russia Convention line; and the Central Bering Sea-Bogoslof Island pollock. These three management stocks undoubtedly have some degree of exchange (Ianelli et al. 2013b).

Bering Sea Pollock

In the Bering Sea, the 2014 age 3+ biomass is estimated to be 8,045,000 mt (Ianelli et al. 2013b). The 2014 ABC in the Bering Sea subarea is 1,369,000 mt. The 2014 Bering Sea pollock TAC is 1,267,000 mt and set well below the ABC. The fishery is apportioned seasonally with 40% of TAC allowed from January 20 to June 10 and the remaining 60% from June 10 to November 1.

Bogoslof Pollock

The most recent Bogoslof pollock echo integration-trawl survey was conducted in March 2012. This resulted in a survey biomass estimate of 67,063 mt. The 2014 ABC for the Bogoslof subarea is 10,059 mt.

The Bogoslof area has been closed to directed fishing since 1992 (Barbeaux et al. 2013, Ianelli et al. 2013a).

Aleutian Islands Pollock

The 2014 age 2+ biomass estimate for Aleutian Islands pollock is 241,050 mt and the 2014 ABC is 35,048 mt (Barbeaux et al. 2013).The 2014 Aleutian Islands TAC is 19,000 mt as specified in regulation. Unlike the Bering Sea, where only 40% of the TAC can be harvested during the A season, Aleutian Islands pollock is seasonally managed where 40% of the ABC can be harvested in the A season. Therefore, 14,019 mt, 79% of the TAC, can be harvested in the 2014 A season. There has been limited participation in the Aleutian Islands pollock fishery since this directed fishery reopened in 2005. In recent years, less than 3,000 mt has been harvested, mostly as incidental catch in other target fisheries.

GOA Pollock

The 2014 age 3+ biomass estimate for Gulf of Alaska pollock is 972,750 mt (Dorn et al. 2013). The 2014 ABC for pollock in the Gulf of Alaska west of 140° W long. is 100,756 mt. There were three surveys in 2013: the Shelikof Strait acoustic survey, the NMFS bottom trawl survey, and ADFG crab/groundfish survey. The 2013 Shelikof Strait acoustic survey biomass estimate is 2.7 times the biomass estimate for 2012, and is largest biomass estimate in Shelikof Strait since 1985. The 2013 NMFS bottom trawl survey biomass estimate is the highest in the time series, and is an increase of 43% from the 2011 estimate. In contrast, the ADFG crab/groundfish survey biomass estimate decreased by 40% from the 2012 estimate, but is close to the 2011 estimate.

In the GOA, pollock is apportioned by season and area, and is further allocated for processing by inshore and offshore components. Pursuant to § 679.20(a)(5)(iv)(B), the annual Pollock TAC specified for the Western and Central Regulatory Areas of the GOA is apportioned into four equal seasonal allowances of 25%.

3.12.2.3 Pacific Cod

Pacific cod (*Gadus macrocephalus*) is a transoceanic species, occurring at depths from shoreline to 500 m. Pacific cod is distributed widely over the eastern Bering Sea as well as in the Aleutian Islands. Prior to 2014, the BSAI Pacific cod stock was managed as one stock. In 2014, the Aleutian Islands Pacific cod stock and Bering Sea Pacific cod stock have separate stock assessments, OFL, ABC, and TAC.

The 2014 age 3+ biomass estimate for the Bering Sea is 1,545,070 mt (Thompson 2013). The 2014 ABC for the Bering Sea is 255,000 mt. The 2014 survey biomass estimate for the Aleutian Islands is 59,000 mt (Thompson 2013). The 2014 ABC for the Aleutian Islands is 15,100 mt.

GOA Pacific cod

The 2014 age 0+ biomass estimate for GOA Pacific cod is 422,000 mt (A'mar and Palsson 2013). The 2014 ABC for the GOA is 84,200 mt. The ABC for GOA Pacific cod is apportioned among regulatory areas (western, Central, and Eastern) based on the trawl survey biomass estimates using a random effects model. The 2013 NMFS GOA bottom trawl survey provided Pacific cod biomass and abundance estimates and length composition data.

Further information on arrowtooth flounder, including effects of fishing on the age and size structure of arrowtooth flounder stocks, may be found in the arrowtooth flounder chapter of the annual SAFE report(Spies et al. 2013). Further information on Kamchatka flounder, including effects of fishing on the age and size structure of Kamchatka flounder stocks, may be found in the Kamchatka flounder chapter of the annual SAFE report (Wilderbuer et al. 2012). These documents are incorporated by reference.

Relevant information from these documents is summarized in this section. This section also contains recent information on arrowtooth flounder, Kamchatka flounder, and their fisheries.

Arrowtooth Flounder

Arrowtooth flounder (*Atheresthes stomias*) is a relatively large flatfish that occupies continental shelf waters almost exclusively until age four, but at older ages occupies both shelf and slope waters. Two species of *Atheresthes* occur in the Bering Sea. Arrowtooth flounder and Kamchatka flounder (*A. evermanni*) are very similar in appearance and are not always distinguished in the commercial catches. Arrowtooth flounder are found throughout the BSAI management area; however, their abundance in the Aleutian Islands is lower than in the Bering Sea (Spies et al. 2013). The resource in the BSAI is managed as a single stock although the stock structure has not been studied.

Historically in the BSAI, arrowtooth flounder was mostly caught while pursuing other high value species and discarded. With the development of marketable products and Amendment 80 fishing practices in 2011, the percentage of arrowtooth flounder catch retained has increased to 81% of the BSAI total catch. The largest discard amounts still occur in the Pacific cod fishery and the various flatfish fisheries. An increasing trend of catch and retention is expected in the near future due to Amendment 80. Model predictions indicate that this stock is neither overfished nor approaching an overfished condition.

Although the standard sampling trawl changed in 1982 to a more efficient trawl, which may have caused an overestimate of the biomass increase in the pre-1982 part of the time-series, biomass estimates from AFSC surveys on the continental shelf have shown a consistent increasing trend since 1975. Since 1982, biomass point-estimates indicate that arrowtooth flounder abundance has increased eight-fold to a high of 570,600 mt in 1994. The population biomass remained at a high level from 1992 to 1997. Results from the 1997 to 2000 bottom trawl surveys indicate the Bering Sea shelf population biomass had declined to 340,000 mt, 60% of the peak 1994 biomass point estimate. Beginning in 2002 the shelf survey estimate increased further and peaked in 2005 at a biomass of 757,685 mt. In 2006 to 2008 the estimates declined slightly but were still at high levels. The 2009 survey point estimate is lower at 453,559 mt (Spies et al. 2013).

Arrowtooth flounder absolute abundance estimates are based on "area-swept" bottom trawl survey methods. These methods require several assumptions that can add to the uncertainty of the estimates. For example, it is assumed that the sampling plan covers the distribution of the species and that all fish in the path of the trawl are captured (no losses due to escape, or gains due to herding). Due to sampling variability alone, the 95% confidence intervals for the 2009 point estimate are 370,742 mt to 536,377 mt (Spies et al. 2013).

The combined arrowtooth/Kamchatka flounder abundance estimated from the 2006 Aleutian Islands trawl survey is 229,205 mt, the highest estimate observed in the Aleutian Islands since surveys began in 1980. Results from trawl surveys in Areas 541, 542, and 543 indicate that approximately 15 percent to 20 percent of the arrowtooth/Kamchatka flounder biomass is located in the Aleutian Islands in any year. Until 2009 the stock assessment model did not consider the Aleutian Islands portion of the biomass to model stock abundance and was therefore a conservative estimate of the stock size. In the 2009 assessment, the 10 surveys conducted in the Aleutian Islands are included in the base model. An increase in the arrowtooth flounder biomass may increase predation on Atka mackerel. Arrowtooth flounder are an important ecosystem component as predators (Spies et al. 2013).

4 ENVIRONMENTAL BASELINE

The Environmental Baseline identifies the effects of past and ongoing human-caused and natural factors leading to the current status of the species or its habitat and the ecosystem within the action area. Environmental baselines for Biological Opinions include past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

4.1 Aleutian Islands Ecosystem

The action area for the federally managed Aleutian Islands groundfish fisheries effectively covers all of the Aleutian Islands fishery management areas of the U.S. Exclusive Economic Zone (EEZ) (Area 541, 542, and 543; Figure 2-1 and Figure 4-1) and adjacent state waters. The Aleutian Islands are the tip of a submerged volcanic mountain chain that stretches over 1,600 km (1,000 miles). Both benthic and pelagic fish habitats around the islands reflect this mountainous structure. Bottom habitats are highly complex, with primarily rough, rocky bottom (rock, boulders, and corals) steep slopes and drop-offs, and few areas of fine sediments. Both bottom and pelagic habitats are subject to strong currents and tidal movements funneled through the many passes in the chain (Conners et al. 2013b).

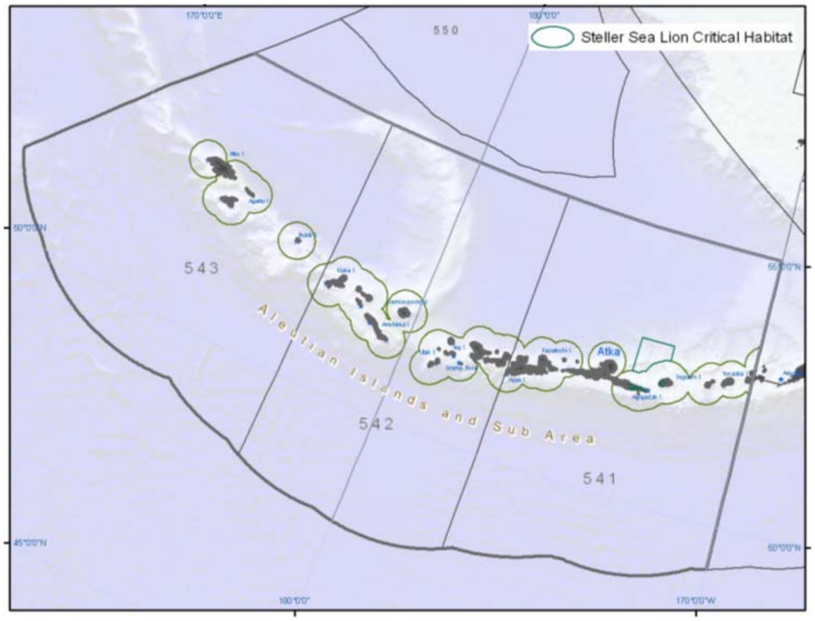

Figure 4-1. Map of the Aleutian Islands fishery management areas (541, 542, and 543) and designated critical habitat in the action area.

The marine environment of the Aleutian Islands is very dynamic and unique to the world's oceans. The east-west orientation of the island chain forms a porous boundary between two ocean basins, the warmer North Pacific and the colder Bering Sea. The depths of the Aleutian Trench (greater than 7,000 m deep) to sea level or above, in a distance of less than 150 km, provides a huge variety of habitat and enables tighter coupling between onshore, nearshore, and offshore systems (NPFMC 2007). This physical environment also presents challenges in data collection; persistent cloudiness creates difficulties in obtaining comprehensive satellite-derived data while the long expanse of the archipelago makes comparing west-east trends difficult due to differences in timing of oceanographic surveys. As a result, there are large gaps in knowledge about local physical processes and their impact on biological processes (Zador 2012).

The Aleutian Islands climate is wet and stormy with average summer temperatures of 7 to 14°C (45 to 57°F) and -3 to 3°C (27 to 37°F) in the winter. Precipitation is highly variable with annual averages between 75 and 160 cm per year depending on location (NPFMC 2007). Climate and other physical forcing can impact ecosystem functions through oceanic, atmospheric, and terrestrial processes, such as changes in ocean temperature, chemistry, currents, storminess, and freshwater runoff. Physical forcing changes may occur on interannual (El Niño and La Niña), decadal regime shifts, or longer (global climate change) timescales (NPFMC 2007). Figure 4-2 plots the time series of the commonly used climate indices from 2003 to early summer 2013(Bond 2013).

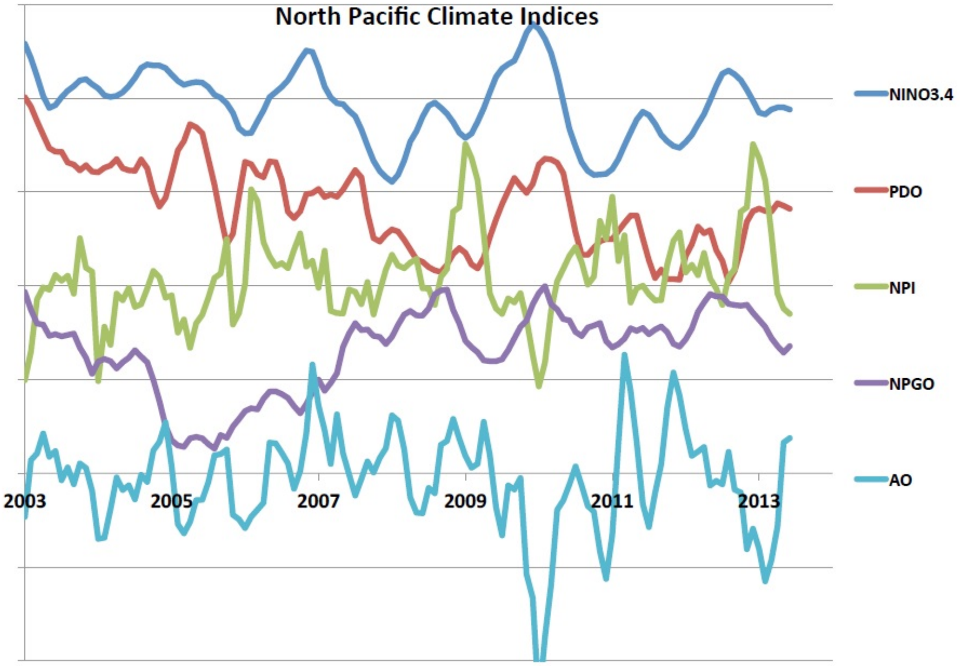

Figure 4-2 Time series of the NINO3.4 (blue), PDO (red), NPI (green), NPGO (purple), and AO (turquoise) indices. Each series represents monthly values that are normalized and then smoothed with the application of three-month running means. The distance between the horizontal grid lines represents 2 standard deviations.

- NINO3.4 index — characterizes the state of the El Niño/Southern Oscillation phenomenon. Slightly positive in the fall of 2012 and slightly negative since late 2012, the small magnitude of this signal implies a near-neutral state for the El Niño/Southern Oscillation.
- Pacific Decadal Oscillation (PDO) — the leading mode of North Pacific sea surface temperature variability. It has been in largely a negative state since late 2007.
- North Pacific Index (NPI) —a commonly used measure of the strength of the Aleutian Low. In 2012/2013, the winter NPI was strongly positive implying a weak Aleutian Low pressure system and suppressed storminess in the region.
- Arctic Oscillation (AO) — a measure of the strength of the polar vortex, with positive values signifying anomalously low pressure over the Arctic and high pressure over the Pacific and Atlantic, at a latitude of roughly 45° N. It has a weakly positive correlation with sea ice extent in the Bering Sea.

- North Pacific Gyre Oscillation (NPGO) — the second dominant mode of sea surface height variability in the Northeast Pacific. It has been in a positive state since 2007, which projects on stronger than normal flows in the Alaska Current portion of the Subarctic Gyre (Bond 2013).

The Aleutian North Slope Current in the Bering Sea, and the Alaska Coastal Current and Alaskan Stream in the North Pacific are the three primary currents in the Aleutian Islands (Stabeno et al. 2005). The narrow shelf west of Samalga Pass allows the Alaskan Stream, which flows southwestward along the southern side of the Aleutian Islands, to approach the islands and is the primary influence for the oceanic marine environment of these areas (Ladd et al. 2005). East and west of Samalga Pass, the community structure, diets, and distributions for demersal fish, corals, seabirds, and marine mammals differ in general (Heifetz et al. 2005, Logerwell et al. 2005, Jahncke and Coyle 2005, Sinclair et al. 2005, Ortiz 2007). Samalga Pass has a major influence on the WDPS population structure (Fritz 2013).

West of Samalga Pass, in the western and central Aleutian Islands ecoregions, the continental shelf is much narrower than to the east of Samalga, and the passes are also wider and deeper (NPFMC 2007). The wider passes allow bidirectional currents with mean flow to the north (from the Pacific Ocean to the Bering Sea) on the eastern side of the passes and to the south on the western side (Stabeno et al. 1999).

Within the passes, the tidal currents result in substantial mixing. As the tidal current pushes water over the shallow sills of the passes, salt, nutrients, and plankton from deeper water can be mixed into the surface waters (NPFMC 2007). Winds may also influence transport through the passes. For example, easterly wind anomalies prevailed in this region during the fall of 2012 and spring of 2013 and may have enhanced the northward transport through Unimak Pass and perhaps also the Aleutian North Slope current (Bond 2013).

Eddies in the Alaskan Stream south of the Aleutian Islands have been shown to influence flow into the Bering Sea through the Aleutian Passes (Okkonen 1996). Particularly strong eddies were observed south of Amukta Pass in 1997/1998, 1999, 2004, 2006/2007, 2009/2010, and summer 2012, and may indicate higher than average volume, heat, salt, and nutrient fluxes to the Bering Sea through Amukta Pass during these periods (Ladd 2012). Eddy energy in the region has been low from the fall 2012 through early 2013, and fluxes were likely smaller during this period.

Water temperature variations in the Aleutian Islands are mediated by large-scale atmospheric patterns and ocean currents (NPFMC 2007). Water temperature data has been collected on NMFS survey bottom trawl hauls since 1994. Data have varied considerably with 2012 producing some of the coldest temperatures of the series; however, these data represents a snapshot of water temperatures as the vessels moved through the area and are often affected by short term events. Cool temperatures in 2012 may have impacted low abundance estimates of some species such as Atka mackerel and pollock (Laman 2012). While National Multi-Model Ensemble projections suggest the continuation of rather cold upper ocean temperatures for most Alaskan waters, the skill in these projections is limited. Based on sea surface temperatures as well as other forecast fields, it is likely there will be a warming of Alaskan water over the next two to three seasons, relative to the mostly cooler than normal temperatures that have prevailed over the last five years (Bond 2013).

Due to the steepness of the slopes in the Aleutian Islands, potential groundfish habitat[11] occurs primarily in narrow bands around the island chain, with the majority of habitat within the 20 nm critical habitat buffer around Steller sea lion haulouts and rookeries. Approximately 80% of the area less than 200 m in depth is within critical habitat in the central and western Aleutian Islands. In Area 541, the only shelf area outside of critical habitat is part of the southern side of Atka Island–an area with historically low

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[11] Groundfish habitat is discussed in Section 3.12.2.

groundfish catches. In Area 542, depths less than 200 m are almost entirely within critical habitat, except for parts of Petrel Bank. In Area 543, there are two offshore areas 200 to 400 m deep that are outside critical habitat–Tahoma Reef seamounts south of Buldir Island and Stalemate Banks at the far western end of the chain (Conners et al. 2013b).

Aleutian Islands food web

The full food web of the Aleutian Islands is vastly complex, and even a relatively simplified quantitative representation still contains 149 groups, 134 of which are predator/prey groups and 15 are fisheries (Figure 4-3). The production of the pelagic prey base, composed of euphausiids, copepods, and other zooplankton, dominates the Aleutian Island food web (NPFMC 2007). The Aleutian Islands food web model suggests a relationship between the relative importance of fishing mortality and trophic level. High trophic level predators, such as halibut, experience the majority of their mortality from fishing. In contrast, the lower tropic level pollock experience much larger predation mortality than high tropic level predators (Aydin et al. 2007).

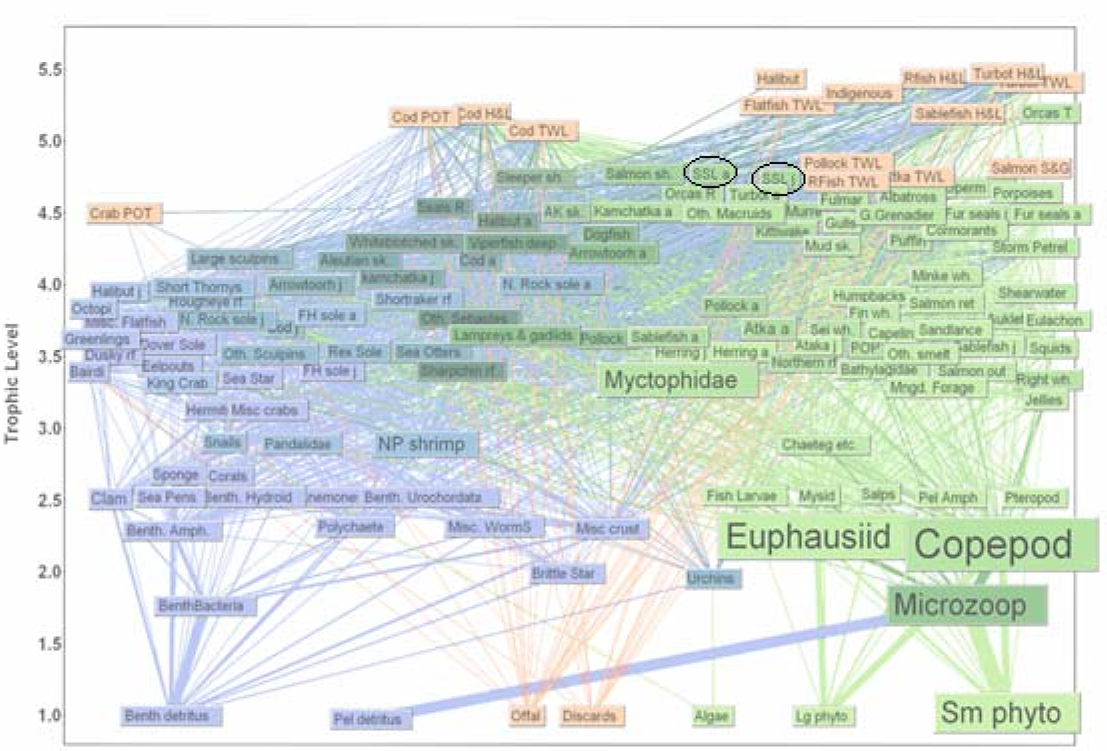

Figure 4-3 The food web of the Aleutian Islands shelf (management areas 541–543, less than 500 depth) ecosystem, as modeled for the early 1990s by Ortiz (2007) and Aydin et al. (2007). Blue coloration indicates the benthic energy pathway; green coloration indicates the pelagic energy pathway. Fisheries are shown in orange. The apex predators are at the highest tropic levels. Box size is proportional to biomass density and line width is proportional to energy flow between boxes. The location of Steller sea lions has been circled on the food web for the purposes of this analysis.

Groundfish relationships and ecological linkages between species, such as predators and prey, can be analyzed using multispecies models.[12] A three-species minimum realistic model was constructed for the

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[12] At the time the current multispecies models of the Aleutian Islands were generated, the best available science on Pacific cod overall biomass was a combined Bering Sea/Aleutian Islands stock assessment model (e.g., Thompson and Lauth 2012) and made limited use of Aleutian Islands data, thus overwhelmingly reflecting Bering Sea dynamics. As described in Kinzey and

Aleutian Islands in (Kinzey and Punt 2009); this model was an aged-structured stock assessment model of Atka mackerel, Pacific cod, and pollock. This model is very similar in structure to a non-spatial single species stock assessment in the structure of its results (both reporting of results and uncertainty of results). While this model offers good prognosis for future modeling and monitoring of Steller sea lion prey, its results and implications for Steller sea lions have not been fully analyzed at this time.

In comparative study of the eastern Bering Sea, Gulf of Alaska and Aleutian Islands, Aydin et al. (2007) built and investigated models of the whole food web to allow for visualizing and calculating energy flow relationships between species. Results suggest that in the Aleutian Islands, unlike the Eastern Bering Sea and Gulf of Alaska, Atka mackerel, pollock, and Pacific cod production rates are tightly interlinked—they consume each other's juveniles and respond to climate variation with strong spatial structure. For example, Atka mackerel are a central species in the Aleutian Islands food web, serving as both predator and prey for many species, as well as being the source for a commercially important fishery (Figure 4-4).

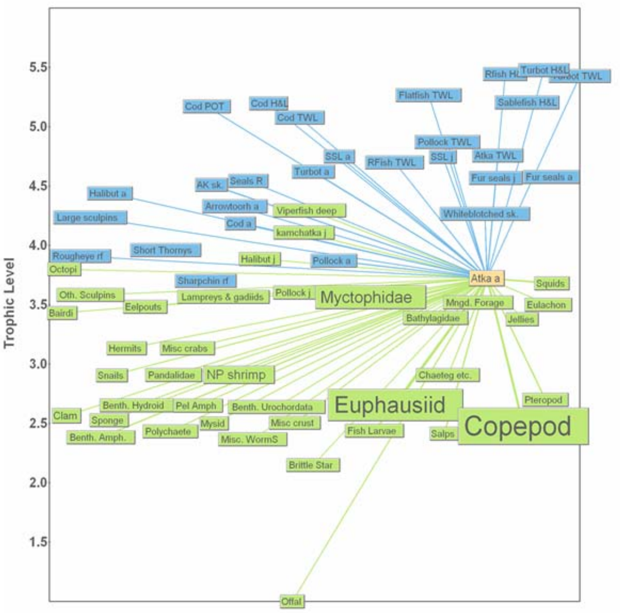


Figure 4-4. The position of Atka mackerel in the food web of the Aleutian Islands shelf (management areas 541 through 543, less than 500 m depth) ecosystem, as modeled for the early 1990s by (Ortiz 2007) and Aydin et al. (2007). Blue coloration shows predators of mackerel, green coloration shows prey. Species not directly connected to Atka mackerel are not shown.

Pollock and Atka mackerel were both estimated to cause high mortality on each other despite being a small proportion of each other's diet. The high mortality is a result of the relatively large biomass of each species estimated to be in the ecosystem, combined with their consumption rates. Therefore, small changes in the biomass of either could result in large changes in the amount of mortality caused by predation (assuming the diet and consumption rates remain the same (NPFMC 2007)). Atka mackerel cause most juvenile pollock mortality (71%), while major predators of Aleutian Islands adult pollock are Pacific cod, Steller sea lions, pollock themselves, halibut, and skates (Aydin et al. 2007).[13]

Punt (2009), there is considerable uncertainty as to functional responses between predators and prey that require careful analysis of the statistical properties of multiple alternate models (Aydin 2010).

[13] In the Aleutian Islands, food web modeling suggests that most adult pollock mortality was caused by the pollock trawl fishery (48%) during the early 1990s. By the late 1990s, fishery catch of pollock in the Aleutian Islands had declined to less than half the early 1990s catch, and the directed fishery was closed in 1999 (Ianelli et al. 2005). Limited harvests have occurred outside of critical habitat since 2005 and in recent years predation mortality of Aleutian Islands pollock likely exceeds fishing mortality as in the Gulf of Alaska or Eastern Bering Sea.

Pacific cod play a strong role as a predator within the Aleutian Islands as well as being a food source for marine mammals and a target for groundfish fisheries. In the Aleutian Islands, Atka mackerel and sculpins are predominant fish prey for Pacific cod (15% each), with pollock less than 5% (Aydin et al. 2007). The largest source of Pacific cod mortality in the Aleutian Islands is the Pacific cod trawl and hook-and-line fisheries, followed by the directed Atka mackerel fishery, and then adult and juvenile Steller sea lion predation (Aydin et al. 2007).

4.2 Steller Sea Lion Status and Trends in the Central and Western Aleutian Islands

Section 3 describes the WDPS Steller sea lion status and trends throughout their range. The environmental baseline focuses on the WDPS Steller sea lion status and trends in the central and western Aleutian Islands. The first reported trend counts of Steller sea lions in Alaska were made in 1956–1960, which estimated at least 140,000 sea lions in the Gulf of Alaska and Aleutian Islands (Merrick et al. 1987). Subsequent surveys indicated a major population decrease, first detected in the eastern Aleutian Islands in the mid-1970s (Braham et al. 1980). Counts from 1976 to 1979 totaled about 110,000 sea lions. The decline of Steller sea lions appears to have spread eastward to the Kodiak Island area during the late 1970s and early 1980s, and then westward to the central and western Aleutian Islands during the early and mid-1980s (Byrd 1989, Merrick et al. 1987).

Between 1991 and 2000, overall counts of Steller sea lions at trend sites decreased 40 percent, an average annual decline of 5.4 percent (Loughlin and York 2000). In the 1990s, counts decreased more at the western (western Aleutians; -65%) and eastern edges (eastern and central GOA; -56% and -42%, respectively) of the U.S. range than they did in the center (range of -24% to -6% from the central Aleutians through the western Gulf of Alaska) (Fritz et al. 2008). Survey data collected since 2000 indicate that the decline continues in the central and western Aleutian Islands but that regional populations east of Samalga Pass have increased or are stable.

4.2.1 Steller Sea Lion Counts in the Central and Western Aleutian Islands

The most recent comprehensive estimate (pups and non-pups) of abundance of the WDPS of Steller sea lions in Alaska is derived from aerial photographic surveys of non-pups conducted in June-July 2008 through 2012 and aerial photographic and ground-based pup counts conducted in June-July 2009 through 2012 (DeMaster 2011, 2012).

Table 4-1 shows the total pups and non-pups counted in the central and western Aleutian Islands during the last complete surveys conducted by age class in these areas. A total of 745 non-pups were counted in the western Aleutians on all trend sites in 2012, which is a decline of -44% since 2004 (DeMaster 2012). Non-pup counts on all western Aleutians trend sites declined at rates of -6.2% y_{-1} (P=0.007) between 2000 and 2012 (a change of -56%) and -9.0% y_{-1} (P<0.0001) between 1991 and 2012 (a change of -84%) after accounting for differences in resolution and orientation between the vertical, high resolution photographs taken in the years 2004–2012 and the 35 mm oblique photographs taken previously (Fritz and Stinchcomb 2005).

A total of 200 pups were counted at the 4 rookeries and 1 major haulout (Alaid Island) in the western Aleutian Islands during the last complete survey for pups conducted in this area in 2012 (Fritz 2013). The sum of pup counts at all rookeries in the western Aleutians in 2012 (N=191) was similar to 2011 (N=186) but remains considerably below totals from earlier in the decade (2002: N=488; 2005: N= 343). Live pup counts declined at a rate of -8.9% y_{-1} ($p<0.001$) between 2002 and 2012, and -10.3% y_{-1} ($p<0.0001$) between 1997 and 2012 in the western Aleutians (DeMaster 2012).

A total of 6,223 non-pups were counted in the central Aleutian Islands in 2008, and 2,701 pups were counted in this area in 2009 (Fritz et al. 2013).

Table 4-1. Count of Steller sea lion pups and non-pups in the central and western Aleutian Islands Source: (Fritz et al. 2013).

Count	Western AI	Central AI
Non-pup	745	6,223
Pup	200	2,701

Western AI: Last complete survey for non-pups and pups conducted in 2012
Central AI: Last complete survey for non-pups conducted in 2008 and for pups conducted in 2009

4.2.2 Steller Sea Lion Trend in the Central and Western Aleutian Islands

Non-pup counts were essentially stable (slow decline at-0.56% y^{-1}; -1.45% y^{-1} to 0.43% y^{-1}) in the central Aleutian Islands, but there is strong evidence of a steep decline (-7.23% y^{-1}; -9.04% y^{-1} to -5.56% y^{-1}) in the western Aleutian Islands (Johnson and Fritz, In Review; Table 4-2). While less is known about inter-regional movement west of Samalga Pass, including Russia, sea lion dispersal during the breeding season may have had a smaller influence on non-pup trends here than in the eastern-central Gulf of Alaska given the much larger area over which regional non-pup (and pup) trends are declining (see discussion in Section 3).

Regional variation in trends in pup counts in 2000–2012 is similar to that of non-pup counts (Johnson and Fritz In Review)Table 4-2). Pup counts declined steeply in the western Aleutian Islands (-9.36% y^{-1}; -10.93% y^{-1} to -7.78% y^{-1}), but were stable (declining slowly) in the central Aleutian Islands (-0.46 % y^{-1}; -1.50% y^{-1} to 0.72% y^{-1}). As with non-pup counts, there is a west-east cline in pup trends in the central Aleutians, with declining counts in the western central Aleutians and stable (slowly increasing) counts in the eastern central Aleutians In the eastern Aleutian Islands, there is strong evidence that pup counts increased (>3% y^{-1}).

Table 4-2. Trends (annual rates of change expressed as % y-1 with 95% credible interval) in counts of western Steller sea lion non-pups (adults and juveniles) and pups in Alaska, by region, for the period 2000-2012 (Johnson and Fritz; In Review).

		Non-pups			Pups		
Region	**Latitude Range**	**Trend**	**-95%**	**+95%**	**Trend**	**-95%**	**+95%**
Central Aleutian Islands	170°W-177°E	-0.56	-1.45	0.43	-0.46	-1.50	0.72
Western Aleutian Islands	172° -177°E	-7.23	-9.04	-5.56	-9.36	-10.93	-7.78

Table 4-3 shows Steller sea lion sites designated as critical habitat in 50 CFR 226.202 and sites that have been used since the designation of critical habitat in the Aleutian Islands Fishery Management Areas 543, 542, and 541. Critical habitat includes an aquatic zone that extends 20 nm seaward from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144° W. longitude. The site type and season fields indicate the usage of the site as analyzed by NMML in 2006. In this table summer reflects usage meeting the thresholds (greater than 200 non-pups in summer and greater than 100 non-pups in winter from 1990–2005) in May through October, and winter reflects usage in November through April.

Table 4-3. Sea lion sites in the Aleutian Islands Fishery Management Areas 543, 542, 541 (modified from FMP BiOp Table 3.31).

		Site Type[1]	**Season[2]**	**542**	**Site Type[1]**	**Season[2]**	**541**	**Site Type[1]**	**Season[2]**
543 Rookeries	Attu Island/ Cape Wrangell	R	All	Ulak Island/ Hasgox Pt.	R	All	Adak Island	R	All
	Attu Island/ Cape Sabak	R	All	Amchitka Island/ East Cape	H/R	All	Seguam Island/Saddleridge Pt.	R	All
	Agattu Island/ Gillon Pt.	R	All	Kiska Island/ Cape St. Stephen	R	All	Kasatochi Island	R	All
	Buldir	R	All	Kiska Island/ Lief Cove	R	All	Agligadak Island	H/R	S
				Semisopochnoi/ Petrel Pt.	H/R	All	Yunaska Island	R	All
				Ayugadak Point	R	S			
				Amchitka Island/ Column Rocks	R	S			
				Semisopochnoi Island/ Pochnoi	H/R	All			
				Tag Island	R	All			
				Gramp Rock	R	All			
Haulouts	Attu Island/ Chirikof Pt.	H	S	Kavalga Island	H	W*	Amlia Island/ East	H	All
	Alaid Island	H	All	Unalga & Dinkum Rocks	H	W	Great Sitkin Island	H	N
	Shemya Island	H	S	Kiska Island/ Sobaka & Vega	H	N	Seguam Island/ Turf Point	H	All
				Tanaga Island/ Bumpy Point	H	N	Seguam Island/ Finch Point	H	W*
				Segula Island	H	W	Little Tanaga Strait	H	All
				Amatignak Island/Nitrof Point	H	W			
				Kiska Island/ Sirius Point	H	N	Anagaksik Island	H	N
				Tanadak Island (Kiska)	H	N	Atka Island/ N. Cape	H	All
				Little Sitkin Island	H	W	Amlia Island/ Sviech. Harbor	H	All
				Ugidak Island	H	N	Sagigik Island	H	N
				Bobrof Island	H	W	Tanadak Island (Amlia)	H	N
				Kanaga Island/ Ship Rock	R/H	All	Amukta Island & Rocks	H	N
				Kanaga Island/ North Cape	H	W	Chagulak Island	H	W
				Hawadax Island/ Krysi Point	RPA	All			
				Amchitka Island/ Cape Ivakin	RPA	N			

*The seasonal site use has been revised relative to the information in the FMP BiOp Table 3.31 due to updated count information. In March, 2012 National Marine Mammal Lab sited 632 animals at Seguam Island/Finch Point and 103 animals at Kavalga Island.

[1] RPA = haulout not designated as critical habitat, but listed as an important site for management purposes in 1999; R/H = functional rookery that is a listed critical habitat haulout; H/R = functional haulout that is listed as a critical habitat rookery; R = rookery critical habitat; H = haulout critical habitat

[2] S = summer; W = winter, N = neither

4.3 Factors Affecting WDPS Steller Sea Lions in the Action Area

Potential causes of the WDPS Steller sea lion decline and threats to their recovery were identified in the Steller sea lion Recovery Plan (NMFS 2008). In Chapter 3 we reviewed the information available to assess the threats to the WDPS. In this section we review what is known about the factors affecting sub-populations in the action area− the western and central Aleutian Islands.

As discussed in section 3.7, the extent to which current population dynamics in the western and central Aleutian Islands are influenced by low survival or low reproduction is unknown. As discussed in section 3.7.1, there are data to compare how juvenile or adult survivorship has changed over time. Current estimates of adult survivorship are not available for the western and central Aleutian Islands. A minimum survival estimate from pups branded in 2011 and resighted from June through November 2012 in the western Aleutian Islands is 48% which is higher than the survival estimates to the east. These data suggest that first year survival is not compromised in the western Aleutian Islands (Fritz et al. In Review) Comparable data are not available for juvenile survival in the central Aleutian Islands at this time.

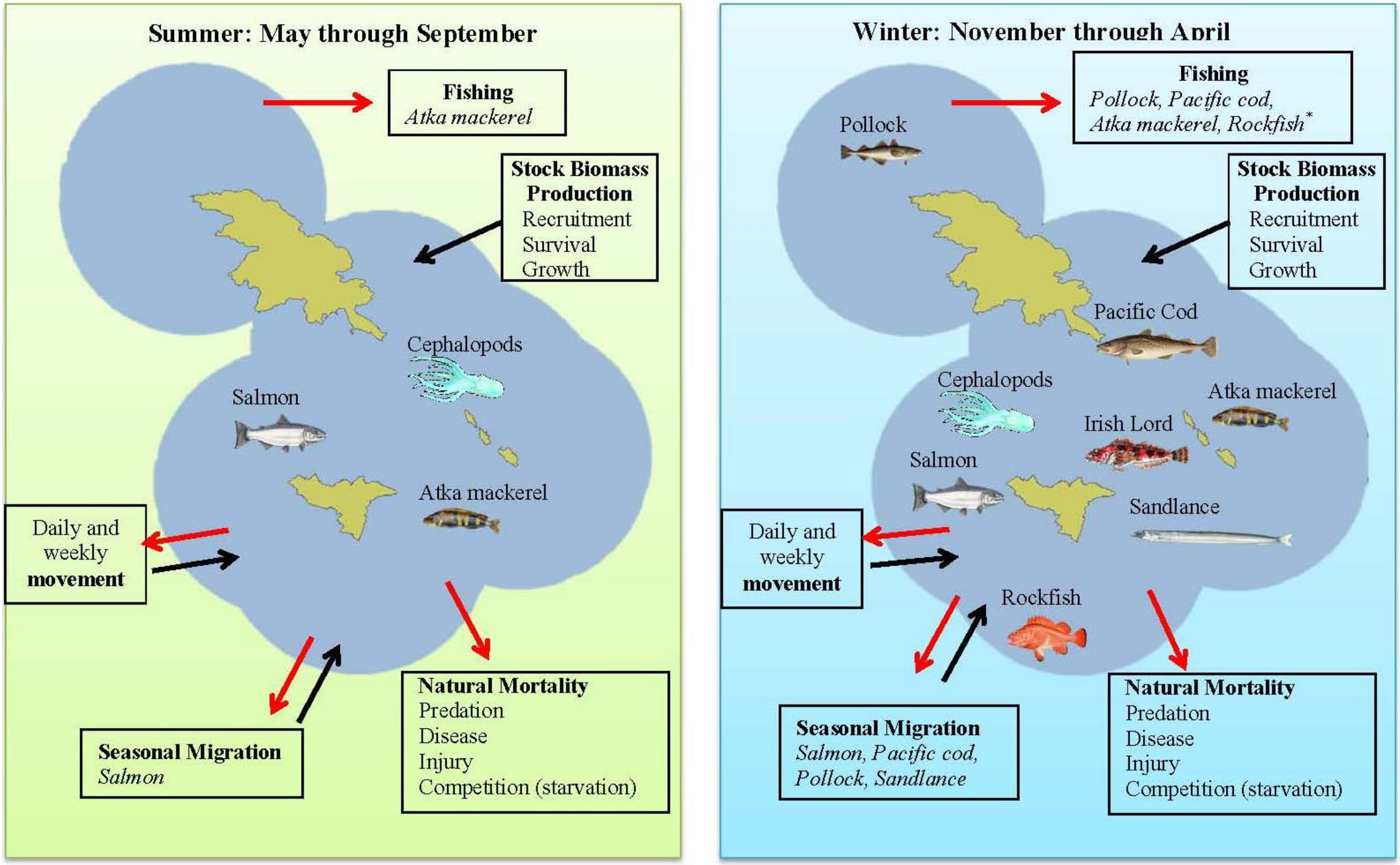
As discussed in section 3.7.2, there are no empirical birth rate estimates for the western and central Aleutian Islands. Additional, regionally-explicit age-composition data are required to inform inferential studies that aim to understand the relative contribution of survival and reproduction to the central and western Aleutian Islands sub-population dynamics.

Based on the review of threats identified in the Recovery Plan (NMFS 2008) and considered in-light of new information since completion of the Recovery Plan in Chapter 3, the following bottom-up and top-down factors may be affecting the population growth in the western and central Aleutian Islands: natural environmental variability, competition with fisheries, and contaminants (bottom-up); and predation by killer whales (top-down). Data are unavailable to discern the cause of the continued decline in the western Aleutian Islands and the lack of recovery in the central Aleutian Islands and the FMP BiOp (NMFS 2010) concludes that the dynamics are likely being influenced by a combination of factors which likely interact. Moreover, these factors have likely changed over time.

4.4 Status of Essential Features of Critical Habitat in the Action Area

Figure 4-5 depicts NMFS's conceptual model of the essential features of Steller sea lion critical habitat in the western and central Aleutian Islands and the factors influencing the status of those features. In summer, Atka mackerel, salmon, and cephlapods comprise the essential features of critical habitat as they occur in more than 10% of the scats collected from April through September (Sinclair et al. 2013). Pollock, Pacific cod, Atka mackerel, cephlapods, Irish Lord, sandlance, salmon and rockfish comprise the essential features in winter (November through March). The base status of marine critical habitat, represented as the abundance and distribution of principal prey, is affected by natural (recruitment, survival, growth, seasonal migration, and daily and weekly movements) and anthropogenic (fishing) factors.

With the exception of the commercial fishery removals, the extent of the other influences are highly uncertain and dynamic. While we have good estimates for the amount of catch taken by the fishery, we have less information about the abundance and distribtion of the essential features of critical habitat, especially in the winter. The purpose of Figure 4-5 is to depict how essential features of critical habitat are continually depleted and replenished.



→ Decrease essential features inside critical habitat ← Increase essential features inside critical habitat

Figure 4-5. Principal Steller sea lion prey species (≥ 10% FO) assumed to be essential features of designated critical habitat in the western and central Aleutian Islands based on diet information in Sinclair et al. (2013) and conceptual model of factors influencing prey availability.

4.4.1 Overview of Fishery Management Reference Points

The full groundfish fishery management structure is discussed and analyzed in the FMP BiOp (NMFS 2010). A short overview is included here to provide context for the effects analysis. Three reference points are used for management of groundfish fisheries in the North Pacific including the Aleutian Islands. The overfishing level (OFL) – based on the fishing mortality rate associated with producing the maximum sustainable yield on a continuing basis – is the catch limit which should never be exceeded. The acceptable biological catch (ABC) is the annual sustainable catch limit, and is set lower than OFL. The buffer between these reference points allows for scientific uncertainty in single species stock assessments, ecosystem considerations, and operational management of the fishery. The total allowable catch (TAC) is the annual catch target that incorporates economic considerations and management uncertainty. The fishery management plans prescribe that TAC ≤ ABC ≤ OFL. Fisheries are managed in-season to achieve the TACs without exceeding the ABC or OFL. All catch taken in directed fisheries or caught incidentally in other fisheries, whether retained or discarded accrues towards the TAC (NPFMC 2011).

The reference points (catch limits) are established annually. Scientists assess the status of each stock and include alternate model simulations and tier assignments (see NMFS (2010)) to arrive at recommendations for OFLs and ABCs. The scientists' recommendations are reviewed and potentially modified by the Groundfish Plan Teams. After review by the plan teams, the information is reviewed by the Council's Scientific and Statistical Committee (SSC) which ultimately sets the OFL and ABC for each stock based on the stock assessment report and the Plan Teams' recommendations. The SSC retains the flexibility to adjust ABC and OFL values from the control rule (see NMFS (2010)). The Council then sets the TAC at or below the ABC, incorporating recommendations from the Advisory Panel and industry stakeholders (NPFMC 2011).

4.4.2 Status of Atka mackerel in the Action Area

A comparison of the Atka mackerel spawning biomass trend from the current and previous assessments (Table 17.13 in Lowe et al. (2013b) indicates consistent trends throughout the time series, i.e., biomass increased during the early 1980s and again in the late 1980s to early 1990s. After the estimated peak spawning biomass in 1993, spawning biomass declined for nearly 10 years until 2001 (Fig. 17.6 in Lowe et al. (2013b). Thereafter, spawning biomass began a steep increase which continued to 2005. The abundance trend has been declining since the most recent peak in 2005, which represented a build-up of biomass from the exceptionally strong 1999–2001 year classes. The most recent Aleutian Islands biomass estimate from the 2012 Aleutian Islands bottom trawl survey is 276,877 t, down 70% relative to the 2010 survey estimate (Lowe et al. 2013). The decrease in biomass in the 2012 survey is largely a result of decreases in biomass found in Area 541 and the Southern Bering Sea areas (down 91 and 99%, respectively), but all areas showed large declines (Table 17.6 in Lowe et al. (2013). Relative to the 2010 survey, the 2012 biomass estimates are down 48% in Area 543, down 45% in Area 542, and down 99% in Area 541 (Lowe et al. 2013). The 95% confidence interval about the mean total 2012 Bering Sea/Aleutian Islands biomass estimate is 106,811-447,595 mt. The coefficient of variation (CV) of the 2012 mean Bering Sea/Aleutian Islands biomass is 18% (Lowe et al. 2013).

Table 4-4. Aleutian Islands Atka mackerel survey biomass (mt) by bottom-depth category by region and subareas for 1991, 1994, 1997, 2000, 2002, 2004, 2006, 2010, and 2012.

Depth (m)	1991	1994	1997	2000	2002	2004	2006	2010	2012
Area 543, 542, 541 and 521 (the Southern Bering Sea) Combined									
1-100	429,873	211,562	284,176	160,940	394,092	518,232	374,774	304,909	130,616
101-200	277,907	472,725	177,672	344,674	393,159	631,150	326,426	624,294	145,351
201-300	520	1,691	130	8,636	48,723	7,410	40,091	1,008	886
301-500	0	30	20	82	221	292	67	41	23
Total	708,299	686,007	461,997	514,332	836,195	1,157,084	741,358	930,252	276,877
Western Aleutian Islands (543)									
1-100	168,968	93,847	90,824	120,257	50,481	140,669	64,429	59,449	62,247
101-200	174,182	231,733	43,478	52,948	154,820	229,675	35,926	195,819	70,983
201-300	276	1,656	66	7,910	48,362	6,033	318	134	350
301-500	-	6	-	-	8	36	21	17	8
Total	343,426	327,242	134,367	181,115	253,671	376,414	100,693	255,419	133,588
Central Aleutian Islands (542)									
1-100	187,194	50,513	70,458	38,805	131,770	198,243	192,832	102,211	62,238
101-200	100,329	33,255	116,295	290,766	199,743	70,267	85,215	96,457	46,861
201-300	70	13	53	674	169	367	103	207	16
301-500	-	3	6	9	143	194	-	-	15
Total	287,594	83,784	186,813	330,255	331,824	269,071	278,150	198,874	109,130
Eastern Aleutian Islands (541)									
1-100	73,663	641	27,222	25	152,159	54,424	107,230	44,981	6,029
101-200	3,392	207,707	17,890	772	38,492	188,592	205,108	327,105	26,685
201-300	163	19	11	48	94	971	37,829	339	435
301-500	-	12	14	73	71	57	40	5	-
Total	77,218	208,379	45,137	919	190,817	244,043	350,206	372,429	33,149
Southern Bering Sea									
1-100	47	66,562	95,672	1,853	59,682	124,896	10,284	98,268	103

101-200	3	30	9	187	103	142,616	176	4,914	822
201-300	11	3	-	4	98	39	1,842	327	85
301-500	-	8	-	-	-	4	6	19	-
Total	61	66,603	95,680	2,044	59,883	267,556	12,308	103,529	1,010

Surveys indicate that Atka mackerel prefer depths of less than 200 m with a small proportion encountered in deeper waters (Lowe et al. 2013) (Table 4-4). Approximately 80% of the 0–200 m depth strata occur within Steller sea lion critical habitat in the western and central Aleutian Islands (Conners et al. 2013b). Finer scale examinations of Atka mackerel distribution in the western and central Aleutian Islands indicate that Atka mackerel are found in only a few locations outside of Steller sea lion critical habitat– an area Southeast of Seguam pass in Area 541, Petrel Bank and Bowers Ridge in Area 542, and Tahoma Reef seamounts and Stalemate Bank in Area 543.

Atka mackerel is primarily harvested by non-pelagic trawl gear. The patterns of the Atka mackerel fishery generally reflect the behavior of the species: (1) the fishery is highly localized and usually occurs in the same few locations each year, (2) the schooling semi-pelagic nature of the species makes it particularly susceptible to trawl gear fished on the bottom, and (3) trawling occurs almost exclusively at depths less than 200 meters (m). Fishery data and ongoing studies of Atka mackerel in the Aleutian Islands (McDermott et al. 2005, McDermott 2012) indicate that there may be some seasonal variation in catch.

The times series of BSAI Atka mackerel directed fishery catch by management area and corresponding ABC and TAC from 1994 through 2013 is shown in Table 4-5. Since 1994, the aggregate annual BSAI Atka mackerel ABC has been apportioned among the management areas to spatially apportion the TAC. Since 1998, management measures have been implemented to spatially and temporally disperse Atka mackerel harvest to reduce the potential for locally depleting this important Steller sea lion prey.

Table 4-5. BSAI Atka mackerel ABC, TAC, catch by area, and estimated annual total age 1+ biomass from 1994 through 2013 (amounts in metric tons). Source: NMFS Catch accounting system, Lowe et al. (2013).

	Eastern (541 and EBS)			Central (Area 542)			Western (Area 543)			
Year	ABC	TAC	Catch	ABC	TAC	Catch	ABC	TAC	Catch	Total 1+ Biomass
1994	13,475	13,475	15,433	55,125	44,525	41,004	53,900	10,000	8,923	769,570
1995	13,500	13,500	14,201	55,900	50,000	50,386	55,600	16,500	16,967	754,030
1996	26,700	26,700	28,173	33,600	33,600	33,523	55,700	45,857	42,246	704,220
1997	15,000	15,000	16,315	19,500	19,500	19,990	32,200	32,200	29,537	607,100
1998	14,900	14,900	12,271	22,400	22,400	20,209	27,000	27,000	24,617	599,680
1999	17,000	17,000	17,453	25,600	22,400	22,419	30,700	27,000	16,366	571,830
2000	16,400	16,400	14,344	24,700	24,700	22,383	29,700	29,700	10,503	584,640
2001	7,800	7,800	8,424	33,600	33,600	32,829	27,900	27,900	20,309	701,620
2002	5,500	5,500	4,920	23,800	23,800	22,291	19,700	19,700	18,077	848,540
2003	10,650	10,650	10,725	29,360	29,360	25,435	22,990	19,990	17,885	933,990
2004	11,240	11,240	10,838	31,100	31,100	30,169	24,360	20,660	19,554	908,610
2005	24,550	7,500	7,200	52,830	35,500	35,069	46,620	20,000	19,743	839,220
2006	21,780	7,500	7,421	46,860	40,000	39,836	41,360	15,500	14,637	727,700
2007	23,800	23,800	22,943	29,600	29,600	26,723	20,600	9,600	9,097	667,030
2008	19,500	19,500	19,118	24,300	24,300	22,471	16,900	16,900	16,500	635,300
2009	27,000	27,000	26,417	33,500	32,500	30,071	23,300	16,900	16,319	603,050
2010	23,800	23,800	23,608	29,600	29,600	26,389	20,600	20,600	18,650	541,860
2011	40,300	40,300	40,901	24,000	11,280	10,713	21,000	1,500	206	462,950
2012	38,500	38,500	36,342	22,900	10,763	10,323	20,000	1,500	195	422,350
2013	16,900	16,900	n/a	16,000	7,520	n/a	17,100	1500	n/a	400,860

Gear and Sector Allocations

Amendment 80 to the BSAI groundfish FMP was adopted by the Council in June 2006 and implemented for the 2008 fishing year. This action allocates several BSAI non-pollock groundfish species among trawl fishery sectors, and facilitates the formation of harvesting cooperatives in the non-American Fisheries Act (non-AFA) trawl catcher/processor sector. BSAI Atka mackerel is an Amendment 80 species (50 CFR 679.90(d)(1)(v)).

Community Development Quota (CDQ) groups receive 10.7% of the TAC; the remainder is set aside for non-CDQ sectors in an initial TAC (ITAC). The ITAC is divided between the (1) incidental catch allowance (ICA)[14]; (2) a jig allocation; (3) BSAI trawl limited access; (4) Amendment 80 cooperatives; and (5) Amendment 80 limited access sectors.

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[14] The Magnuson-Stevens Act defines by-catch as fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards (Section 3). Regulations at § 679.2 define incidental catch as fish caught and retained while targeting on some other species, but does not include discard of fish that were returned to the sea. Regulations at § 679.2 also define prohibited species catch (PSC) as species listed in Table 2b to part 679, including various species of crab, Pacific halibut, Pacific herring, various

Regulations allow an allocation of up to 2% of the Area 541 Atka mackerel ITAC to jig gear. The amount of this allocation is annually recommended by the Council and approved by NMFS based on several criteria, including the anticipated harvest capacity of the jig gear fleet. From 2010 through 2014, the Council allocated 0.5% of the ITAC, minus the ICA, to jig gear (75 FR 11778; 76 FR 11139; 77 FR 10669; 78 FR 13813).

The ITAC, after the ICA and jig deductions, is divided between the Amendment 80 sector and the BSAI trawl limited access sector. In Areas 541 and 542, the allocations to the BSAI trawl limited access sector started at 2% in 2008 and increased 2% per year until 2012 when the allocations reached the final amount of 10 percent. The BSAI trawl limited access sector does not receive an allocation in Area 543. In Areas 541 and 542, the Amendment 80 allocations started at 98% in 2008 and decreased 2% per year until 2012 when the allocations reached the final amount of 90% (§ 679.20; 75 FR 11783). In 2010, the Amendment 80 sector allocation was 94% in Areas 541 and 542, and 100% in Area 543. The Amendment 80 sector allocations are divided between Amendment 80 cooperatives and an Amendment 80 limited access sector.

Spatial and Seasonal Management

Since 1979, the Atka mackerel fishery has occurred largely within critical habitat. While total removals from critical habitat may be small in relation to estimates of total Atka mackerel biomass in the Aleutian Islands, fishery harvest rates in localized areas may have been high enough to affect prey availability of Steller sea lions (Lowe and Fritz 1997).The localized pattern of fishing for Atka mackerel apparently does not affect fishing success from one year to the next since local populations in the Aleutian Islands appear to be replenished by immigration and recruitment. However, this fishing pattern could have created temporary reductions in the size and density of localized Atka mackerel populations which may have affected Steller sea lion foraging success during the time the fishery was operating and for a period of unknown duration after the fishery closed. The Council passed regulations in 1998 and 2001 (described above) to disperse fishing effort temporally and spatially as well as reduce effort within Steller sea lion critical habitat.

Harvest limit area (HLA) management, also known as platoon management was implemented in 2001. This required all vessels to register to fish Atka mackerel in the HLA. A lottery was drawn to establish two platoons and closures were predetermined based on expected effort. This resulted in temporally compressing the majority of the Atka mackerel catch into when the HLA was open. Most of this was due to the race for fish; however, with the implementation of Amendment 80 this ended. However, in order to participate in critical habitat openings the HLA lottery and open dates remained. This continued to compress catch to the open HLA season dates even though vessels were not racing for fish.

The interim final rule implemented on January 1, 2011 (FR 75 77535, corrected 75 FR 81921), changed several elements of the BSAI Atka mackerel fisheries. The platoon management of Atka mackerel harvest inside the HLA was removed because the reasonable and prudent (RPA) prohibited all retention of Atka mackerel in Area 543 and restricted nearly all directed fishing for Atka mackerel in waters 0 nm to 20 nm around Steller sea lion sites in Area 542. Removal of the HLA allowed the fishery to temporally disperse instead of being compressed into a short time period, while maintaining the goals of limiting catch inside critical habitat. Amendment 80 cooperatives and CDQ groups were permitted to fish inside critical habitat within waters 10 nm to 20 nm of Gramp Rock and Tag Island, as described on Table 12 to part 679. Under the interim final rule, those sectors are required to limit harvest to 10% of their Area 542 Atka mackerel allocation equally divided between the A and B seasons. Vessels not fishing under the authority

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species of Pacific salmon, and steelhead trout. PSC species must be avoided, to the extent practicable, and must be discarded, unless legally authorized to retain for donation to a charitable food organization.

of an Amendment 80 cooperative quota or CDQ allocation are prohibited from conducting directed fishing for Atka mackerel inside Steller sea lion critical habitat in Area 542.

The implementation of Amendment 80, removal of the HLA and the extension of the seasons may have dispersed Atka mackerel catch in space and time better than prior management measures. The greatest dispersion of catch was observed in 2011 and 2012 and was done voluntarily by the fishing fleet due to increased flexibility with through these management actions. However, there is no regulation that prevents temporal compression, so there is a possibility that catch could become temporally compressed if the fishing fleets change behavior for economic reasons.

Atka mackerel Seasonal Management

In 1999, the Atka mackerel fishery was temporally dispersed with the creation of two seasonal allowances. The A season would start January 20 and end on April 15. The B season would start September 1 and end November 1. From 1999 to 2008 these seasons were enforced and TACs were reached prior to the season end dates. When Amendment 80 (A80) was implemented in 2008, it changed the majority of the Atka mackerel fishery from a race for fish to cooperative management. This cooperative management allowed the A80 participants to temporally spread out the catch of Atka mackerel to meet business needs. However, HLA management continued to temporally compress the Atka mackerel fishery. In 2011 the interim final rule removed the HLA management, changed the end date of the A season from April 15 to June 10, and changed the B season start date to June 10. This resulted in the Alternative 1 seasons (status quo) of the A season starting on January 20 and ending on June 10 and the B season starting on June 10 and ending on November 1.

Figure 4-6 shows the percentage of total Atka mackerel catch per week in the 2006, 2010, and 2012. The chart represents the percentage of Atka mackerel harvested in a single week in relation to the total harvest of Atka mackerel in the Aleutian Islands. In 2006 without Amendment 80 and with HLA management and an A season end date of April 15, the Atka mackerel fishery was temporally compressed in weeks 4 through 8 and weeks 36 through 40. In 2010, A80 was in effect and the fishery was more temporally dispersed, but HLA management still compressed the fishery into weeks 4 through 14 and weeks 36 through 42. In 2012, A80 was still in effect; however, the A season end date of April 15 was relaxed and HLA management was removed. The Atka mackerel fishery was then spread throughout the year though it remains compressed in weeks 41 through 45, or the month of October, because of the season end date of November 1.

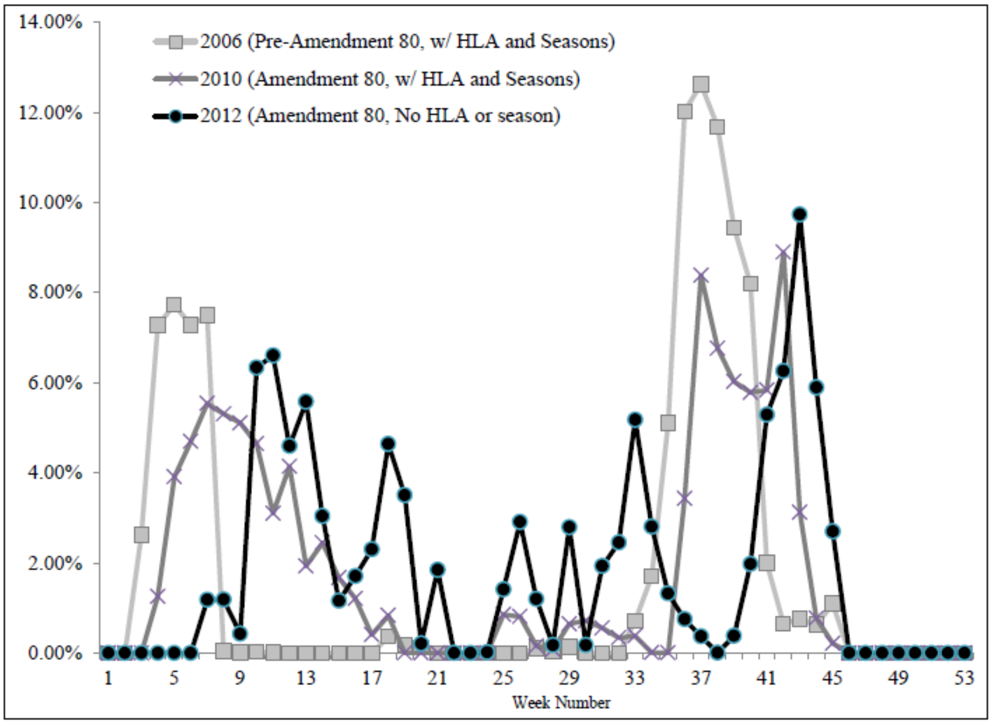


Figure 4-6. Weekly percentage of Atka mackerel harvest under different management programs from 2006 through 2012.

Figure 4-7 shows the average location of Atka mackerel harvest from 2004 through 2010. From 2004 through 2010, the majority of Atka mackerel harvest in Area 543 occurred on the continental shelf between Agattu Islands and Kiska Island. More specifically, the catch occurs in areas around Tahoma Reef and Middle Reef south of Buldir Island and shallower areas surrounding Heck Canyon, southeast of Agattu Island.

In Area 542, Atka mackerel fishing occurs inside critical habitat in many areas. The only major fishing for Atka mackerel outside of Steller sea lion critical habitat occurs on Petrel Bank which is the peninsula of shallow shelf that extends northeast of Semisopochnoi Island. Inside critical habitat fishing areas were concentrated along the southern side of Amchitka Island, to the west of Kiska Island, and around Gramp Rock/Tag Island. In Area 541, critical habitat is closed and most of Atka mackerel fishing occurs in a small area south/southeast of Seguam Pass.

Figure 4-8 shows how fishing shifted with the interim final rule in 2011. In Area 543, directed fishing and retention of Atka mackerel was prohibited. Only very small amounts were harvested incidental to the Pacific Ocean perch directed fishery in the area south of Buldir Island. In Area 542, the TAC reduction and a prohibition of fishing in the majority of critical habitat under the interim final rule shifted fishing almost entirely to Petrel Bank, although in smaller amounts than had occurred on average from 2004 through 2010. In Area 541 there was no shift in harvest location of Atka mackerel compared to prior years. However, the TAC increases for Atka mackerel in Area 541 in 2011 and 2012 allowed for more harvest to occur in Area 541.

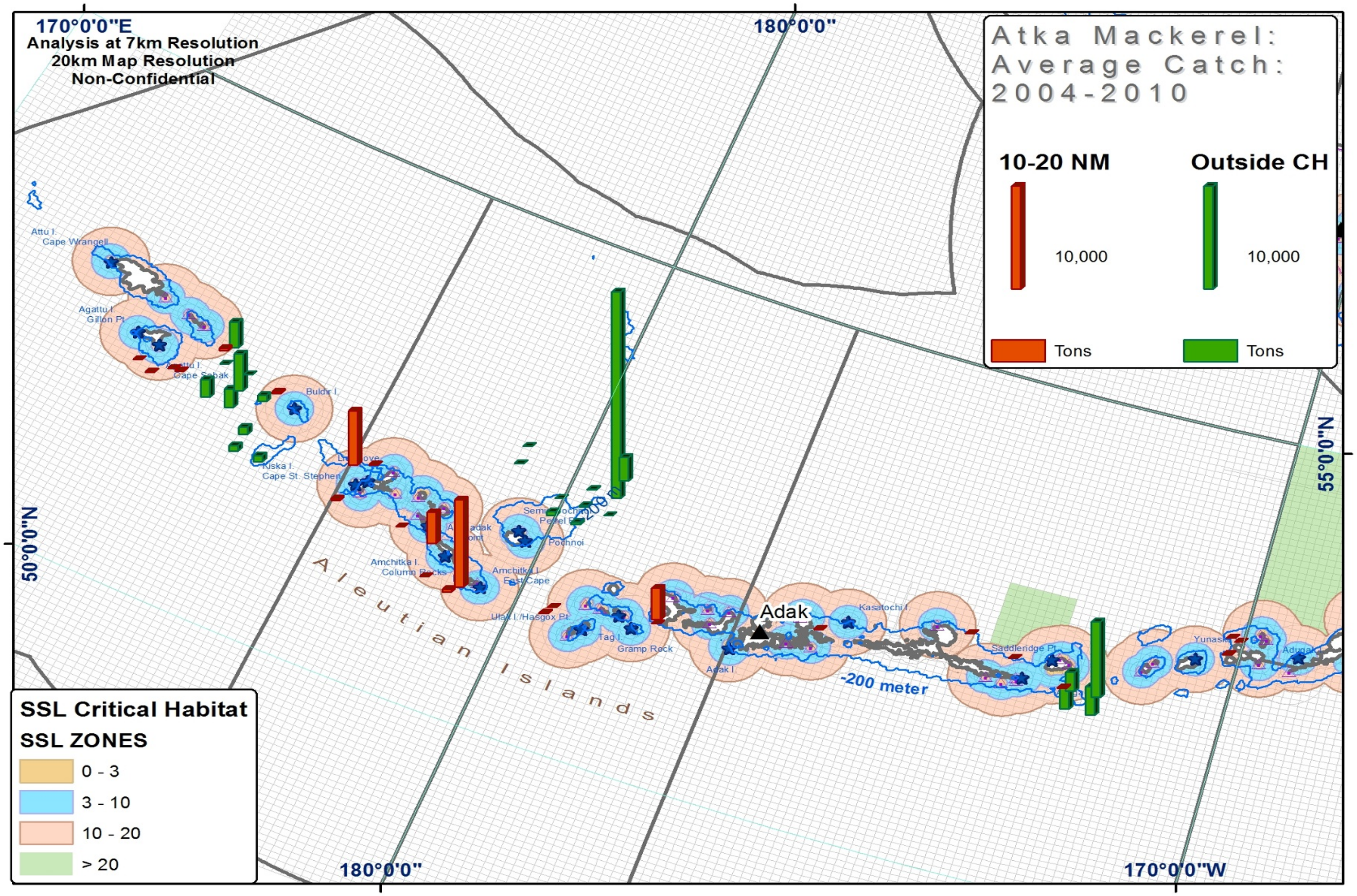


Figure 4-7. **Average 2004 through 2010 Atka mackerel harvest. Red bars represent fishery catch that occurred from 10-20 nm of critical habitat and green bars represent catch that occurred outside of critical habitat. Source: NMFS Catch-In-Areas database.**

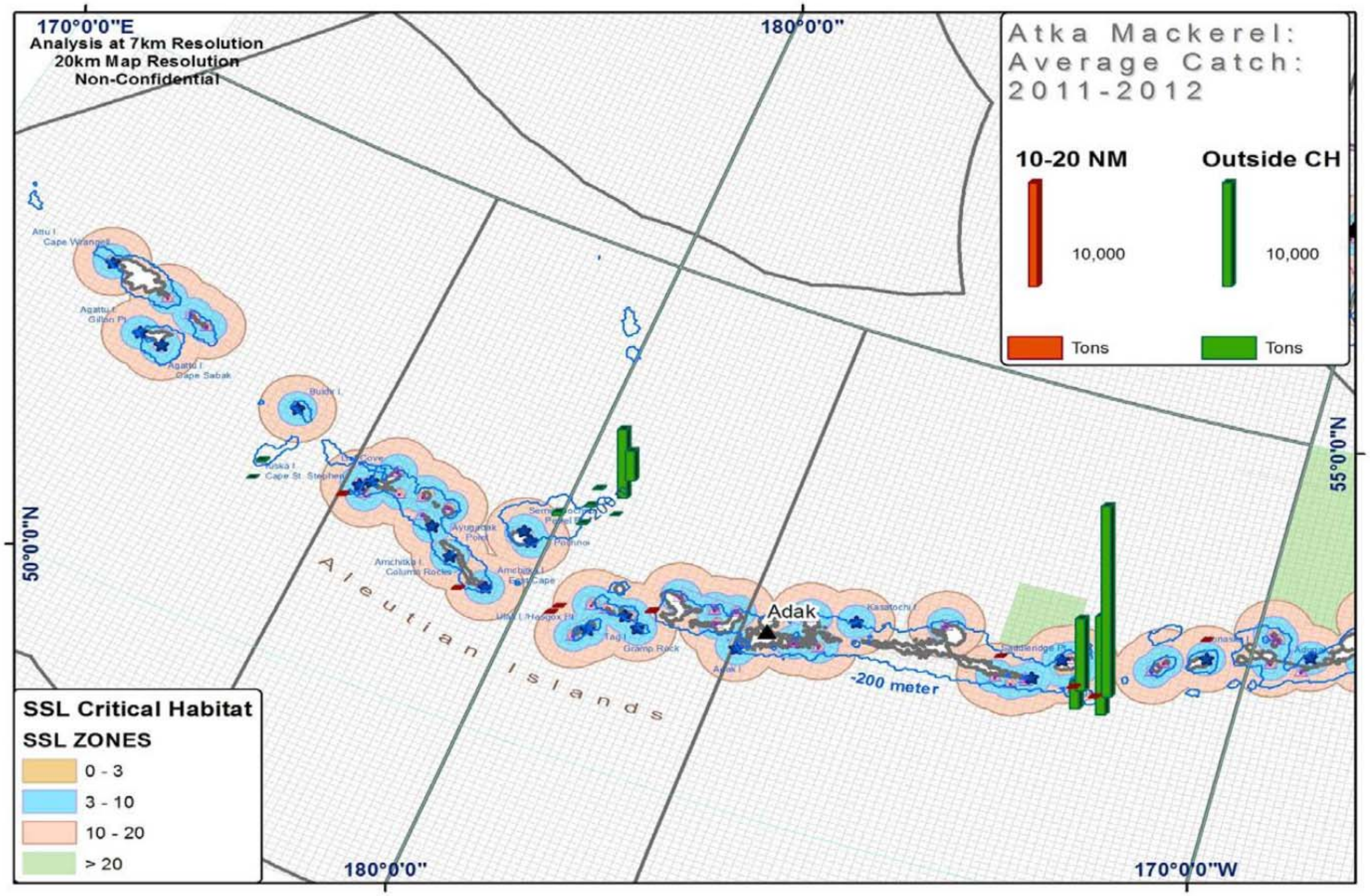


Figure 4-8. Average 2011 through 2012 Atka mackerel harvest. Red bars represent fishery catch that occurred from 10-20 nm of critical habitat and green bars represent catch that occurred outside of critical habitat. Source: NMFS Catch-In-Areas database.

Aleutian Islands Atka mackerel Fine Spatial Scale Biomass Estimates

Stock assessments are generally at the large spatial scale of FMP area (i.e., Bering Sea, Aleutian Islands, GOA), with some exceptions that estimate biomass at a smaller spatial scale (i.e., Area 543). Stock assessments are also at a temporal scale of year. A team of AFSC stock assessment scientists examined the available data on principal Steller sea lion prey species to determine if biomass could be estimated at a finer spatial and temporal scale than the stock assessments are currently done. The goal was to see if biomass of Steller sea lion prey species could be estimated inside Steller sea lion critical habitat at a seasonal temporal scale to determine a proportion of species removal inside critical habitat in relation to biomass during time periods the prey species is important to Steller sea lions. There was consensus that any spatial scale smaller than the survey strata would not have enough observations to support a reliable estimate (Conners et al. 2013b). The survey strata provide a slightly finer spatial scale biomass estimate compared to the overall survey estimate but they do not allow for a temporal split due to surveys primarily taking place in summer months. The survey strata are shown in Figure 4-9.

An examination of fishery dependent data to estimate biomass at a finer scale could not be accomplished for several reasons. Observer data are available, and a CPUE based estimate was explored. However, it was the consensus that using these data to describe local abundance and seasonal fish distribution would be problematic. Irregular spatial distribution of fishing effort and lack of mensuration of effective bottom time and net width in addition to inconsistencies in gear, vessel horsepower, and trawl speeds do not allow for biomass estimates to be calculated. The only summarization that these data can provide is frequency of occurrence (Conners et al. 2013b).

While estimates of biomass inside critical habitat are not able to be accomplished, survey strata do allow for estimates at a finer scale than have been done in the past. As seen in Table 4-6, biomass for Atka mackerel has been estimated for 10 subareas of the Aleutian Islands based on available survey data. The AFSC based these finer scale biomass estimates on the bottom trawl surveys, which take place every 2 to 3 years in the Aleutian Islands. The surveys are well designed with substantial attention to quality control however there are several sources of uncertainty that typically occur with trawl surveys. These sources of uncertainty include unknown trawl efficiency and selectivity factors for different fish species and the inability of trawl nets to sample fish in all fish habitats (Conners et al. 2013b).

Atka mackerel are schooling fish with high spatial and temporal variation on density. Therefore, estimates of Atka mackerel have high sampling uncertainty (Conners et al. 2013b). Fishery removal occurs at different times of the year than when surveys are done. The seasonal variability of Atka mackerel is not well known. The recommended ABCs in the annual stock assessment reports are based on biomass estimates generated from the stock assessment models. The survey biomass estimate is one of many parameters used to derive the total estimated stock biomass.

There also is the uncertainty due to the inability to sample in all habitats. This is especially important in the Aleutian Islands. Approximately 19% of the total area in the Aleutian Islands is considered known trawl-able habitat and part of the AFSC sampling frame. If a particular species is encountered more or less frequently in trawl-able habitat, biomass estimates maybe biased (Conners et al. 2013b). Fishing gear is different (heavier, more robust) than survey gear.

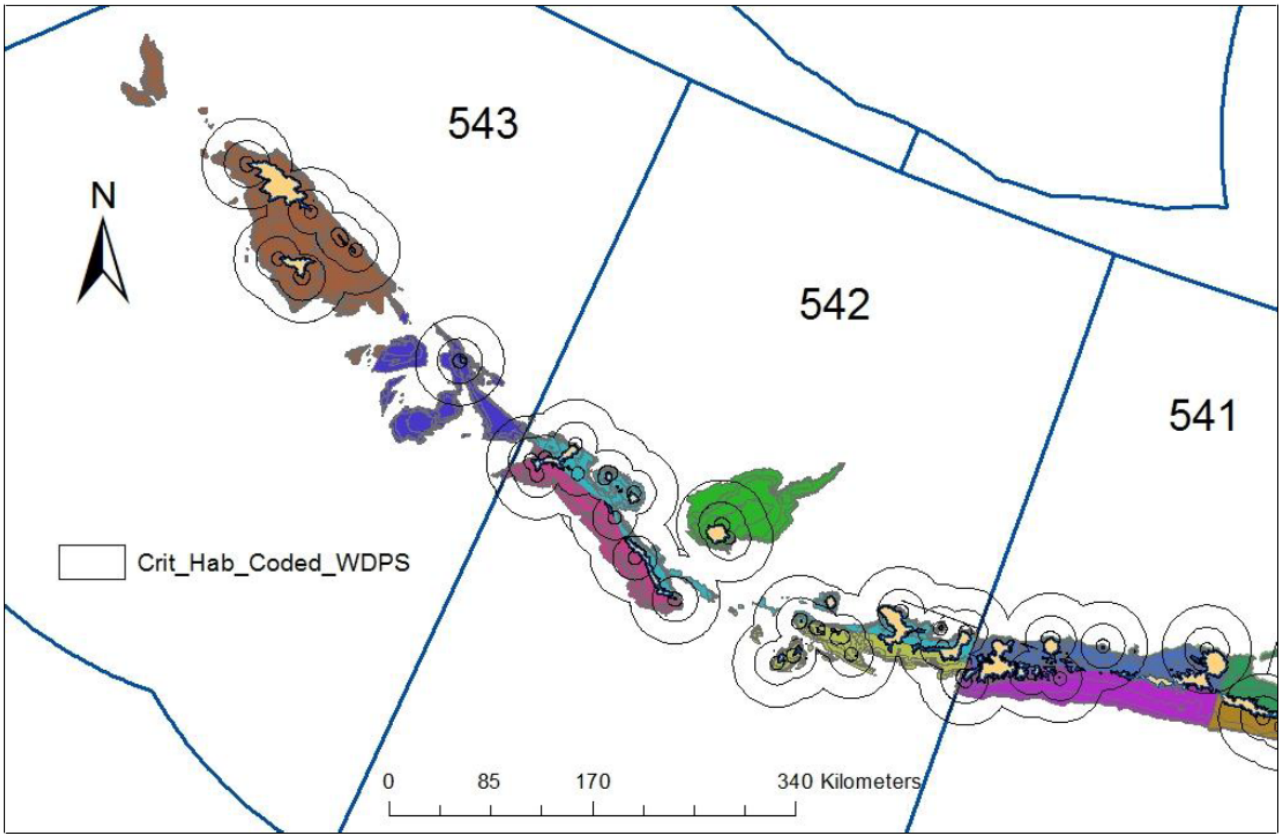


Figure 4-9. Fishery management areas (numbered), survey areas (colored), and critical habitat zones for the central and western Aleutian Islands. Source: Conners et al. (2013).

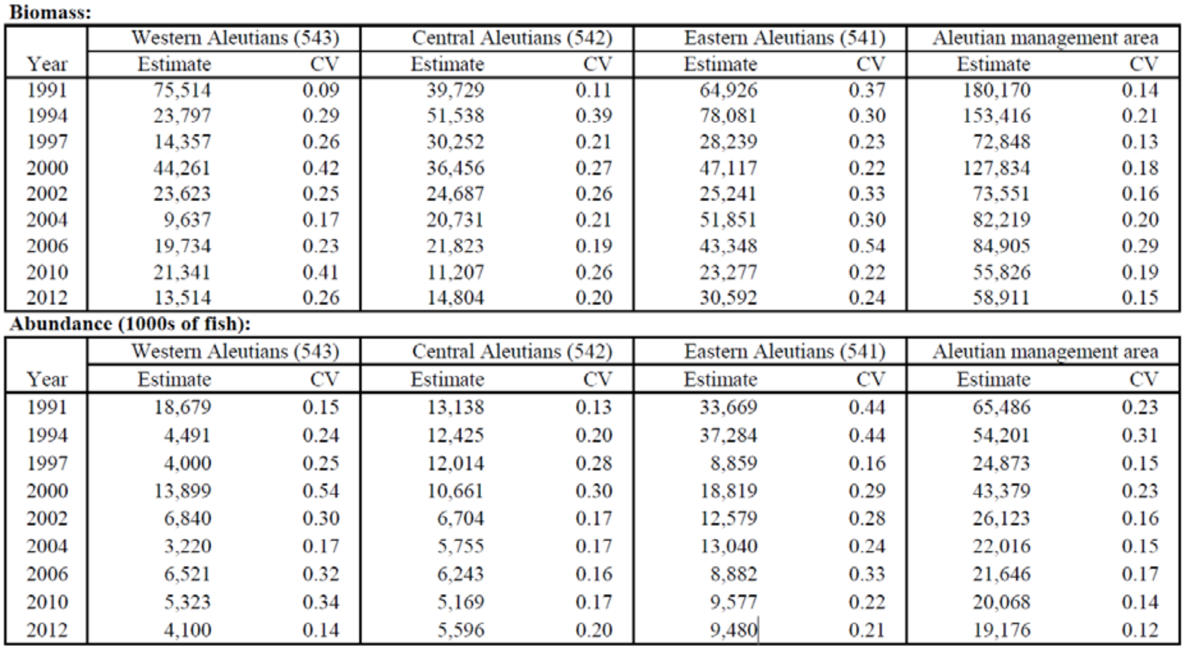
Table 4-6. AI trawl survey biomass estimates (thousands of mt) for Atka mackerel by survey subarea and year. Refer to Figure 4-9 for subarea locations (listed in the table from west to east, N and S indicate north and south sides of the Aleutian chain). Test statistic and p-value for a one-tailed Mann-Kendal test of trend over time are shown for each subarea. A positive test statistic indicates increasing trend, negative indicates decreasing trend. Significant trends (*p*<0.05) are in bold type. Source: Conners et al. (2013).

		Atka mackerel									One tailed MK test	
Area	Subarea	1991	1994	1997	2000	2002	2004	2006	2010	2012	SSUM	P
543	Aggatu	87.6	105.7	39.8	64.1	137.8	141.9	26.7	159.0	36.9	2	0.460
	Buldir	255.8	221.5	94.5	117.0	115.9	234.5	74.0	96.4	96.7	-14	0.090
542	Petrel	40.7	0.7	16.1	12.8	28.7	45.1	68.4	83.2	41.1	20	**0.022**
	N Amchitka	11.5	32.3	73.4	41.5	51.3	60.1	57.2	25.5	6.9	-2	0.460
	S Amchitka	165.3	46.2	46.5	158.2	108.2	17.3	45.5	37.7	25.2	-20	**0.022**
	S Tanaga	70.1	4.6	50.8	117.7	143.6	146.6	107.1	52.5	35.8	2	0.460
541	N Adak	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.0	0.0	2	0.460
	N Seguam	0.4	107.4	17.9	0.8	25.8	109.6	213.8	298.7	16.5	16	0.060
	S Adak	0.0	74.9	27.1	0.0	10.5	21.6	0.0	0.0	0.9	-4	0.381
	S Seguam	76.8	26.1	0.1	0.1	154.4	112.7	136.3	73.7	15.8	2	0.460

4.4.3 Status of Pacific cod in the Action Area

The biomass and numerical abundance data from the bottom shelf surveys indicate consistent declines ($p < 0.01$) of Aleutian Islands Pacific cod from 1991 to 2012 (Thompson and Palsson 2013), Table 4-7. The 2014 estimated Aleutian Islands Pacific cod biomass is 59,000 mt (95% CI 45,400 - 76,600 t) (Thompson and Palsson 2013).

Table 4-7. Total Aleutian Islands Pacific cod biomass and abundance, with coefficients of variation (CV) as estimated by the Aleutian Islands bottom trawl surveys, 1991-2012. Source: (Thompson and Palsson 2013).



Biomass:

	Western Aleutians (543)		Central Aleutians (542)		Eastern Aleutians (541)		Aleutian management area	
Year	Estimate	CV	Estimate	CV	Estimate	CV	Estimate	CV
1991	75,514	0.09	39,729	0.11	64,926	0.37	180,170	0.14
1994	23,797	0.29	51,538	0.39	78,081	0.30	153,416	0.21
1997	14,357	0.26	30,252	0.21	28,239	0.23	72,848	0.13
2000	44,261	0.42	36,456	0.27	47,117	0.22	127,834	0.18
2002	23,623	0.25	24,687	0.26	25,241	0.33	73,551	0.16
2004	9,637	0.17	20,731	0.21	51,851	0.30	82,219	0.20
2006	19,734	0.23	21,823	0.19	43,348	0.54	84,905	0.29
2010	21,341	0.41	11,207	0.26	23,277	0.22	55,826	0.19
2012	13,514	0.26	14,804	0.20	30,592	0.24	58,911	0.15

Abundance (1000s of fish):

	Western Aleutians (543)		Central Aleutians (542)		Eastern Aleutians (541)		Aleutian management area	
Year	Estimate	CV	Estimate	CV	Estimate	CV	Estimate	CV
1991	18,679	0.15	13,138	0.13	33,669	0.44	65,486	0.23
1994	4,491	0.24	12,425	0.20	37,284	0.44	54,201	0.31
1997	4,000	0.25	12,014	0.28	8,859	0.16	24,873	0.15
2000	13,899	0.54	10,661	0.30	18,819	0.29	43,379	0.23
2002	6,840	0.30	6,704	0.17	12,579	0.28	26,123	0.16
2004	3,220	0.17	5,755	0.17	13,040	0.24	22,016	0.15
2006	6,521	0.32	6,243	0.16	8,882	0.33	21,646	0.17
2010	5,323	0.34	5,169	0.17	9,577	0.22	20,068	0.14
2012	4,100	0.14	5,596	0.20	9,480	0.21	19,176	0.12

Prior to 2014, the BSAI Pacific cod ABC and TAC were combined among all BSAI management areas. For the first time, in 2014 the Aleutian Islands Pacific cod stock is managed separately from the Bering Sea Pacific cod stock. The split resulted in a substantial reduction in the amount of cod available to directed fishing in the Aleutian Islands. In prior years, there was no limit on the amount of the BSAI TAC that could be harvested in the Aleutian Islands; it was only constrained on the amount set as the BSAI ABC. On average, approximately 24,000 mt of Pacific cod was harvested in the Aleutian Islands from 1992–2010. This amount does not include the State of Alaska Aleutian Islands GHL fishery. In relation to the ABC, the average catch of Aleutian Islands Pacific cod was approximately 12% of the combined BSAI ABC in those years.

Table 4-8. BSAI Pacific cod ABC, TAC, total catch from 1981 through 2013, and age 0+ biomass (amounts in metric tons). Source: Thompson and Lauth (2012) and NMFS Catch Accounting System.

Year	ABC	TAC	Catch	Biomass
1981	160,000	78,700	63,941	1,621,340
1982	168,000	78,700	69,501	1,974,690
1983	298,200	120,000	103,231	2,157,450
1984	291,300	210,000	133,084	2,170,450
1985	347,400	220,000	150,384	2,151,230
1986	249,300	229,000	142,511	2,103,880
1987	400,000	280,000	163,110	2,088,340
1988	385,300	200,000	208,236	2,021,390
1989	370,600	230,681	182,865	1,822,510
1990	417,000	227,000	179,608	1,590,520
1991	229,000	229,000	220,038	1,387,960
1992	182,000	182,000	207,272	1,252,640
1993	164,500	164,500	167,362	1,246,770
1994	191,000	191,000	193,802	1,297,640
1995	328,000	250,000	245,033	1,328,740
1996	305,000	270,000	240,676	1,274,300
1997	306,000	270,000	257,765	1,196,590
1998	210,000	210,000	193,256	1,097,170
1999	177,000	177,000	173,998	1,129,590
2000	193,000	193,000	191,060	1,180,400
2001	188,000	188,000	176,749	1,209,090
2002	223,000	200,000	197,356	1,248,060
2003	223,000	207,500	196,495	1,241,430
2004	223,000	215,500	212,161	1,171,460
2005	206,000	206,000	205,635	1,061,770
2006	194,000	194,000	189,304	943,742
2007	176,000	170,720	170,296	845,398
2008	176,000	170,720	166,391	825,138
2009	182,000	176,540	173,652	918,703
2010	174,000	168,780	168,015	1,079,660
2011	235,000	227,950	219,866	1,330,430
2012	314,000	261,000	245,367	1,474,330
2013	307,000	260,000	245,380	1,600,230

For years prior to 2014, Aleutian Islands biomass distribution can be estimated by survey proportion. The approximate Pacific cod biomass distribution in the Bering Sea and Aleutian Islands based on stock assessments is shown in Table 4-9.

Table 4-9. Biomass distribution of Pacific cod in the Bering Sea and Aleutian based on annual stock assessments. Source: Thompson and Lauth (2012).

Year	Aleutian Islands	Bering Sea
2004	15%	85%
2005	15%	85%
2006	16%	84%
2007	16%	84%
2008	16%	84%
2009	16%	84%
2010	16%	84%
2011	9%	91%
2012	9%	91%
2013	7%	93%
2014	5.6%	94.4%

Table 4-10 shows the recalculated TACs based on this estimated biomass distribution from Table 4-9, with the assumption that the Aleutian Islands TAC is set equal to the Aleutian Islands ABC and reduced to account for the Aleutian Islands State of Alaska GHL fishery.

Table 4-10. Estimated Aleutian Islands Pacific cod TAC based on biomass distribution (amounts in metric tons).

Year	BSAI ABC	BSAI TAC	AI %	State GHL	AI TAC	Total catch	TAC - catch
2004	223,000	215,500	15%	6,690	26,760	28,873	(2,113)
2005	206,000	206,000	15%	6,180	24,720	22,699	2,021
2006	194,000	194,000	16%	5,820	25,220	20,498	4,722
2007	176,000	170,720	16%	5,280	22,880	30,216	(7,336)
2008	176,000	170,720	16%	5,280	22,880	26,597	(3,717)
2009	182,000	176,540	16%	5,460	23,660	26,500	(2,840)
2010	174,000	168,780	16%	5,220	22,620	25,164	(2,544)
2011	235,000	227,950	9%	7,050	14,100	10,601	3,499
2012	314,000	261,000	9%	9,420	18,840	12,991	5,849

Aleutian Islands Pacific cod fishing locations depend on the gear type, vessel type, and the processing sector (i.e., catcher/processor, catcher vessel delivering shoreside). The three main gear and sector combinations that typically directed fish for Pacific cod in the Aleutian Islands include trawl catcher/processors, trawl catcher vessels (delivering shoreside or to motherships) and fixed gear catcher/processors.

Figure 4-10 shows the spatial distribution of Pacific cod harvest by trawl catcher/processors from 2004 through 2010. Targeted catch was primarily located in Area 543 along the shelf north of Agattu Island. Further east in Area 542, catch occurred along Kiska and Amchitka Islands and on Petrel Bank. In Area 541, the majority of the catch occurred off of Atka North Cape with some fishing between Adak and Atka. Most of the Pacific cod catch was in critical habitat except the fishing in areas on Petrel Bank, west of Atka North Cape, and southeast of Seguam Pass. The area off Atka North Cape seems to be an important area for most sectors.

Pacific cod trawl catcher vessel (deliver to shoreside processors) harvest locations from 2004 through 2010 are shown in Figure 4-11 (note the different amount of harvest represented by the bars in each of the harvest figures). As a result of being associated to fixed shoreside locations, most of the catch is concentrated in areas near the ports of Adak and Atka. Atka North Cape is the most important area to this sector and vessels harvesting fish in this area deliver to Adak, Akutan, and Dutch Harbor. The area southeast of the port of Adak also is important to these vessels. In 2011 there was a decrease in Pacific cod harvested in the Aleutian Islands by trawl catcher vessels delivering shoreside. This is a result of no processing plant operating in the Aleutian Islands in the early months of 2011 and anecdotal reports from industry that Pacific cod fishing was exceptionally good in the Bering Sea. As a result, fishing effort shifted to the Bering Sea.

Pacific cod trawl catcher vessel (deliver to motherships) harvest locations from 2004 through 2010 area shown in Figure 4-12 (note the different amount of harvest represented by the bars in each of the harvest figures). These vessels are not associated with a processor at a fixed location. This catch is not as concentrated in areas near a port and more of this catch is in Area 543 compared to vessels delivering to shoreside processors. The area used by the trawl catcher vessels is similar to the area used by trawl catcher/processors as vessels that operate as motherships are also vessels that operate as trawl catcher/processors. Outside of Area 543, Atka North Cape also is important to these vessels.

Pacific cod non-trawl vessel harvest locations from 2004 through 2010 are shown in Figure 4-13. Note the different amount of harvest represented by the bars in Figures 4-9 through 4-12, for example, the amount of harvest represented by the bar in Figure 4-10 is 750 mt whereas the amount represented by the bar in Figure 4-13 is 190 mt. Compared to trawl vessels, the catch by non-trawl vessels is dispersed throughout the Aleutian Islands and almost exclusively inside Steller sea lion critical habitat, except for Area 541. Non-trawl catch seems to occur in all areas where depths are less than 200 m that are open to directed fishing.

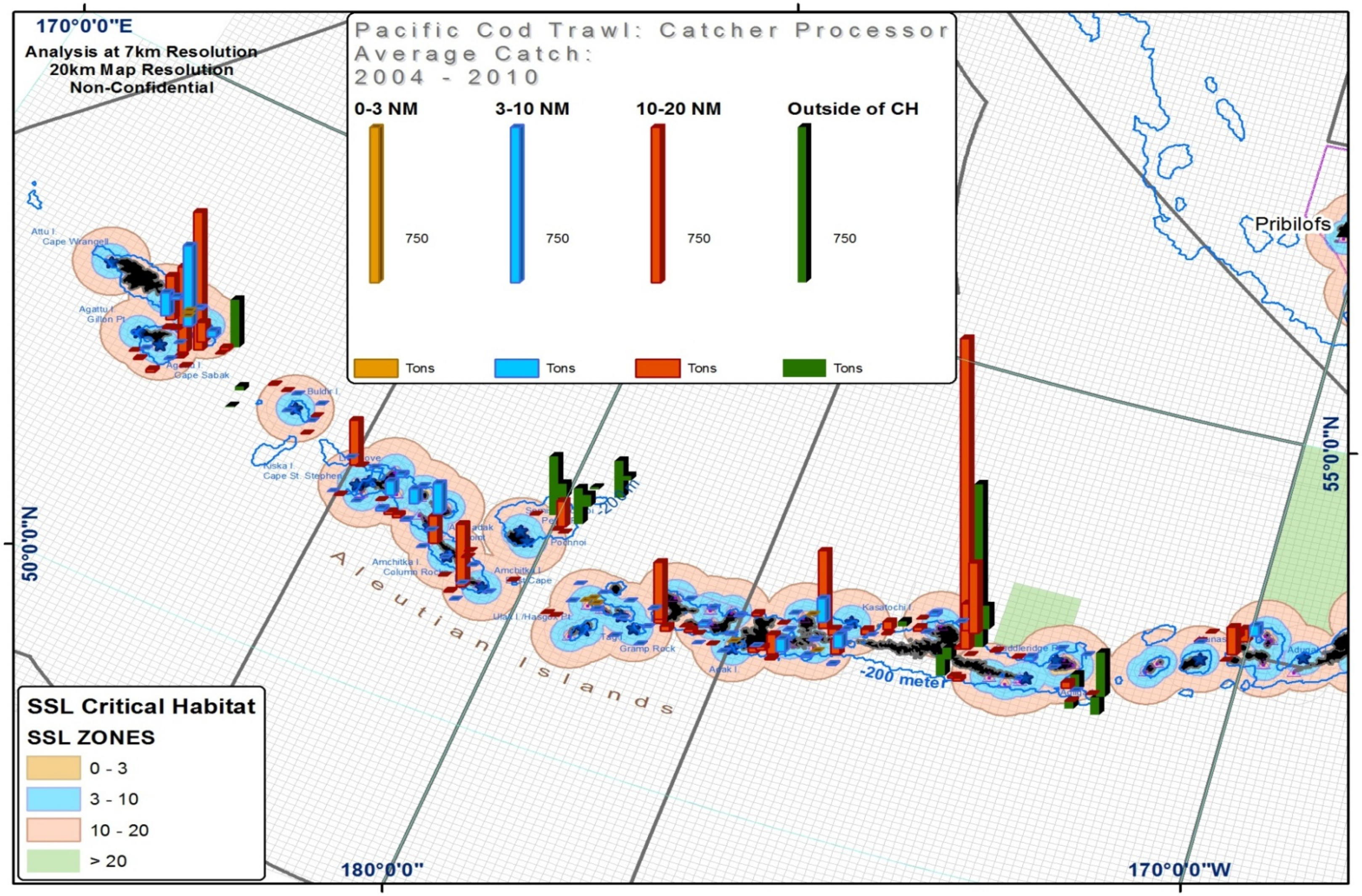


Figure 4-10. **Average 2004 through 2010 Pacific cod harvest by trawl catcher/processors. Gold bars represent catch inside 0-3 nm of Steller sea lion critical habitat, blue bars represent 3-10 nm inside critical habitat, red bars represent 10-20 nm of critical habitat and green bars represent catch outside of critical habitat.**

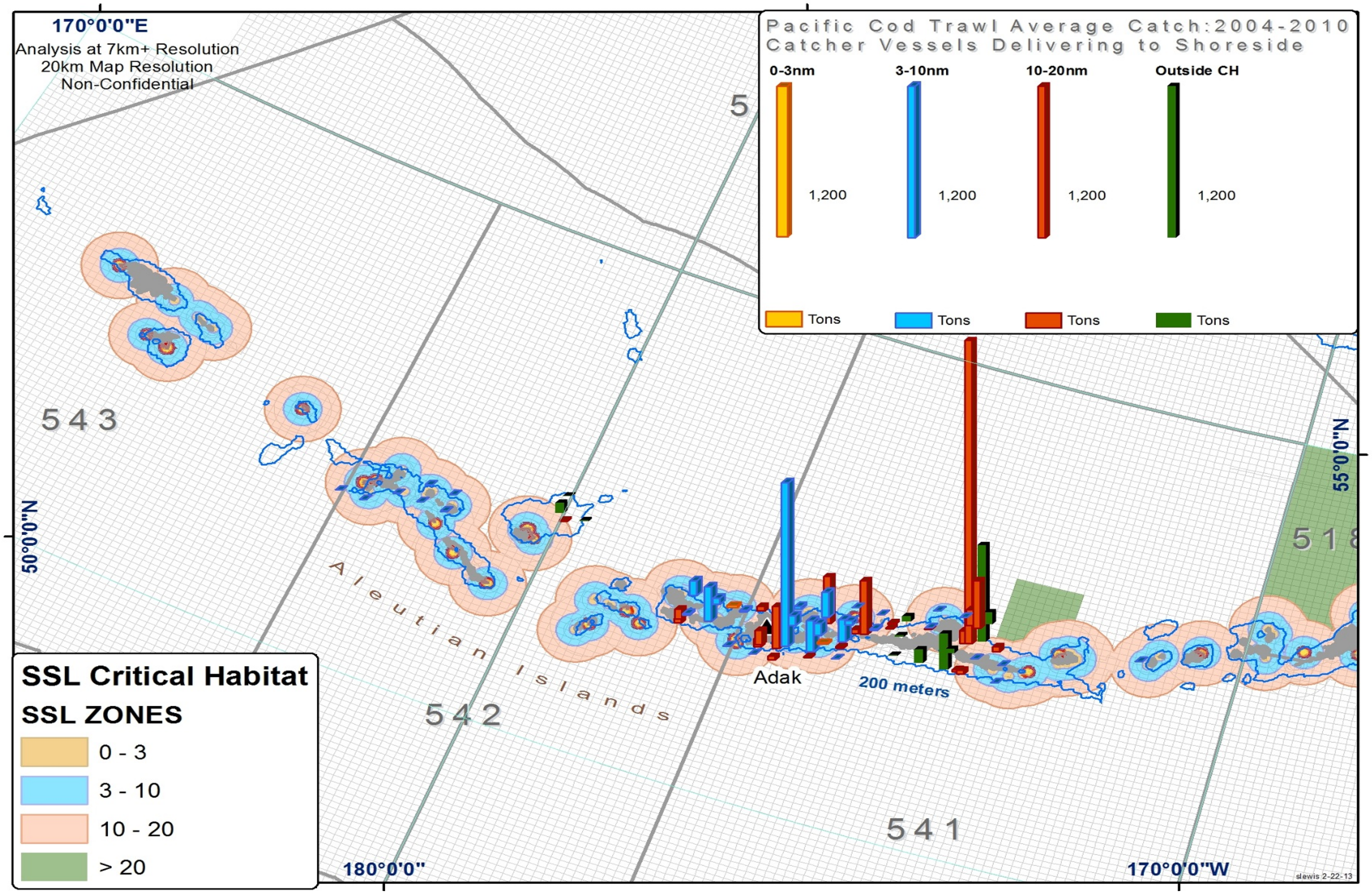


Figure 4-11. Average 2004 through 2010 Pacific cod harvest by trawl catcher vessels delivering to shoreside plants. . Gold bars represent catch inside 0-3 nm of Steller sea lion critical habitat, blue bars represent 3-10 nm inside critical habitat, red bars represent 10-20 nm of critical habitat and green bars represent catch outside of critical habitat.

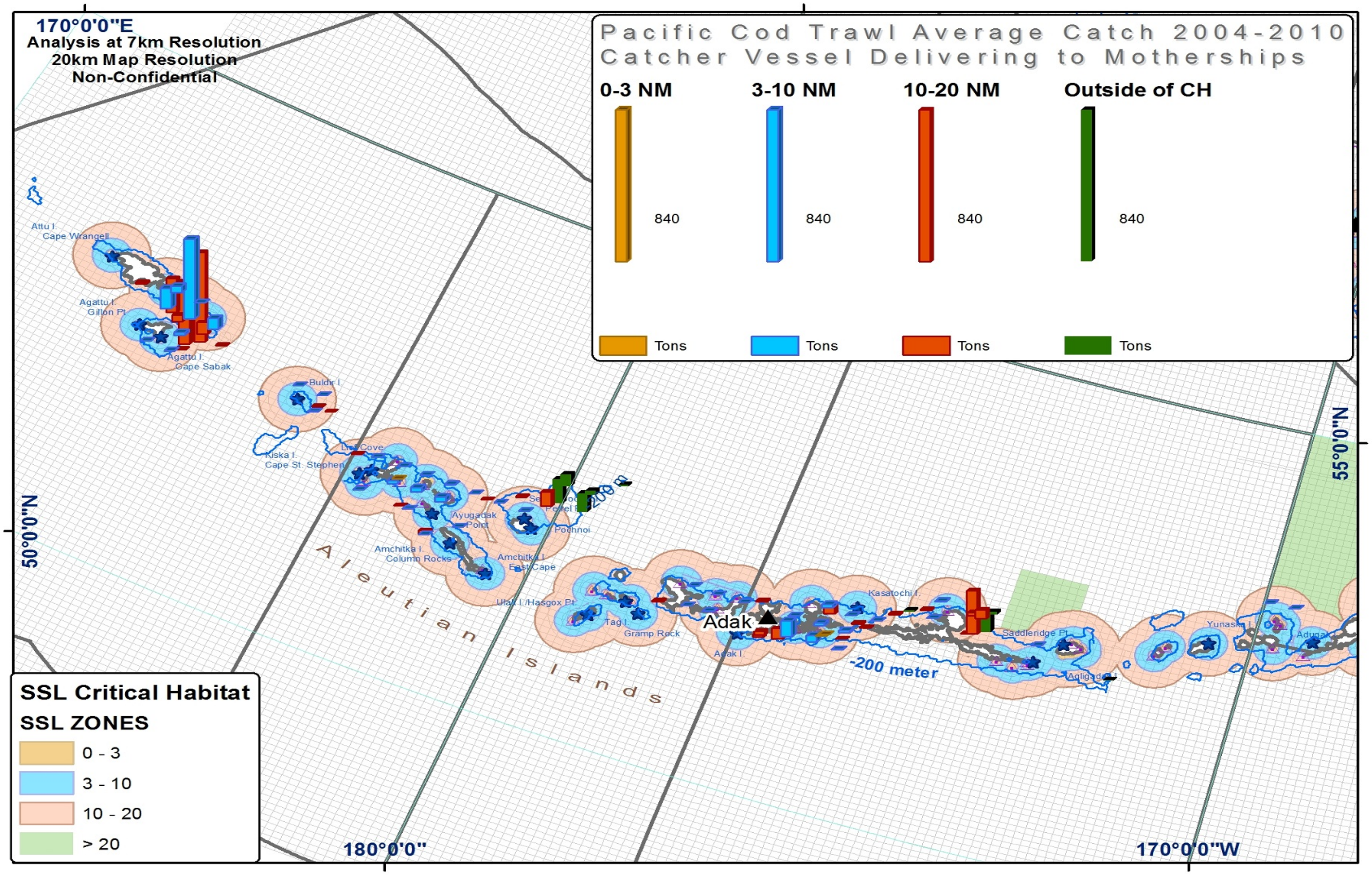


Figure 4-12. Average 2004 through 2010 Pacific cod harvest by trawl catcher vessels delivering to motherships. Gold bars represent catch inside 0-3 nm of Steller sea lion critical habitat, blue bars represent 3-10 nm inside critical habitat, red bars represent 10-20 nm of critical habitat and green bars represent catch outside of critical habitat.

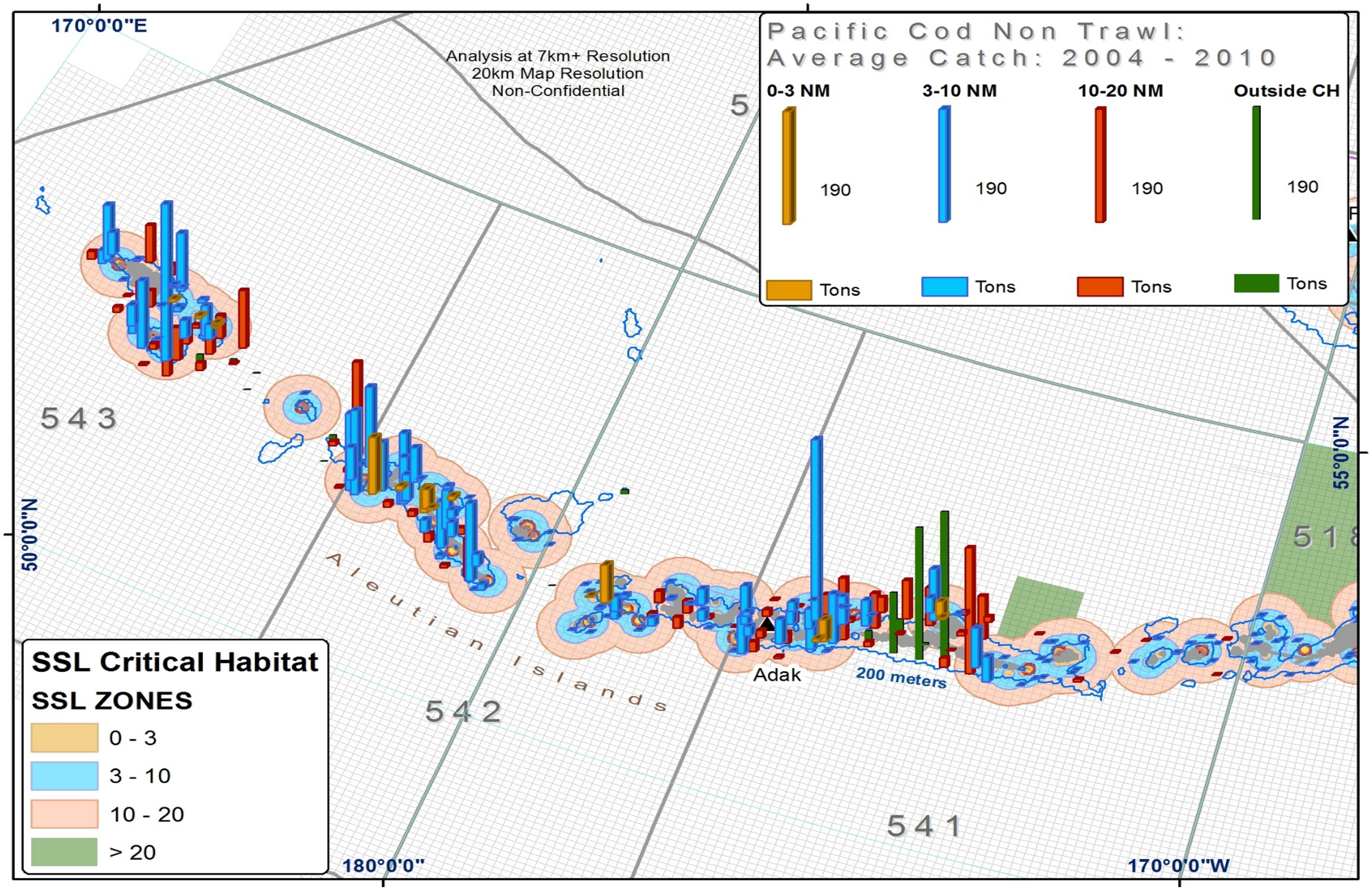


Figure 4-13. Average 2004 through 2010 location of Pacific cod harvest by non-trawl vessels (hook-and-line, pot, and jig gear. Gold bars represent catch inside 0-3 nm of Steller sea lion critical habitat, blue bars represent 3-10 nm inside critical habitat, red bars represent 10-20 nm of critical habitat and green bars represent catch outside of critical habitat.

Aleutian Islands Pacific cod fine spatial scale biomass estimates

As with Atka mackerel (see section 4.4.2), scientists examined the available data on Pacific cod to determine if biomass could be estimated at a finer spatial and temporal scale than the stock assessments. As with Atka mackerel, there was consensus that any spatial scale smaller than the survey strata would not have enough observations to support a reliable estimate (Conners et al. 2013b).

While estimates of biomass inside critical habitat are not able to be accomplished, survey strata do allow for estimates at a finer scale than have been done in the past. As seen in Table 4-11, biomass for Pacific cod has been estimated for 10 subareas of the Aleutian Islands based on available survey data. The AFSC based these finer scale biomass estimates on the bottom trawl surveys, which take place every 2 to 3 years in the Aleutian Islands. The surveys are well designed with substantial attention to quality control however there are several sources of uncertainty that typically occur with trawl surveys. These sources of uncertainty include unknown trawl efficiency and selectivity factors for different fish species and the inability of trawl nets to sample fish in all fish habitats (Conners et al. 2013b).

Pacific cod may have high spatial and temporal variation in density. Therefore, estimates of Pacific cod may have high sampling uncertainty. Most commercial Pacific cod fishing occurs in the winter and spring and the surveys are conducted in the summer. Anecdotal reports from industry indicate that Pacific cod are abundant and in dense, highly localized concentrations in February and March, and are more dispersed at other times of the year. Thus, comparing localized fishery removals from February and March to the summer survey biomass estimate will have high uncertainty.

Table 4-11. Aleutian Islands trawl survey biomass estimates (thousands of mt) for Pacific cod by survey subarea and year. Refer to Figure 4-9 for subarea locations (listed in the table from west to east, N and S indicate north and south sides of the Aleutian chain). Test statistic and p-value for a one-tailed Mann-Kendal test of trend over time are shown for each subarea. A positive test statistic indicates increasing trend, negative indicates decreasing trend. Significant trends (*p*<0.05) are in bold type. Source: Conners et al. (2013).

					Pacific cod						One tailed MK test	
Area	Subarea	1991	1994	1997	2000	2002	2004	2006	2010	2012	SSUM	P
543	Aggatu	32.3	12.6	9.1	34.0	12.9	5.1	15.2	11.5	10.2	-10	0.179
	Buldir	43.2	11.2	5.2	10.2	10.7	4.5	4.6	9.8	3.3	-22	**0.012**
542	Petrel	10.2	1.7	1.6	4.2	1.5	1.1	0.8	0.1	0.6	-30	**0.000**
	N Amchitka	10.9	20.4	12.4	10.5	10.2	9.3	3.2	5.1	3.5	-28	**0.001**
	S Amchitka	10.7	4.4	7.7	9.1	6.9	3.5	7.6	3.5	5.3	-16	0.060
	S Tanaga	7.9	25.0	8.5	12.7	6.1	6.8	10.3	2.5	5.4	-16	0.060
541	N Adak	6.7	5.6	1.7	7.7	4.5	4.8	1.1	1.2	4.0	-16	0.060
	N Seguam	36.1	41.8	13.8	24.9	14.9	38.3	10.1	12.4	15.3	-12	0.130
	S Adak	4.3	6.2	4.8	4.7	1.3	1.8	2.6	2.8	1.4	-16	0.060
	S Seguam	17.8	24.5	8.0	9.8	4.5	7.0	29.6	6.9	9.9	-6	0.306

4.4.4 Status of Pollock in the Action Area

The population of pollock in the Aleutian Islands incurred an apparent drop in abundance from the mid-1980s to the mid-1990s (1986 bottom trawl survey estimate of 444,000 mt to a 1994 bottom trawl survey estimate of 78,000 t) with a relatively slow but steady increase in surveyed abundance through 2010. The 2012 survey abundance was a record low at 44,281 mt. The 2014 estimated age 2+ pollock biomass in the Aleutian Islands is 259,525 mt and the 2014 ABC is 35,048 mt. The most recent surveys show that the Aleutian Islands pollock population is predominantly concentrated in the eastern portion of the Aleutian Island chain, closer to the Eastern Bering Sea shelf. Surveys from the 1980s and 1990s estimated higher proportions of pollock biomass in the central and western Aleutians.This recent spatial imbalance in population abundance may reflect a spatial contraction of the stock in the Eastern Bering Sea after the collapse of the Central Bering Sea population in the early 1990s, low Aleutian Islands pollock recruitments since the mid-1980s, documented high exploitation rate of the Aleutian Islands pollock in the mid to late 1990s, and possibly a high undocumented exploitation rate in the late 1980s by foreign fishermen (Barbeaux et al. 2013).

Pollock are distributed throughout the Aleutian Islands with concentrations in areas and depths dependent on diel and seasonal migration. The general trend for recent years (2002–current) is low pollock abundance in Areas 542 and 543 with a more abundant, but patchy distribution in Area 541. The largest proportions of pollock biomass encountered in the 2012 survey were observed in Area 541. However the survey did not find large concentrations as it has in prior surveys. In 2012 Aleutian Island pollock biomass was down in all areas. The 2012 biomass estimate for Area 543 was 68% of the 2010 biomass estimate; Area 542 and Area 541 were 26% and 30% respectively, of the 2010 biomass estimates. A single tow in Seguam Pass made up the majority of Aleutian Islands pollock (approximately 70%) in the 2012 survey (Barbeaux et al. 2013).

The Aleutian Islands pollock ABC, TAC, catch, and biomass from 1991 through 2014 are summarized in Table 4-12. The reported catch estimates include CDQ and incidental catches, as well as Aleut Corporation catches. Between 2005 and 2014, the Aleutian Islands ABCs ranged between 29,400 mt and 44,500 mt. Since 2005 the TAC has been constrained by regulation to 19,000 mt or the ABC, whichever is lower, thus the TAC has been 19,000 mt since 2005. Catches have been a small fraction of the TAC (ranging from 5 percent to 13 percent) (Barbeaux et al. 2013). The increase in pollock catch in 2013 is entirely incidental catch in Pacific ocean perch, Atka mackerel, and arrowtooth flounder fisheries.

Table 4-12. Aleutian Island pollock catch limits and total catch from 1992 through 2013 (amounts are in metric tons).

Year	Biomass	OFL	ABC	TAC	Catch	541	542	543	% catch 541	% catch 542	% catch 543
1992	537,631	62,400	51,600	47,730	52,352	52,140	206	6	100%	0%	0%
1993	464,358	62,600	58,700	51,600	57,132	54,512	2,536	83	95%	4%	0%
1994	384,318	60,400	56,600	56,600	58,659	58,091	554	15	99%	1%	0%
1995	319,261	60,400	56,600	56,600	64,925	28,109	36,714	102	43%	57%	0%
1996	259,626	47,000	35,600	35,600	29,062	9,226	19,574	261	32%	67%	1%
1997	232,659	38,000	28,000	28,000	25,940	8,110	16,799	1,031	31%	65%	4%
1998	209,891	31,700	23,800	23,800	23,822	1,837	3,858	18,127	8%	16%	76%
1999	184,714	31,700	23,800	2,000	1,010	484	420	105	48%	42%	10%
2000	178,971	31,700	23,800	2,000	1,244	615	461	169	49%	37%	14%
2001	183,570	31,700	23,800	2,000	824	332	386	105	40%	47%	13%
2002	208,034	31,700	23,800	1,000	1,156	842	180	133	73%	16%	12%
2003	225,577	52,600	39,400	1,000	1,666	577	760	329	35%	46%	20%
2004	227,923	52,600	39,400	1,000	1,158	397	513	248	34%	44%	21%
2005	225,232	39,100	29,400	19,000	1,621	689	415	517	43%	26%	32%
2006	215,559	39,100	29,400	19,000	1,745	1,036	488	220	59%	28%	13%
2007	200,870	54,500	44,500	19,000	2,519	1,919	476	124	76%	19%	5%
2008	192,595	34,040	28,160	19,000	1,278	872	290	116	68%	23%	9%
2009	196,174	32,553	26,873	19,000	1,779	1,136	400	243	64%	22%	14%
2010	201,785	40,000	33,100	19,000	1,285	754	382	150	59%	30%	12%
2011	208,144	44,500	36,700	19,000	1,208	695	447	66	58%	37%	5%
2012	250,905	42,900	35,200	19,000	970	501	427	42	52%	44%	4%
2013	265,591	45,588	37,295	19,000	2,964	2,342	309	313	79%	10%	11%

Aleutian Island Pollock management

In 1999, the NPFMC closed the Aleutian Islands region to pollock directed fishing due to concerns for Steller sea lion recovery. In 2002, the directed fishery for pollock in the Aleutian Islands was allowed outside of Steller sea lion critical habitat. In 2005, the entire Aleutian Islands pollock directed fishery was allocated to the Aleut Corporation and CDQ program. The fishery is still restricted to areas outside of 20 nm of Steller sea lion rookeries and haulouts. Pollock TAC is restricted to 19,000 mt or ABC, whichever is less.

The Aleutian Islands pollock TAC is split seasonally, where 40% of the ABC can be harvested in the A season. Since TAC is limited to 19,000 mt and ABC, in recent years, is much higher, this allows for a much larger percentage to be harvested in the A season. Additionally, 50% of the pollock TAC is limited to vessels less than 60 ft. This limits fishing to two small areas with commercial concentrations of pollock within easy delivery distance to Adak Island. Although there may be other areas further west that may have commercial concentrations of pollock, to date there have been no attempts by the reopened directed fishery to explore these areas.

The Aleutian Islands pollock chapter in the 2012 annual SAFE report described the early years of the Aleutian Islands pollock fishery:

> The nature of the pollock fishery in the Aleutian Islands Region has varied considerably since 1977 due to changes in the fleet makeup and in regulations. During the late 1970s through the 1980s the fishing fleet was primarily foreign and joint venture (JV) where US catcher vessels delivered to foreign motherships. The last JV delivery was conducted in 1989 when the domestic fleet began operating in earnest. The distribution of observed catch differed between the foreign and JV fishery (1977–1989) and the domestic fishery (1989–2009…). The JV and foreign fishery operated in the deep basin area extending westward to Bowers Ridge and in the eastern most portions of the Aleutian Islands. Some operations took place out to the west but observer coverage was limited. In the early domestic period (1991-1998) the fishery was more dispersed along the Aleutian Islands chain with no observed catches along Bowers Ridge and fewer operations in the deep basin area. The majority of catch in the beginning of the domestic fishery came from the eastern areas along the 170° W longitude line, and around Seguam Island in both Seguam and Amukta passes. As the fishery progressed more pollock were removed from the north side of Atka Island around 174° W and later near 177° W northwest of Adak Island inside Bobrof Island. While the overall catch level was relatively low, the domestic fishery moved far to the west near Buldir Island in 1998…. In 1999 the North Pacific Fishery Management Council closed the Aleutian Islands region to directed pollock fishing due to concerns for Steller sea lion recovery. (Barbeaux et al. 2012)

The Regional Administrator may reallocate the Aleutian Islands pollock fishery allocations to the Bering Sea directed fisheries or CDQ pollock fisheries, once it is determined that vessels in either the Aleutian Islands directed fisheries or CDQ directed fisheries will be unable to harvest their entire allocation in the Aleutian Islands (50 CFR 679.20(a)(5)(iii)). In practice, on notification by the Aleut Corporation and CDQ groups that they will not harvest their allocations of the Aleutian Islands pollock TAC, NMFS reallocates the projected unused amounts to the Bering Sea directed fishery allocations, if the Bering Sea pollock TAC is less than the ABC. This occurred in 2005, 2006, 2011, 2012, 2013, and 2014. In 2007–2010, NMFS was unable to reallocate unused amounts of the Aleutian Islands pollock TAC because the Bering Sea pollock TAC was set equal to the Bering Sea ABC. Reallocation typically occurs in January.

The Aleutian Islands pollock chapter in the 2012 groundfish SAFE report described the Aleutian Islands fishery since 2005 (Barbeaux et al. 2012):

In 2004 the entire Aleutian Islands pollock directed fishing allowance was allocated to the Aleut Corporation and CDQ groups and in 2005 the directed fishery was managed under this program. The fishery was still restricted to areas outside of 20 nm of Steller sea lion rookeries and haulouts, limiting fishing to two small areas with commercial concentrations of pollock within easy delivery distance to Adak Island. One area is a 4 mile stretch of shelf break located northwest of Atka Island between Koniuji Island and North Cape of Atka Island, the other is a 7 mile stretch located east of Nazan Bay in an area referred to as Atka flats. Bycatch of Pacific ocean perch can be very high in both these areas and it appears that pollock and Pacific ocean perch share these areas intermittently; depending on time of day, season, and tide. Although there may be other areas further west that may have commercial concentrations of pollock, to date there have been no attempts by the reopened the directed fishery to explore these areas.

Two catcher/processor vessels attempted directed fishing for pollock in February 2005, but failed to find commercially harvestable quantities outside of Steller sea lion critical habitat closure areas and in the end removed less than 200 mt of pollock. In addition, bycatch rates of Pacific ocean perch were prohibitively high in areas where pollock aggregations were observed. The 2005 fishery is thought to have resulted in a net loss of revenue for participating vessels. Data on specific bycatch and discard rates for the 2005 fishery are not presented due to issues of data confidentiality.

In 2006 and 2007 the Aleut Corporation, in partnership with the Alaska Fisheries Science Center (AFSC), Adak Fisheries LLC and the owners and operators of the F/V *Muir Milach*, conducted the Aleutian Islands Cooperative Acoustic Survey Study (AICASS) to test the technical feasibility of conducting acoustic surveys of pollock in the Aleutian Islands using small (<32 m) commercial fishing vessels. This work was supported under an exempted fishing permit that allowed directed pollock fishing within Steller sea lion critical habitat. A total of 932 mt and 1,100 mt of pollock were harvested during these studies in 2006 and 2007 respectively, and biological data collected during the studies were treated in the stock assessment as fishery data. In 2008, additional surveys of Aleutian Islands region pollock in the same area were conducted on board the R/V *Oscar Dyson* and in cooperation with the F/V *Muir Milach*; the work was funded through a North Pacific Research Board grant and less than 10 mt of groundfish were taken for the study. In 2009 the directed pollock fishery in the Aleutian Islands region took 403 mt, and 1,326 mt were taken as bycatch in other fisheries, predominantly the Pacific cod and rockfish fisheries. In 2010 through 2012 financial problems with the Adak processing plant greatly hindered the directed fishery. In 2010 and 2011 50 mt and 0 mt were harvested in the directed fishery, respectively. As of October 9, 2012, 0 mt had been taken in the directed fishery. In 2010 and 2011, 1,235 mt and 1,208 mt were harvested as bycatch in other fisheries. In 2012, 961 mt had been taken as bycatch in other fisheries as of October 9.

Spatial data on the location of the pollock fishery during the baseline years is limited. Therefore data from the observer program in the 1990s were used to identify where pollock fishing may occur. Figure 4-14 shows the haul retrieval locations from the Aleutian Islands pollock directed fishery from 1991 through 1998.

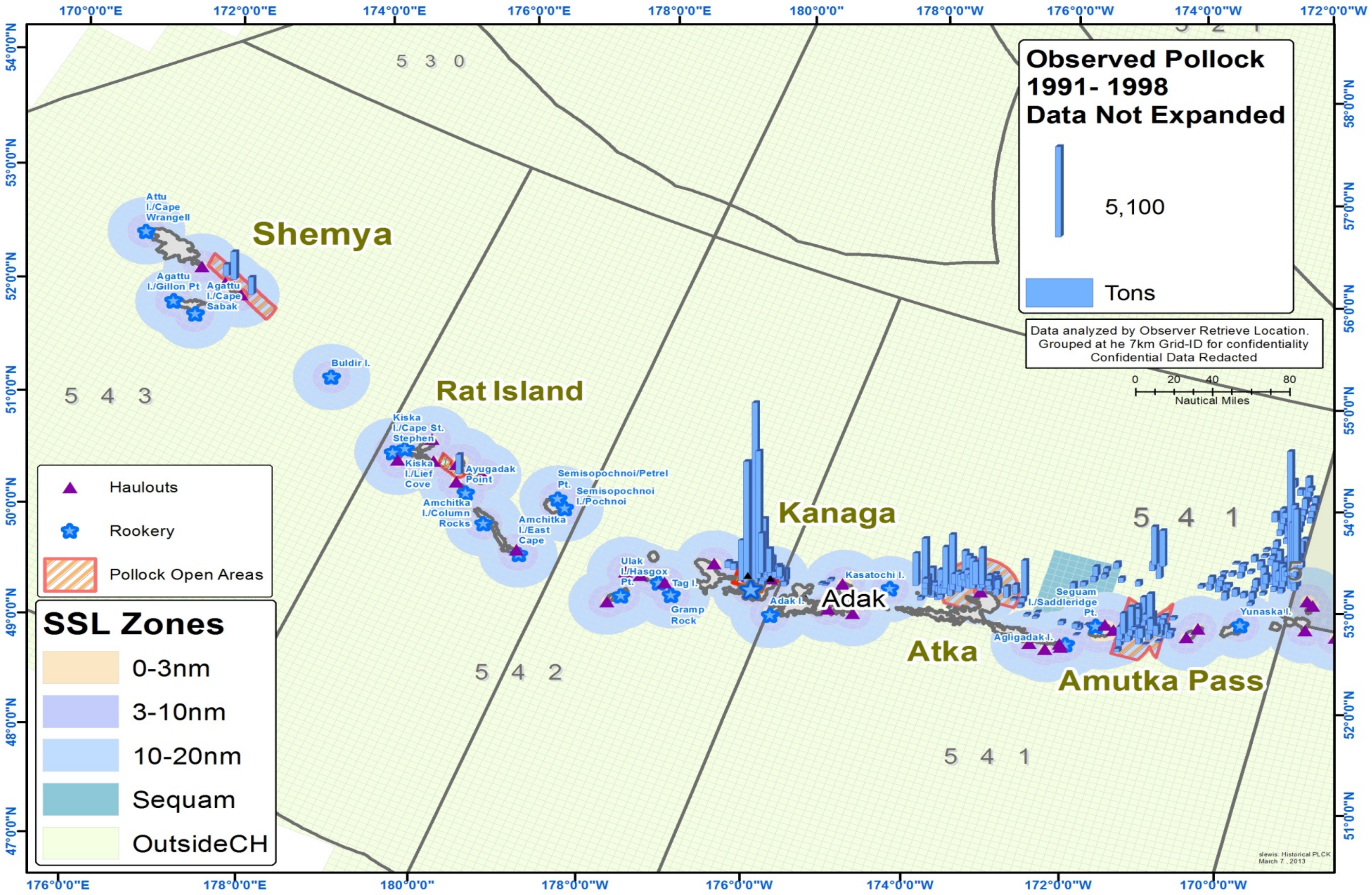


Figure 4-14. Observed pollock haul locations in the Aleutian Islands from 1991 through 1998.

Aleutian Islands finer scale pollock biomass estimates

Stock assessment for Aleutian Islands pollock are assessed at the large spatial scale of the Aleutian Islands FMP area. As with Atka mackerel (see section 4.4.2), a team of AFSC stock assessment scientists examined the available data on principal Steller sea lion prey species to determine if biomass could be estimated at a finer spatial and temporal scale than the stock assessments are currently done (Conners et al. 2013b). Please see section 4.4.1 for a description of the fine scale biomass estimates.

While estimates of biomass inside critical habitat are not able to be accomplished, survey strata allow for estimates at a finer scale than have been done in the past. As seen in Table 4-13, biomass for pollock has been estimated for 10 survey strata of the Aleutian Islands based on available survey data.

Pollock are schooling fish with high spatial and temporal variation on density and also inhabit the entire water column and not just the bottom. Trawl surveys focus on bottom habitat and do not designed to sample mid water pollock. Therefore estimates of pollock from bottom trawl surveys have high sampling uncertainty. Fishery removal occurs at different times of the year than when surveys are done. Therefore comparing fishery removals throughout the year to a survey biomass estimate will have high uncertainty.

Table 4-13. Aleutian Islands trawl survey biomass estimates (thousands of mt) for pollock by survey subarea and year. Refer to Figure 4-9 for subarea locations (listed in the table from west to east, N and S indicate north and south sides of the Aleutian chain). Test statistic and p-value for a one-tailed Mann-Kendal test of trend over time are shown for each subarea. A positive test statistic indicates increasing trend, negative indicates decreasing trend. Significant trends (*p*<0.05) are in bold type. Source: Conners et al. (2013b).

				Pollock							One tailed MK test	
Area	Subarea	1991	1994	1997	2000	2002	2004	2006	2010	2012	SSUM	P
543	Aggatu	3.2	4.9	11.7	1.8	4.4	4.8	2.4	6.1	4.8	2	0.460
	Buldir	23.5	9.3	6.4	5.1	8.8	1.8	4.1	1.9	0.6	-28	**0.001**
542	Petrel	9.6	3.4	1.6	1.7	9.2	5.3	3.6	6.1	1.7	-4	0.381
	N Amchitka	17.0	6.3	8.1	32.7	89.4	3.9	11.9	20.8	3.6	-4	0.381
	S Amchitka	13.2	8.3	21.9	8.5	9.3	2.3	2.2	1.7	1.5	-26	**0.003**
	S Tanaga	10.5	9.1	5.2	0.1	0.3	0.4	0.4	0.1	0.7	-16	0.060
541	N Adak	6.5	3.1	7.3	1.3	2.2	0.6	0.5	2.0	0.9	-20	**0.022**
	N Seguam	31.5	14.3	15.0	23.6	49.7	2.8	40.0	99.2	4.8	4	0.381
	S Adak	6.2	7.0	1.9	27.1	0.7	0.5	0.3	0.4	0.3	-26	**0.003**
	S Seguam	16.7	12.9	14.4	4.1	2.0	108.2	29.2	2.7	25.5	0	0.540

4.4.5 Status of Rockfish; Pacific Ocean Perch in the Action Area

Rockfish in the Aleutian Islands primarily consist of Pacific Ocean perch (POP). POP inhabit the outer continental shelf and upper slope regions of the North Pacific Ocean and Bering Sea. POP and four other associated species of rockfish (northern rockfish, rougheye rockfish, shortraker rockfish, and sharpchin rockfish) were managed as the POP complex in separate Bering Sea and Aleutian Islands subareas from 1979 to 1990. In 1991, the NPFMC separated POP from the other red rockfish to provide protection from possible overfishing. Of the five species in the former POP complex, POP has historically been the most abundant rockfish in this region and has contributed most of the commercial rockfish catch. Starting in 1996, the POP ABC and TAC were subdivided into the three Aleutian districts in proportion to the estimated biomass from the biennial Aleutian Islands trawl survey. The 2013 age 3+ biomass estimate for POP is 661,440 mt (Spencer and Ianelli 2012). The 2013 ABC was 35,068 mt and the TAC was subdivided into the three Aleutian Islands areas and the Bering Sea.

Since 2008, Aleutian Islands POP is allocated under the Amendment 80 program. Regulations at 50 CFR 679.20(a)(10)(i) and (ii) require the allocation between the Amendment 80 sector and BSAI trawl limited access sector for Aleutian Islands POP after subtraction of 10.7 percent for the CDQ reserve and an incidental catch allowance for the BSAI trawl limited access sector and vessels using non-trawl gear. The allocation of the initial ITAC for Aleutian Islands POP to the Amendment 80 sector is established in Tables 33 and 34 to 50 CFR part 679 and 50 CFR 679.91. For the most current allocation by sector see Tables 7a and 7b of the final 2013 and 2014 harvest specifications (78 FR 13813, March 1, 2013).

POP is commonly caught while directed fishing for Atka mackerel. Approximately 4.9% of the total groundfish caught in the Atka mackerel fishery is POP (NMFS Catch Accounting System). Directed fishing for pollock in the Aleutian Islands from 2004 through 2010 has shown high incidental catch of POP as well. Table 4-14 shows the total ABC, TAC, and catch of POP from 2004 through 2012.

Table 4-14. Pacific Ocean perch ABC, TAC, and catch (mt) in the Aleutian Islands from 2004 through 2012.

	Eastern Aleutian District (Area 541)			Central Aleutian District (Area 542)			Western Aleutian District (Area 543)		
Year	ABC	TAC	Catch	ABC	TAC	Catch	ABC	TAC	Catch
2004	3,059	3,059	2,536	2,926	2,926	3,143	5,187	5,187	5,485
2005	3,210	3,080	2,586	3,165	3,035	2,235	5,305	5,085	4,727
2006	3,256	3,080	3,069	3,212	3,035	3,251	5,372	5,085	5,506
2007	4,970	4,970	5,098	5,050	5,050	4,659	7,720	7,720	7,824
2008	4,900	4,900	4,698	4,990	4,990	4,808	7,610	7,610	7,417
2009	4,200	4,200	4,037	4,260	4,260	4,277	6,520	6,520	6,411
2010	4,220	4,220	4,038	4,270	4,270	4,033	6,540	6,540	6,234
2011	5,660	5,660	5,453	4,960	4,960	4,767	8,370	8,370	8,182
2012	5,620	5,620	1,979	4,990	4,990	1,202	8,380	8,380	1,639

4.4.6 Status of Sculpins; Irish Lord in the Action Area

Further information on sculpins, including effects of fishing on the age and size structure of sculpin stocks, may be found in the sculpin chapter of the annual SAFE report (Spies et al. 2012). This document is incorporated by reference. Relevant information from this document is summarized in this section. This section also contains recent information on sculpin and sculpin fisheries.

Sculpins are relatively small, benthic-dwelling, fish. This group includes 48 species. Sculpins are distributed throughout the Bering Sea/Aleutian Islands and occupy all benthic habitats and depths. The assessment focuses on species from the genera *Myoxocephalus*, *Hemitripterus*, and *Hemilepidotus* that observers from the North Pacific Groundfish and Halibut Observer Program identify to genus in commercial catches. Sculpins catch in the Aleutian Islands is entirely incidental catch in other target fisheries. Aleutian Islands sculpins biomass estimates from trawl surveys in 2004, 2006, 2010, and 2012 Aleutian Islands trawl surveys and total catch of sculpins in the Aleutian Islands are shown in Table 4-15. The current biomass estimate of sculpins is 215,713 mt (Spies et al. 2012). The 2014 ABC is 42,318 mt (Spies et al. 2012), and the TAC is 5,600 mt (78 FR 74063).

Table 4-15. 2004–2012 Sculpin biomass estimate, total catch, and survey proportion of sculpins in the Aleutian Islands (AI) (amounts in mt).

	2004	2006	2010	2012
Total AI Biomass estimate	19,003	20,838	24,473	22,306
Aleutian Islands Catch	955	909	1,307	807
Survey proportion of Irish lord	44%	52%	62%	64%

Source: (Spies et al. 2012) and NMFS Catch Accounting System

4.4.7 Status of Pacific Sandlance in the Action Area

Pacific sandlance are part of the forage fish group. In 1998, Amendment 36 to the BSAI FMP created a separate forage fish category, with conservation measures that included a ban on directed fishing. Beginning in 2011, forage fish are considered “ecosystem components” in the annual stock assessment reports. Distribution of Pacific sandlance is primarily in depths less than 50 m, suggesting a nearshore distribution. Sand lance also exhibit strong habitat preference, requiring sandy substrates for burrowing (Ormseth 2013b).

Forage fish in general are not typically encountered in the trawl surveys; however, sandlance were found in abundance in the 2012 Aleutian Islands survey. Sandlance were observed throughout the Aleutian Islands with the highest concentrations found in the Western Aleutian Islands beyond Amchitka Pass (Ormseth 2013b). Incidental catch of Pacific sandlance in the commercial groundfish fisheries is rare. In the entire BSAI, bycatch totals less than half a metric ton in all years combined between 2004 and 2013. There is no current biomass estimate of Pacific sandlance.

4.4.8 Status of Pacific Herring in the Action Area

Herring are highly abundant and ubiquitous in Alaska marine waters. Pacific herring are a critical component of the BSAI forage base. In federal fisheries herring are managed as prohibited species and are rarely encountered in BSAI non-pollock groundfish fisheries. Historically, incidental catch of herring in the Aleutian Islands has been low. In recent years the total annual incidental harvest of herring has been less than 0.5 mt. The best estimate of herring biomass in the BSAI, 264,802 mt, is derived using survey data and an age-structured biomass projection model developed by the Alaska Department of Fish and Game (ADFG).

4.4.9 Status of Pacific Salmon in the Action Area

There are five Pacific salmon species in Alaska: sockeye salmon (*Oncorhynchus nerka*), pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*). The Aleutian Islands have runs of sockeye, pink, chum, and coho salmon, and there are no known Chinook salmon runs in the Aleutian Islands. However, salmon migrate long distances between feeding areas and spawning streams and stocks from North America, Asia, and Russia have distributions around or migrate through the Aleutian Islands (Groot and Margolis 1991). Large pink salmon runs occur during even-numbered years in streams on Unalaska, Umnak, Atka, Amlia, Adak, and Attu Islands. Kiska, Kanaga, and Tanaga each have at least one important pink salmon stream (Poetter and Nichols 2013). All of these islands are located in Areas 541, 542, and 543 except for Unalaska and Unmak Islands. Salmon escapement information for the Aleutian Islands and Atka-Amlia Island areas is limited. Surveys are limited because of poor weather, remoteness, unavailability of suitable aircraft, and the high cost of aircraft. Therefore, data are incomplete and of limited use for fisheries management in the Aleutian Islands (Poetter and Nichols 2013).

ADFG prepares salmon harvest projections rather than conducting run size forecasts for each salmon run. Salmon in the Aleutian Islands is managed in the Aleutian Islands Management Area (Area M) and the Atka-Amlia Islands Management Area (Area F). Commercial salmon harvest records for these areas date back to 1911. ADFG has been responsible for managing salmon in these areas since 1960 (Poetter and Nichols 2013).

Since 2006, a renewed interest for commercial harvest of pink salmon in the Aleutian Islands has developed around the island of Unalaska (Poetter and Nichols 2013). No commercial salmon fishing has occurred in Area F since 1996 because interest in this fishery diminished due to low volumes of fish, high processing costs, and lack of markets (Holmes 1997). Subsistence salmon fishing permits are only required in the larger communities in the Unalaska and Adak districts and are therefore the only communities from which subsistence information is compiled on an annual basis. The subsistence harvest for the Unalaska District was primarily for coho and pink salmon. An average of four annual subsistence permits were issued to Adak district residents from 1998 through 2010. In 2012, the two subsistence permits issued in the Adak district were attributed a harvest of 25 sockeye salmon (Poetter and Nichols 2013).

Salmon are also caught as bycatch in other groundfish fisheries. The 1993 through 1998 averages indicate that salmon PSC rates in the pollock fishery in the Aleutian Islands are less than the Bering Sea PSC rates from recent years; however, the historical pollock fishery in these areas occurred under different regulations than pollock directed fisheries currently operate. More recent data, from 2005 through 2010, indicates that the PSC rates in the pollock directed fishery in the Aleutian Islands are higher than in the Bering Sea. However, pollock catch is very low compared to the Bering Sea and the PSC rates may not represent what will occur when an Aleutian Islands pollock directed fishery is fully developed (NMFS 2013). The NPFMC and NMFS established a 700 Chinook salmon PSC limit for the Aleutian Islands subarea pollock fishery (50 CFR 679.21(e)(1)(viii)). Section 679.21(e)(3)(i)(A)(*3*)(*i*), allocates 7.5%, or 53 Chinook salmon, to the Aleutian Islands subarea PSQ for the CDQ program, and allocates the remaining 647 Chinook salmon to the non-CDQ fisheries. If the Regional Administrator determines that catch of Chinook salmon in the Aleutian Islands pollock directed fishery will reach an annual Chinook salmon limit then NMFS will close the Aleutian Islands Chinook Salmon Savings Area, as defined in Figure 8 to 50 CFR part 679, to pollock directed fishing. The closures dates depend on when the limit is reached. The directed pollock fishery would be closed from the closure date until April 15, and from September 1 through December 31, if the annual limit of Aleutian Islands Chinook salmon is reached before April 15 or from September 1 through December 31, if the annual limit is reached after April 15. Also, the NPFMC and NMFS have implemented Chinook salmon bycatch management measures in the Bering Sea and GOA pollock fishery (75 FR 53026; 77 FR 42629). These efforts are being expanded to reduce the bycatch of other salmon species and to manage the PSC of salmon in other groundfish fisheries. These management measures may reduce bycatch of salmon that may also occur in the Aleutian Islands subarea.

4.4.9.1 Octopus and Squid

The following information on the status of Octopus and Squid is from the 2013 Stock Assessment and Fishery Evaluation reports Conners et al. (2013a) and Ormseth (2013a).

Since 2011, octopus is managed as a species group. At least seven species of octopus are found in the BSAI. The species composition of the octopus community is not well documented, but data indicate that the giant Pacific octopus *Enteroctopus dofleini* is most abundant in shelf waters and predominates in commercial catch. Octopuses are taken as incidental catch in trawl, longline, and pot fisheries throughout the BSAI; a portion of the catch is retained or sold for human consumption or bait. The highest octopus catch rates are from Pacific cod fisheries in the three reporting areas around Unimak Pass. The BSAI trawl surveys produce estimates of biomass for octopus, but these estimates are highly variable and do not reflect the same sizes of octopus caught by industry. Examination of size frequency from survey and fishery data shows that both commercial and survey trawls catch predominantly small animals (<5 kg), while commercial pot gear catches or retains only larger animals (10-20 kg). In general, the state of knowledge about octopus in the BSAI is poor. A number of research studies and special projects have been initiated to increase knowledge for this assemblage; results of these studies are summarized.

Aleutian Islands octopus biomass in 2012 was estimated at 2,779 mt but this is likely a substantial under estimation due to survey bottom trawl gear not being efficient at capturing octopus. The ABC for 2014 and 2015 is 2,590 mt and the TAC is 500 mt to cover incidental catch. Harvests of octopus in 2013 the BSAI was 223 mt, well below the TAC and OFL of 3,450 mt.

Because reliable biomass estimates do not exist for squids in the BSAI, harvest recommendations are made using Tier 6 criteria. Under Tier 6, the OFL is defined as the average catch during the period 1978-1995, and the ABC is defined as 0.75 * OFL. As a result the harvest recommendations do not change from year to year. New information regarding squids comes mainly from the eastern Bering Sea (EBS) slope and Aleutian Islands (AI) trawl surveys. Because these are biennial surveys, full assessments are only conducted in years when those surveys occur.

Incidental catches of squid in the BSAI were low in 2013 and have been consistently low since 2008 (Tables 1-3 in Ormseth (2013a). For the first time in 2013, more squid removals occurred in the arrowtooth and Kamchatka flounder fisheries than in the pollock fishery, which has historically been the main source of squid catches (Table 2 in Ormseth (2013a). Also for the first time, catches in the AI exceeded those in the EBS (Table 1 & 3 in Ormseth (2013a) with most of the squid coming from Area 541 (104 mt) and very little coming from Areas 542 and 543 (6 mt and 8 mt respectively). Both of these harvest changes appear to be due to a large reduction in the amount of squid captured by the pollock fishery in the Bering Sea. Overfishing did not occur on this stock in 2011 or 2012. The total catch of BSAI squid in 2013 was 300 mt, well below the ABC of 1,970 mt.

4.4.10 Chronology of Steller Sea Lion Protection Measures Implemented in the Action Area

This section reviews the fishery management measures implemented in the action area since 1990 to reduce potential competition between the groundfish fisheries and Steller sea lions. Table 4-16 through Table 4-18 show the chronology of fishery management measures implemented to protect Steller sea lions in the action area. These changes were primarily implemented in 1999, 2002, and 2011. Before 1999, there was minimal spatial and temporal control of the Atka mackerel, Pacific cod, and pollock fisheries in the Aleutian Islands subarea. In 1999, spatial and temporal controls on harvest were applied to the Atka mackerel fisheries and the pollock fishery was closed in the Aleutian Islands. In 2002, additional spatial and temporal management measures were applied to the Atka mackerel fishery to further control harvests through the HLA fishery management; and management measures for Pacific cod based on gear type were implemented in the Aleutian Islands. Pacific cod harvest by trawl gear was restricted more than the non-trawl fisheries due to the higher rate of fishing by trawl gear. In 2011, the restrictions for the Atka mackerel and Pacific cod fisheries were greatly increased in Area 543, effectively eliminating fishing for these species in this Area. Restrictions on Atka mackerel and Pacific cod harvests in Area 542 were greatly increased inside critical habitat resulting in very little harvest of these species inside critical habitat in 2011 through 2013. Spatial fishery restrictions for Pacific cod in Area 541 critical habitat increased when the interim final rule was implemented in 2011.

Modified Steller sea lion protection measures were implemented in 2002 (by emergency rule) that included a harvest control rule for principal prey species and temporal and spatial dispersal of Atka mackerel, Pacific cod, and pollock harvests in the Aleutian Islands subarea. Some of these protection measures remain in place under the 2011 interim final rule and in the proposed action analyzed in this biological opinion (e.g., harvest control rule and vessel monitoring requirements). The pollock, Pacific cod, and Atka mackerel harvest is limited globally by prohibiting directed fishing if the projected spawning biomass of the fish stock falls below 20% of the unfished spawning biomass (50 CFR 679.20(d)(4)). None of these fisheries have experienced this type of directed fishing closure since this regulation became effective in 2003 (68 FR 204, January 2, 2003).

Table 4-16. **Fishery management measures implemented from 1990 to 2013 in Area 543 to reduce potential competition with Steller sea lions. An "x" indicates that the measure was in effect in a given year.**

Year	No transit 3 nm from rookeries	No trawl 10 nm from rookeries	Forage fish fishing ban	Atka mackerel harvest limit and seasons	CH Closed to Pollock	Atka mackerel CH TAC Limit	Closed to pollock	Injunction (Aug through Nov 30 2000)	CH Closed to Trawl	No P cod trawl 3 nm from haulouts	Modified SSL measures	Closed to Atka mackerel and P cod
1990	x											
1991	x											
1992	x	x										
1993	x	x										
1994	x	x										
1995	x	x										
1996	x	x										
1997	x	x										
1998	x	x	x									
1999	x	x	x	x	x	x	x					
2000	x	x	x	x	x	x	x	x				
2001	x	x	x	x	x	x	x		x	x	x	
2002	x	x	x	x	x	x	x			x	x	
2003	x	x	x	x	x	x				x	x	
2004	x	x	x	x	x	x				x	x	
2005	x	x	x	x	x	x				x	x	
2006	x	x	x	x	x	x				x	x	
2007	x	x	x	x	x	x				x	x	
2008	x	x	x	x	x	x				x	x	
2009	x	x	x	x	x	x				x	x	
2010	x	x	x	x	x	x				x	x	
2011	x	x	x		x				x	x		x
2012	x	x	x		x				x	x		x
2013	x	x	x		x				x	x		x

Table 4-17. Fishery management measures implemented from 1990 to 2013 in Area 542 to reduce potential competition with Steller sea lions. An "x" indicates that the measure was in effect in a given year.

Year	No transit 3 nm from rookeries	No trawl 10 nm from rookeries	Forage fish fishing ban	Atka mackerel harvest limit* and seasons	CH Closed to Pollock	Atka mackerel CH TAC Limit	Closed to pollock	Injunction (Aug through Nov 30 2000)	CH Closed to Trawl	No Pacific cod 6 nm from haulouts and rookeries	No P cod trawl 3 nm from haulouts	Modified SSL measures	CH mostly closed to Atka mackerel and P cod trawl
1990	x												
1991	x												
1992	x	x											
1993	x	x											
1994	x	x											
1995	x	x											
1996	x	x											
1997	x	x											
1998	x	x	x										
1999	x	x	x	x	x	x	x						
2000	x	x	x	x	x	x	x	x					
2001	x	x	x	x	x	x	x		x		x	x	
2002	x	x	x	x	x	x	x				x	x	
2003	x	x	x	x	x	x					x	x	
2004	x	x	x	x	x	x					x	x	
2005	x	x	x	x	x	x					x	x	
2006	x	x	x	x	x	x					x	x	
2007	x	x	x	x	x	x					x	x	
2008	x	x	x	x	x	x					x	x	
2009	x	x	x	x	x	x					x	x	
2010	x	x	x	x	x	x					x	x	
2011	x	x	x		x					x			x
2012	x	x	x		x					x			x
2013	x	x	x		x					x			x

* Critical habitat (CH) TAC limit applied to Steller sea lion sites west of 178° W longitude.

Table 4-18. Fishery management measures implemented from 1990 to 2013 in Area 541 to reduce potential competition with Steller sea lions. An "x" indicates that the measure was in effect in a given year.

Year	No transit 3 nm from rookeries	No trawl 10 nm from rookeries	Forage fish fishing ban	CH Closed to Pollock	CH closed to Atka mackerel, harvest limit and seasons	Closed to pollock	Injunction (Aug through Nov 30 2000)	CH Closed to Trawl	No P cod 10 nm from haulouts and rookeries	No P cod trawl 3 nm from haulouts	Modified SSL measures	No CH P cod non-trawl east of Seguam Foraging Area
1990	x											
1991	x											
1992	x	x										
1993	x	x										
1994	x	x										
1995	x	x										
1996	x	x										
1997	x	x										
1998	x	x	x									
1999	x	x	x	x	x	x						
2000	x	x	x	x	x	x	x					
2001	x	x	x	x	x	x		x		x	x	x
2002	x	x	x	x	x	x				x	x	x
2003	x	x	x	x	x					x	x	x
2004	x	x	x	x	x					x	x	x
2005	x	x	x	x	x					x	x	x
2006	x	x	x	x	x					x	x	x
2007	x	x	x	x	x					x	x	x
2008	x	x	x	x	x					x	x	x
2009	x	x	x	x	x					x	x	x
2010	x	x	x	x	X					x	x	x
2011	x	x	x	x	X				x	x		
2012	x	x	x	x	X				x	x		
2013	x	x	x	x	X				x	x		

5 EFFECTS OF THE ACTION

In this section, NMFS assesses the probable direct and indirect effects of the groundfish fisheries and associated research on the endangered WDPS of Steller sea lions and designated critical habitat. "Effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). The purpose of this assessment is to determine whether the fisheries can reasonably be expected to have direct or indirect effects on the endangered WDPS of Steller sea lions and/or associated critical habitat that appreciably reduce its likelihood of survival and recovery.

5.1 Effects of the Alaska Groundfish Fisheries and Research

The 2010 FMP BiOp (NMFS 2010) considered the direct effects of the groundfish fisheries on Steller sea lions including incidental take and disturbance. Modifications to the proposed action relative to the action analyzed in the 2010 FMP BiOp are not likely to alter the magnitude of direct effects. The jeopardy and adverse modification conclusion in the 2010 FMP BiOp resulted from the spatial and temporal effects of fishery removal of prey rather than the extent of incidental take or disturbance. Because the proposed action would replace the RPA from the 2010 FMP BiOp the effects analysis in this project-level biological opinion specifically focuses on the indirect effects of the fisheries removal of prey on Steller sea lions and designated critical habitat.

5.2 Steller Sea Lion Telemetry Data

NMFS uses location data from animals fitted with satellite telemetry tags to infer the foraging behavior and diving ontogeny of Steller sea lions. In prior biological opinions (NMFS 2000, 2001, 2003, 2010) NMFS reviewed publications summarizing the available telemetry information and relied on those data to define important Steller sea lion foraging areas and design measures to reduce the spatial and temporal overlap with the fisheries. Throughout the 2000s, NMFS sought to reduce the extent of overlap between the fisheries and adult female and juvenile sea lions. Early telemetry work focused on adult female sea lions during summer since the population dynamics of Steller sea lions are largely determined by the reproductive success of adult females and the survival of their young (York 1994).

The results of the early telemetry tagging studies were summarized in the original Steller Sea Lion Recovery Plan (NMFS 1992). At that time, tagging effort had concentrated on adult females in the central GOA and eastern Aleutian Islands and results were reported for six animals in summer and five animals in winter. In summer, the adult females stayed within 30 km of the rookeries, took brief trips to sea (< 2 d) and made shallow dives (mean depth < 30 m, max depth 120 m). In winter, the adult females made longer trips to sea, ventured further from shore (> 450 km) and executed much deeper dives (mean depth 84 m, max depth 273 m) than in summer (NMFS 1992).

The final rule to designate Steller sea lion critical habitat in 1993 (58 FR 45269) summarized data from 52 telemetered adult female and juvenile (younger than 11 months) animals from 1989 through 1993. When critical habitat was designated, NMFS's understanding of at-sea habitat use was that foraging strategies change according to age and reproductive status– postpartum females occurred mainly in relatively shallow waters within 20 nm of rookeries in summer while females with and without pups during winter had the ability to forage at locations far removed from their rookeries and haulouts and at great depths (> 250 m) (58 FR 45269). The final rule noted the limited dive depths for animals less than 11 months old which were rarely observed below 20 m. NMFS also referred to data implicating reduced juvenile survival due to lack of food post-weaning and during the winter/spring of the first year as a significant causative threat to the Alaska sea lion decline, which was part of the rationale for designating aquatic critical habitat 20 nm seaward from important rookery and haulout sites west of 144° W longitude (58 FR 45269).

Given evidence of reduced juvenile survival, telemetry research focused on juveniles younger than 2 years in the breeding and non-breeding seasons from 1994 through the early 2000s (NMFS 2001). In the 2000 FMP BiOp (NMFS 2000), NMFS noted that Steller sea lions appear to rely less on areas outside of critical habitat for foraging and that NMFS would likely continue with less stringent protection measures outside of critical habitat though these areas may also be important for Steller sea lions. NMFS's understanding of sea lion foraging patterns in 2000 was that substantial individual variation in distance traveled occurs for foraging Steller sea lions and that: 1) foraging around rookeries and haulouts is crucial for adult females with pups, pups, and juveniles; and 2) foraging that may occur over much larger areas where these and other animals may range to find optimal foraging conditions when they are not tied to rookeries or haulouts for reproductive success or survival (NMFS 2000). Table 4.3 in the 2000 FMP BiOp showed the number of satellite locations for adult female (breeding) and juvenile (non-breeding) animals inside and outside of critical habitat by season. Almost all of the locations were inside critical habitat except for April through June (17.89% of adult female and 5.6 % of juvenile locations were outside of critical habitat) and October through December (55.56% of adult female and 8.33% of juvenile locations were outside of critical habitat (NMFS 2000).

In 2000, NMFS concluded that there was a higher probability that fish, sea lions, and fisherman would be spatially concentrated in the smaller designated critical habitat area than the large bodies of water outside of critical habitat and that sea lions and fish were likely to disperse over larger areas outside of critical habitat. Thus, NMFS concluded that measures to spatially and temporally disperse fishing were needed inside of critical habitat but not outside, even though adult females and juveniles were known to forage offshore in the spring and winter (NMFS 2000).

NMFS began to separate out at-sea locations from tagged animals by zones of critical habitat based on distance from land in a biological opinion on the groundfish fisheries in 2001 (NMFS 2001). The 2001 BiOp presented telemetry data from adult females and juveniles and revealed that adult females can travel more than 500 km offshore during winter and one young of the year animal traveled more than 320 km offshore in the winter. When the data were evaluated in aggregate, the large majority of locations for both life stages occurred within 10 nm from shore across regions and seasons. NMFS (2001) highlighted several caveats to inferring Steller sea lion foraging distribution from the telemetry data, including the observation that activity close to shore may reflect behavior other than foraging. Thus, NMFS presented the location data in two ways—as a raw percentage of the total locations and as a percentage of locations with 90% of the 0 – 2 nm locations removed (Table 5-1).

Table 5-1. Table 5.1 from NMFS (2001). At-sea locations for Steller sea lions in summer and winter. Percentages reflect the proportion of locations obtained within certain distances from shore. Table 5.1a reflects the raw database of NMML deployments from 1990-2000. In Table 5.1b 90% of the observations in the 0-2 nm areas were deleted to show one method for approaching potential biases in the data.

Table 5.1a	Summer (Apr–Sept)		Winter (Oct–Mar)	
Zone	Pups/Juveniles (*n=274*)	Adults (*n=201*)	Pups/Juveniles (*n=1062*)	Adults (*n=96*)
0-3 nm	68.4 %	89.6 %	92.8 %	74.0 %
3-10 nm	6.0 %	6.0 %	6.3 %	5.2 %
10-20 nm	5.1 %	0 %	0.6 %	4.2 %
beyond 20 nm	20.4 %	4.5 %	0.4 %	16.7 %

Table 5.1b	Summer		Winter	
Zone	Pups/Juveniles (*n=111*)	Adults (*n=46*)	Pups/Juveniles (*n=205*)	Adults (*n=34*)
0-3 nm	22.1 %	54.5 %	62.7 %	26.3 %
3-10 nm	14.9 %	26.0 %	32.4 %	14.7 %
10-20 nm	12.6 %	0 %	2.9 %	11.8 %
beyond 20 nm	50.4 %	19.5 %	1.9 %	47.2 %

NMFS (2001) qualitatively ranked the importance of foraging areas for sea lions based on the at-sea telemetry locations and known foraging ecology. NMFS determined that the zones from 0-3 nm and 3-10 nm were used most heavily by pups and lactating females during the fall and winter periods and expressed a high level of concern with possible adverse interactions with fisheries in these portions of critical habitat. NMFS (2001) considered the designated critical habitat area beyond 10 nm from shore in the same manner as the area beyond 20 nm in the 2000 FMP BiOp (NMFS 2000)– with less concern for negative interaction between the fisheries and sea lions in the areas beyond 10 nm. NMFS (2001) also rated the area beyond critical habitat as a low concern compared to the 0-3 nm zone given the significant size of the area beyond 20 nm and the pattern of dispersal of fishing vessels in these zones.

NMFS supplemented the 2001 BiOp in 2003 due to a Court remand of the 2001 BiOp. NMFS (2003) adopted a new method for filtering the telemetry data in an effort to more accurately describe juvenile foraging events relative to the method used in 2001. In 2003, NMFS was most concerned about juveniles (greater than 10 months) learning to forage on their own given evidence of nutritional stress and low juvenile survival in the 1990s. NMFS (2003) only included telemetry data from juvenile animals, used dives greater than 4 m as a proxy for a foraging bout, and removed all locations with dives less than 4 m from the dataset. The 0-3 and 3-10 nm zones were also combined into one zone in 2003 because there was no natural break in the data at 3 nm and because the 0-3 nm bin was likely too small for the spatial accuracy of the telemetry data (NMFS 2003). Table II-7 in NMFS (2003) shows the number of locations associated with diving of juvenile animals. These data strengthened the conclusions of the 2001 BiOp regarding the importance of 0-10 nm from rookeries and haulouts for foraging juvenile sea lions (NMFS 2003).

Table 5-2. Table II-7 from NMFS (2003). Number of locations associated with diving and percent of those locations found in various zones from a listed rookery or haulout site, based on juvenile Steller sea lions instrumented from 2000-2002.

	Summer (Apr–Sept)		Winter (Oct–Mar)	
Zone	**0-10 Months (n[1] =41,n[2] =2920)**	**>10 Months (n=46, n=3550)**	**0-10 Months (n=45, n=2950)**	**>10 Months (n=8, n=586)**
0-10 nm	91.0 %	87.1 %	94.7 %	67.9 %
10-20 nm	4.7 %	6.8 %	3.9 %	22.4 %
>20 nm in CH	1.6 %	3.0 %	0.5 %	7.7 %
Outside CH	2.8 %	3.1 %	0.8 %	2.0 %

[1] n=the number of animals instrumented.

[2] n=the number of telemetry locations received from all the animals.

In 2010, NMML compiled telemetry data from 116 juvenile Steller sea lions tagged from 2000 through 2005 between the ages 3 and 26 months (NMML 2010). The objective of the 2010 analysis was to evaluate the extent to which potential foraging by individual, juvenile sea lions is encompassed within 10 and 20 nm of critical habitat. In the 2010 analysis, the location data were filtered according to the same dive depth of >4 m to infer foraging as in NMFS (2003) and separated out by individual animal. For the first time, data were reported by the number of juveniles with ≥ 50%, ≥ 75%, and 100% of their locations within 10 or 20 nm from a rookery or haulout by (a) season (summer and winter), and (b) geographic zone from east to west across the WDPS in Alaska.

NMML (2010) found that most individuals had at least 75% of their dive locations within critical habitat, however, some animals in each age and season category had locations outside of critical habitat (Table 5-3 and Table 5-4). There was substantial variability in habitat use by individuals among the geographic zones (Table 5-5). NMML (2010) notes that no juveniles in zones 1 or 2 (the western Aleutians and the western portion of the central Aleutian Islands) had more than 75% of their locations associated with diving to > 4 m within 20 nm of a rookery or haulout. No animals were tagged within these zones and the 3 animals that used the offshore areas of these zones were juvenile males older than 10 months in age (NMML 2010). Nonetheless, the patterns for these animals varied from the other zones where most juvenile sea lions had ≥75% of their diving locations encompassed within 20 nm (NMML 2010). Figure 1 in NMML (2010) shows the greatest number of locations furthest offshore in the western and central Aleutian Islands zones.

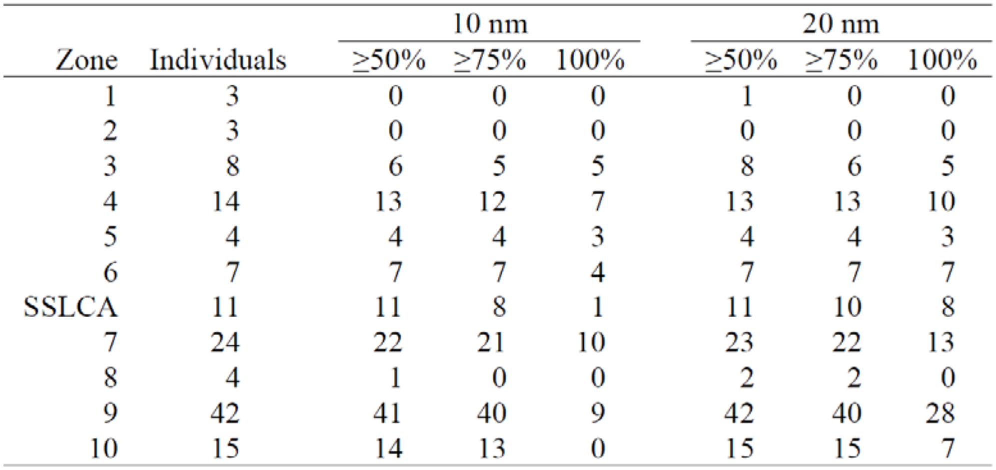
Table 5-3. (Table 2 from NMML (2010). Number of juvenile Steller sea lions with greater than 50%, 75% or all of their locations associated with diving to >4 m contained within 10 and 20 nm distances to the nearest haulout or rookery stratified by season (summer: April – September, winter: October – March) and age class.

			10 nm			20 nm		
Season	Age class	Individuals	≥50%	≥75%	100%	≥50%	≥75%	100%
Summer	3-10 mo	39	36	35	25	37	36	32
	>10 mo	77	71	65	24	74	69	51
Winter	3-10 mo	59	58	55	30	59	59	44
	>10 mo	13	13	11	1	13	13	7

Table 5-4. Number and percent of juvenile Steller sea lions from NMML (2010) with locations > 20 nm from a haulout or rookery by season and age class.

Season	Age class	Number with locations > 20 nm	Percent of individuals per age class with locations > 20 nm
Summer	3-10 mo	7	18%
	> 10 mo	26	34%
Winter	3-10 mo	15	25%
	> 10 mo	6	54%

Table 5-5. (Table 3 from NMML (2010). Number of Steller sea lions with greater than 50%, 75% or all of their locations associated with diving to >4 m contained within 10 and 20 nm distances to the nearest listed haul-out or rookery. The zones are shown in Figure 1 of NMML (2010). SSLCA is the Steller Sea Lion Conservation Area.



		10 nm			20 nm		
Zone	Individuals	≥50%	≥75%	100%	≥50%	≥75%	100%
1	3	0	0	0	1	0	0
2	3	0	0	0	0	0	0
3	8	6	5	5	8	6	5
4	14	13	12	7	13	13	10
5	4	4	4	3	4	4	3
6	7	7	7	4	7	7	7
SSLCA	11	11	8	1	11	10	8
7	24	22	21	10	23	22	13
8	4	1	0	0	2	2	0
9	42	41	40	9	42	40	28
10	15	14	13	0	15	15	7

Table 3.11 in the FMP BiOp (NMFS 2010) summarized the proportion of juvenile telemetry locations by zone of critical habitat by season and area (e.g. Prince William Sound, Kodiak, the eastern Aleutian Islands, and the central/western Aleutian Islands). That table shows a higher proportion of outside critical habitat use by juvenile sea lions in summer compared to the other areas, however it also shows that 100% of the winter locations were within 10 nm from a listed rookery or haulout. Reconciling the information in Table 5-3, Table 5-4, and Table 5-5 with the information in Table 3.11 of the 2010 FMP BiOp reveals that the large proportion of locations outside of critical habitat in the central and western Aleutian Islands were locations of juveniles in summer. The large proportion of tagged juveniles > 10 months in age in winter (Table 5-4) were from areas further to the east. No information on juvenile behavior during September through January has been collected in the central and western Aleutian Islands.

In the 2010 FMP BiOp (NMFS 2010), NMFS relied on the individual, juvenile telemetry information as presented in NMML (2010) in conjunction with a new analysis summarizing opportunistic sightings of sea lions of unknown age and sex in the BSAI and GOA (Himes Boor 2010) to infer that the area outside of critical habitat is more important to Steller sea lions in the western and central Aleutian Islands compared to areas outside of critical habitat further to the east. The base data in Himes Boor (2010) (now published as Himes Boor and Small 2012)– the platforms of opportunity data (Platform data)– have been available to NMFS since before Steller sea lions were listed under the ESA. While the Platform data have been discussed in many biological opinions, their use to directly infer adult female and juvenile sea lion foraging distribution to inform the delineation of Steller sea lion protection measures was novel in the 2010 FMP BiOp. While (a) new methods were used in Himes Boor (2010) to increase the utility of the Platform data by standardizing the data for sighting effort and (b) alternate data for inferring at-sea foraging patterns for adult female and juvenile sea lions were extremely limited for the central and western Aleutian Islands sub-regions, the Platform data are not as informative as telemetry information for inferring at-sea foraging patterns for particular sex and age classes. Based on the Platform data as presented in Himes Boor (2010) and the individual offshore foraging locations of a few animals, NMFS closed all of fishery management Area 543 (the western Aleutian Islands), including areas outside of critical habitat, to fishing for Pacific cod and Atka mackerel effective in 2011 to reduce the potential for these fisheries create localized depletions of prey (primarily) for adult females (75 FR 77535, corrected 75 FR 81921).

The review above of the information available in 2010 prompted by the external reviews (Bernard et al. 2011, Bowen 2012, Stewart 2012, Stokes 2012) of the 2010 FMP BiOp (NMFS 2010) demonstrates that: (a) the observed use of areas outside of 20 nm by juvenile sea lions older than 10 months in summer is not abnormal for this age class when the complete series of telemetry data are considered (e.g., NMFS 2000, 2001); (b) sea lion foraging patterns vary by age, sex, season, and reproductive status, thus juvenile foraging patterns may not be a direct proxy for adult females; (c) adult females and juveniles have been tracked in waters far from shore (> 500 km and 320 km, respectively) when they are not tied to a rookery or haulout site for breeding and in some areas adult female and juvenile inshore/offshore patterns appear to be opposite (e.g. Table 5-1) ; (d) the Platform data contain many locations that represent adult male sea lion locations (NMFS POP Database); (e) sea lion locations in the Platform data may not be indicative of foraging; and (f) prior to 2010 NMFS consistently found potential fishing impacts on foraging sea lions to be less likely in areas beyond 20 nm from rookeries and haulouts (e.g., NMFS 2000, 2001 and 2003).

One external review (Bowen 2012) of the 2010 FMP BiOp emphasized the presentation and analysis of the telemetry data as an area for improvement. In particular, Bowen (2012) commented that he could not find in the FMP BiOp the number of adult females that have been tracked with satellite telemetry and recommended that NMFS qualify any conclusions about adult female foraging behavior with the observation that few adult females have been tracked and that the small number of adult females that have been tracked have had dependent pups or juveniles. Bowen (2012) expressed concern about the lack of a quantitative synthesis of the results of movement and distribution, particularly with respect to juveniles and thought NMFS's conclusions about habitat use in the central and western Aleutian Islands based only on 3 juvenile males that were tagged elsewhere and moved into the area was problematic.

For this biological opinion, in response to the concerns raised by Bowen (2012), NMFS (Lander et al. 2013) analyzed telemetry data collected from Steller sea lions from 2000 through 2013 throughout the western and central Aleutian Islands to include new information available since the completion of the FMP BiOp (NMFS 2010). Lander et al. (2013) combined all telemetry deployments during 2000 – 2013 in the central and western Aleutian Islands, including recent deployments on adult females, and conducted a spatial analysis to identify patterns of use relative to sea lion critical habitat and bathymetry. The analysis modeled travel paths using the continuous-time correlated random walk model (CTCRW) described in Johnson et al. (2008). Results were shown by individual to show variation in habitat use and then aggregated by age-class, season, critical habitat zone, and occurrence inside/outside of the 200 m isobath contour. Some of the data in this analysis have been used in prior studies, however the analysis is novel and includes data that have not been included in prior studies (Lander et al. 2013).

A total of 45 Steller sea lions (n = 39 juveniles, 17 F, 22 M, 9-23 months old at capture, 10 – 26 months old at last transmission; and n = 6 adult females) within the central and western Aleutian Islands were captured and equipped with a satellite-linked dive recorder between February 2000 and October 2012. Details on the individual ages, sex, capture date, and transmission duration are shown in Table 1 in

Lander et al. (2013). New data that were not included in NMML (2010) include data from 6 adult females tagged in 2011 and 2012 (3 in the western Aleutian Islands and 3 in the central Aleutian Islands) and 17 juveniles tagged between 2002 and 2004 (Lander et al. 2013).

Lander et al. (2013) applied a speed filter of 2 m/s to the location data per the method described in McConnell et al. (1992) to eliminate many locations that were likely erroneous. The percentage of locations within each critical habitat zone were summarized for each individual and summary statistics were calculated for each age class and season where winter was defined as October through March and summer was defined as April through September. Lander et al. (2013) also evaluated how many locations occurred on the continental shelf (i.e. in depths < 200 m). Seven of the animals were tracked in both summer and winter, whereas data are available for only one season for 38 of the animals. There were clear seasonal and age differences in proportions of locations inside and outside of critical habitat (Lander et al. 2013). A summary of the data from Lander et al. (2013) follows.

Juveniles

Deployment durations for each animal are provided in Lander et al. (2013). The deployment duration for juveniles was 8-121 days. Most of the juveniles tracked were between the ages of 10-13 months old and it is unknown if they were weaned. Results of individual juvenile tracks are shown in Figure 5-1 and summarized in Table 5-6. The 4 juveniles between 9-10 months in age stayed within the 0-10 nm zone of critical habitat in the central Aleutian Islands sub-region from February through March (winter). There was very little individual variation in movement patterns for this age/season class (Table 5-6). Given their age, it is unlikely these animals were weaned. Habitat use by individuals was more variable in summer, although, on average, 93.9% of the pooled at-sea locations were within 20 nm of a rookery or haulout (Table 5-6). Most juvenile locations were within the 200 m isobath in summer and winter (µ = 92.7% and 100%, respectively) though one animal had 61.3% of its locations outside of the 200 nm isobath in summer (Table 5-6). Prior research has demonstrated that pups are capable of traveling up to 120 km from their natal rookery by 2 months (Raum-Suryam et al. 2004) and capable of traveling >400 km by 5 months of age (Raum-Suryam et al. 2002).

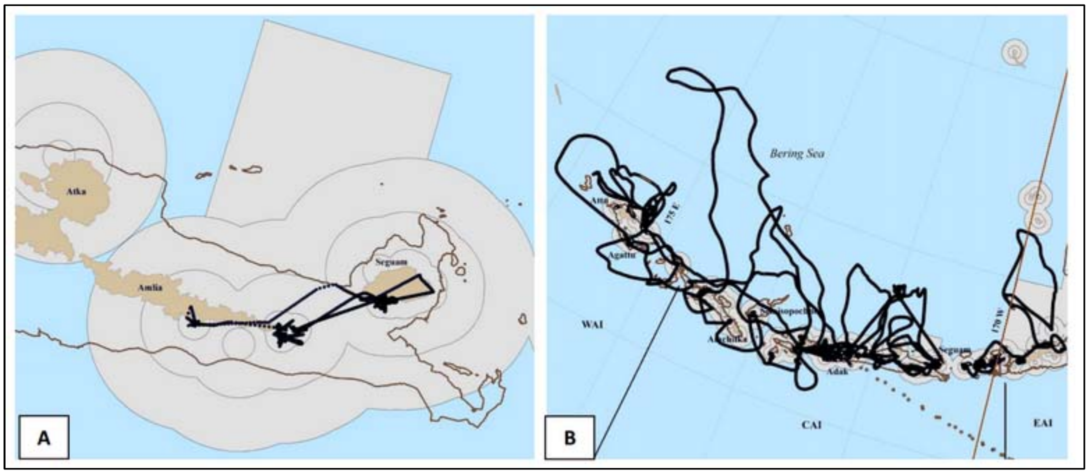


Figure 5-1. Predicted at-sea locations obtained from the CTCRW models for a) four juvenile Steller sea lions (n = 5,752 locations) during winter (October-March) and b) 39 juvenile Steller sea lions (n = 85,010 locations) during summer (April-September) with respect to designated critical habitat (depicted in gray) and the continental shelf (defined as 200 m, depicted as brown lines). Source: Lander et al. (2013).

Table 5-6. Mean ± standard error and (range) of percentages, of at-sea predicted locations of individual sea lions generated from CTCRW models in zones of critical habitat and within/outside the 200 m isobaths by season and age class. Winter is defined as October through March, whereas summer is defined as April through September. Source: Table 2 (Appendix 1 for the 0-10 and 0-20 nm zones) in Lander et al. (2013).

	Winter Juv (*n=4*)	Summer Juv (*n=39*)	Winter AF (*n=6*)	Summer AF (*n=3*)
Inside Critical Habitat				
0 -3 nm	95.7 ± 1.5 (91.9 – 98.8)	44.6 ± 5.4 (0.0 – 100.0)	34.7 ± 6.0 (19.8 – 55.3)	44.3 ± 22.4 (0.6 – 75.3)
3-10 nm	4.3 ± 1.5 (1.2 – 8.1)	33.8 ± 5.2 (0.0 – 100.0)	21.6 ± 4.8 (4.3 – 39.7)	34.2 ± 15.8 (13.7 – 65.3)
0-10 nm	100.0 ± 0.0 (100.0 – 100.0)	78.4 ± 4.7 (8.5 – 100.0)	56.3 ± 6.2 (40.0 – 80.3)	78.5 ± 10.2 (66.0 – 98.8)
10-20 nm	0.0 ± 0.0 (0.0 – 0.0)	15.5 ± 4.0 (0.0 – 91.5)	24.3 ± 9.5 (3.0 – 55.8)	13.9 ± 10.2 (1.2 – 34.0)
0-20 nm	100.0 ± 0.0 (100.0 – 100.0)	93.9 ± 2.2 (52.2 – 100.0)	80.6 ± 8.9 (47.6 – 100.0)	92.3 ± 7.7 (77.0 – 100.0)
> 20 nm (forage areas)	0.0 ± 0.0 (0.0 – 0.0)	0.3 ± 0.2 (0.0 – 8.7)	0.0 ± 0.0 (0.0 – 0.0)	0.0 ± 0.0 (0.0 – 0.0)
Outside Critical Habitat	0.0 ± 0.0 (0.0 – 0.0)	5.8 ± 2.1 (0.0 – 47.8)	19.4 ± 8.9 (0.0 – 52.4)	7.7 ± 7.7 (0.0 – 23.0)
Bathymetry				
Inside 200 m isobath	100.0 ± 0.0 (100.0 – 100.0)	92.2 ± 2.7 (38.7 – 100.0)	73.9 ± 9.7 (42.0 – 100.0)	92.7 ± 6.5 (79.7 – 99.7)
Outside 200 m isobath	0.0 ± 0.0 (0.0 – 0.0)	7.8 ± 2.7 (0.0 – 61.3)	26.1 ± 9.7 (0.0 – 58.0)	7.3 ± 6.5 (0.3 – 20.3)

Adult Females

The deployment duration for the 6 adult females was 21-256 days. Figure 5-2 shows the tracks of the individual adult females predicted from the CTCRW model in winter and summer. At-sea habitat use was variable among individual adult female sea lions (Figure 5-1and Table 5-6). In the summer, an average of 92.3% of the adult female locations (n = 3) were ≤ 20 nm from a rookery or haulout and an average of 78.5% of the locations were within 10 nm (Table 5-6). Most female locations ($\mu = 92.7\%$) were within the 200 m isobath in summer (Table 5-6). One adult female had 23% of her locations beyond 20 nm from a rookery or haulout in summer. In the winter, an average of 80.6% of the locations from 6 adult females were ≤ 20 nm from a rookery or haulout (Table 5-6). One adult female had 52.4% of her locations beyond 20 nm from a rookery or haulout in winter and more than 30% of two adult female's winter locations were outside of 20 nm (Lander et al. 2013). One adult female had 58% of her locations beyond the 200 m isobath in winter (Table 5-6).

From these data, based on a limited sample size, we can infer that adult females primarily use waters less than 200 m deep within 20 nm of a rookery or haulout (with a large proportion within 10 nm) in summer in the western and central Aleutian Islands (see Table 5-6). We can also infer that adult females use a broader range of habitats in winter that can vary substantially among individuals. Though a large proportion of the adult female locations were within 20 nm from a rookery or haulout in winter, there were more locations beyond 10 nm and outside the 200 m isobath compared to summer. While there were more adult female locations outside of 20 nm in winter, an average of 80.6% of the locations were within 20 nm in winter in the central and western Aleutian Islands.

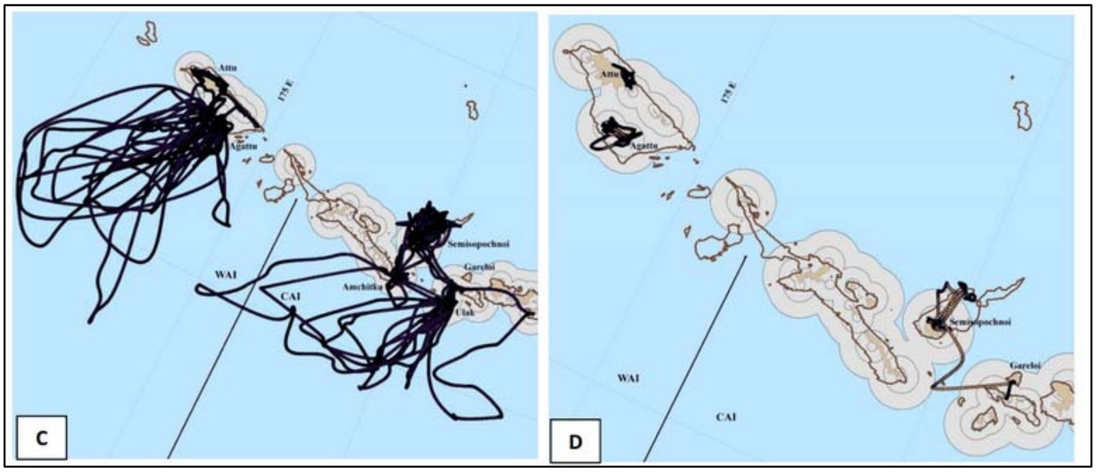


Figure 5-2. Predicted at-sea locations obtained from the CTCRW models for c) six adult female Steller sea lions (n = 42,901 locations) during winter (October-March) and d) 3 adult female Steller sea lions (n = 9,161 locations) during summer (April-September) with respect to designated critical habitat (depicted in gray) and the continental shelf (defined as 200 m, depicted as brown lines). Source: (Lander et al. 2013).

Of the 4 season/age categories analyzed in Lander et al. (2013), adult females in winter had more locations > 20 nm from a rookery or haulout compared to adult females in summer or juveniles in summer or winter. Similar to earlier studies with data pooled across regions (e.g., (NMFS 2001, 2003), this analysis specific to the western and central Aleutian Islands justifies treating the 0-10 nm zone of critical habitat as more important than the 10-20 nm zone, especially for juveniles in summer and winter and adult females in summer. The data from the 6 adult females tracked in winter in the central and western Aleutian Islands (Table 5-6) suggests higher use of the 10-20 nm zone (24%) compared to the data available for adult females tracked in areas further to the east in NMFS (2001) (Table 5-1). However, more than twice as many winter adult female locations were tracked from 0-10 nm compared to the 10-20 nm zone (Table 5-6). This suggests that 0-10 nm may be more important for foraging by both adult females and juveniles in summer and winter in the central and western Aleutian Islands, though adult females appear to be foraging further offshore in winter to a greater extent in the action area relative to areas to the east. For this biological opinion NMFS will treat the area outside of critical habitat (e.g., outside of the Seguam foraging area and the 20 nm zones) consistent with prior biological opinions (NMFS 2000, 2001, 2003) given the similarities in the proportion of habitat use outside of the 20 nm zones in those analyses and in Lander et al. (2013).

Table 5-7. Comparison of the percentage of telemetry locations that were within 0-10 nm of critical habitat upon which NMFS ranked the importance of the 0-10 nm zone in various studies. While these data were filtered with different methods, NMFS relied on the percentage of locations in reaching the conclusions in the respective time periods. Seasons as defined in Figure 5-2.

Study	Adult Females		Juveniles	
	Summer	Winter	Summer	Winter
NMFS 2001	95.6	79	74.4	99.1
NMFS 2003	n/a	n/a	87.1*	67.9*
Lander et al. 2013	78.5	56.3	78.4	100

* Juveniles > 10 months

Though more sea lions were included in this analysis than prior analyses (NMFS 2003, 2010), telemetry coverage relative to the overall age-sex composition of the population remains limited and there are significant gaps. Most juveniles were between 10-13 months old and the greatest temporal coverage was between April-June (Lander et al. 2013). No information on juvenile behavior during September-January has been collected in the western-central Aleutian Islands. Though the sample sizes for adult females are low, there is much better coverage throughout the year due to the seasons over which adult females have been captured. However, data for adult females during the pup-rearing period is lacking in the western and central Aleutian Islands (Lander et al. 2013).

5.3 Exposure Analysis

The objective of the exposure analysis is to establish and describe the resources (e.g., species, populations, individuals, life stages, or habitat elements) that are present in the action area that may be affected by the proposed action. Resources that co-occur with the stressors of a proposed action are exposed to the stressor even if they do not suffer adverse effects from the exposure. We establish which resources will be exposed to which stressors of the proposed action and then we consider the probable duration, frequency, and severity of this overlap.

First, we break the proposed action into constituent elements to understand which resources will be exposed to the various elements of the proposed action. Figure 2.1 in NMFS (2010) shows the constituent elements of the Groundfish Fishery Management Plans (FMPs). Four primary elements are shown in that diagram– the fisheries management policy, the exploitation strategy, the annual fisheries assessment, and the implementation of the fisheries. The focal elements of the proposed action for this project-level consultation are sub-elements of "implementation of the fisheries" – the fishery component, comprised of the harvest of the total allowable catch (TAC) and spatial and temporal restrictions for Steller sea lion conservation (see Figure 2.1 in NMFS (2010). The other element is the research component discussed in Section 2.2. The proposed action can be broken out further by fishery (Atka mackerel, Pacific cod trawl, Pacific cod non-trawl, and pollock) and the research component. We have identified removal of fish, and more specifically sea lion prey, as the primary stressor of these elements. Here we assess the co-occurrence of the proposed removal of sea lion prey with Steller sea lions and designated critical habitat.

The amount of Steller sea lion critical habitat in the action area is approximately 100,286 km^2 (NMFS 2013). Only a few segments of land are not surrounded by a 20 nm critical habitat buffer in fishery management Areas 543, 542, or 541 (Figure 5-3). Thus, almost all fishing activity that takes place within 20 nm of land is within designated Steller sea lion critical habitat. Table 5-9 shows the amount of designated critical habitat within each fishery management area in the central and western Aleutian Islands.

Table 5-8. The amount of area that is designated as Steller sea lion critical habitat in each fishery management area and the total amount of area that is designated as Steller sea lion critical habitat in the action area. Source: Table 5-79 in NMFS (2013).

Fishery Management Area	km^2	Percent of critical habitat in Action Area
541	38,725	38.5%
542	40,743	40.5%
543	20,818	21%
Total	100,286	

5.3.1 Atka Mackerel Fishery

The proposed action would authorize fishing for Atka mackerel in fishery management Area 543 and continue to authorize Atka mackerel fishing in fishery management Areas 541 and 542. Fishery management Area 543 directly overlaps the western Aleutian Islands Steller sea lion sub-region and fishery management Areas 541 and 542 directly overlap the central Aleutian Islands Steller sea lion sub-region.

The Atka mackerel fishery would be open annually into the foreseeable future from January 20 through December 31. The Atka mackerel fishery is split into two seasons, an A season which runs January 20 through June 10 and a B season which runs June 10 through December 31. Fifty percent of the Atka mackerel TAC is apportioned to each season to disperse catch throughout the year to mitigate the potential of depleting Atka mackerel availability for sea lions in either season. Figure 4-6 shows that the Aleutians Islands Atka mackerel catch is more dispersed over the year as managed under Amendment 80 to the BSAI FMP without the Harvest Limit Area management discussed in Section 4.4.2. As discussed in Section 4.4, the data suggest that Atka mackerel is the dominant prey item in the Steller sea lion diet in the western and central Aleutian Islands sub-region year-round.

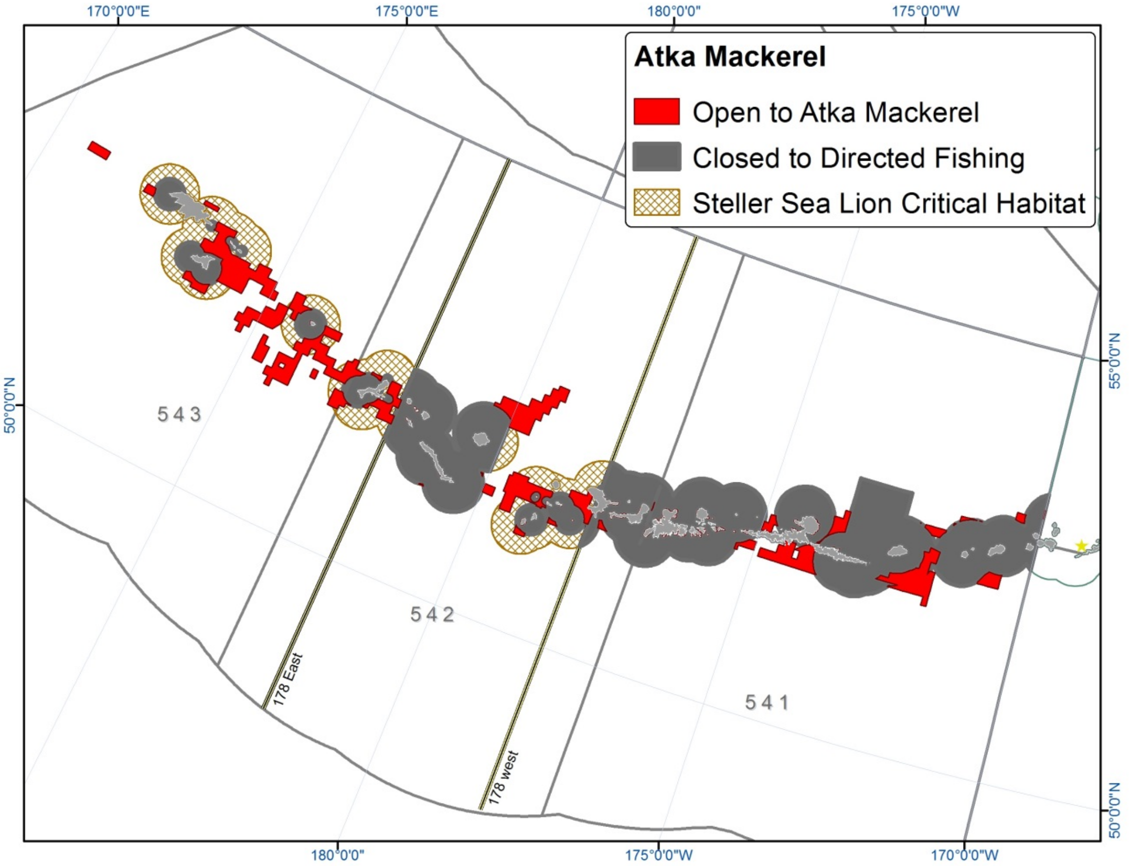


Figure 5-3. Proposed Steller sea lion protection measures for the Atka mackerel fishery in the action area.

Fishery Management Area 543 – The Western Aleutian Islands Sub-region
The proposed action would authorize fishing for Atka mackerel in Area 543 within areas of Steller sea lion critical habitat from 3-20 nm around the three haulouts and from 10-20 nm from the four rookeries, but only in areas outside of the Aleutian Islands Habitat Conservation Area (AICHA). The area open to non-pelagic trawling (outside the AIHCA) outside of critical habitat would be open to fishing for Atka mackerel (Figure 5-3). Table 5-9 shows the percent of critical habitat area, by zone, that would be open to Atka mackerel fishing in Area 543 under the proposed action.

Table 5-9. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Atka mackerel in Area 543 under the proposed action including the area closed to non-pelagic trawling in the AIHCA.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Atka mackerel (km^2)	Percent critical habitat closed (open) with AIHCA	
0–3 nm	698	698	100%	(0%)
3–10 nm	5,893	5,009	85%	(15%)
10–20 nm	14,222	10,098	71%	(29%)
Total	20,818	15,822	76%	(24%)

Fishery Management Area 542 – The Central Aleutian Islands Sub-region (western portion)

There are 11 rookeries in Area 542, 10 that are designated as rookeries and 1 (Kanaga Island/Ship Rock) that is currently used as rookery and treated as a rookery under the proposed action. There are 14 haulouts in Area 542 (15 including Kanaga Island/Ship Rock). In Area 542 the Atka mackerel fishery could occur in critical habitat from 3 to 20 nm around 7 haulouts: Kavalga Island, Unalga & Dinkum Rocks, Kiska Island/Sobaka & Vega, Kiska Island/Sirius Point, Tanadak Island, Amatignak Island/Nitrof Point, and Ugidak Island. Some of the critical habitat zones around these haulouts overlap critical habitat that would be closed around other sites, for example, critical habitat area beyond 3 nm would be closed around Ugidak Island and Kiska Island/Sobaka and Vega given the proximity to other sites that are closed out to 10 or 20 nm. Atka mackerel fishing could occur from 10-20 nm from 5 rookeries (Ulak Island, Kiska Island/Cape St. Stephen, Kiska Island/Lief Cove, Tag Island, and Gramp Rock) in Area 542. Atka mackerel fishing would not be allowed inside critical habitat around the remaining 6 rookeries (including Kanaga Island/Ship Rock) and 7 haulouts in Area 542. Table 5-10 shows the amount of critical habitat that would be open to Atka mackerel fishing in Area 542.

Table 5-10. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Atka mackerel in Area 542 under the proposed action including the area closed to non-pelagic trawling in the AIHCA.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Atka mackerel (km^2)	Percent critical habitat closed (open) with AIHCA	
0–3 nm	2,246	2,246	100%	(0%)
3–10 nm	14,830	13,347	90%	(10%)
10–20 nm	23,666	22,009	93%	(7%)
Total	40,743	37, 483	92%	(8%)

Fishery Management Area 541 – The Central Aleutian Islands Sub-region (eastern portion)

Just less than 40% of the critical habitat in the action area is in Area 541 (Table 5-8) there are 5 rookeries and 12 haulouts in Area 541. Atka mackerel fishing would be allowed in 3% of the critical habitat in Area 541 (Table 5-11)—in a swath of critical habitat from 12 to 20 nm southeast of Seguam Island (Figure 5-3). This swath of open critical habitat is within the 20 nm buffer from the Agligadak Island rookery and the Seguam Island/South Side, Sagigik Island, and Tanadak Island haulouts.

Table 5-11. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Atka mackerel in Area 541 under the proposed action including the area closed to non-pelagic trawling in the AIHCA.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Atka mackerel (km^2)	Percent critical habitat closed (open) with AIHCA	
0–3 nm	1,413	1,413	100%	(0%)
3–10 nm	10,383	10,383	100%	(0%)
10–20 nm	23,445	22,273	95%	(5%)
Seguam	3,484	3,484	100%	(0%)
Total	38,725	37,563	97%	(3%)

5.3.2 Pacific Cod Fishery

Pacific cod are an important prey item in the Steller sea lion diet in winter (October through March) in the central and western Aleutian Islands sub-regions (Sinclair et al. 2013) NMFS does not consider Steller sea lions to be exposed to the effects of the Pacific cod fishery in April through September.

Steller sea lion protection measures are proposed separately for vessels fishing for Pacific cod with trawl and non-trawl gear. The BSAI Pacific cod TAC is apportioned among sectors per regulations at 50 CFR part 679(a)(7)(i) and (ii). Pacific cod TAC is further allocated by season among these sectors per regulations at 50 CFR 679(a)(7)(i)(B) and (a)(7)(iv)(A). Prior to 2014, the Aleutian Islands Pacific cod ABC and TAC was combined with the Eastern Bering Sea (EBS). Beginning in 2014, a separate ABC and TAC was specified for the Aleutian Islands Pacific cod fishery given evidence that the Aleutian Islands stock is distinct from the EBS stock (Thompson and Palsson 2013). Despite the specification of a separate ABC and TAC for the Aleutian Islands, the sector and seasonal apportionments continue to be based on the combined BSAI TAC per the 50 CFR part 679 regulations. The 2014 BSAI combined Pacific cod TAC is 260,880 mt and the 2014 Aleutian Islands TAC is 6,997 mt. Because the Aleutian Islands TAC is such a small percentage of the combined BSAI TAC (~3%), the Aleutian Islands TAC is likely to be harvested and the directed Pacific cod fishery is likely to be closed before any sector or seasonal limit is reached.

Figure 5-4 shows the weekly distribution of Pacific cod harvest in the Aleutian Islands by sector from 2004 through 2010. Since 2010, the non-trawl sector catch has been distributed more evenly across the year, with a much higher proportion of harvest in the summer months (Source: NMFS Catch Accounting System).

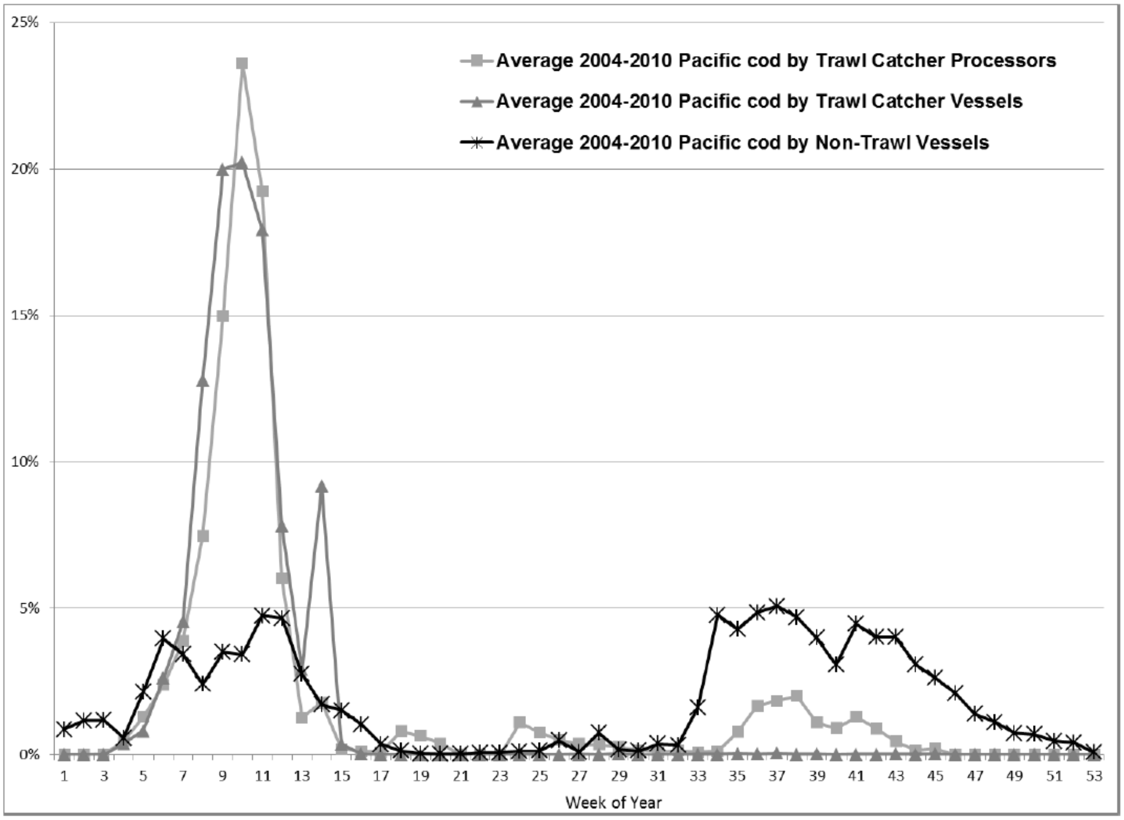


Figure 5-4. The average weekly percentage of Pacific cod catch by sector from 2004-2010. Source: NMFS (2013).

Pacific Cod Trawl Fishery

The BSAI Pacific cod trawl sector catch is allocated among three seasons—the A season (January 1 through April 1), the B season (April 1 through June 10), and the C season (June 10 through November 1). The proposed action would extend the C season date to end December 31 for Amendment 80 vessels and vessels fishing community development quota (CDQ). Trawl catcher/processors and catcher vessels typically start fishing for Pacific cod in week 8 (mid-February and continue fishing Pacific cod through week 12 (mid-March) (Figure 5-4). Trawling is efficient when fish are aggregated and Pacific cod are aggregated in the Aleutian Islands in February and March (NMFS 2013). Fisherman have indicated that it is difficult to find trawlable amounts of Pacific cod after mid-April and most catch outside of the February to March timeframe is Pacific cod catch that is incidental to other fisheries (NMFS 2013). Given the small Aleutian Islands TAC relative to the BSAI Pacific cod season allocations, directed fishing for Pacific cod in the Aleutian Islands is likely to be closed in the A season in the foreseeable future.

The Pacific cod trawl fishery would be allowed to operate within 3-20 nm of critical habitat around haulouts and 10-20 nm around rookeries in areas that are open to non-pelagic trawl gear under the proposed action. One exception is in Area 541 where critical habitat would be closed from 0-20 nm around the Algigadak Island rookery (the only rookery open from 12-20 nm for Atka mackerel fishing in area 541).

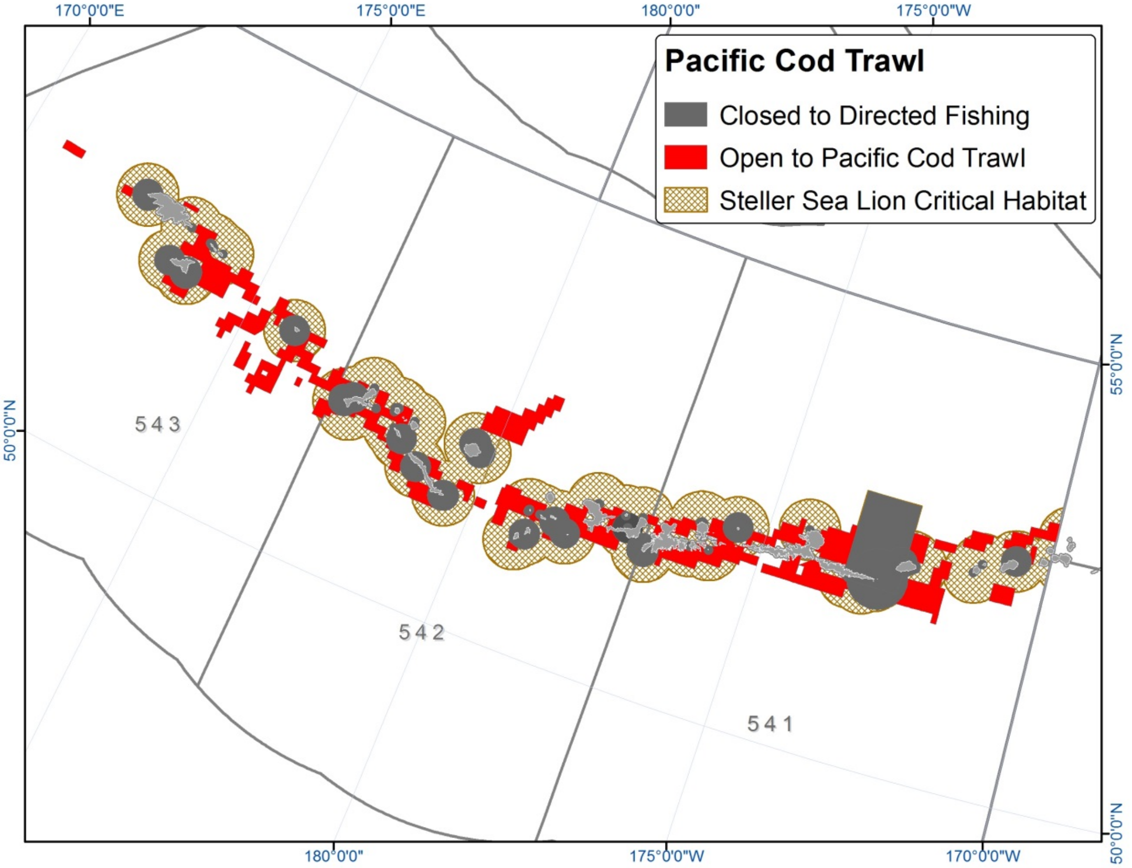


Figure 5-5. Proposed Steller sea lion protection measures for the Pacific cod trawl fishery in the action area.

Table 5-12. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Pacific cod with trawl gear in Area 543 under the proposed action including the area closed to non-pelagic trawling in the AIHCA.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pacific cod trawl (km^2)	Percent critical habitat closed (open) with AIHCA	
0–3 nm	698	698	100%	(0%)
3–10 nm	5,893	5,009	85%	(15%)
10–20 nm	14,222	10,098	71%	(29%)
Total	20,818	15, 805	76%	(24%)

Table 5-13. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Pacific cod with trawl gear in Area 542 under the proposed action including the area closed to non-pelagic trawling in the AIHCA.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pacific cod trawl (km^2)	Percent critical habitat closed (open) with AIHCA	
0–3 nm	2,246	2,246	100%	(0%)
3–10 nm	14,830	12,012	81%	(19%)
10–20 nm	23,666	19,169	81%	(19%)
Total	40,743	7741	82%	(18%)

Table 5-14. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Pacific cod with trawl gear in Area 541 under the proposed action including the area closed to non-pelagic trawling in the AIHCA.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pacific cod trawl (km^2)	Percent critical habitat closed (open) with AIHCA	
0–3 nm	1,413	1,413	100%	(0%)
3–10 nm	10383	8,099	78%	(22%)
10–20 nm	23445	15,943	68%	(32%)
Seguam	3,484	3,484	100%	(0%)
Total	38,725	29,043	75%	(25%)

Pacific Cod Non-trawl Fishery

The Pacific cod non-trawl allocation is split between three gear types—hook-and-line, pot, and jig gear. The majority of non-trawl Pacific cod catch is harvested by hook-and-line catcher/processors in the Aleutian Islands. The hook-and-line allocation is apportioned between an A (January 1 through June 10) and a B (June 10 through December 31) season. Pacific cod catch by non-trawl gear is distributed throughout the year to a much greater extent than Pacific cod catch with trawl gear, even more so in more recent years than those included in Figure 5-4 (source: NMFS Catch Accounting System). Though, as mentioned above, the Aleutian Islands directed Pacific cod fishery is likely to close prior to the end of the A season under the new Aleutian Islands-specific TAC.

The Pacific cod non-trawl fishery would be allowed to operate within 0-20 nm of critical habitat around haulouts and 3-20 nm around rookeries in Areas 543, 542, and 541. The one exception is around the Buldir Island rookery in Area 543 that would only be open from 10-20 nm.

Table 5-15. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Pacific cod with non-trawl gear in Area 543 under the proposed action.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pacific cod non-trawl (km^2)	Percent critical habitat closed (open)	
0–3 nm	698	374	54%	(46%)
3–10 nm	5,893	991	17%	(83%)
10–20 nm	14,222	0	0%	(100%)
Total	20,818	1,365	7%	(93%)

Table 5-16. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Pacific cod with non-trawl gear in Area 542 under the proposed action.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pacific cod non-trawl (km^2)	Percent critical habitat closed (open)	
0–3 nm	2,246	805	35%	(65%)
3–10 nm	14,830	0	0%	(100%)
10–20 nm	23,666	0	0%	(100%)
Total	40,743	805	2%	(98%)

Table 5-17. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for Pacific cod with non-trawl gear in Area 541 under the proposed action.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pacific cod non-trawl (km^2)	Percent critical habitat closed (open)	
0–3 nm	1,413	1,038	73%	(27%)
3–10 nm	10,383	5,065	49%	(51%)
10–20 nm	23,445	11,260	48%	(52%)
Seguam	3,484	3,484	100%	(0%)
Total	38,725	20,846	54%	(46%)

5.3.3 Pollock Fishery

Pollock are assumed to be an important prey item in the Steller sea lion diet in winter (October through March) in the central and western Aleutian Islands sub-regions based on the results of Sinclair et al. (2013) and the 10% FO threshold used in our ESA section 7 groundfish fishery consultations. NMFS does not consider Steller sea lions to be exposed to the effects of the pollock fishery in April through September.

The pollock fishery is split into two seasons—an A season (January 20 through June 10) and a B season (June 10 through November 1). The A season apportionment cannot exceed 40% of the Aleutian Islands pollock ABC. There has not been any fishing for pollock the past several years (see section 4.4.4), so we looked at the average weekly catch distribution of the BSAI pollock fishery in 2000 through 2004 in the 2003 Biological Opinion (Figure III-7 in NMFS (2003) for an estimate of the seasonal distribution of pollock catch in the Aleutian Islands. Figure III-7 in NMFS (2003) shows a peak in pollock harvest from early January through mid-March and another peak of similar magnitude from approximately June through September.

Area 543

The proposed action would open a 1,112 km^2 patch of critical habitat from 3 to 20 nm around the three haulouts in Area 543. This would open 13% of the Area 543 critical habitat from 3-10 nm, 2% of the critical habitat from 10-20 nm, and 5% of the total Area 543 critical habitat (Table 5-18).

Table 5-18. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for pollock in Area 543 under the proposed action.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pollock fishing (km^2)	Percent critical habitat closed (open)	
0–3 nm	698	698	100%	(0%)
3–10 nm	5,893	5,124	87%	(13%)
10–20 nm	14,222	13,884	98%	(2%)
Total	20,818	19,706	95%	(5%)

Area 542

The proposed action would open a patch of critical habitat to pollock fishing outside of 3 nm from three haulouts around Hawadax Island—the Tanadak Island, Segula Island, and Hawadax Island/Krysi Point haulouts—which also includes area outside of 10 nm from the Little Sitkin Island haulout and the Ayugadak Point rookery. In one degree of longitude (178° W to 177° W) on the eastern edge of Area 542, a patch of critical habitat would be open to pollock fishing outside of 3 nm from the Kanaga Island/North Cape and Bobrof Island haulouts. Critical habitat would be closed out to 20 nm on the west side of the Tanaga Island/Bumpy Point haulout and closed out to 3 nm on the east side. The proposed action would close pollock fishing to 3 nm from the north side of the Kanaga Island/Ship Rock site that is designated as a haulout and also functioning as a rookery. The south side of Kanaga Island/Ship Rock would be closed to 10 nm. In all, 13% of critical habitat would be open to fishing for pollock in Area 542 (Table 5-19).

Table 5-19. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for pollock in Area 542 under the proposed action.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pollock fishing (km^2)	Percent critical habitat closed (open)	
0–3 nm	2,246	2,246	100%	(0%)
3–10 nm	14,830	12,996	88%	(12%)
10–20 nm	23,666	20,374	86%	(14%)
Total	40,743	35,616	87%	(13%)

Area 541

Pollock fishing would be allowed inside critical habitat from 3-20 nm from haulouts and from 10-20 nm from rookeries, although no fishing would be allowed inside the Seguam special foraging area. In total, fishing for pollock would be allowed in 72% of the designated critical habitat in Area 541 (Table 5-20).

Table 5-20. Amount (km^2) and percent of Steller sea lion critical habitat closed to fishing for pollock in Area 541 under the proposed action.

Critical habitat Zone	Critical habitat total (km^2)	Critical habitat closed to Pollock fishing (km^2)	Percent critical habitat closed (open)	
0–3 nm	1,413	1,413	100%	(0%)
3–10 nm	10,383	4,089	39%	(61%)
10–20 nm	23,445	1,778	8%	(92%)
Seguam	3,484	3,484	100%	(0%)
Total	38,725	10,764	28%	(72%)

5.3.3.1 Summary of critical habitat area open to fishing and estimated seasonal catch distribution

Table 5-22 shows which zones of critical habitat would be open to which fisheries under the proposed action in each fishery management area. Of the 36 cells in Table 5-22, 6 would be open to all 4 fisheries under the proposed action, though in most of those cells pollock is only open to fishing in a patch of critical habitat. The greatest extent of overlap in terms of number of active fisheries would occur in winter from 3-20 nm of critical habitat in a maximum of 5% of the area designated as critical habitat in Area 543 (Table 5-21 and Table 5-22, Figure 5-6). When the open critical habitat area is combined among all fisheries, Area 541 has the largest amount of critical habitat open to fishing, Area 542 is a close second, and 543 has the smallest amount of critical habitat open to fishing (accounting for the proportion of the critical habitat in each area).

From this analysis, we assume that, in summer, Steller sea lions would only be exposed to the effects of the Atka mackerel fishery in 24%, 8%, and 3% of the area designated as critical habitat in Areas 543, 542, and 541 respectively (in a total of 9% of the critical habitat in the action area). In winter, we assume that Steller sea lions would be exposed to the effects of the Atka mackerel fishery in a total of 9% of the critical habitat in the action area, the effects of the Pacific cod trawl fishery in a total of 52% of the critical habitat in the action area, the effects of the Pacific cod non-trawl fishery in a total of 77% of the critical habitat in the action area, and the effects of the pollock fishery in 34% of the critical habitat in the action area.

From the catch data, we see that Pacific cod trawl fisheries are the most temporally compressed fisheries (approximately mid-February to mid-March). The next most temporally compressed fishery is likely pollock (historically two peaks—one in early January through mid-March and another approximately June through September). The amount of the pollock that can be harvested in the A season, when pollock is important in the sea lion diet, is limited to 40% of the ABC. Atka mackerel and Pacific cod non-trawl catches are distributed more evenly throughout the year.

There would be no direct spatial overlap between the fisheries and Steller sea lions from 0-3 nm around rookeries. Rookeries are important sites for Steller sea lions in the summer. The only overlap between the fisheries and Steller sea lions in summer would be with the Atka mackerel fishery from 10 to 20 nm around rookeries. There would be more overlap between the fisheries and Steller sea lion critical habitat around haulouts in the winter (Table 5-22). Figure 5-6 shows which areas would be open to all four fisheries, which areas are open to three fisheries, and so on and includes area inside and outside of critical habitat.

Table 5-21. Amount of critical habitat that would be open to each fishery, by fishery management area and season when each species is assumed to be important in the Steller sea lion diet (see section 3.12.2).

		543	**542**	**541**
Summer	Atka Mackerel	24%	8%	3%
Winter	Atka mackerel	24%	8%	3%
	Pacific cod-Trawl	24%	18%	25%
	Pacific Cod-Non-trawl	93%	98%	46%
	Pollock	5%	13%	72%

Table 5-22. Summary of which zones of critical habitat would be open to which fisheries in each fishery management area under the proposed action. Cells are shaded according to the number of fisheries that would be open in each zone of Steller sea lion critical habitat (4, 3, 2, 1 or none).

	Zone	**543**		**542**			**541**
			177° E – 178 ° E	**178° E-180°**	**180 ° - 178 ° W**	**178 ° W - 177 ° W**	
Rookeries	0-3 nm						
	3-10 nm	P cod non-trawl[1]	P cod non-trawl, pollock (patch)	P cod non-trawl	P cod non-trawl	P cod non-trawl, pollock (Kanaga only)	P cod non-trawl[2]
	10-20 nm	Atka mackerel, P cod trawl, P cod non-trawl	Atka mackerel, P cod trawl, P cod non-trawl	P cod trawl, P cod non-trawl	Atka mackerel, P cod trawl, P cod non-trawl	P cod trawl, P cod non-trawl, pollock	Atka mackerel (patch[3]), P cod trawl[4], P cod non-trawl[2], pollock
Haulouts	0-3 nm	P cod non-trawl	P cod non-trawl, pollock (patch)	P cod non-trawl	P cod non-trawl	P cod non-trawl	P cod non-trawl[2]
	3-10 nm	Atka mackerel, P cod trawl, P cod non-trawl, pollock (patch)	Atka mackerel, P cod trawl, P cod non-trawl, pollock (patch)	P cod trawl, P cod non-trawl	Atka mackerel, P cod trawl, P cod non-trawl	P cod trawl, P cod non-trawl, pollock	P cod trawl, P cod non-trawl[2], pollock
	10-20 nm	Atka mackerel, P cod trawl, P cod non-trawl, pollock (patch)	Atka mackerel, P cod trawl, P cod non-trawl, pollock (patch)	P cod trawl, P cod non-trawl	Atka mackerel, P cod trawl, P cod non-trawl,	P cod trawl, P cod non-trawl, pollock	Atka mackerel[3], P cod trawl, P cod non-trawl[2], pollock

[1] Except Buldir Island Rookery
[2] Except east of 172.59° W
[3] Only in 12-20 nm around Seguam Island Rookery
[4] Except Agligadak Island Rookery

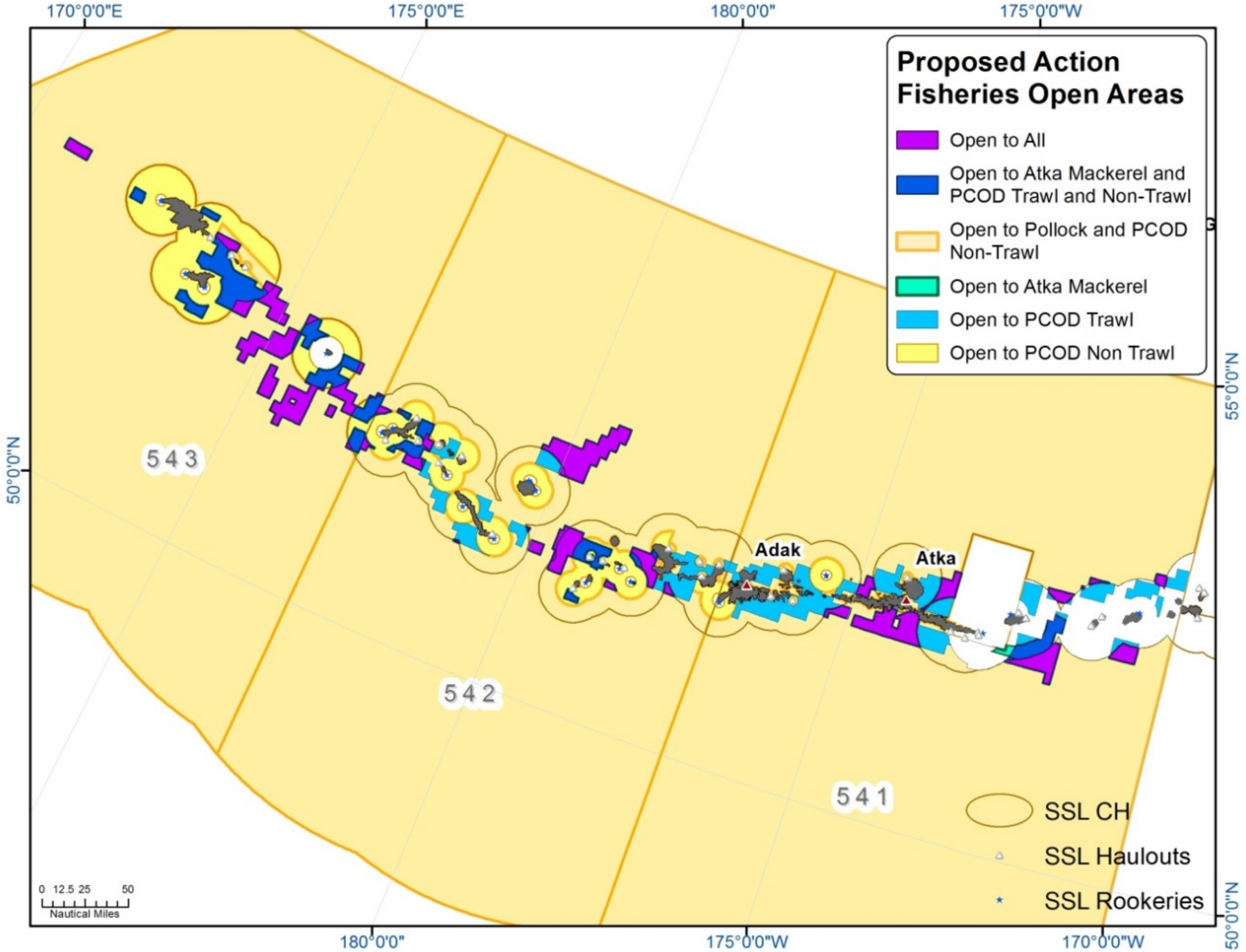


Figure 5-6. Areas that would be open to particular fisheries and to multiple fisheries under the proposed action.

5.3.4 Fishery Overlap with Observed Steller Sea Lion Locations

We used a geographic information system (GIS) to explore the extent of spatial overlap between observed Steller sea lion locations (telemetry and Platforms of Opportunity (Platform) data sightings), historic Pacific cod and Atka mackerel fishing locations, and areas proposed to be open to fishing in the central and western Aleutian Islands. We plotted the available central and western Aleutian Islands sea lion telemetry data in Lander et al. (2013) and confirmed Steller sea lion sightings in the Platform database from 1992 through 2012 by summer (April through September) and winter (October through March). Using the same season dates, summer and winter Atka mackerel and winter Pacific cod fishery data from individual hauls from 1992 through 2012 were summed over a 7 km^2 grid. The Steller sea lion locations were plotted over the respective fishery grids and maps of the areas that would be open to directed fishing under the proposed action. The objective of this exercise was to provide a snapshot of the available Steller sea lion at-sea location information and to examine how many of the sea lion sightings or locations overlap each fishery in each Area. Several limitations with the available data complicate interpretation of the extent of expected overlap between the fisheries and Steller sea lions. For example, the sample size of telemetered animals is small and may not be representative of the whole population. Steller sea lions spend more time at the surface near haulouts and rookeries which may result in a higher proportion of location information in nearshore areas and fewer locations (satellite transmissions) when sea lions are offshore. Position fixes are autocorrelated (not independent of one another) and due to infrequent position fixes there is no information on the animal's location between positions. To date, no juvenile sea lions have been tracked with telemetry devices from September through January in the western-central Aleutian Islands.

The Platforms database contains information on animals other than those that have been tracked with telemetry. The available telemetry data for the western and central Aleutian Islands consists of data from juveniles and adult females (Lander et al. 2013). The Platforms database does not record age or sex, but contains some records of body length and behaviors. Across the years there have been Platform sightings in every month of the year, perhaps providing additional information about distribution in months when animals have been tagged.

The Platform and telemetry locations comprise the extent of the available at-sea observations of Steller sea lions. The Platform data indicate where animals have been sighted from opportunistic platforms but do not provide information about where animals do not occur. The telemetry data show important areas for sea lions near rookeries and haulouts which may be closed to vessel transit or fishing and thus would not reflect high use in the Platform data. With respect to Steller sea lions, this exercise is a presence-only look at where sea lions have been seen (Platform) or tracked (telemetry). If an area has few or no sea lion locations or sightings, we cannot infer that the area is not used by sea lions. However, the fishery data may be used to infer historic presence and absence of fishing.

The fishing data from all fisheries were summed over a 7 km^2 grid to examine the extent of overlap with the number of sea lion locations and sightings. To preserve the confidentiality of the Pacific cod and pollock fishing, we display the areas fished by summing over a 20 km^2 grid in the following maps. Thus, there appears to be more direct overlap between the Pacific cod and pollock fisheries and the sea lion locations in the figures than is reported in the text. The numbers in the text reflect the overlap with the 7 km^2 grid and may not match the figures shown here. The Atka mackerel fishery data do not disclose confidential information at the resolution of the 7 km^2 grid and thus the data are shown in the 7 km^2 grid. For this comparison, we used directed pollock harvest from 1992 through 1998, and directed Atka mackerel and Pacific cod harvest from 1992 through 2012.

Table 5-23 shows the number of adult female and juvenile Steller sea lions for which we have telemetry data in the central (Areas 541 and 542) and western (Area 543) Aleutian Islands, by season. Table 5-24 shows the total number of Steller sea lion sightings in the Platform database for each fishery management area from 1992 through 2012, by season. As shown in the tables below, the Platform database contains 189 confirmed Steller sea lion sightings (representing 1,005 individual sea lions) in the western and central Aleutian Islands over the past 20 years.

We used the filtered, raw diagnostic telemetry data in Lander et al. (2013) for this comparison of sea lion and fishery locations. The initial dataset consisted of 24,004 locations from 39 juvenile and 6 adult Steller sea lions. Many (n = 6,836) of these locations plotted near the edge of the islands or onshore, and were thus not available to be selected in the overlap analysis. A total of 17,168 filtered telemetry locations in the western and central Aleutian Islands from the 45 sea lions in Lander et al. (2013) were available for this comparison. Thus, the telemetry information provides the bulk of the information about at-sea habitat use in the western and central Aleutian Islands. This analysis includes new telemetry data from 17 juveniles and 6 adult females that were not available for NMFS (2010) in addition to the data from 22 juveniles analyzed in NMFS (2010) (see section 5.2).

Table 5-23. Number of Steller sea lions fitted with telemetry devices by area, age class and season and the number of telemetry locations available for the spatial overlap analysis by area and season. Data source: Lander et al. (2013).

Area	Winter				Summer			
	Adult tagged	Adult locations	Juvenile tagged	Juv locations	Adult tagged	Adult locations	Juvenile tagged	Juv locations
541/542	4	2,079	3	322	1	125	36	10,822
543	3	1,884	0	0	2	1,125	3	811

Table 5-24. Number of Steller sea lion sighting events (and number of sea lions sited) in the Platform database from 1992 through 2012 by area and season.

Area	Winter	Summer
541	8 (102)	8 (22)
542	56 (384)	69 (364)
543	15 (56)	33 (77)
Total	189 (1,005)	

Table 5-25. Number of Platform sightings and telemetry locations that directly overlap the area that would be open to Atka mackerel fishing where the fishery has historically operated, by fishery management area and season.

Atka Mackerel								
Area	**Winter**				**Summer**			
	Inside CH		Outside CH		Inside CH		Outside CH	
	Platform	Telemetry	Platform	Telemetry	Platform	Telemetry	Platform	Telemetry
541	0	0	0	0	0	1	0	0
542	7 (41)	0	5 (12)	75	3 (8)	2	3 (9)	1
543	2 (9)	2	1 (1)	0	6 (19)	2	6 (12)	5

Atka mackerel in 543 - Summer

Of the fisheries included in this consultation, the Atka mackerel fishery is the only fishery expected to affect Steller sea lions in summer (see Figure 5-7). There were 1,936 telemetry locations from 2 adult females and 3 juveniles in Area 543 in the summer. Only 7 of the telemetry locations overlapped areas where fishing has occurred historically that would be open to the fishery under the proposed action—2 of these locations were inside critical habitat and 5 were outside of critical habitat (Table 5-25). Historically, Atka mackerel fishing has only occurred in a small amount of the area that would be open to the fishery in Area 543. The fishery has only operated in a small portion of the critical habitat area open to the Atka mackerel fishery between Shemya and Agattu Islands (Figure 5-7). Over the last 20 years, there have been 33 at-sea sightings (representing 77 sea lions) of Steller sea lions in Area 543 in the summer (Table 5-24).

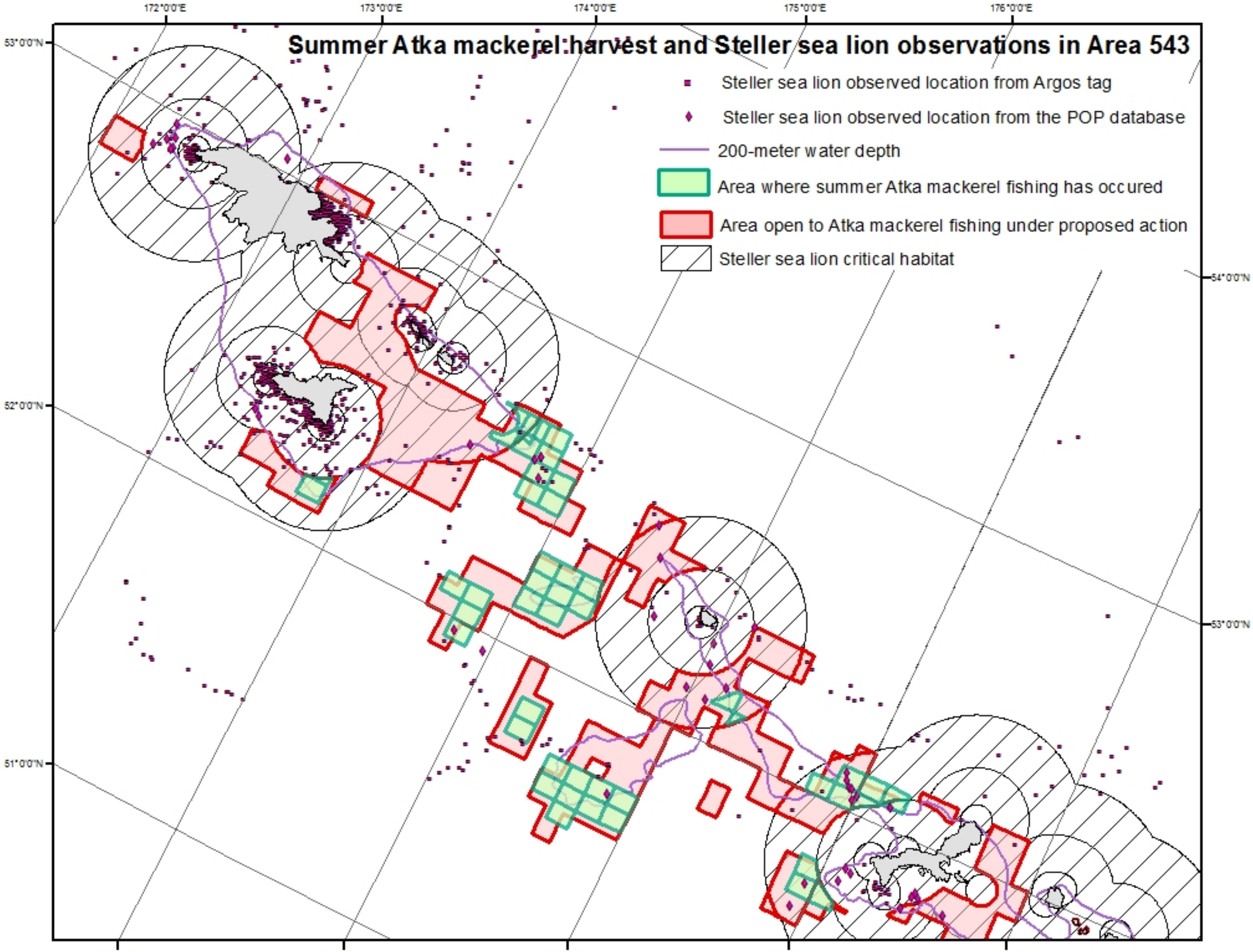


Figure 5-7. Atka mackerel fishery and Steller sea lion locations in summer in Area 543.

Atka mackerel in Area 543 – Winter
Telemetry location data are available from 3 adult females (1,884 locations) in Area 543 in the winter. The telemetry locations were tightly clustered in the same general locations as in the summer. There was greater use of the 10 to 20 nm zone of critical habitat south of the Shemya Island haulout near Ingenstrem Rocks by sea lions in the winter; however, the majority of the available locations were clustered just outside of the area open to the Atka mackerel fishery (Figure 5-8). Two of the available winter telemetry locations overlapped the area that would be open to the Atka mackerel fishery where fishing has occurred in the past inside critical habitat in Area 543. Two Platform sightings (consisting of 9 sea lions) overlap the area open to the Atka mackerel fishery where fishing has occurred inside of critical habitat in winter in Area 543 (Table 5-25).

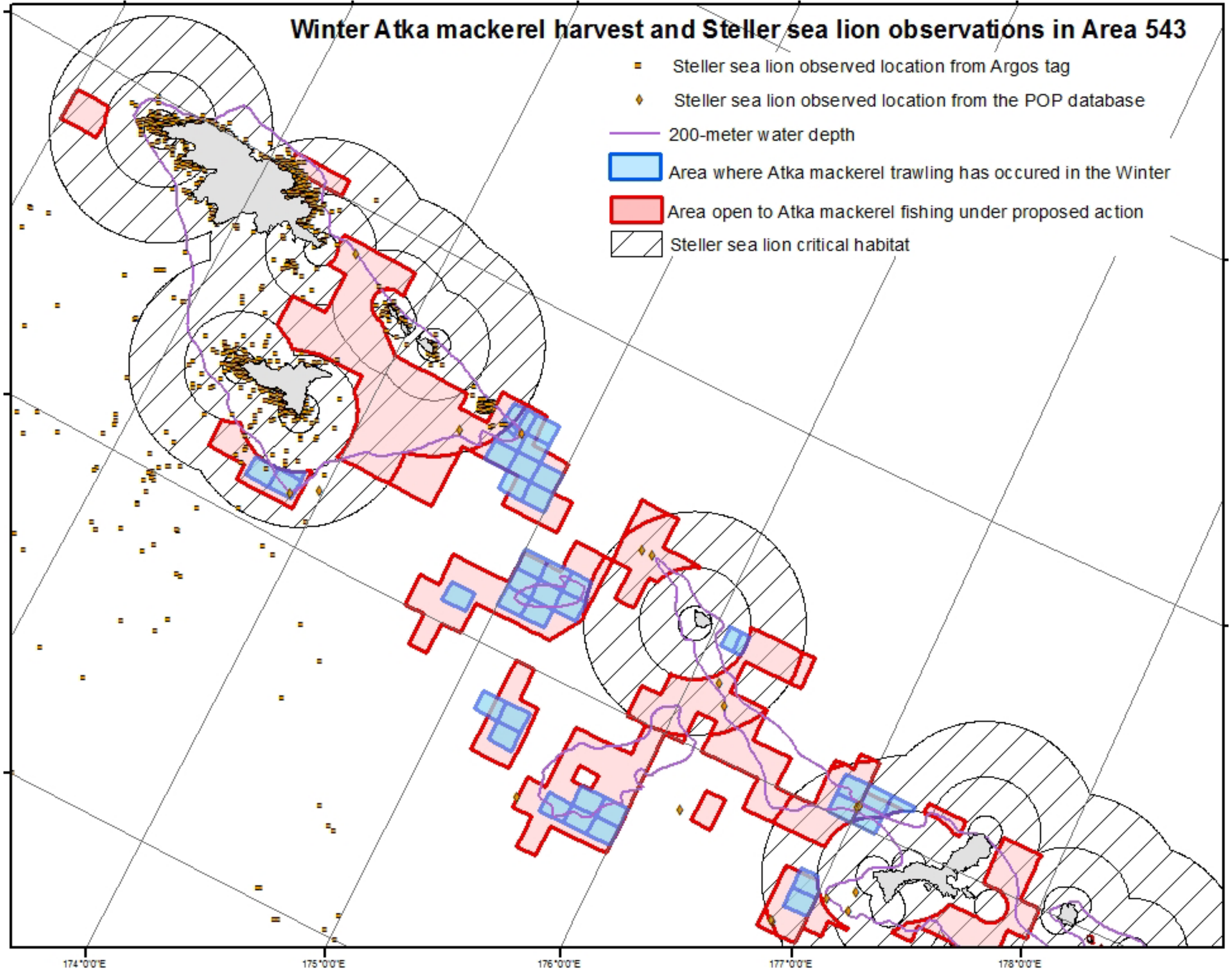


Figure 5-8. Atka mackerel fishery and Steller sea lion locations in winter in Area 543.

Atka mackerel in Area 541/542 – Summer
Telemetry data are available from one adult female and 36 juveniles in summer in Areas 541 and 542.

In Area 542, only 2 of the 10,947 telemetry locations overlap the anticipated fishing area inside of critical habitat. The available telemetry data are primarily from juveniles and the sample size (n=36) larger than in Area 543. However, telemetry data are only available for one adult female in Area 542 in summer. There are 11 rookeries (counting Kanaga Island/Ship Rock as a rookery) in Area 542 (Table 4-3). This adult female was tagged at the Ulak Island/Hasgox Point rookery. Her summer locations comprise transmissions from April 1 through 24, 2012 when her transmissions ended. As noted above, the areas without direct location or sighting data cannot be used to infer areas of low sea lion use. The 2 telemetry locations and 2 of the Platform sightings overlap with the critical habitat area that would be open to Atka mackerel fishing where fishing has occurred inside critical habitat, just west of 178°W longitude in the 10-20 nm zone from the Gramp Rock rookery, Tag Island rookery, and Ugidak Island haulout. One Platform sighting is in an area that would be open to fishing, where fishing has occurred, is in the 10-20 nm zone from the Amatignak Island/Nitrof Point haulout (Figure 5-9).

One telemetry location and 3 Platform sightings (consisting of 9 sea lions total) overlap the anticipated Atka mackerel fishing area on Petrel Bank outside critical habitat in Area 542 in summer (Table 5-25, Figure 5-9). Figure 5-9 shows the area to the southwest of the Amchitka Island/Column Rocks rookery and to the west of Amchitka Island/East Cape rookery where fishing occurred under the action analyzed in the FMP BiOp (NMFS 2010). This area with a relatively high density of Platform sightings would be closed to directed fishing for Atka mackerel under the proposed action.

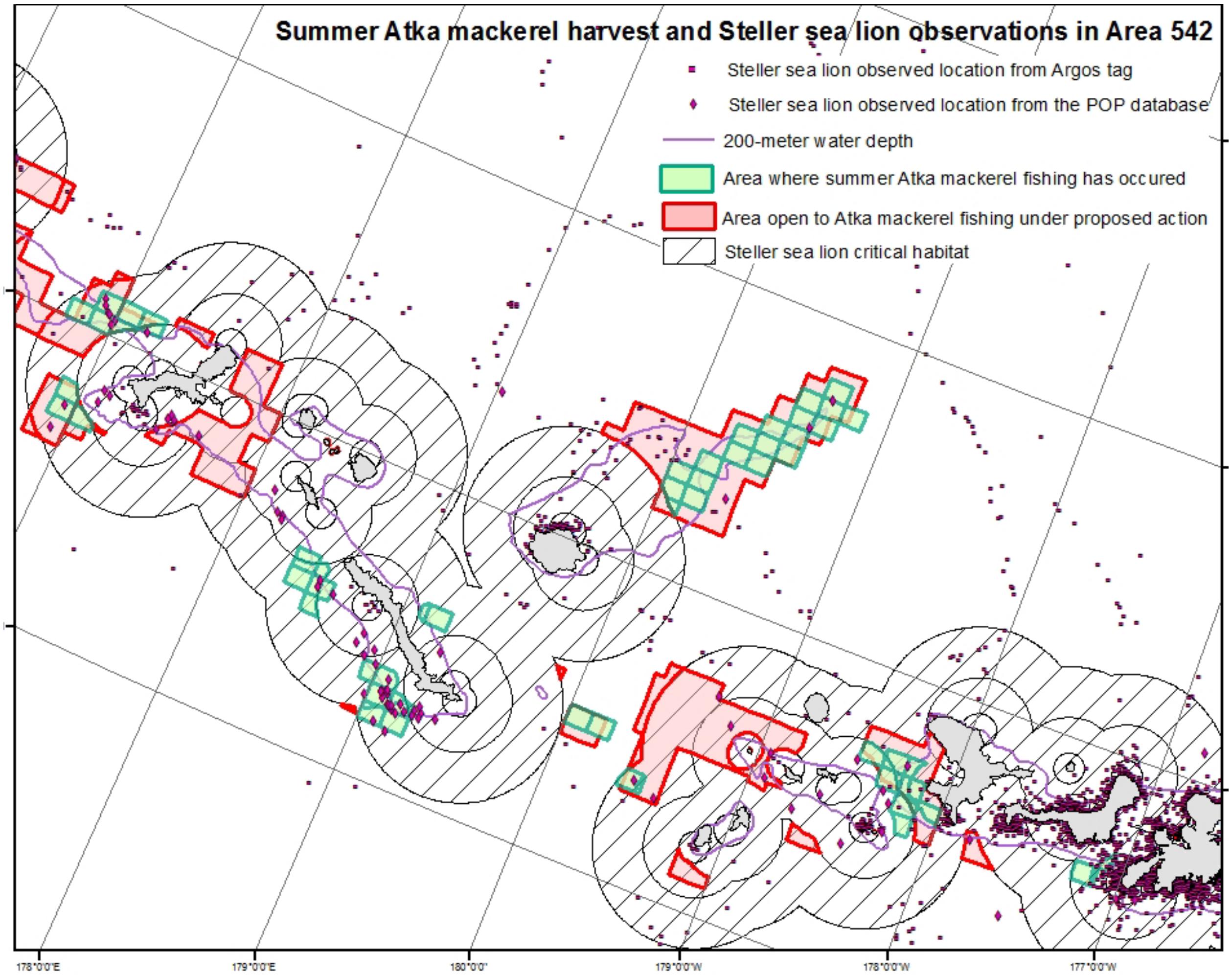


Figure 5-9. Atka mackerel fishery and Steller sea lion locations in summer in Area 542.

The telemetry location data in summer in Area 541 are from juveniles, thus the available data do not inform adult sea lion habitat use in Area 541 in summer. None of the available location data or Platform sightings overlap the area that would be open to the Atka mackerel fishery where fishing has occurred historically (Figure 5-10, Table 5-25). The proposed Atka mackerel fishery would be open inside a portion of critical habitat from 12-20 nm that has been closed since 2001. We examined the sea lion locations that occurred in this area that would be open to the Atka mackerel fishery under the proposed action and found that one juvenile location from the limited set of winter locations occurred in this area.

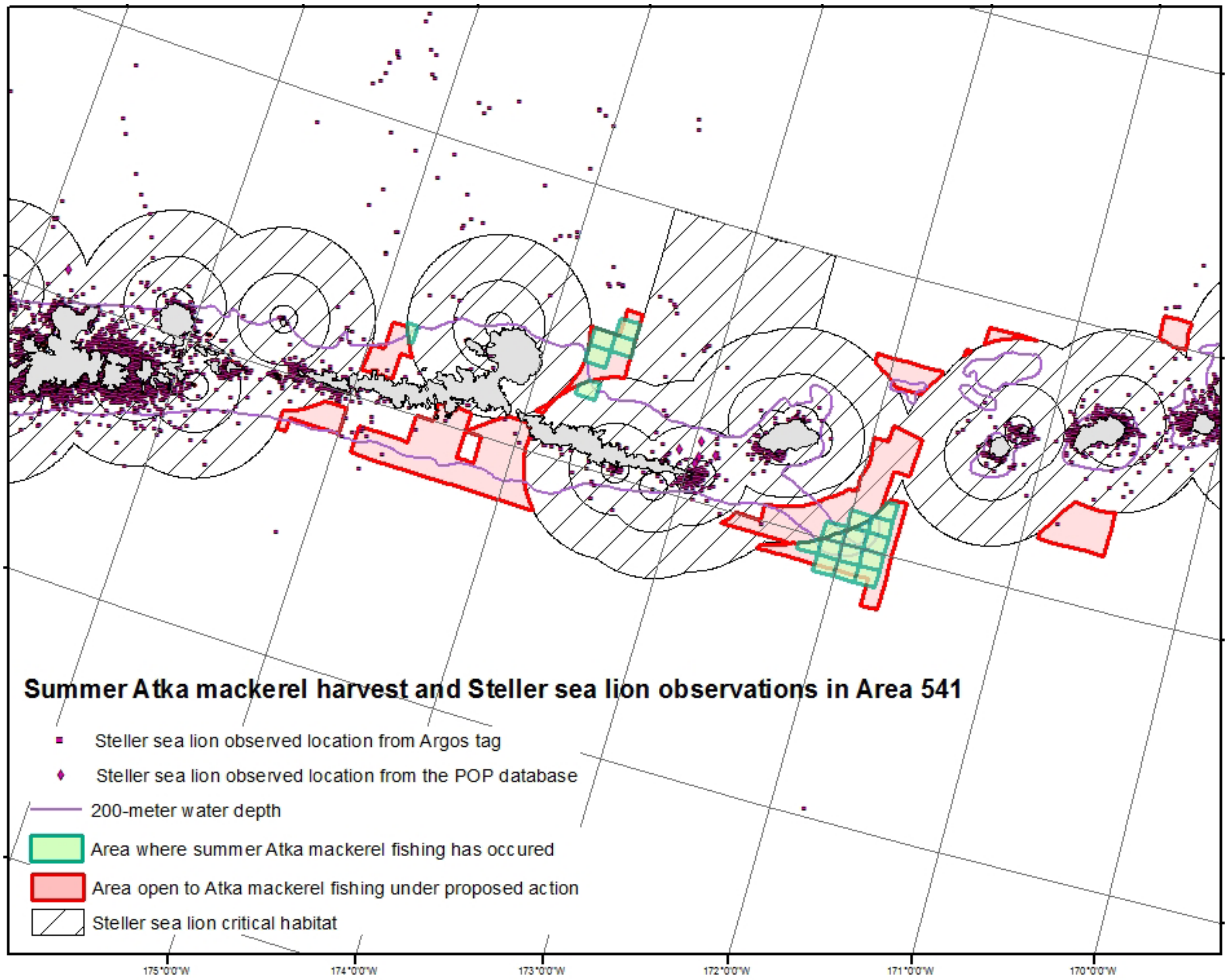


Figure 5-10. Atka mackerel fishery and Steller sea lion locations in summer in Area 541.

Atka mackerel in Area 541/542 – Winter

There are a total of 64 Platform sightings (486 sea lions) and 2,401 telemetry locations in winter in Areas 541 and 542. The telemetry data represent winter locations of 4 adult females and 3 juveniles. The general location information is similar to the summer, though there are more locations in the southwestern portion of Petrel Bank. The greatest overlap between the available sea lion telemetry locations and the Atka mackerel fishery is in the middle of Petrel Bank (outside of critical habitat) with additional observed overlap in the 10-20 nm zone of the Gramp Rock and Tag Island rookeries and the Tanaga Island/Bumpy Point haulout (Figure 5-11).

The available winter telemetry location data in Area 541 comprise locations from juveniles tagged at the Seguam Island/Turf Point haulout (Lander et al. (2013). The winter data are based on transmissions by these juveniles in March. The available telemetry data are most limited for Area 541 in winter. There have been 8 Platform sightings in Area 541 in winter consisting of a total of 102 sea lions (Table 5-24). None of the available telemetry or Platform locations overlap the area that would be open to the Atka mackerel fishery, though the sea lion location data are very limited in that area and season (Figure 5-12).

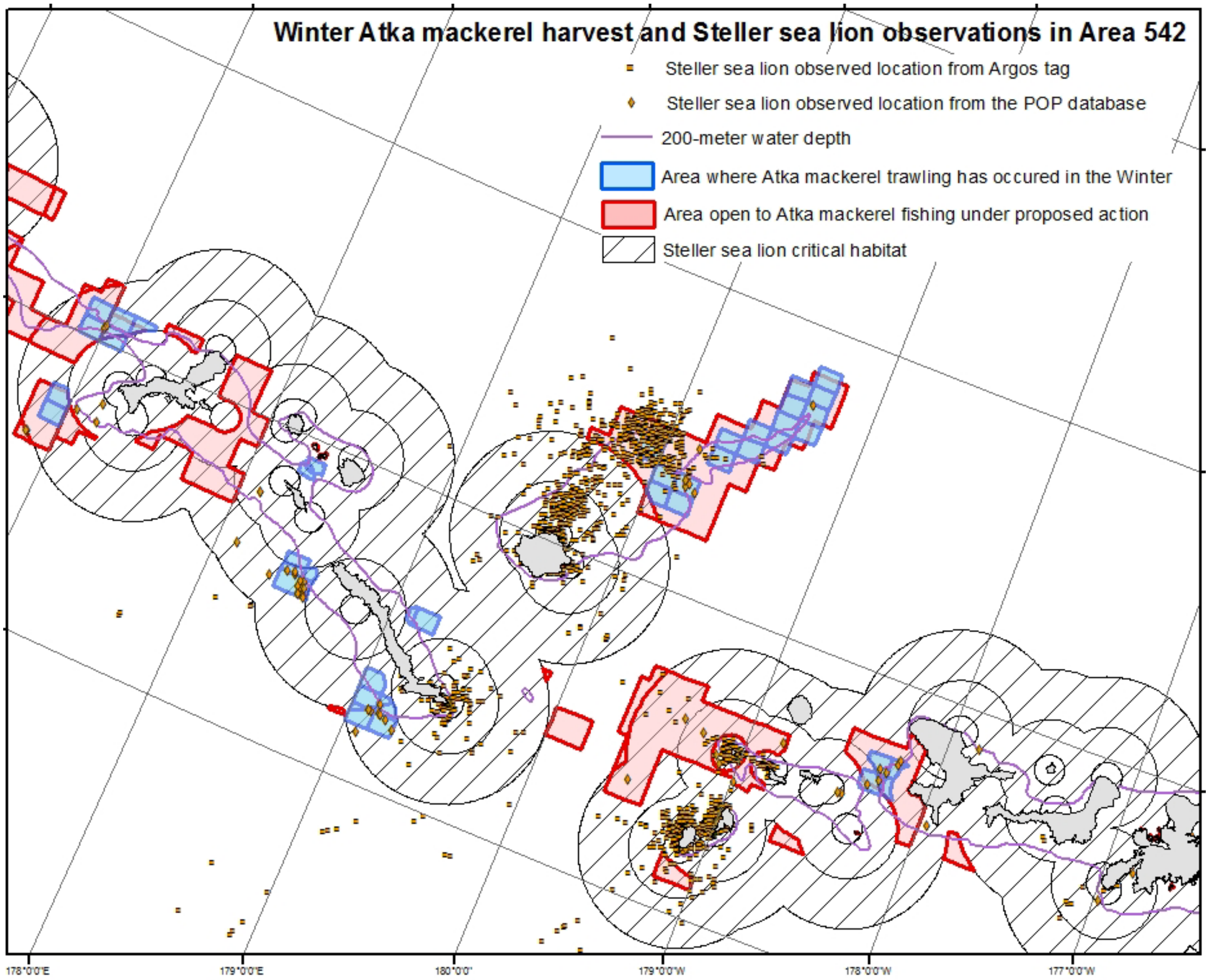


Figure 5-11. Atka mackerel fishery and Steller sea lion locations in winter in Area 542.

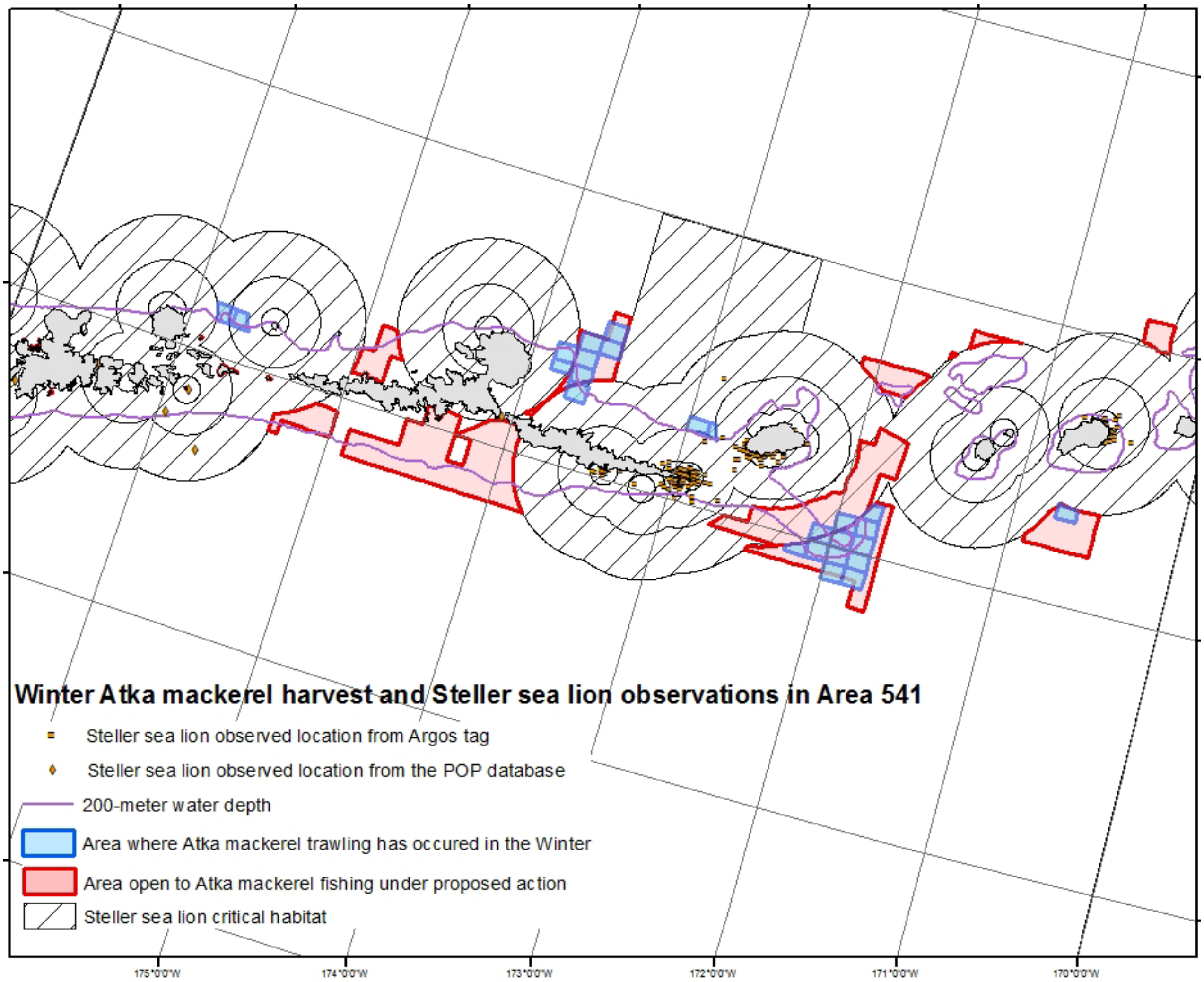


Figure 5-12. Atka mackerel fishery and Steller sea lion locations in winter in Area 541.

Table 5-26. Number of the total winter Platform sightings (79 sightings representing 723 sea lions) and telemetry locations (see Table 5-23) that directly overlap the area that would be open to the Pacific cod trawl fishery where the fishery has historically operated by fishery management area in the winter.

Pacific cod -Trawl				
Area	Inside CH		Outside CH	
	Platform	Telemetry	Platform	Telemetry
541	2 (2)	0	0	0
542	78 (640)	152	12 (25)	256
543	20 (66)	78	7 (13)	0

Pacific cod Trawl in Area 543 – Winter

The available telemetry data in Area 543 in winter consist of 1,884 locations from 3 adult females. There have been 21 Platform sightings in Area 543 in winter over the past 20 years. Seventy-eight of the 1,884 telemetry locations and 3 of the Platform sightings overlapped the area that would be open to trawling for Pacific cod where the fishery has operated historically in Area

543. This overlap occurred in the area open to Pacific cod trawling between the south end of Attu Island and the north end of Alaid Island inside10-20 nm of critical habitat, and inside 10-20 nm of critical habitat south of Agattu Island. As with the Atka mackerel fishery in Area 543, the Pacific cod fishery operates just adjacent to several sea lion locations near Ingenstrem Rocks (Figure 5-13). We conducted the comparison on a 7 km^2 grid, but the Pacific cod fishery data are displayed here in a 20 km^2 grid to preserve confidentiality. Thus, the direct fishery footprint area shown in Figure 5-13 through Figure 5-18 is larger than the actual direct footprint.

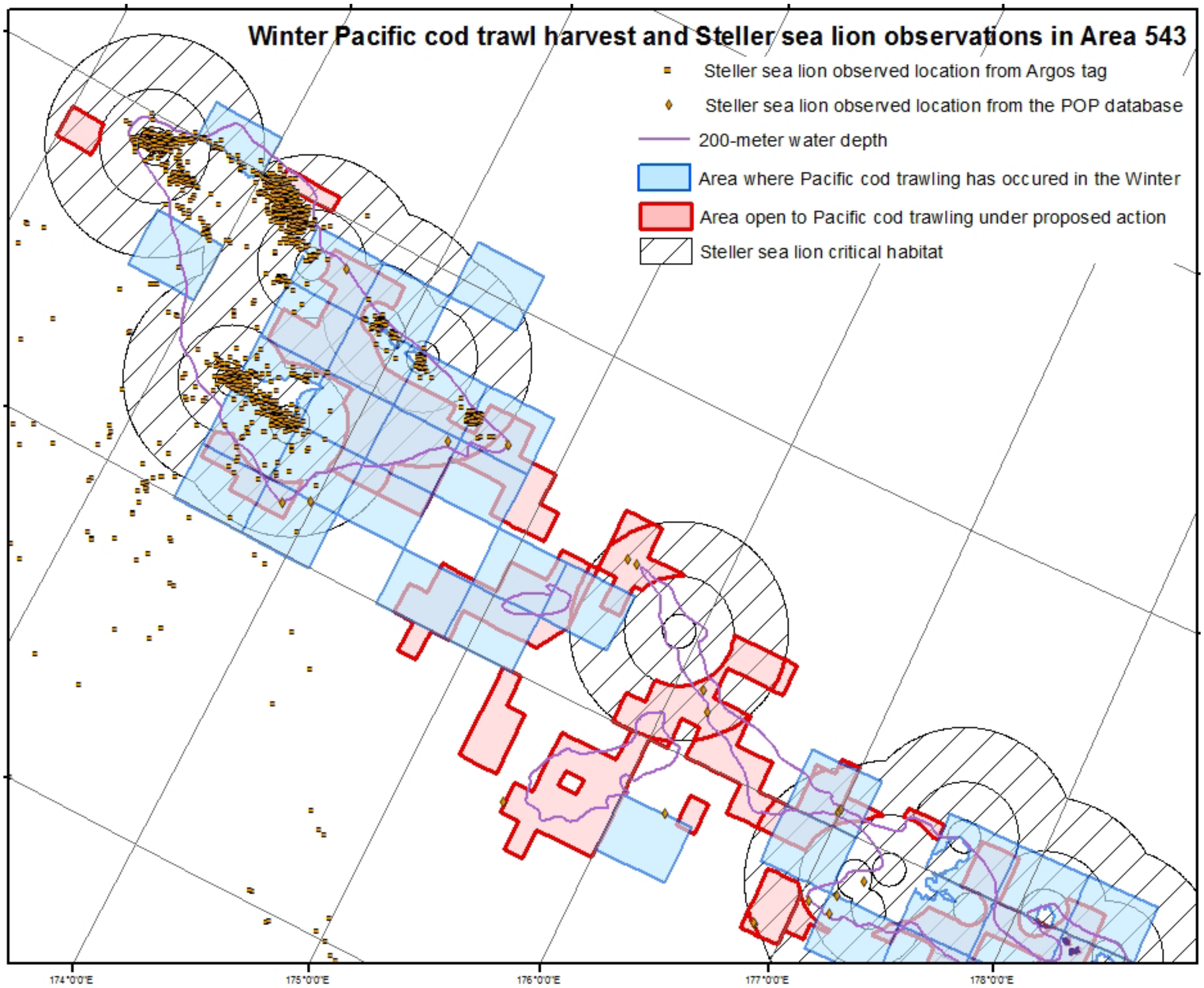


Figure 5-13. Pacific cod trawl fishery and Steller sea lion locations in winter in Area 543.

Pacific cod Trawl in Area 542/541 – Winter

The available telemetry data in Areas 542 and 541 in winter consist of 2,401 locations from 4 adult females and 3 juveniles. There have been 87 POP sightings of 656 animals over the past 20 years in Areas 541 and 542, with most of these in Area 542. The area that would be open to Pacific cod trawling where fishing has occurred overlaps 408 of the sea lion telemetry locations—152 inside critical habitat and 256 outside of critical habitat (Table 5-26). The majority of these locations are from 10-20 nm inside critical habitat to the northeast of the Semisopochnoi Island/Petrel Point rookery extending outside of critical habitat along the west end of Petrel Point. Overlap also occurred southwest of Amchitka Islands inside 10-20 nm of critical habitat, as well as inside 3-10 nm of critical habitat between Unalga and Kavalga Islands. Many of the available telemetry locations occurred within 0-10 nm from most other sea lion sites in Area 542. The Platform sightings (Table 5-26) overlap the Pacific cod trawl fishing area from 10-20 nm inside critical habitat on the northwest and southwest side of Amchitka Island.

As with the Atka mackerel fishery, the available winter telemetry data in Area 541 is limited to 3 juveniles tagged at the Seguam Island/Turf Point haulout and tracked in March. None of these telemetry locations overlapped the area that would be open to the Pacific cod trawl fishery (Table 5-26). Two of the 79 Platform sightings overlapped the area previously fished and open to fishing inside 3-10 nm of critical habitat southwest of Anagaksik Island (Figure 5-15).

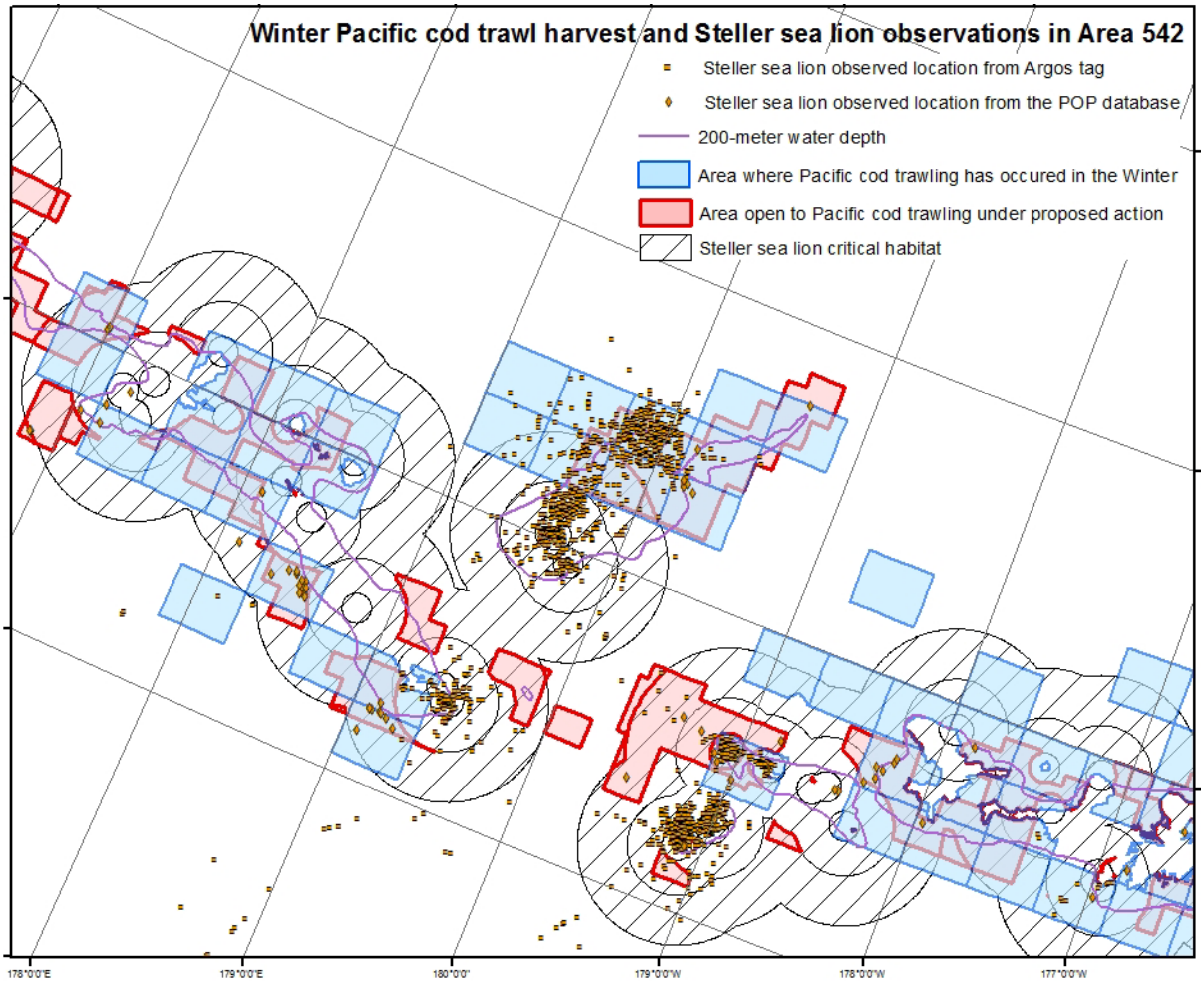


Figure 5-14. Pacific cod trawl fishery and Steller sea lion locations in winter in Area 542.

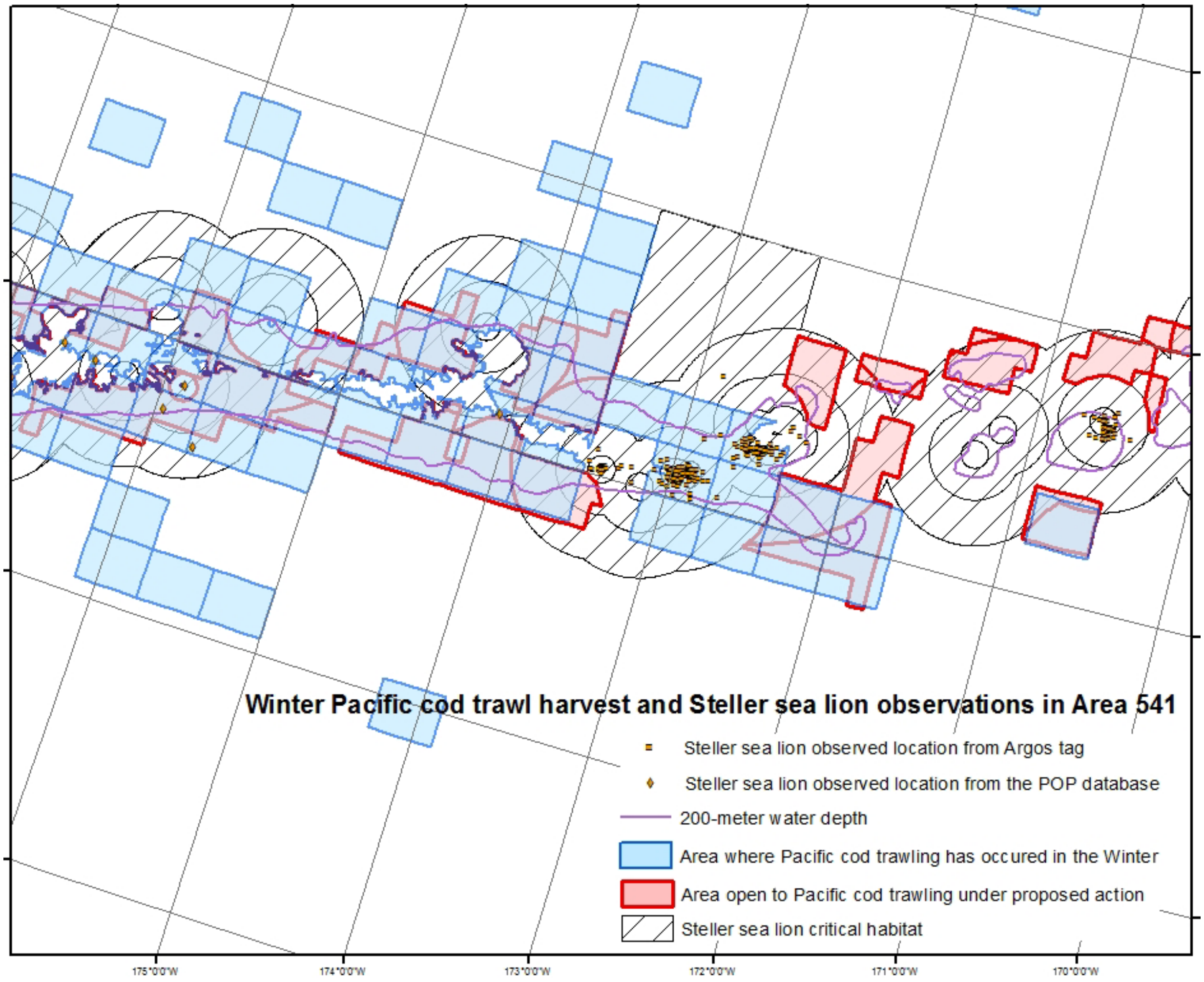


Figure 5-15. Pacific cod trawl fishery and Steller sea lion locations in winter in Area 541.

Table 5-27. Number of the total winter Platform sightings (79 sightings representing 723 sea lions) and telemetry locations (see Table 5-23) that directly overlap the area that would be open to the Pacific cod non-trawl fishery where the fishery has historically operated by fishery management area.

	Pacific cod –Non-trawl			
Area	**Inside CH**		**Outside CH**	
	Platform	Telemetry	Platform	Telemetry
541	3 (61)	0	0	0
542	39 (289)	517	5 (10)	31
543	6 (26)	968	1	7

Pacific cod Non-trawl in Area 543 – Winter
The available telemetry data in Area 543 in winter consist of 1,884 locations from 3 adult females. There have been 15 Platform sightings representing 56 sea lions in Area 543 in winter over the past 20 years. Three Platform sightings (8 sea lions) overlapped the area that would be open to Pacific cod non-trawl fishing within critical habitat and we expect most of the Pacific cod

non-trawl fishery to occur within critical habitat in Area 543 (Figure 5-16). Overlap occurred between 3-20 nm of critical habitat around the three haulouts. Note, in Figure 5-16 through Figure 5-21, the red polygons represent the area that would be closed to fishing which is the opposite of the Figures above.

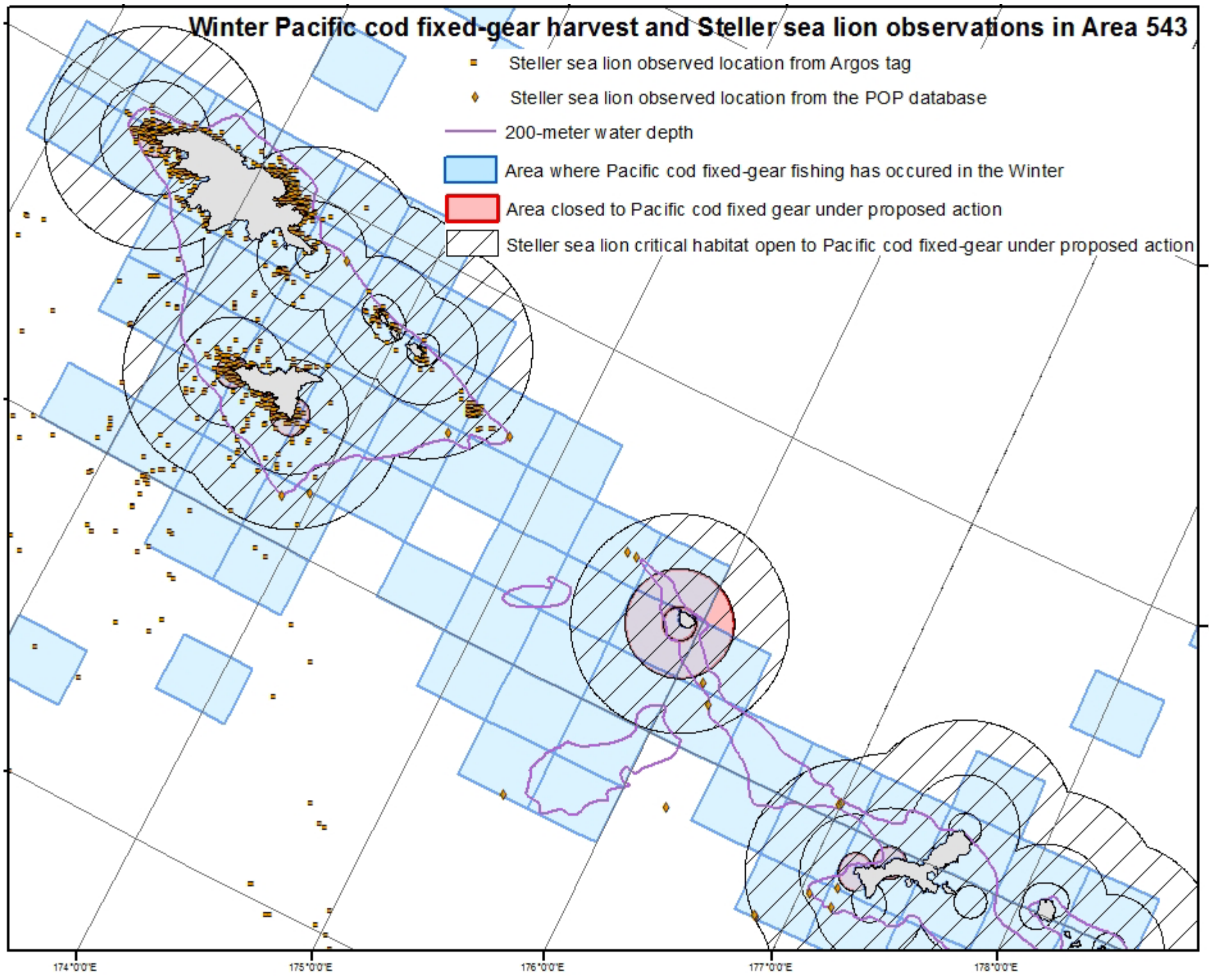


Figure 5-16. Pacific cod non-trawl fishery and Steller sea lion locations in winter in Area 543.

Pacific cod Non-trawl in Area 542/541 – Winter
The available telemetry data in Areas 542 and 541 in winter consist of 2,401 locations from 4 adult females and 3 juveniles. There have been 64 Platform sightings of 486 sea lions over the past 20 years in Areas 541 and 542, with most of these (384) in Area 542. In Area 542, 517 of the available telemetry locations (consisting of locations from 4 adult females) overlapped the area that would be open to the Pacific cod non-trawl fishery in critical habitat where fishing has historically occurred. Figure 5-17 shows overlap north of Semisopochnoi Island and towards Petrel Bank, between 3-20 nm of critical habiat around East Cape on Amchitka Island, and from 0-20 nm inside critical habitat around Amatignak, Ulak, and Unalga Islands.

As with the other fisheries, the available winter telemetry locations in Area 541 are limited to data from 3 juveniles tagged at the Seguam Island/Turf Point haulout and tracked in March (Figure 5-18). None of these locations occurred in the area that would be open to the Pacific cod non-trawl fishery. Three Platform sightings consisting of a total of 6 sea lions were observed inside critical habitat in the area that would be open to the Pacific cod non-trawl fishery in Area 541.

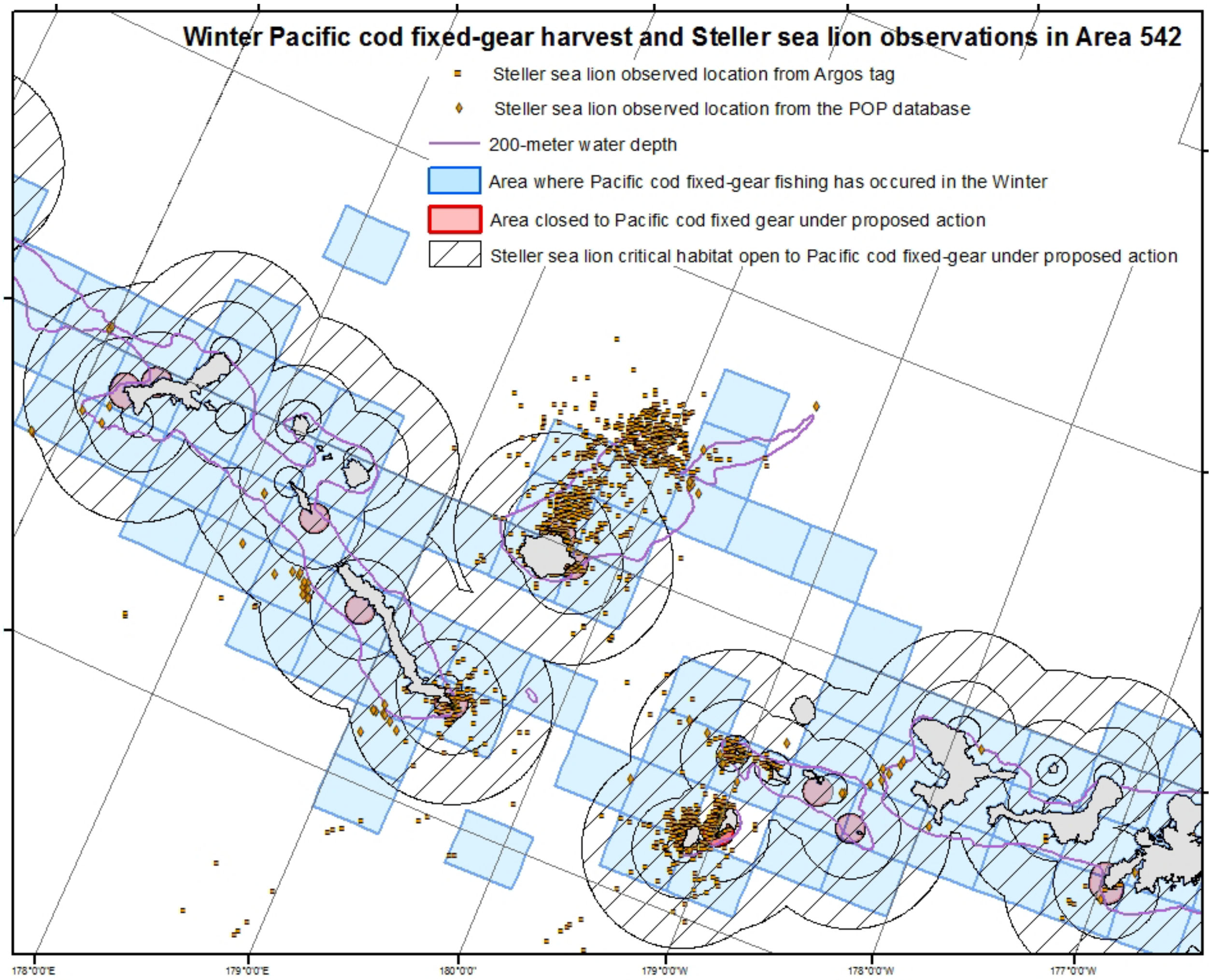


Figure 5-17. Pacific cod non-trawl fishery and Steller sea lion locations in winter in Area 542.

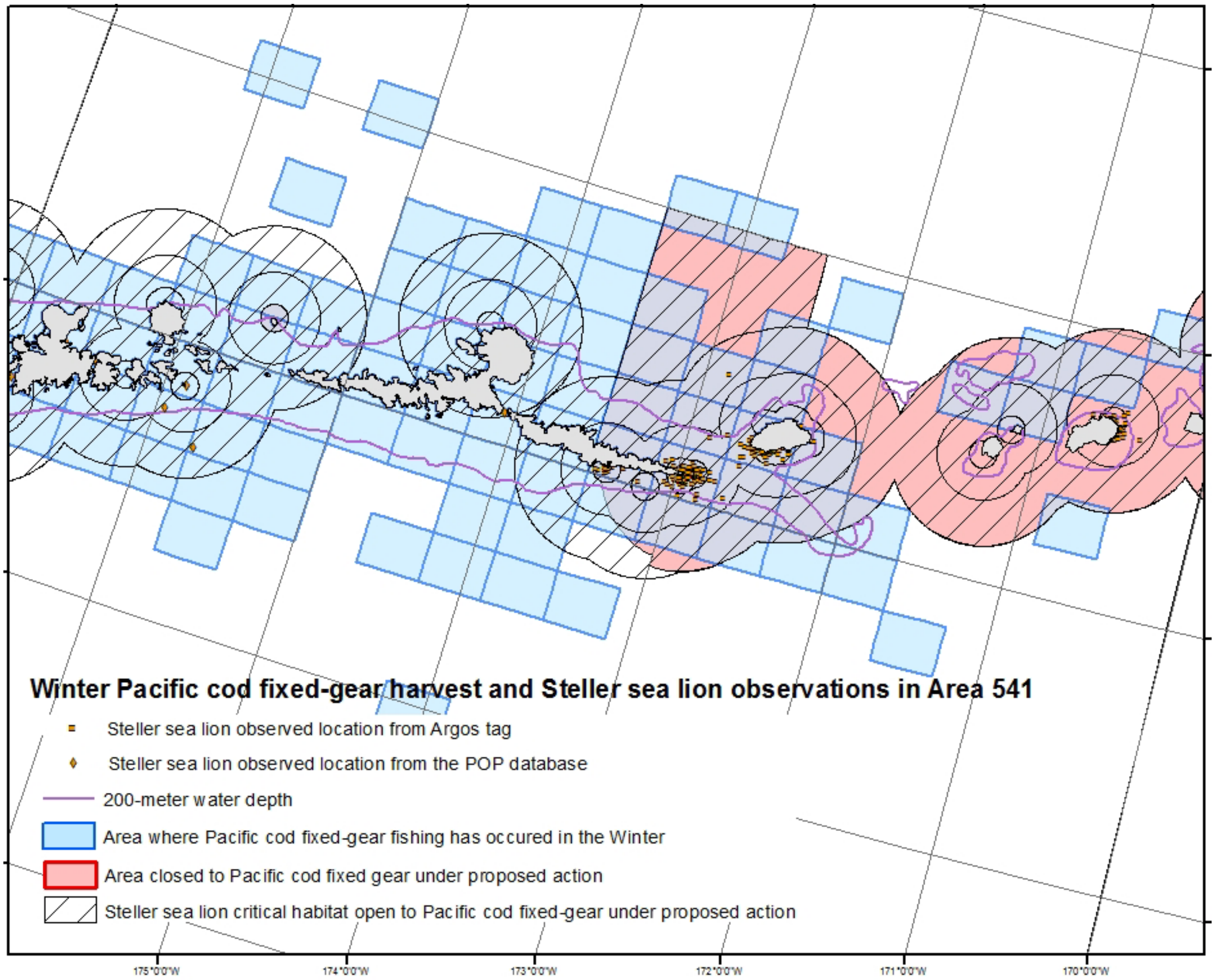


Figure 5-18. Pacific cod non-trawl fishery and Steller sea lion locations in winter in Area 541.

Table 5-28. Number of the total winter Platform sightings (79 sightings representing 723 sea lions) and telemetry locations (see Table 5-23) that would be open to the pollock fishery by fishery management area.

	Pollock trawl			
Area	Inside CH		Outside CH	
	Platform	Telemetry	Platform	Telemetry
541	5 (33)	0	0	5
542	34 (299)	126	6 (13)	460
543	1	21	5 (20)	207

Pollock in Area 543 – Winter
The available telemetry data in Area 543 in winter consist of 1,884 telemetry locations from 3 adult females. There have been 15 Platform sightings (representing 56 sea lions) over the past 20 years in Area 543 in winter. Prior to the closure of critical habitat to pollock fishing in 1998, the

fishery operated within 10 nm of the three haulouts in Area 543. The proposed action would permit fishing for pollock within 3-20 nm of critical habitat in Area 543. Twenty-one of the adult female telemetry locations occurred in the area that would be open to the pollock fishery in Area 543 (Table 5-28 and Figure 5-19). For the comparison of the available sea lion locations with the pollock fishery location, we included all telemetry locations and sightings that overlapped the area that would be open to the fishery under the proposed action since some of the proposed open area was closed when directed fishing for pollock was last allowed inside of critical habitat.

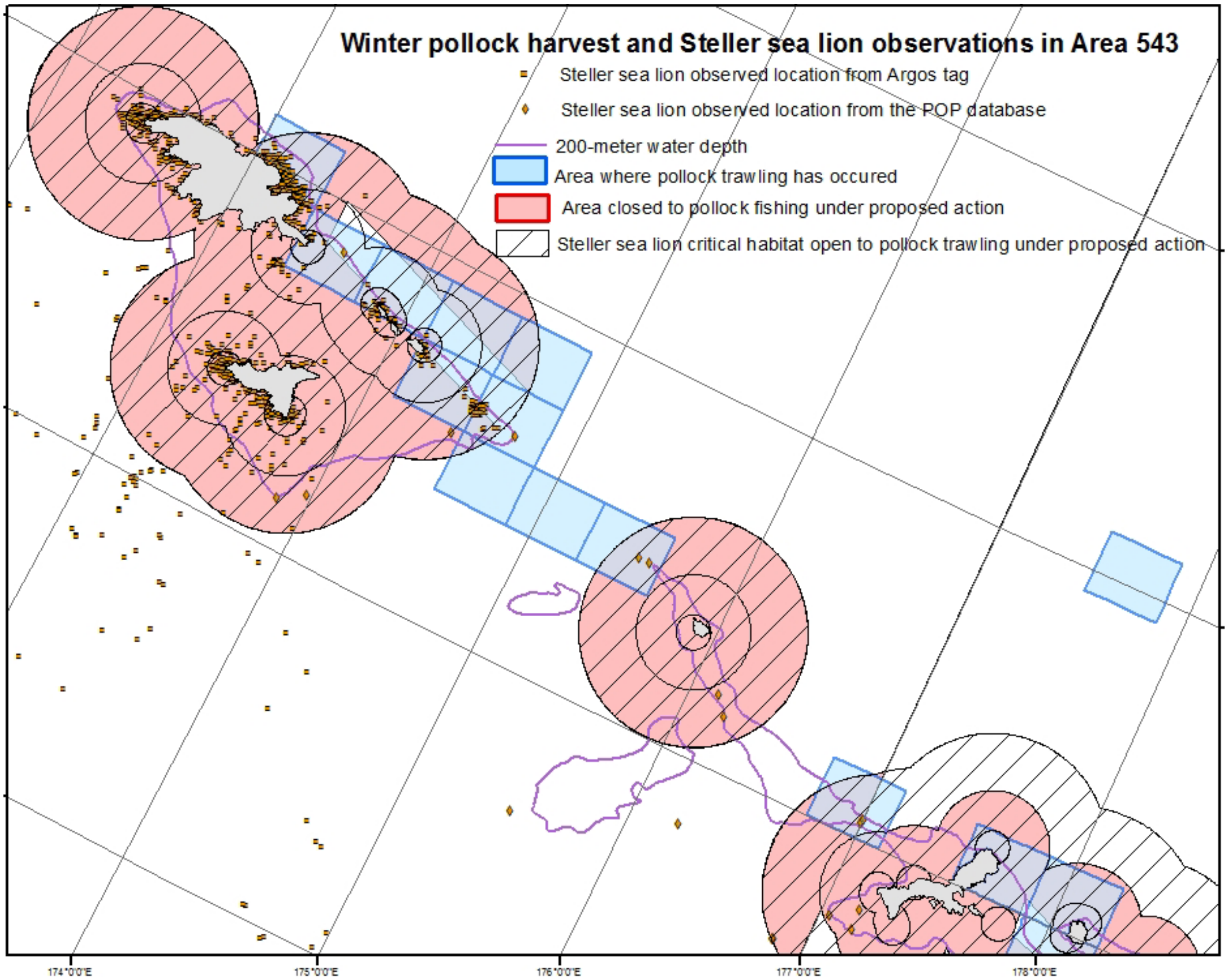


Figure 5-19. Pollock fishery and Steller sea lion locations in winter in Area 543.

Pollock in Area 542 – Winter

The available telemetry data in Areas 542 and 541 in winter consist of 2,401 locations from 4 adult females and 3 juveniles. Thirty-four Platform sightings (consisting of 299 sea lions) and 126 telemetry locations occurred in the area that would be open to the pollock fishery inside critical habitat in Area 542 (Table 5-28, Figure 5-20). Six Platform sightings (consisting of 13 animals) and 460 of the available telemetry locations overlap the area that would be open to the pollock fishery outside of critical habitat in Area 542. Telemetry location and Platform sightings occurred inside the 10-20 nm zone of critical habitat between the Hawadax Island/Krysi Point haulout and the Amchitka Island/Column Rocks rookery that would be open to the pollock fishery. Locations and sightings also occurred inside the 10-20 nm zone of critical habitat near the Semisopochnoi

Island/Petrel Point and Pochnoi rookeries, the Amchitka Island/East Cape rookery, the Amatignak Island/Nitrof Point haulout, and the Unalga and Dinkum Rocks haulout.

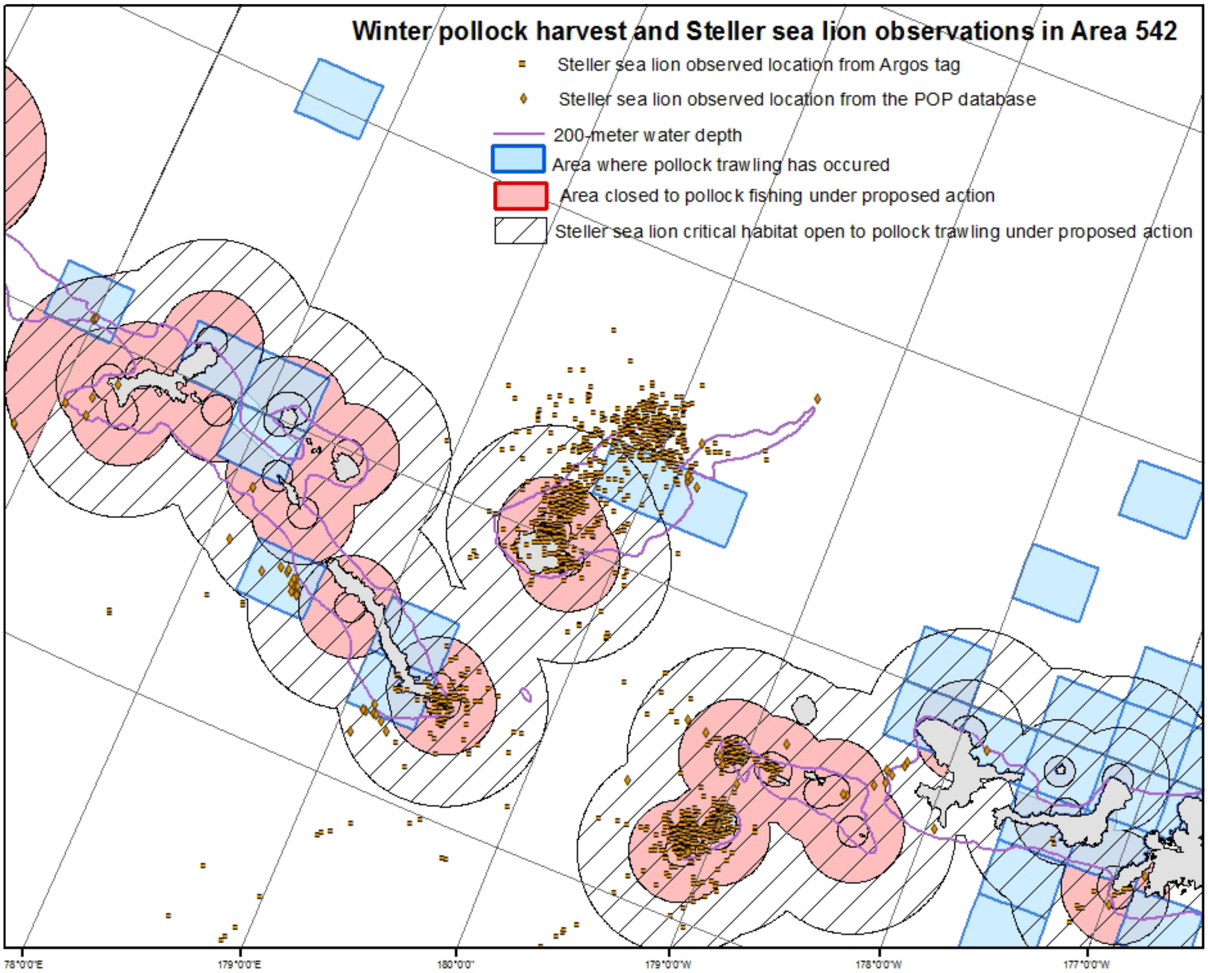


Figure 5-20. Pollock fishery and Steller sea lion locations in winter in Area 542.

Pollock in Area 541 – Winter

As with the other fisheries, the available winter telemetry locations in Area 541 are limited to data from 3 juveniles tagged at the Seguam Island/Turf Point haulout and tracked in March (Figure 5-18). None of the small number of telemetry locations overalapped the area that would be open to the pollock fishery inside of critical habitat in Area 541. Five telemetry locations occurred in the area that would be open to the pollock fishery outside of critical habitat in Area 541. Five Platform sightings consisting of a total of 33 sea lions were observed inside critical habitat in the area that would be open to the pollock fishery in Area 541 (Figure 5-21).

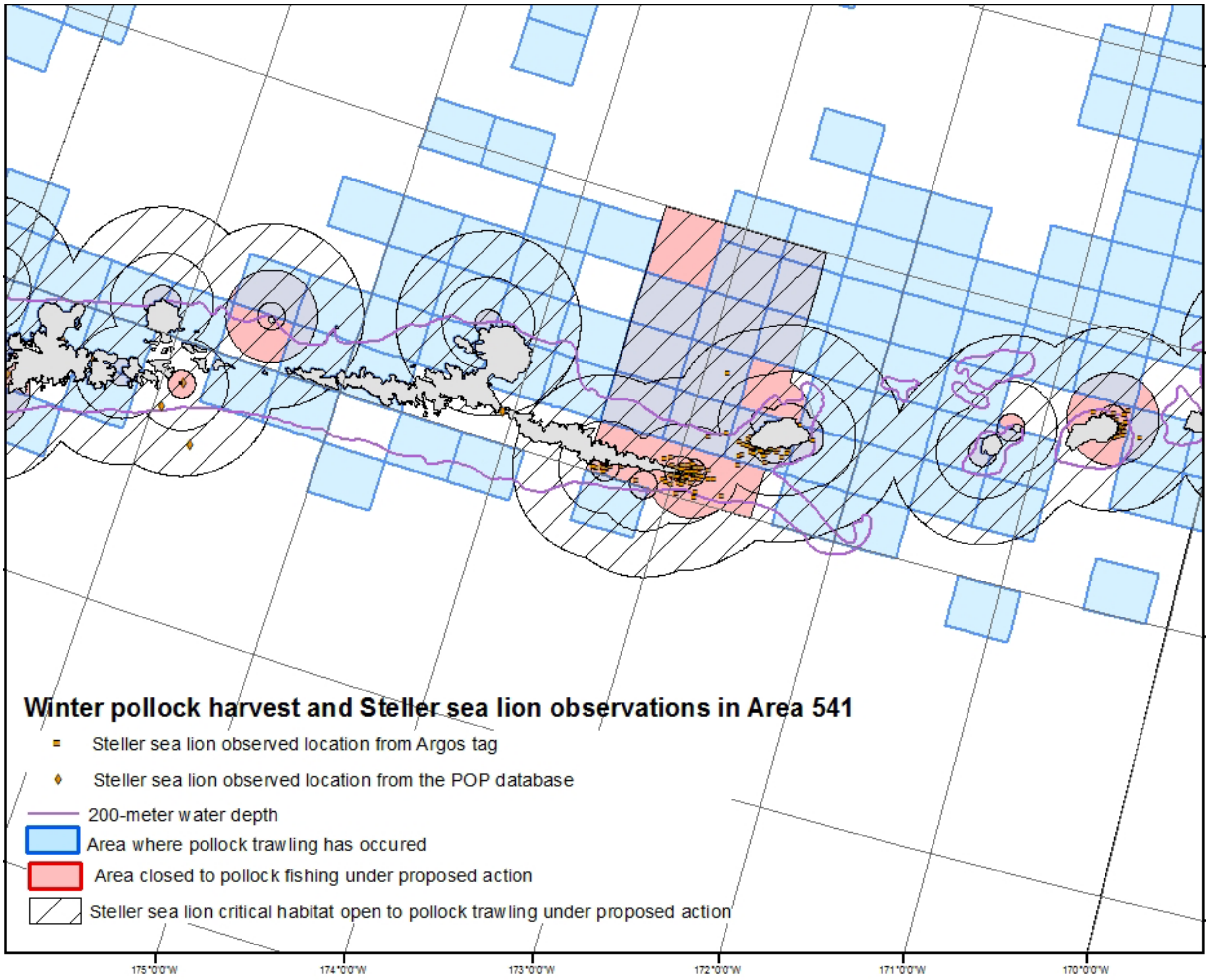


Figure 5-21. Pollock fishery and Steller sea lion locations in winter in Area 541.

As mentioned above, the available telemetry data are inadequate to understand regionally explicit habitat use by Steller sea lions due to inadequate sample sizes in specific areas, months, and age- and sex-classes. To overcome limitations with the available telemetry data, Himes Boor and Small (2012) created a model to correct for effort in the Platform data and estimated the likelihood of sea lion habitat use in Alaska at the spatial scale of a 15 x 15 km^2 grid and the temporal scale of year-round as well as breeding (May through August) and nonbreeding (August through April) seasons. Himes Boor and Small (2012) sought to improve quantitative estimates of Steller sea lion at-sea use patterns to increase the utility of the Platform data beyond the limited context of "presence only" approaches (such as the approach used above) to which the Platform data had previously been constrained.

Based on the effort-corrected examination of the Platform data from 1958 through 2000, Himes Boor and Small (2012) conclude that the at-sea use of Steller sea lions is more complex and spatially-variable than suggested by the summarized metrics from telemetry studies (e.g., (Merrick and Loughlin 1997, Loughlin et al. 2003, Raum-Suryan et al. 2004, Rehberg et al. 2009) and that the generalized application of depth and distance to shore to identify Steller sea lion habitat is contraindicated by their results. Their results indicated high use of the central Aleutian Basin, interior waters of southeast Alaska, the shelf break in the central and western Gulf of Alaska, Shelikof Strait, areas north and south of Unimak Pass, the southern terminus of Bowers

Ridge, and areas west and south of Buldir Pass. Of these areas, the central Aleutian Basin, Bowers Ridge, and Buldir Pass occur in the action area for this biological opinion. In Area 543, the area east and south of Agattu Island had a high level of sampling effort and showed a clear pattern of high use closest to Buldir Pass and Agattu Island. The high encounter rates south of Buldir Pass are based primarily on Platform data from the 1980s—whether sea lions still use this area to a great extent, especially given severely declining sea lion counts in the western Aleutian Islands sub-region, is unclear (Himes Boor and Small 2012). The high use area south of Buldir Pass occurred solely during the breeding season but extended far offshore which is inconsistent with the patterns from telemetry information from adult female and juvenile sea lions in the breeding season described in Merrick and Loughlin (1997), Loughlin et al. (1998), and Rehberg et al. (2009).

Cells with low or no survey effort (e.g., less than 2 platform-days) were excluded from the Himes Boor and Small (2012) model. Where the Platform data were sparse, the Platform data provide no information about the use or lack of use by Steller sea lions. Himes Boor and Small (2012) do not address the low Platform effort inside various nearshore zones of designated critical habitat due to the fishing closures around sea lion rookeries that began in 1990 (see Table 4-16 through Table 4-18), and this lower level of effort may affect their conclusions about the different indications of sea lion habitat use relative to the conclusions based on the telemetry data. Also, the Platform data do not contain information on the age or sex of the sea lions observed. Through various management actions, including the designation of critical habitat and implementation of fishery management measures, NMFS has sought to conserve prey for adult female and juvenile Steller sea lions and it is unknown to what extent the Platform-based habitat model in Himes Boor and Small (2012) reflects adult female and juvenile at-sea habitat use. We acknowledge that the Platform data provide a more comprehensive temporal and spatial representation of the general sea lion at-sea distribution than is possible with the telemetry data collected thus far, especially with the effort-correction provided by Himes Boor and Small (2012). However, we cannot determine whether the lower apparent importance of the nearshore zones of critical habitat is due to low Platform effort in the nearshore areas.

5.3.5 Depth Overlap

Steller Sea Lions

We also examined the overlap in depth between the fisheries and Steller sea lion diving, by season, based on our best understanding of the two variables. The best available information on Steller sea lion diving behavior in the western and central Aleutian Islands consists of the data from the small number of juvenile and adult female Steller sea lions that have been fitted with telemetry tags, literature on Steller sea lion diving depths (e.g. Merrick and Loughlin (1997), Loughlin et al. (2003), Fadely et al. (2005) and summaries in recent NMFS analyses (2010 and 2013). Adult females fitted with telemetry devices remained within critical habitat in areas less than 200 m deep in summer, but showed a much broader distribution in winter (Lander et al. 2013). Loughlin et al. (2003) reported that sea lions typically forage near shore at night in waters less than 50 m deep.

Usually juvenile dives are short and shallow; however, observations of dives to over 300 meters deep have been recorded for both juveniles and adult females in the central and western Aleutian Islands (Table 5-29). Table 5-29 reports sample size, season, mean and maximum dive depth and duration, and the referenced study for each dataset. We calculated the upper 95% confidence intervals for the dive depths in Table 5-29 which show increasing dive depth with age. The upper 95% CI for the 6-12 month old sea lions was 11.1 m. The upper 95% confidence intervals were similar among sea lions from 11 through 24 months in age and ranged from 34 to 38.4 m. The 4 juveniles tracked at ages ≥ 30 months had an upper 95% confidence interval of 56.5 m in diving depth, whereas the only adult female with mean dive depth reported dove to 145.9 m or shallower 95% of the time. The maximum dive depths shown in Table 5-29 were not as variable as the upper 95% confidence interval dive depths among ages and all ages demonstrated the ability to dive deeper than 200 m. However, as suggested by the mean and upper 95% dive depths, juvenile sea lions in the western and central Aleutian Islands do not appear to dive to depths greater than 60 m on a regular basis. The sole adult female for which dive data are available in the central Aleutian Islands mostly dove to depths shallower than 31.9 m through 145.9 m, though she dove to 344 m at least once (Table 5-29).

Dive data from 38 adult females tagged from Russia through Southeast Alaska from 1996 through 2010 are summarized in NMFS (2013) including data from 22 adult females in summer and 16 adult females in winter. The resulting histograms indicate about half of the dives made by adult females are less than 10 m deep (Figure 5-22), and mean dive depths range to about 50 m (NMFS 2013). A broad range of behaviors occur at or near the surface, which may include foraging, but also traveling, social interaction and play, resting, and possibly sleeping (Pitcher et al. 2005). This shallow mode in diving can overwhelm other modes in the histogram that may be more indicative of foraging behavior (Rehberg et al. 2009), but it is evident that adult female sea lions are capable of reaching depths greater than 300 m and dive durations greater than 13 minutes (Table 5-29). At this level of resolution there is no clear difference in dive profiles among areas (Rehberg et al. 2009; Figure 5-22). Most of the dives by all 38 adult females were less than 100 m (Figure 5-22). Approximately 15% of the dives by 4 of 16 adult females tagged in the winter exceeded 100 m (Figure 5-22). While Figure 5-22 does not break out the 100 – 250 m depth range, the proportion of dives by one adult female that exceeded 150 m was 4.10% (Swain 1996). Thus, these data from 38 adult females (which include the one adult female tagged in the central Aleutian Islands) are similar to the data for just the one adult female tagged in the central Aleutian Islands in the winter.

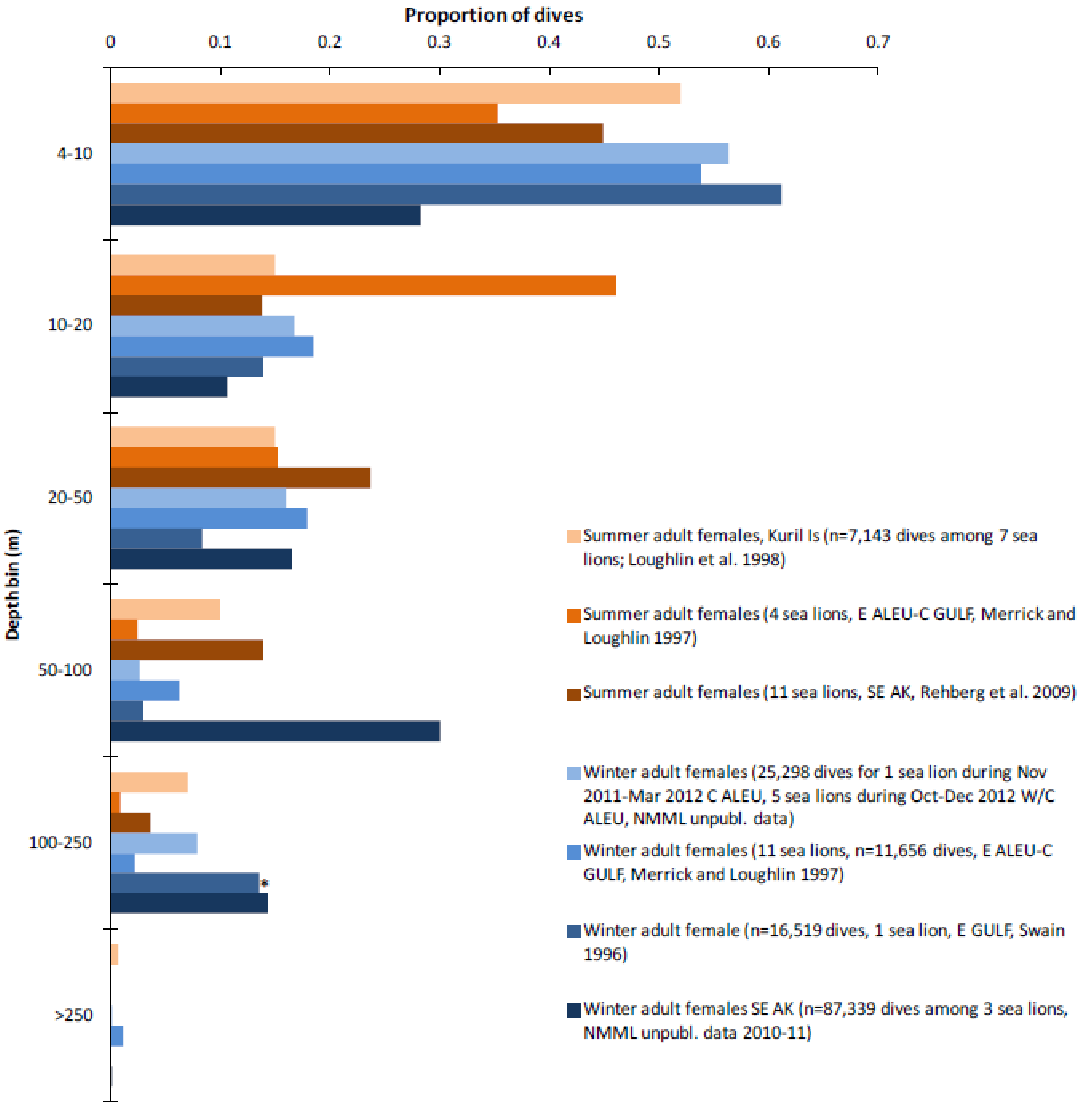


Figure 5-22. Proportion of dive depths for adult female Steller sea lions, aggregated by depth range bin to maximize comparability across studies. Measurements during the summer pup-rearing period (orange shades) and winter non-pup breeding season (blue shades) are arranged geographically west to east (* deepest depth bin of Swain (1996) is all dives greater than 100m; reported proportions are 9.48% in the 100-150 m bin and 4.10% >150 m).

Table 5-29. Steller sea lion dive depths (m) recorded in the Aleutian Islands, adapted from NMFS (2013).

Region	age (mo)	Study year(s)	Season(s)	n	Mean dive depth (m)	Upper 95% CI of dive depth (m)	Max dive depth (m)	Mean dive duration (min)	Max dive duration (min)	Mean proportion time at-sea (%)	Mean prop time diving at-sea (%)	Study[3]
W Aleu	12	2002	Su	1M/2F	11.7±12.7[4]	37.1	201	0.7±0.7[4]	4.9	52.9	7.3±3.4[4]	A
C Aleu	11-23	2004	Sp-Su	5M/1F	14.6±11.7[4]	38	333	0.9±0.8[4]	10	43.0	13.0±5.4[4]	A
C Aleu	11	2005	Sp-Su	9M/7F	11.8±12.6[4]	37	255	0.8±0.6[4]	>13			B
C Aleu-E Gulf	6-12	1994-2000	Wi/Sp	13	7.7±1.7[4]	11.1	252	0.8±0.1[4]				D
C Aleu-E Gulf	9-12	2001-2005	Sp	5M/5F	13 10.2-16.5[2]	16.5	325	0.9 0.8-1.1[2]	4.9	41 33-50[2]	10 5-17[2]	E[7]
C Aleu-E Gulf	12-22	1994-2000	Wi/Sp	5	16.6±10.9[4]	38.4	288	1.1±0.4[4]				D
C Aleu-E Gulf	17-24	2001-2005	Sp	5M/5F	29 23.9-34.0[2]	34	>361	1.7 1.5-1.9[2]	13.2	56 50-62[2]	27 20-34[2]	E[7]
C Aleu-E Gulf	≥30	2001-2005	Sp	3M/1F	38 25.8-56.5[2]	56.5	>361	2.0 1.5-2.7[2]	32.9	69 55-80[2]	32 16-50[2]	E[7]
W Aleu-C Aleu	Adult female non-breeding	2012	Oct-Dec	5			302		>13			O
C Aleu	Adult female non-breeding	2011	Nov-Mar	1	31.9±57.0[4]	145.9	344	1.6±2.1[4]	>13			O

[2] 95% CI

[3] A) Lander et al. (2010); B) Lander et al. 2011; D) Loughlin et al. (2003); E) Rehberg and Burns (2008); O)NMML unpublished data

[4] SD

[5] Range

[6] Median

[7] Used 8 m and 8 s thresholds for dive depth and dive duration, respectively, whereas SDR-based studies typically used 4 m and no time threshold to define dives.

Fishery Depth and Fish Vertical Migration

Averages and ranges of depths of the groundfish fisheries in the Aleutian Islands are described in Table 5-30 below. Figure 5-23 through Figure 5-28 show the frequency distribution of trawl depths in the Pacific cod, Atka mackerel, and pollock mid-water fisheries based on observer data from 1993 through 2012. Observers record bottom depth and fishing depth. Pollock are harvested with mid-water trawl gear and for this analysis we report observed pollock harvest in the Aleutian Islands from 1993-1998 to infer pollock fishing depth. Due to limited observer data from the non-trawl Pacific cod fishery we have not included figures for the distribution of fishing depth for non-trawl Pacific cod fisheries, however, we rely on the data in NMFS (2013) and shown in Table 5-30 as a gauge for non-trawl fishing depth.

Table 5-30. Distribution of depths of groundfish fisheries in the Aleutian Islands (m), including average, range, and standard deviation.

Species/ Gear	Values reported in NMFS (2013)			Fishery depths reported in observer data								
				541			542			543		
	# hauls	Average	Range	# hauls	average	STD	# hauls	average	STD	# hauls	average	STD
Pollock trawl	20	315	150-400	246 (1993-1998)	355.52	135.51	148 (1993-1998)	317.68	92.23	24 (1998)	345.72	32.61
Pacific cod trawl	4,600	137	95% harvest <175	1,114	127.50	24.79	1,779	126.02	31.11	784	110.54	20.18
Pacific cod non-trawl		125	89% harvest <150	9,056			4,686			4,283		
Atka mackerel trawl	7,900	160	88% harvest <200	6,024	141.61	35.80	9,957	125.91	33.41	6,901	126.9	32.06

Atka mackerel

Atka mackerel trawling occurs in similar depths in Areas 543, 542, and 541 (Figure 5-23 and Figure 5-24). Sixty-eight percent of the dives made by the one adult female tracked in the central Aleutian Islands from November through March, 2011 were shallower than the shallowest Atka mackerel trawl hauls, though there is a high degree of overlap between the Atka mackerel trawl depth distribution and the upper 95% of the adult female's dive depths. From the data presented here, there appears to be little depth overlap between juvenile sea lions and the Atka mackerel fishery, although, from a young age, Steller sea lions are capable of diving to the deepest depths fished by the Atka mackerel fishery. If Steller sea lions in the central and western Aleutian Islands behave similarly to the animals studied in Loughlin et al. (2003) and shown in Figure 5-22, about 15% of Steller sea lion dives would overlap in depth with about 25% of the Atka mackerel trawl hauls in the Aleutian Islands.

While the direct depth overlap between sea lions and the fishery appears to be limited based on the data presented here, Atka mackerel display strong diel behavior, with vertical movements away from the bottom almost exclusively during daylight hours, presumably for feeding, and little to no movement at night (Lowe et al. 2013, Nichol and Somerton 2002). At nighttime Atka mackerel exhibit a settling period, and remain on the bottom at depths typically ranging from 100 to 120 m (Nichol and Somerton 2002). Not surprisingly, anecdotal information from commercial fishermen operating in US waters, as well as information from those in the western Bering Sea (Medveditsyna 1962), indicates that bottom trawling for Atka mackerel is most effective at night (Nichol and Somerton 2002).

According to Loughlin et al. (2003), sea lions typically forage near shore at night. Lander et al. (2011) found that juvenile Steller sea lions from the central Aleutian Islands conducted deeper dives during nocturnal hours and performed a greater proportion of dives at night. Juvenile Steller sea lion maximum daily depth increased with decreasing lunar illumination. While this behavior was in alignment with targeting Atka mackerel as a prey resource (Lander et al. 2011), Figure 5-22 shows that approximately 75% of the sea lion dives across age, region, and season were less than 50 m. If Atka mackerel settle from 100 to 120 m at night (Nichol and Somerton 2002) when the fishery occurs, we would not expect much direct overlap between the fishery and sea lions for the same sub-population of Atka mackerel unless sea lions forage on Atka mackerel predominantly during the day when Atka mackerel are higher in the water column. In that scenario, overlap could occur between the fishery and sea lions for the same sub-population of Atka mackerel at different times of the day. If the deepest dives performed by Steller sea lions indicate when they are targeting aggregated Atka mackerel at night, it makes sense that they will be deeper as lunar illumination decreases (Lander et al. 2011) in that case there could be overlap with the fishery for about 25% of sea lion dives (Figure 5-22). Alternately, the dive data suggest that sea lions may be preying on nest guarding Atka mackerel males which are typically in waters less than 70 m depth near rookeries (McDermott and Haist In Review). In that case, the trawl exclusion zones around rookeries may provide refuge for Atka mackerel spawning and rearing and effectively conserve prey for foraging sea lions (McDermott and Haist In Review). The available data on sea lion dive depth, Atka mackerel spawning depth, and observed fishing depths support this potential partitioning.

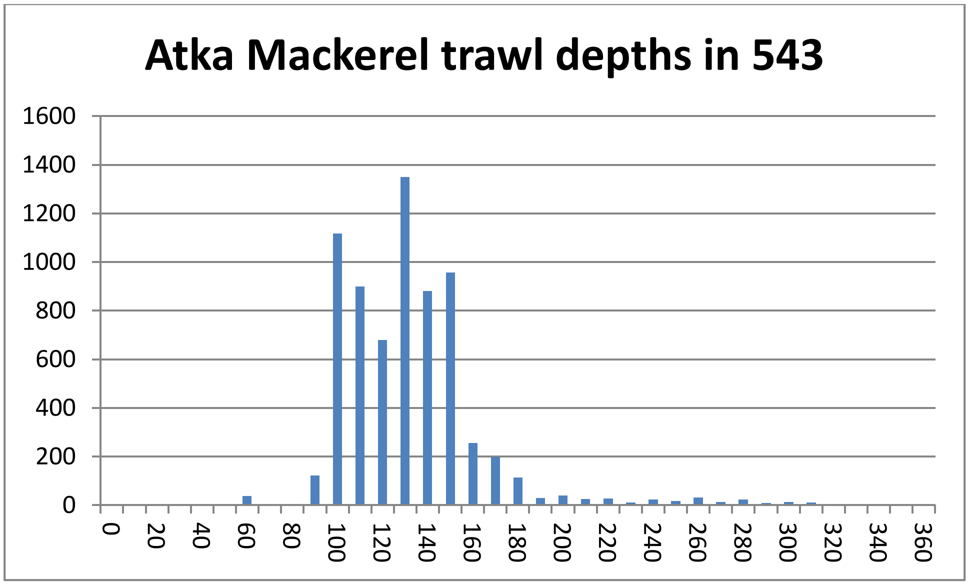


Figure 5-23. Atka mackerel trawl depths in Fishery Management Area 543 from 1993-2012. Horizontal axis indicates depth in meters and vertical axis indicates frequency of those depths occurring. 6,895 trawls occurred in depths less than 360m and 1 occurred deeper (not shown on this graph to preserve scale).

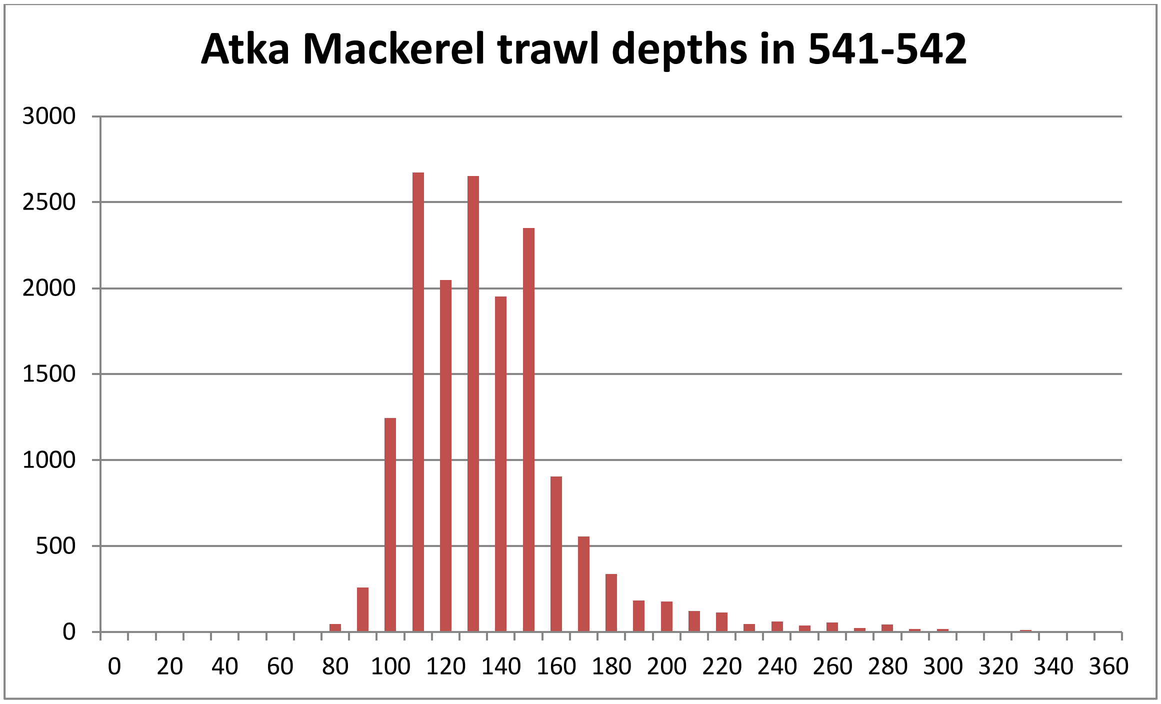


Figure 5-24. Atka mackerel trawl depths in Fishery Management Areas 541 and 542 from 1993-2012. Horizontal axis indicates depth in meters and vertical axis indicates frequency of those depths occurring. 15,940 trawls occurred in depths less than 360m and 38 occurred in depths greater than 360m (not shown in graph to preserve scale).

Pacific Cod

The Pacific cod trawl depths were shallower in Area 543 than in Areas 541 and 542 (Figure 5-25 and Figure 5-26) and the distribution of Pacific cod trawl hauls is slightly shallower than Atka mackerel hauls with a large proportion of Pacific cod trawl hauls occurring between 50 and 80 m deep in area 543 (Figure 5-25). While minimal depth overlap is expected between the Pacific cod trawl fishery and juvenile sea lions < 30 months (based on the data presented here) there would be some depth overlap between juvenile sea lions >30 months in age and nearly complete overlap with adult females and the Pacific cod trawl fishery in Area 543 and more than 60% depth overlap between the Pacific cod trawl fishery and sea lions over 30 months in age in Areas 541 and 542 (Figure 5-26).

The best available data indicate that the depth distribution for Pacific cod non-trawl fishing is shallower than for the Pacific cod trawl fishery (Table 5-30). While we cannot infer the shallowest fishing depths from the available data, it is estimated that 89% of Pacific cod non-trawl harvest occurs in waters shallower than 150 m. The extent to which the Pacific cod non-trawl fishery overlaps the diving distribution of sea lions less than 30 months in age is unknown, though we assume greater overlap between sea lions over 30 months in age and the Pacific cod non-trawl fishery than in the trawl fishery, given (a) the high overlap between the Pacific cod trawl fishery and Steller sea lions, particularly in Area 543 and (b) the shallower distribution of the Pacific cod non-trawl fishery overall.

There are two types of diel vertical migration (DVM)– type I refers to successive days on which a fish migrates deeper during daytime and type II (or reverse DVM) refers to successive days on which a fish migrates deeper during nighttime (Neilson and Perry 1990). While there are no data for the Aleutian Islands, both type I and type II DVM have been recorded in Pacific cod in the EBS and GOA (Nichol et al. 2013). Despite high among-individual variability, the occurrence of DVM varied significantly with the release site, season, and bottom depth, with the trend in seasonal occurrence nearly opposite for type I compared to type II DVM. Both type I and type II DVMs were attributed to foraging on prey species that also undergo DVM, and increased vertical movements of Pacific cod during twilight and nighttime periods were attributed to more active foraging during dim-light conditions when Pacific cod can potentially exploit a sensory advantage over some of their prey (Nichol et al. 2013).

Type I DVM in Pacific cod occurred more commonly in the summer with type II DVM more common in the winter. While Pacific cod exhibited both type I & II DVM, there were small differences in magnitude (<18 m), and individuals were probably within close proximity to the bottom most of the time. Pacific cod rarely moved >10 m away from the bottom (Nichol et al. 2007). Nichol et al. (2007) anticipated that 91.6% of Pacific cod within the water column would be available to the trawl used in the GOA and Aleutian Islands groundfish surveys.

If we anticipate Pacific cod being in close proximity to the bottom most of the time (Nichol et al. 2007), then we would also anticipate a lot of overlap between Pacific cod trawl depths and Pacific cod occurrence. In addition, in Area 543 we would anticipate near 100% overlap between trawl depth and sea lion diving depth (for sea lions over 30 months), and in Areas 541 and 542 we would anticipate >60% overlap (see Figure 5-25 and Figure 5-26).

From October through March when Pacific cod are considered an important prey species for Steller sea lions (Sinclair et al. 2013), we would anticipate that cod could be exhibiting type II DVM but still maintaining close proximity to the bottom the majority of the time. Based on this information, we would anticipate a high degree of overlap in the depth of the Pacific cod trawl and non-trawl fisheries and the foraging depth of sea lions, with the time of day having little influence on the location of the prey species.

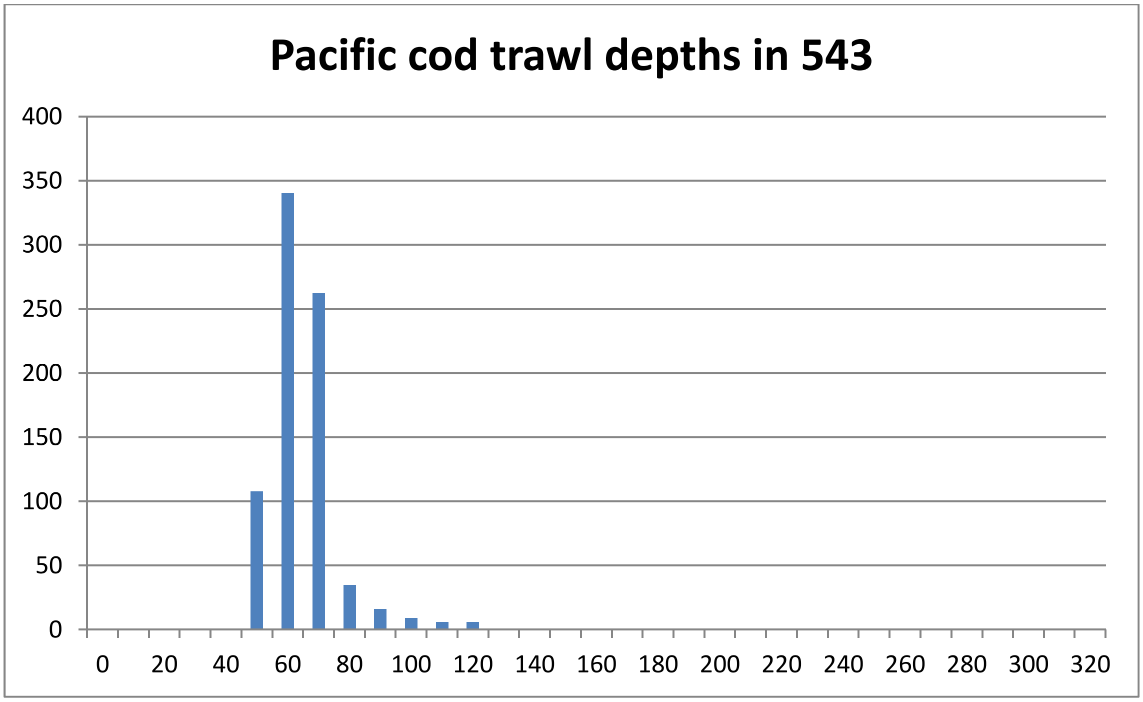


Figure 5-25. Pacific cod trawl depths in Fishery Management Area 543 from 1993-2012. Horizontal axis indicates depth (m) and vertical axis indicates frequency of those depths occurring. All 782 hauls occurred in depths less than 320 m.

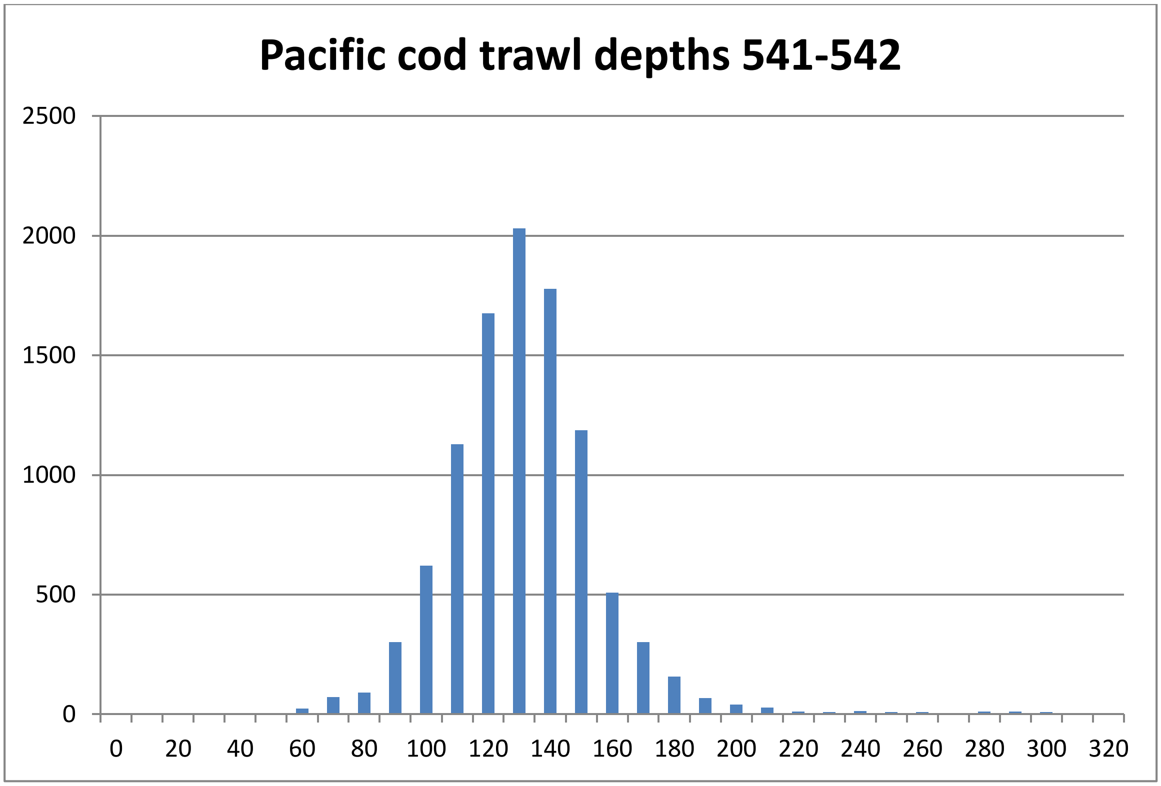


Figure 5-26. Pacific cod trawl depths in Fishery Management Areas 542/541 from 1993-2012. Horizontal axis indicates depth (m) and vertical axis indicates frequency of those depths occurring. 10,112 hauls occurred at depths less than 320 m. Four hauls occurred deeper than 320 m (not shown on this graph to preserve scale).

Pollock

The pollock fishery appears to harvest fish at deeper depths than the other fisheries (according to a much smaller number of hauls from 1993 to1998, and very few hauls in Area 543) (Figure 5-27 and Figure 5-28). The depth range of the historic pollock fishery is much narrower in Area 543 (e.g., ~265 to 405 m) compared to Areas 542 and 541 (e.g., ~120 to 530 m). However, the average depths of the historic pollock trawl hauls are similar among the Areas (all greater than 317 m) (Table 5-30) and at the upper end of the deepest depths observed for adult female and juvenile sea lions diving in the central and western Aleutian Islands. Given the data in Table 5-30 and Figure 5-27 and Figure 5-28 we would not expect much depth overlap between Steller sea lions and the pollock fishery in Area 543 and we would expect some regular overlap in depth between older juvenile and adult sea lions with about 30% of the pollock trawl hauls in Areas 542 and 541.

Adams et al. (2009) described DVM behavior of adult and juvenile pollock in August and November in the northern GOA. In the northern GOA pollock perform DVM as juveniles, but have an increasing tendency to be associated with the bottom with age (Adams et al. 2009). Juvenile pollock in the GOA formed dense shoals near the bottom during the day and dispersed up into the water column at night (Type I DVM). Adams et al. (2009) propose the following model for DVM of adult pollock in the northern GOA: in August, pollock ignore both light and temperature in pursuit of bioluminescent euphausiid prey. In November, when euphausiids are presumably no longer in spawning/feeding patches, denser pollock shoals migrate up and down the isolume (area of similar light intensity) needed for visual foraging on decapods (Adams et al.

2009). The maximum acoustic surveys were conducted in 200 m in the northern GOA (Adams et al. 2009). Adams et al. (2009) also point out that this behavior did not apply to all adult pollock, only to those that exhibit DVM.

If the model proposed by Adams et al. (2009) were applicable to the Aleutian Islands, we may expect to see pollock represented as a greater proportion in sea lion diets in summer when the adult pollock which exhibit DVM come to the surface to feed on euphausiids at night. In the Aleutian Islands, pollock diet data reflects a closer connection with open oceanic environments than in either the EBS or the GOA. Similar to the other ecosystems, euphausiids and copepods together make up the largest proportion of Aleutian Island adult pollock diet (29% and 19%, respectively); however, it is only in the Aleutian Islands that adult pollock rely on mesopelagic forage fish in the family Myctophidae for 24% of their diet. Stomachs from Aleutian Islands juvenile pollock have a lower proportion of euphausiids and a higher proportion of gelatinous filter feeders than in the GOA or EBS (Barbeaux et al. 2013). These documented differences in pollock diet among the Aleutian Island and GOA ecosystems and the low inferred occurrence of pollock in the sea lion diet in summer are inconsistent with the observed northern GOA DVM patterns.

From a query of the NMFS Catch Accounting System we observe that the pollock fishery operates around the clock. The depth range of the historic pollock fishery ranged from ~265-405 m in Area 543 and ~120-530 m in Areas 542 and 541 with the average depths similar among the areas (all greater than 317 m) (Table 5-30). Barbeaux and Fraser (2009) found that during daylight hours in winter, pollock in the central Aleutian Islands formed aggregations near the bottom (inconsistent with the conceptual model proposed by Adams et al. (2009) and tended to concentrate on the upper part of the slope between 180 and 450 m. These depths correspond with the fishery depth data. A large amount of the biomass within 3 m of the bottom is anticipated to be large adult pollock, which is consistent with bottom-trawl survey information (Ianelli et al. 2012).

While there appears to be the least overlap in depth between pollock fisheries and Steller sea lions in the Aleutian Islands, it is possible, but unknown if they are targeting the same sub-populations of pollock, such that one impacts availability to the other. The Aleutian Islands stock assessment notes that pollock are distributed throughout the Aleutian Islands with concentrations in areas and depths dependent on diel and seasonal migrations (Barbeaux et al. 2013). However, we lack information about the pattern of these migrations. Some attribute(s) of Aleutians Island pollock makes them more important to the fishery and to sea lions in winter. The fishery targets pollock for their high roe content just prior to spawning in January and February which could also be why sea lions appear to consume more pollock in winter than summer. It could also be related to a change in the spatial distribution of pollock in the winter since pollock are known to migrate between spawning and feeding areas, however these migrations are not well understood in the Aleutian Islands.

Based solely on the depths that have been observed for the pollock fishery and sea lions, there appears to be partitioning between the depth of the pollock fishery and sea lions, with the greatest apparent partitioning occurring in Area 543. There is some overlap among the deepest sea lion dives with the shallower pollock hauls in Areas 542 and 541. Where depth overlap occurs, we infer the fishery and sea lions are targeting the same sub-population. Where sea lion dive depths and pollock fishing hauls appear to occur at different depths, we do not know the extent to which the inferred partitioning is a result of pollock DVM or of the fishery and sea lions targeting different sub-populations of pollock (or other prey in the case of sea lions).

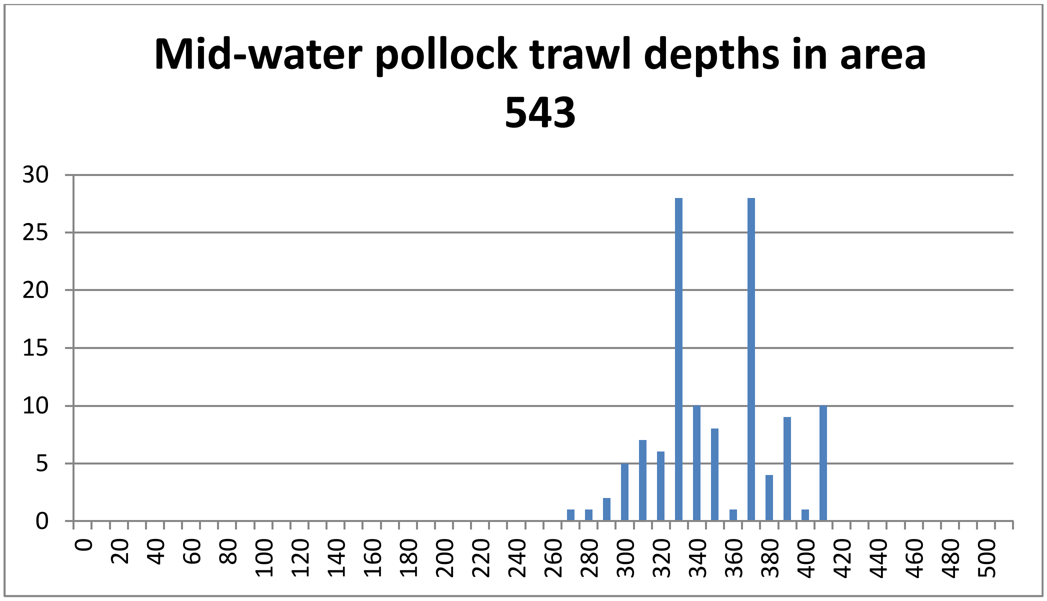


Figure 5-27. Trawl depths of 24 mid-water pollock trawls in Fishery Management Area 543 from 1998. Horizontal axis indicates depth (m) and vertical axis indicates frequency of those depths occurring.

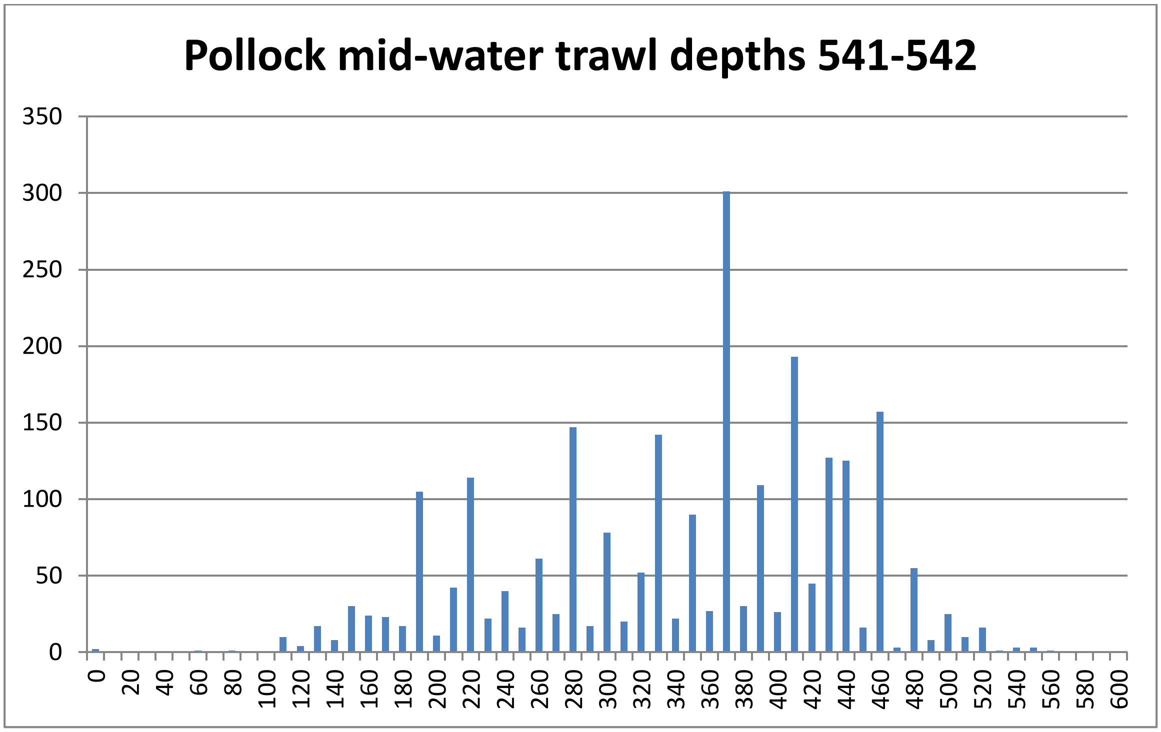


Figure 5-28. Trawl depths of mid-water pollock harvest in Fishery Management Areas 541 and 542 from 1993-1998. Horizontal axis indicates depth (m) and vertical axis indicates frequency of those depths occurring. 2,422 trawls occurred in depths less than 600 meters, while 15 trawls were deeper than 600 meters (not shown on this graph to preserve scale).

Summary of depth overlap between fisheries and Steller sea lions
In summary, of the fisheries included in the proposed action, the pollock fisheries appear to have the least overlap in depth with Steller sea lions in the Aleutian Islands. The average fishing depths

for pollock are at the deepest end of the dives observed for juvenile and adult female Steller sea lions in the western and central Aleutian Islands. While some depth overlap may occur as evidenced by the maximum observed sea lion dive depths and pollock DVM observed in other ecosystems, we assume pollock fishing would have the least potential depth overlap with foraging Steller sea lions compared to the Atka mackerel and Pacific cod fisheries.

Atka mackerel fishing under the proposed action may overlap in depth with about one third of the diving activity for sea lions over 30 months in age in the western and central Aleutian Islands and depth overlap with younger animals will be minimal. Atka mackerel exhibit a strong pattern of DVM, and we infer a high degree of overlap may occur between the fishery and sea lions that are feeding on Atka mackerel at deeper depths at night.

Even without accounting for DVM, we expect greater depth overlap between the Pacific cod trawl fishery and sea lions older than 30 months in age, particularly in Area 543 where we expect near complete overlap between the fishery and older sea lions. We estimate that approximately 60% of the Pacific cod trawl hauls will overlap in depth with older foraging sea lions in Areas 541 and 542, with lesser overlap expected for younger juvenile animals. We used shallower average Pacific cod non-trawl fishing data to infer greater potential overlap between sea lions over 30 months in age and the fishery, thus, as with the Pacific cod trawl fishery, we would expect the greatest depth overlap to occur in Area 543 with less (yet still substantial) depth overlap in Areas 542 and 541.

5.3.6 Size Overlap

Zeppelin et al. (2004) reviewed the sizes of pollock and Atka mackerel consumed by the western stock of Steller sea lions across most of their range from 1998 to 2000. Length of fish species were measured from bones and otoliths obtained from scat samples on rookeries and haulouts in the summer and haulouts in the winter, and thus represent the diet of both adult and juvenile Steller sea lions. Zeppelin et al. (2004) report the average lengths and 95% confidence intervals around those lengths of walleye pollock and Atka mackerel using different bony structures with and without correction factors. The numbers reported in Table 5-31 are the estimates they generated using all of the bony structures and the correction factors. McKenzie and Wynne (2008) reported on the spatial and temporal variation in the diet of Steller sea lions near Kodiak based on scat samples collected from 1999 to 2005 at 10 sites in the winter. They provide the total range of estimated lengths taken by Steller sea lions and the frequency of occurrence of different sizes of prey.

Neither of these studies focus specifically on foraging in the Aleutian Islands, but these data are the best available and have been used for other Aleutian Islands fishery interaction studies (Ortiz and Logerwell In Review). A summary of the results is presented below (Table 5-31), and details of these studies are available in the associated published articles.

Table 5-31. Estimates of lengths of prey in Steller sea lion scats.

Prey species	Fork lengths: Total range, mean, 95% CI, and Frequency of Occurrence	Reference
Atka mackerel	Total range 15.3 – 49.6cm Mean 32.3cm, 95% CI 31.7-33.4cm	Zeppelin et al. 2004
Pacific cod	Total range <8 – 69cm 94% of samples contained Pacific cod >27cm 69% of samples contained Pacific cod 50-69cm	Mckenzie & Wynne 2008
Walleye pollock	Total range 3.7 – 70.8cm Mean 39.3cm, 95% CI 35.9– 42.4cm	Zeppelin et al. 2004
Walleye pollock	Total range <8 – 54cm Sub-adult: 21-34cm occurred in 60% of samples Adult: >35cm occurred in 37% of samples Juvenile: <20cm occurred in 35% of samples	Mckenzie & Wynne 2008

The average, minimum, and maximum weights of Pacific cod and Atka mackerel taken from 1992-2012 and walleye pollock taken from 1992-1998 as measured in the North Pacific Groundfish Observer Program were used to calculate the associated lengths of these prey species. Then we are able to compare the length of the fish caught in the fishery to the same species eaten by Steller sea lions in the Aleutian Islands.

Alaska groundfish stock assessments use the following relationship between length and weight.

$$Weight=\alpha Length^{\beta}$$

Weight equals the product of length to the beta (β) exponent, times the constant alpha (α). The December 2012 BSAI Pacific cod assessment estimates α and β at 5.683×10^{-6} and 3.18, respectively, based on 8,126 samples collected from the AI fishery between 1974 and 2011(Thompson and Lauth 2012). The December 2012 Aleutian Islands pollock assessment estimates α and β at 8.3×10^{-6} and 2.94, respectively (Barbeaux et al. 2012).

The December 2012 Atka mackerel assessment reports values of 3.72×10^{-5} and 2.6949 for α and β, respectively (Lowe et al. 2012). The Atka mackerel constant values were derived from 1990-1996 fisheries, N = 4,041.The stock assessment authors note that the fishery data were mostly collected in the winter when gonad weight would be a smaller percentage of total weight than in summer.

Another description of the distribution of fish lengths taken in the Atka mackerel fishery is presented in the December 2012 stock assessment report. Lowe et al. (2012) report modes in the length distributions of fishery catch. The modes are reproduced in Table 5-32 below. The stock assessment authors also report a strong east-west gradient in the survey length estimates for Atka mackerel, with bigger fish occurring in the Bering Sea and eastern Aleutian Islands than in the central and western Aleutian Islands.

Table 5-32. Length of Steller sea lion prey species caught in the Alaska groundfish fisheries. Bold values indicate direct overlap with values reported for Steller sea lion foraging in Table 5-31. Source: Lowe et al. (2012), Thompson and Lauth (2012), Barbeaux et al. (2012).

Species	Area	Gear	Avg Length (cm)	Min Length (cm)	Max Length (cm)	Length distribution modes reported in stock assessment
Pacific cod	541	Trawl	85.67	**36.76**	112.31	
Pacific cod	542	Trawl	89.96	**36.76**	121.70	
Pacific cod	543	Trawl	89.78	**48.10**	119.29	
Pacific cod	541	Non-trawl	74.79	**32.07**	104.86	
Pacific cod	542	Non-trawl	77.67	**40.59**	108.51	
Pacific cod	543	Non-trawl	78.26	**26.47**	105.81	
Atka mackerel	541	Trawl	**40.52**	**19.41**	56.18	**40** (2011 fishery) **43** (2012 fishery)
Atka mackerel	542	Trawl	**35.26**	11.98	55.75	**35-37** (2010 fishery) **30-33** (2011 fishery) **36-38** and **29** (2 modes in 2012 fishery)
Atka mackerel	543	Trawl	**35.50**	**16.41**	55.53	**36-38** (2012 fishery)
Pollock	541	Trawl	**52.93**	**10.86**	**70.47**	
Pollock	542	Trawl	**54.18**	**26.38**	**68.21**	
Pollock	543	Trawl	**51.61**	**47.01**	**56.25**	

As calculated in this analysis, the size ranges of prey eaten by Steller sea lions and the size range of fish taken in the groundfish fisheries in the Aleutian Islands overlap. Zeppelin et al. (2004) concluded that there was considerable overlap in the sizes of pollock (68%) and Atka mackerel (53%) taken by Steller sea lions and the commercial trawl fisheries. Similar results were reported in Tollit et al. (2004) for the eastern stock of Steller sea lions.

In all samples combined, Atka mackerel eaten by Steller sea lions range from 15.3 to 49.6 cm and average around 32 cm in length (see Table 5-31). The average size of Atka mackerel eaten by Steller sea lions overlaps the minimum to average fishery value in Area 541, and the average values in Areas 542 and 543 (see Table 5-32). Based on these data, the greatest inferred size overlap among all fisheries and Areas occurs between Steller sea lions and the Area 542 Atka mackerel fishery (Figure 5-29). The entire size range of Atka mackerel consumed by Steller sea lions in the available literature (~15-50 cm) overlaps with the estimated size range of Atka mackerel being extracted by the fishery (~12-56 cm). The fishery is also estimated to extract Atka mackerel smaller (~12-14 cm) and larger (~51-56 cm) than those consumed by Steller sea lions (Figure 5-29).

The Pacific cod non-trawl and trawl average lengths (see Table 5-32) suggest overlap with sizes eaten by Steller sea lions as reported in McKenzie and Wynne (2008). However, of the three species in this analysis, Figure 5-29 shows the least amount of overlap in size between cod eaten by Steller sea lions and cod extracted by the Pacific cod fishery. The largest Pacific cod identified from sea lion scat samples around Kodiak is 69 cm (Table 5-31), which is smaller than the average size (75-90 cm) of the Pacific cod caught in the Aleutian Islands trawl and non-trawl fisheries (Figure 5-29 and Table 5-32). The Pacific cod fishery does not catch the small cod eaten by sea lions (Figure 5-29). For example, the smallest Pacific cod were caught in the Area 543 non-trawl fishery (26.47 cm, Table 5-32) and Pacific cod as small as 8 cm have been identified in Steller sea lion scats (Table 5-31). The best available data suggest some size partitioning between the cod fishery and Steller sea lions with the sea lions taking smaller fish than the fishery and the fishery taking larger fish than sea lions consume, with overlap in size occurring between the two for Pacific cod approximately 30 to 70 cm in length (Figure 5-29). The available data on size of Pacific cod consumed by sea lions are from the study in the Kodiak area (McKenzie and Wynne 2008). The extent to which sea lions consume larger Pacific cod in the Aleutian Islands is unknown, though skeletal remains from Pacific cod that were larger than a meter in length were found inside juvenile sea lion stomachs in the western Aleutian Islands (NMML unpublished data).

The largest size range of pollock eaten by Steller sea lions was measured by Zeppelin et al. (2004) as 3.7-70.8 cm (Table 5-31). Most of the pollock eaten by Steller sea lions was between 35.9 and 42.4 cm long (Zeppelin et al. 2004) and pollock between 21- 34 cm (Mckenzie and Wynne 2008) was measured in 60% of samples. Figure 5-29 shows a high degree of overlap between the size of pollock consumed by Steller sea lions and those caught in the fishery, with the entire size range extracted by the fishery (~11-70 cm) overlapping with those consumed by Steller sea lions (~4-71 cm). In Area 541, only juvenile pollock ranging ~4-10 cm are outside the size ranged targeted by the fishery. In Area 542, Steller sea lions consume juvenile and sub-adult pollock from ~ 4 to 25 cm with no overlap with the fishery (Figure 5-29). The smallest range of adult pollock are caught by the fishery in area 543 (~47 to 56 cm), with Steller sea lions consuming pollock ranging from ~4 to 46 cm and larger pollock ranging from ~57 to 71 cm with no overlap from the fishery (Figure 5-29).

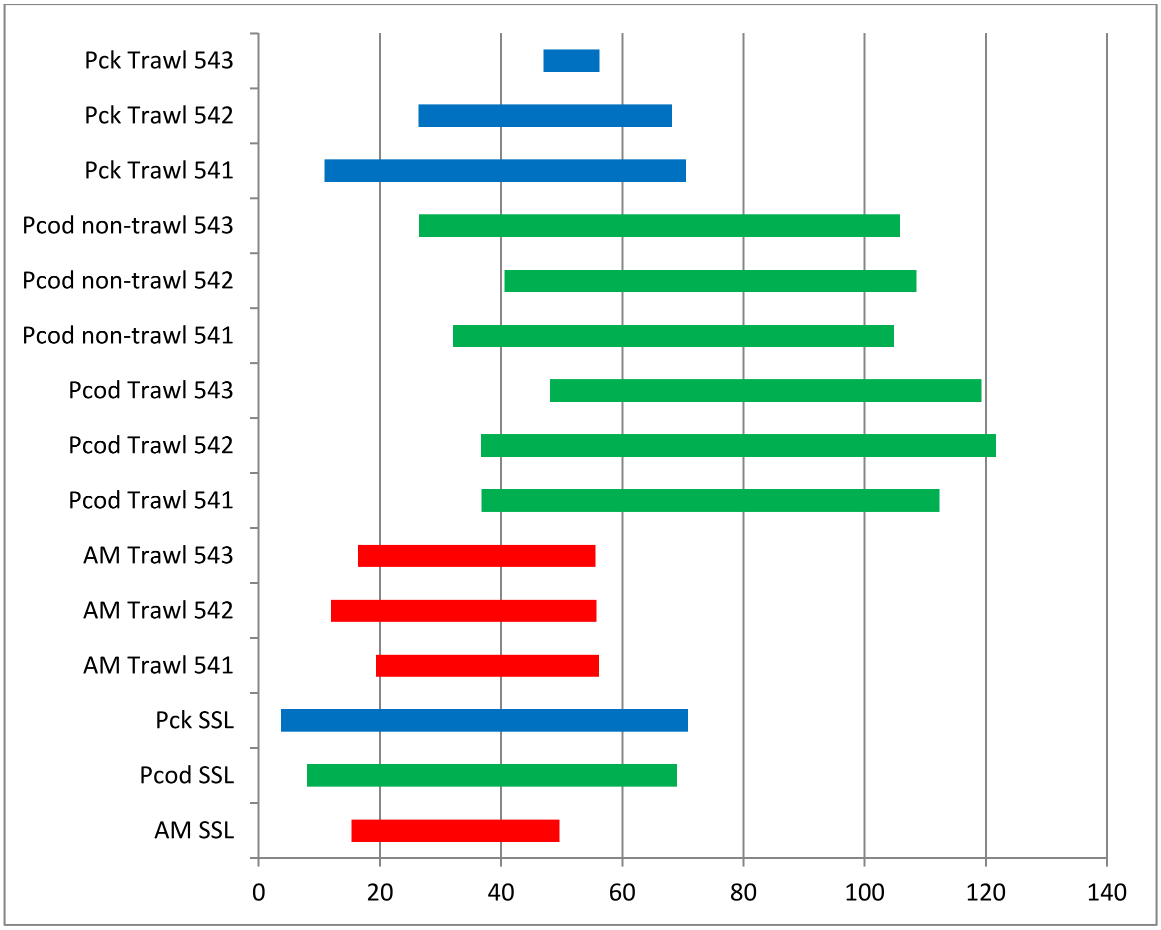


Figure 5-29. Prey size distribution consumed by Steller sea lions and caught in the groundfish fishery. Lengths are in cm. The "AM SSL" red bar shows the distribution of lengths of Atka mackerel eaten by Steller sea lions. The other red bars indicate the distribution of lengths of Atka mackerel that have been caught in the groundfish trawl fishery in each of the Aleutian Islands subareas. Pacific cod is represented by the green bars and the pollock bars are drawn in blue. Data sources are identified in the accompanying text.

5.3.7 Fishery Intensity

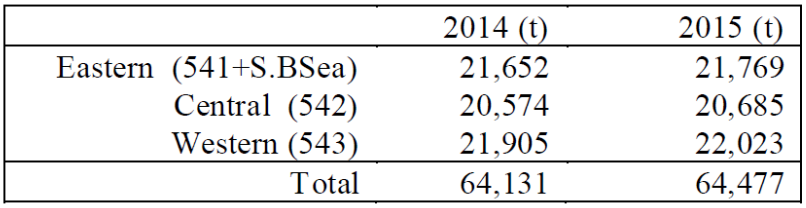
In addition to assessing the extent of overlap between the stressor of the proposed action and Steller sea lions and their designated critical habitat, we examine the frequency and intensity of the stressor as part of the exposure analysis. NMFS developed a new database for this consultation (see Appendix I) with the objective of improving upon the fishery harvest information presented in NMFS (2010). The CIA-Trends database was developed to provide NMFS analysts with consistent spatial data on groundfish harvests from 1992 to 2013. NMFS (2010) used expanded observer data (EOD) to analyze the spatial distribution of groundfish fishery harvests prior to the availability of vessel monitoring system (VMS) data in 2003. However, as presented in NMFS (2010), many of the catch estimates generated from the EOD had a remarkable amount of error relative to NMFS's official Catch Accounting System estimates. Thus, NMFS worked on improving the historic spatial catch estimates in the intervening period between the 2010 FMP BiOp and this biological opinion to more closely match the official catch estimates. The methods used to generate the CIA-Trends database are described in detail in Appendix I.

The most recent stock assessment and fishery evaluation (SAFE) reports were published in December, 2013 for the 2014 fishery and include recommended OFL and ABCs for 2015. We use these recommended values to estimate the potential intensity of fishery harvests under the proposed actions. Because the 2014 fishery has commenced, we often describe the estimated intensity of the 2015 fishery under the proposed action according to the recommended values in the SAFEs as these are the best available data at this time. However, the proposed action may or may not be implemented by 2015.

5.3.7.1 Atka mackerel

The Council used a 4-survey (2004, 2006, 2010, and 2012) weighted average to apportion the 2013 BSAI Atka mackerel ABC among the 3 management areas and the recommended ABCs for 2014 and 2015 shown in Table 5-33 are based on the same method as described in Lowe et al. (2013). Table 4-5 shows the historic Atka mackerel catches by management area along with the corresponding ABC and TAC.

Table 5-33. Apportionments of the 2014 and 2015 recommended Atka mackerel ABCs based on the most recent 4-survey weighted average. Source: Lowe et al. (2013).



	2014 (t)	2015 (t)
Eastern (541+S.BSea)	21,652	21,769
Central (542)	20,574	20,685
Western (543)	21,905	22,023
Total	64,131	64,477

To assess the intensity of the exposure of Steller sea lions and critical habitat to the removal of Atka mackerel under the proposed action, we examined the proportion of the ABC that was caught inside and outside of critical habitat, by season, in each fishery management area. We chose ABC because it is based on a scientific assessment of the species' status whereas the TAC may reflect economic and social considerations in addition to the species' status. Evaluating the proportion of the ABC harvested allowed for a standardized comparison across years.

Area 543 Atka Mackerel

Figure 5-30 shows the change in the seasonal (summer: April through September and winter: October through March) and spatial distribution (inside/outside critical habitat) of Atka mackerel catch in Area 543 as a proportion of the ABC. In the 1990s the majority of the catch was taken inside critical habitat in summer with an increasing proportion coming out of critical habitat in winter in the late 1990s. In 2001 and 2002, the catch was distributed more evenly between seasons and inside and outside of critical habitat. From 2005 through 2007, TACs were set at less than 50% of ABC and the maximum catch inside critical habitat during this period was 17% of ABC in summer in 2007. From 2008 through 2010 TAC was set closer to the ABC and was taken in fairly even proportions outside of critical habitat in summer and winter and inside of critical habitat in summer. A very small proportion of the Atka mackerel catch in Area 543 was taken inside of critical habitat in winter (Figure 5-30). There has been no fishing in Area 543 from 2011 through present due to the RPA from the 2010 FMP BiOp (NMFS 2010).

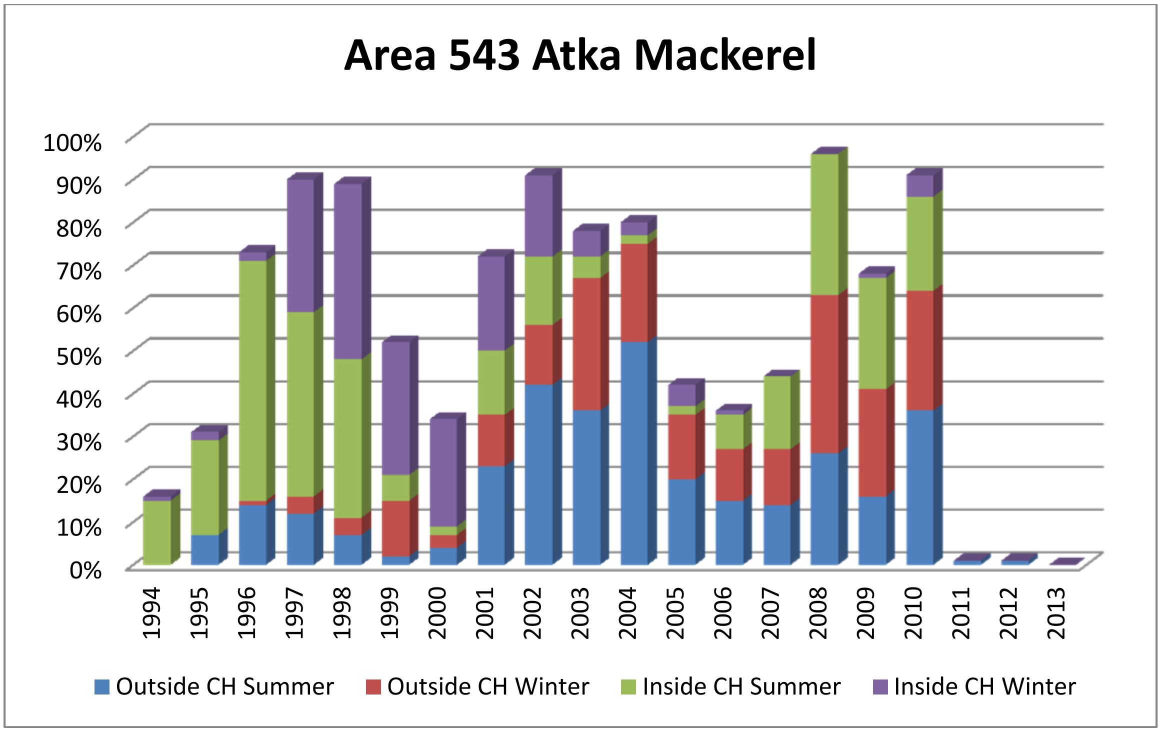


Figure 5-30. Percentage of the Area 543 Atka mackerel ABC caught in Area 543 from 1994 through 2013.

For this analysis, we assume the spatial and temporal Atka mackerel catch distribution in Area 543 would resemble the distribution from 2007 through 2010 because the proposed Area 543 Atka mackerel fishery is similar to the spatial measures in place during that time period, though we expect greater temporal distribution of the fishery due to the removal of the HLA as discussed in sections 2.2 and 4.4.2. Because the Area 543 TAC would be limited to 65% of the Area 543 ABC, the catch distribution may most closely resemble the 2009 Atka mackerel catch. In this case, we would expect a small amount of Atka mackerel (<10% of the Area 543 ABC) to be removed from critical habitat by the fishery in winter and a moderate amount (<30%) to be removed from critical habitat by the fishery in summer. Based on the apportionment in Table 5-33, the total amount of Atka mackerel catch in 2015 (65% of the Area 543 ABC) is estimated to be 14,315 mt. Given the seasonal and critical habitat catch limits under the proposed action it is estimated that approximately 8,589 mt (4,294 mt in each season) of Atka mackerel could be caught inside critical habitat in Area 543 in 2015. Atka mackerel fishery removals from inside of critical habitat averaged 26% ± 11% of the Area 543 TAC from 2004 through 2010—less than the amount permitted under the 60% critical habitat limit that was in place.

Table 5-34. Atka mackerel ABC, TAC, historical catch, 60% critical habitat catch limit and the amount of catch that occurred in critical habitat in Area 543 from 2004 through 2010. Source: NMFS (2013).

Atka mackerel	ABC	TAC	Historical Catch	60% CH Limit	Catch Inside CH
2004	24,360	20,660	19,554	12,396	1,260
2005	46,620	20,000	19,604	12,000	3,431
2006	41,360	15,500	14,636	9,300	3,503
2007	20,600	9,600	9,096	5,760	3,528
2008	16,900	16,900	16,049	10,140	5,516
2009	23,300	16,900	16,193	10,140	6,427
2010	20,600	20,600	18,651	12,360	5,524

To further evaluate fishing intensity, we examined how many vessels were likely to be fishing at a given time in each fishery management area, the average and maximum daily catch rates of those vessels, and percent of ABC taken by a vessel each day. Based on NMFS catch accounting records, prior to the closure of Area 543 to Atka mackerel fishing in 2011, a maximum of 6 vessels per day fished for Atka mackerel in Area 543, and a range of 1 to 3 vessels actively fishing for Atka mackerel was most common. In 2009 and 2010, the greatest percentage of Atka mackerel fishing days were fished by 1 vessel in Area 543 (Table 5-35). In 2009 and 2010 the average amount of Atka mackerel caught per vessel per day was approximately 100 mt and the maximum amount was approximately 240 mt per vessel. To estimate the upper expected Atka mackerel catch per day under the proposed action we multiplied the average and maximum daily catch rate from 2009 and 2010 by the maximum number of vessels. On the rare occasion that 5 to 6 vessels operate simultaneously, approximately 600 through 1,440 mt of Atka mackerel may be removed from Area 543. The number of days fished by the Atka mackerel fleet in Area 543 increased from 2008 through 2010 (53 days in 2008, 69 days in 2009, and 88 days in 2010). In 2009 and 2010, the HLA management compressed the Atka mackerel fishery within the A and B seasons. The Atka mackerel fishery in Area 543 became more temporally dispersed with the elimination of the HLA management under the interim final rule in 2011. Because Area 543 catch amounts varied in those years (Table 5-34), we divided the total catch by the number of days fished for each year and found the mean daily catch to be 302 mt, 234 mt, and 211 mt in 2008, 2009, and 2010 respectively—this implies a greater temporal dispersion of catch in recent years. We roughly estimate that on most days between 100 and 440 mt of Atka mackerel would be taken by the fishery in Area 543.

Table 5-35. The percentage of Atka mackerel fishing days in Area 543 in which x number of vessels were active.

Year	Number of Active Vessels					
	1	2	3	4	5	6
2008	23%	23%	38%	13%	0%	2%
2009	42%	30%	14%	14%	0%	0%
2010	49%	20%	14%	14%	3%	0%

Area 542 Atka mackerel

Figure 5-31 shows the change in the seasonal (summer: April through September and winter: October through March) and spatial distribution (inside/outside critical habitat) of Atka mackerel catch in Area 542 as a proportion of the ABC. From 1995 through 1998 almost all of the Atka mackerel harvest in Area 542 was taken inside of critical habitat with almost all of the catch being taken inside critical habitat in winter in 1997 and 1998. From 2001 through 2010 Area 542 Atka mackerel catch was distributed fairly evenly between inside and outside critical habitat in summer and winter, though the amount being caught in critical habitat increased slightly from 2007 through 2010. From 2011 through 2013, under the RPA from the 2010 FMP BiOp, almost all of the Atka mackerel catch was taken outside of critical habitat in summer and overall catch was reduced as a result of the mandatory TAC limit of 47% of the Area 542 ABC. Under the proposed action, the catch distribution may resemble the fishery in 2008 through 2010 since the 47% area-wide TAC limit and the 10% catch in critical habitat limit would be replaced by a 60% critical habitat catch limit similar to 2008 through 2010. However, there would be some changes to the areas open to fishing inside of critical habitat.

The proposed action would close critical habitat in Area 542 that was open under the pre-2011 measures and would increase 0-10 nm closures to 0-20 nm closures year-round at five rookeries (Ayugadak Point, Amchitka/Column Rocks, Amchitka Island/East Cape, Semishopochnoi/Petrel and Semisopochnoi/Pochnoi) and four haulouts (Amchitka Island/Cape Ivakin, Hawadax Island, Little Sitkin Island, and Segula Island) from 178°E to 180°. According to NMFS (2013), an average of 39% (11,773 mt) and a maximum of 54% (14,350 mt) of the Area 542 Atka mackerel catch from 2004 through 2010 was caught in the area from 178°E to 180° that would be closed under the proposed action. All other critical habitat closures would be the same as the measures in place in 2010. Thus, we may expect a similar amount of catch to be taken from inside critical habitat under the proposed action, though it may be concentrated in the remaining open areas of critical habitat.

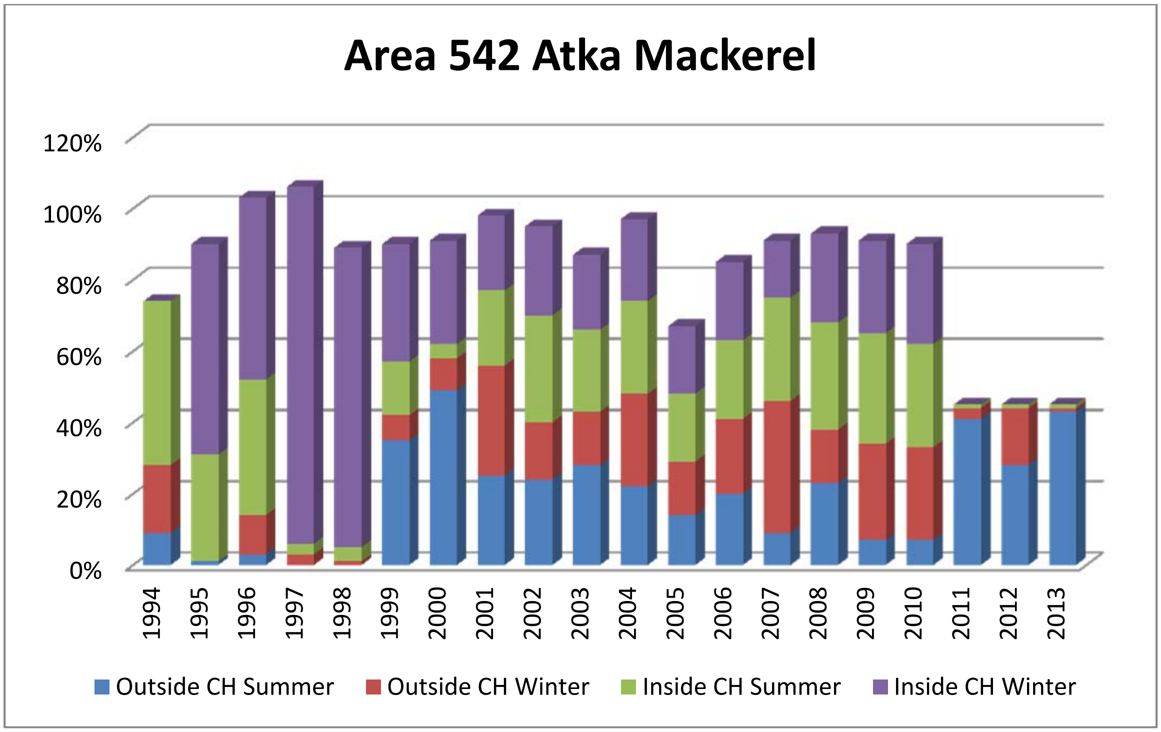


Figure 5-31. Percentage of the Area 542 Atka mackerel ABC caught in Area 542 from 1994 through 2013.

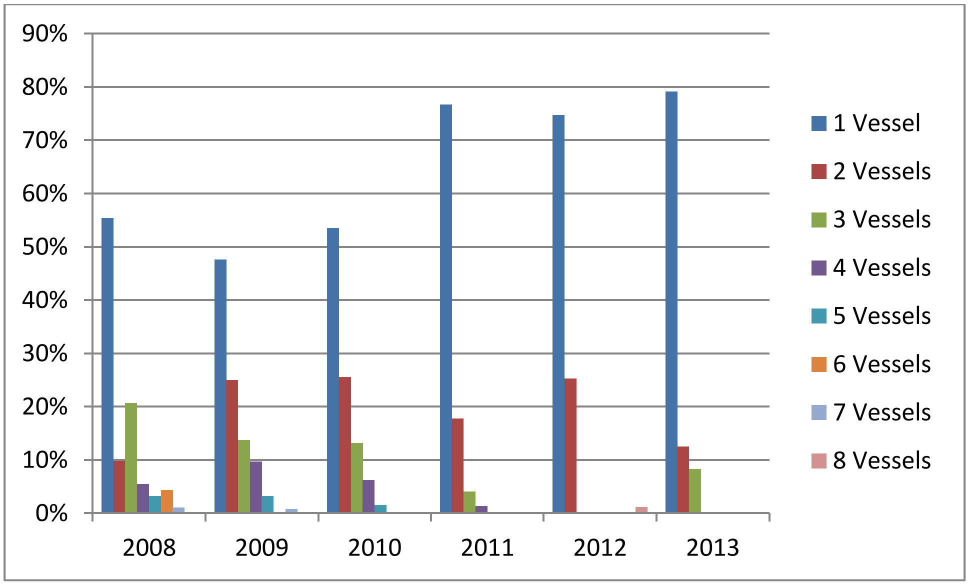
Based on the apportionment in Table 5-33, the total amount of Atka mackerel catch in 2015 under the proposed action is estimated to be 20,685 mt. Given the seasonal and critical habitat catch limits under the proposed action it is estimated that approximately 12,411 mt (6,205 mt in each season) of Atka mackerel could be caught inside critical habitat in Area 542 in 2015. Atka mackerel fishery removals from inside of critical habitat averaged 53% ± 5% of the Area 542 TAC from 2004 through 2010—less than the amount permitted under the 60% critical habitat limit that was in place (Table 5-36).

Table 5-36. Atka mackerel ABC, TAC, historical catch, 60% critical habitat catch limit and the amount of catch that occurred in critical habitat in Area 542 from 2004 through 2010. Source: NMFS (2013).

Atka mackerel	ABC	TAC	Historical Catch	60% CH Limit	Catch Inside CH
2004	31,100	31,100	30,170	18,660	15,261
2005	52,830	35,500	35,207	21,300	19,883
2006	46,860	40,000	39,834	24,000	20,615
2007	29,600	29,600	26,725	17,760	13,303
2008	24,300	24,300	22,921	14,580	13,536
2009	33,500	32,500	30,186	19,500	18,972
2010	29,600	29,600	26,387	17,760	16,775

To further evaluate fishing intensity, we examined how many vessels were likely to be fishing at a given time in each fishery management area, the average and maximum daily catch rates of those vessels, and percent of ABC taken by a vessel each day. A maximum of 8 vessels per day fished for Atka mackerel in Area 542, though since 2011, only 1 vessel has been active over 75% of the fishing days and a maximum of 3 vessels per day were active in 2013 (Figure 5-32). From 2008 through 2010 the average amount of Atka mackerel caught per vessel per day was approximately 110 mt ± 3 mt and the maximum amount was approximately 256 mt ± 3 mt per vessel. These amounts were lower from 2011 through 2013, but we estimate overall catch amounts to be most similar to 2008 through 2010 under the proposed action. We estimate that one to five Atka mackerel vessels may operate per day in Area 542 and harvest between 500 and 1,280 mt of Atka mackerel. The number of days fished by Atka mackerel fleet increased from 2008 through 2010 and was higher than the number of days fished in Area 543 (94 days in 2008, 131 days in 2009, and 134 days in 2010). We estimate that on most days between 110 and 256 mt of Atka mackerel would be taken by the Atka mackerel fishery in Area 542.

Figure 5-32. The percentage of Atka mackerel fishing days in Area 542 in which x number of vessels were active.



Area 541 Atka mackerel

Figure 5-33 shows the change in the seasonal (summer: April through September and winter: October through March) and spatial distribution (inside/outside critical habitat) of Atka mackerel catch in Area 541 as a proportion of the ABC. From 1994 through 1998 the Area 541 Atka mackerel fishery was a winter fishery with the amount of catch from inside critical habitat increasing from 1994 through 1997. In 1998, the amount of catch was roughly even between inside and outside of critical habitat in winter. With the implementation of the 50% season TAC split in 1999, nearly 30% of the Area 541 catch was caught in summer outside of critical habitat. Critical habitat was closed to the directed Atka mackerel fishery beginning in 1999 and from 1999 through 2003 the Atka mackerel catch was predominantly taken from outside of critical habitat with slightly more catch taken in winter.[15] From 2004 through 2006 the Area 541 Atka mackerel TAC was very small (and very small in relation to ABC in 2005 and 2006) so the fishery was open to directed fishing in the A season and closed to directed fishing early in the B season to prevent exceeding the TAC.

A small portion of critical habitat would be open under the proposed action in Area 541. This proposed management structure is different than reflected in the historic spatial and temporal distribution of the 541 Atka mackerel fishery. Our best estimate at characterizing the expected spatial and temporal distribution of the 541 Atka mackerel fishery is similar to the 2007 through 2013 fishery with some portion of the catch being taken inside the open area of critical habitat in winter and summer. There was no seasonal allocation the last time critical habitat in Area 541 was open in the late 1990s, thus we expect the critical habitat catch to be split between summer and winter under the proposed action. Under the proposed action, the full Area 541 TAC could be harvested inside of critical habitat; there would not be a 60% limit on the amount of harvest inside critical habitat yet the 50% seasonal apportionments would apply. Given the area proposed

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[15] Figure 5-33 shows some of the directed Atka mackerel catch within critical habitat in Area 541 after 1999. This is due to the proximity of the fishing outside of critical habitat to the critical habitat boundary and the resolution of the vessel monitoring system data which estimates some of these locations inside of critical habitat.

to be open in relation to the historic fishing areas around Seguam Island, we expect that the fishery will be catching fish from the same population, but over a larger area. Recall that the proposed action would open 5% of the critical habitat in Area 541—1,172 km^2 from 10 to 20 nm.

The projected area 541 ABC for 2015 is 21,769 mt and the TAC is typically set close to the ABC with few exceptions (Table 5-33). Thus, the fishery could harvest 10,885 mt each season and all of this harvest could be taken from inside critical habitat, though given the historic data, it is more likely that about half of the amount will be taken inside of critical habitat (Figure 5-33).

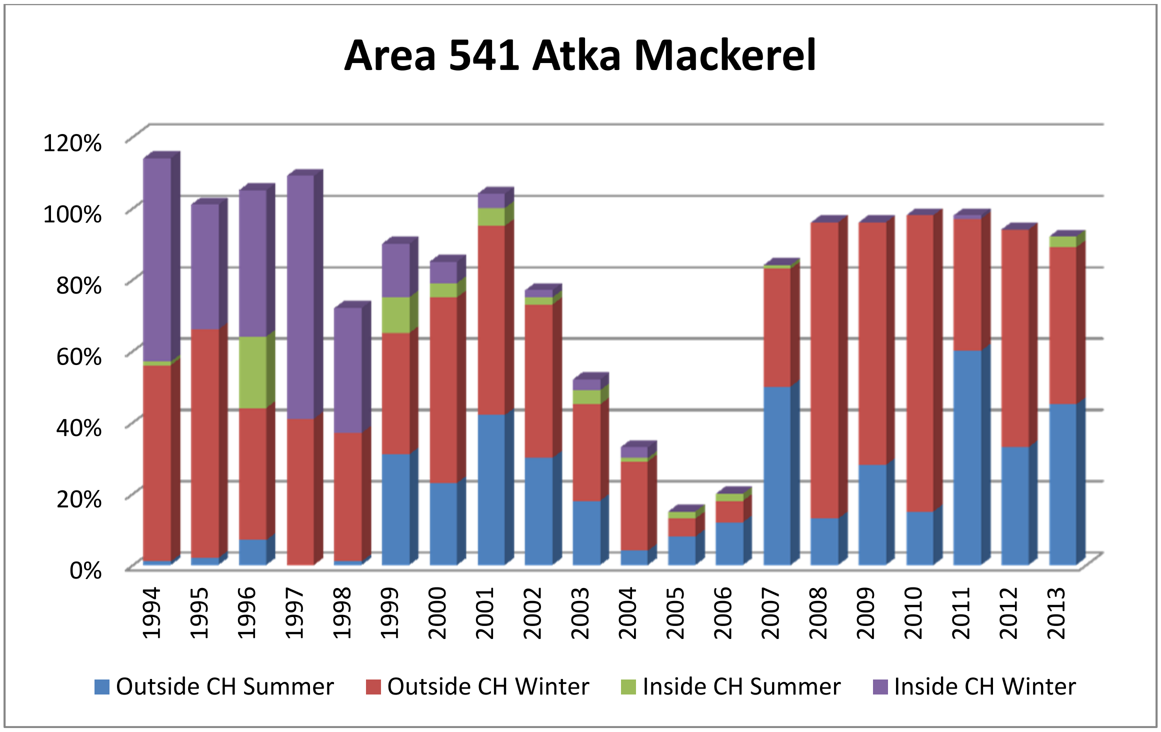

Figure 5-33. Percentage of the Area 541 Atka mackerel ABC caught in Area 541 from 1994 through 2013.

Table 5-37. Atka mackerel ABC, TAC, historical catch, 60% critical habitat catch limit and the amount of catch that occurred in critical habitat in Area 541 from 2004 through 2010. Source: NMFS (2013).

Year	ABC	TAC	Historical Catch	Catch Inside CH
2004	11,240	11,240	3,681	-
2005	24,550	7,500	3,660	-
2006	21,780	7,500	4,246	-
2007	23,800	23,800	19,921	-
2008	19,500	19,500	18,719	-
2009	27,000	27,000	26,171	-
2010	23,800	23,800	23,457	-

Rarely have more than 4 vessels fished for Atka mackerel on any given day in Area 541. More vessels fished a greater percentage of days in 2012 than in 2013 (Figure 5-32). From 2008 through 2010 the average amount of Atka mackerel caught per vessel per day was approximately 135 mt ± 5 mt and the maximum amount was approximately 283 mt ± 21 mt per vessel. These amounts were lower from 2011 through 2013, but we estimate overall catch amounts to be most similar to 2008 through 2010 under the proposed action. We estimate that one to six Atka mackerel vessels may operate per day in Area 541 and harvest upwards of 810 and 1,698 mt of Atka mackerel per day. On more the 40% of the days fished we estimate the Atka mackerel fishery will harvest between 135 and 283 mt. The number of days fished by the Atka mackerel fleet is higher in Area 541 than Area 542 or 543. The fishery operated over a larger number of days from 2011 through 2013 with the elimination of the HLA fishery. The fishery operated over an average of 88 days ± 16 days from 2008 through 2010 and an average of 146 days ± 22 days from 2011 through 2013. Because there would not be an HLA fishery in Areas 543 and 542 under the proposed action, we assume the number of days over which the Atka mackerel fishery will operate to be similar to 2011 through 2013. We estimate that on most days, upwards of 2 vessels will operate in Area 541 and harvest between 270 and 566 mt of Atka mackerel.

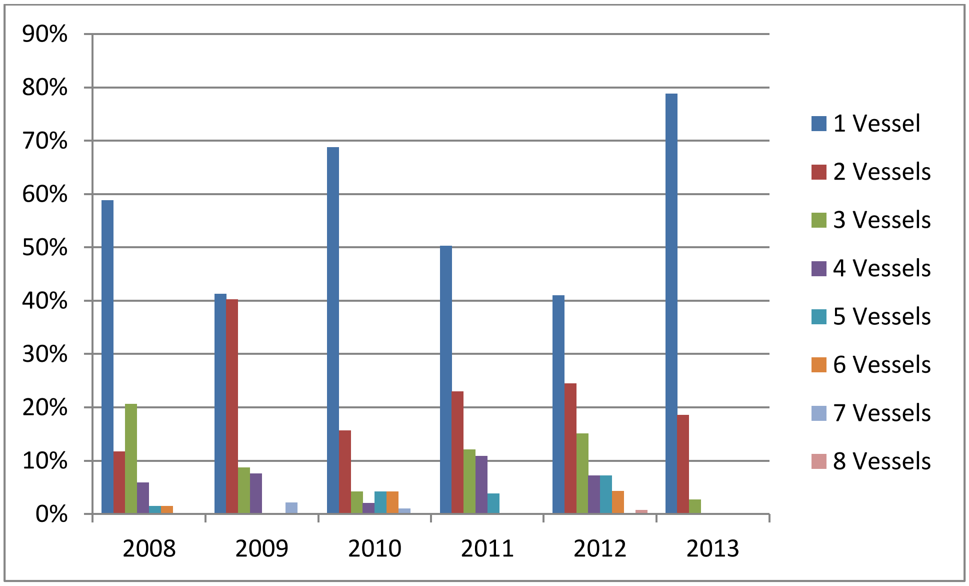

Figure 5-34. The percentage of Atka mackerel fishing days in Area 541 in which x number of vessels were active.

Atka Mackerel Research Component

To assess the effects of the Atka mackerel fishery on the local abundance of Atka mackerel, the Alaska Fisheries Science Center (AFSC) proposes to conduct research under a scientific research permit in 2014 and beyond as described in section 2.3. NMFS would capture, tag, and release Atka mackerel in Areas 543, 542, and 541 and recover those tags by trawling with non-pelagic trawl gear. Tagging work is expected to occur between May and June, 2014 and tag recovery work is expected to occur in September 2014 and March 2015. Similar Atka mackerel tagging studies may occur in future years, with work expected to occur in no more than two fishery management areas in any year. The amount of Atka mackerel, as a proportion of the mean ABC from 2000 through 2014, expected to be caught in each fishery management area as part of this research in 2014 and beyond is shown in Table 5-38. The research component is anticipated to harvest between 5% and 8% of the Atka mackerel ABC in Areas 543, 542, and 541. The highest amount of Atka mackerel catch from research activities in critical habitat is likely to be taken in Area 542 (approximately 800 mt in research years) with 400 and 600 mt estimated to be caught inside critical habitat in Areas 541 and 543, respectively (Table 5-39).

Table 5-38. Anticipated survey catches of Atka mackerel in relation to Allowable Biological Catch (ABC) and AFSC groundfish trawl survey biomass.

	NMFS area		
	541	542	543
Atka mackerel ABC (mt, mean 2000-2014)	20,624	29,518	24,935
Atka mackerel survey biomass (mt, mean 2000-2012)	198,594	252,884	216,817
Anticipated catch during recovery cruises (mt)	800	1,200	1,150
% of mean ABC	3.88%	4.07%	4.61%
% of mean survey biomass	0.40%	0.47%	0.53%
Anticipated catch during opportunistic prey field studies (mt)	910	560	150
% of mean ABC	4.41%	1.90%	0.60%
% of mean survey biomass	0.46%	0.22%	0.07%
Total anticipated catch (mt)	1,710	1,760	1,300
% of mean ABC	8.29%	5.96%	5.21%
% of mean survey biomass	0.86%	0.70%	0.60%

Table 5-39. Anticipated survey catches for Atka mackerel tag recovery studies (mt) inside and outside Critical Habitat (CH) for a given cruise and year (fall or winter/spring).

	NMFS area								
	541			542			543		
Species	Inside CH	Outside CH	Total	Inside CH	Outside CH	Total	Inside CH	Outside CH	Total
Atka mackerel	400	400	800	800	400	1200	600	550	1150
Northern rockfish	69	69	137	137	69	206	77	94	171
Pacific cod	24	24	48	48	24	72	27	33	60
POP	69	69	137	114	48	162	54	66	120
Pollock	9	9	17	17	9	26	10	12	21

5.3.7.2 Pacific cod

Recall that beginning in 2014, a separate ABC and TAC was specified for the Aleutian Islands. For this analysis NMFS multiplied the BSAI Pacific cod ABC by the proportion of the estimated Pacific cod biomass in the Aleutian Islands in each year from 2004 through 2013 as a proxy for an Aleutian Islands-specific ABC per the method employed by the Council for the 2014 Bering Sea and Aleutian Islands TAC split. The proportion of Pacific cod biomass in the Aleutian Islands has been estimated since 2004, thus this analysis was not able to look back beyond 2004. The following Pacific cod catch in relation to ABC information refers to the estimated Aleutian Islands ABC which is combined across Areas 543, 542, and 541 and applicable to all Pacific cod fisheries.

The amount of historic Pacific cod caught in the federal fisheries is shown by fishery management area in Table 5-40. The Pacific cod stock assessment notes that from 2008 through 2012 the trawl and non-trawl fisheries harvested 71% and 29% of the Aleutian Islands Pacific cod respectively (Thompson and Palsson 2013). The mean annual amount of Pacific cod harvest in the Aleutian Islands from 1992 through 2010 was 24,000 mt with a combined BSAI ABC.

Harvest of Pacific cod is expected to decrease markedly in the Aleutian Islands relative to historic harvest amounts due to the TAC split between the EBS and the Aleutian Islands. The Aleutian Islands Pacific cod ABC for 2014 and 2015 was recommended to be 15,100 mt (Thompson and Palsson 2013) which is 5.6% of the combined BSAI ABC (270,100 mt). The Council set the 2014 TAC at 6,997 mt which is the ABC after the deduction of the Aleutian Islands State-waters GHL fishery (8,103 mt).[16] By regulation, the first 10.7% of the TAC (749 mt) is allocated to the Community Development Quota (CDQ) fisheries. The amount of Pacific cod available to most trawl and non-trawl vessels in the Aleutian Islands is 6,248 mt in 2014 and projected to be similar in 2015. Of this amount, NMFS expects to set aside 2,000 mt of the 2014 Pacific cod TAC as an incidental catch allowance for other target fisheries. This amount can change from year to year and within a year depending on closure dates and how other fisheries are prosecuted.
Thus, after all deductions are calculated, the 2014 directed Pacific cod fishing allowance is 4,248 mt for the entire Aleutian Islands. This represents a 72% reduction in the amount of Pacific cod projected to be caught in the Aleutian Islands relative to the mean average annual catch in prior years.

The proposed action would limit the amount of Pacific cod that could be taken in Area 543 to the proportion of the Aleutian Islands biomass estimated to be in Area 543 in the annual SAFE report. From 1991 through 2012, the amount of the biomass in Area 543 averaged 27% ± 10% of the Aleutian Islands biomass and ranged from a high of 42% in 1991 to a low of 12% in 2004 (data from (Thompson and Palsson 2013). To be precautionary, we used the 75th percentile of the proportion of biomass in Area 543 from 1991 through 2008 to estimate the amount of Pacific cod that would be taken out of Area 543 in 2014 and 2015.Using the average proportion of biomass may underestimate the amount that may be taken and the maximum is not likely to occur on a regular basis. Based on the 75th percentile of the proportion of biomass in Area 543 from 1991 through 2012 we estimate that approximately 35% of the Pacific cod biomass will be in Area 543 in a given year. Thus, we estimate that a maximum of 1,469 mt of Pacific cod could be caught in Area 543 in 2015 under the proposed action. The 75th percentile of the proportion of catch in Area 543 from 1994 through 2013 was 20%, so the fishery may not catch the full 1,469 mt in Area 543 in 2015.

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[16] The State of Alaska Aleutian Islands Pacific cod fishery occurs from 0-3 nm in Area 541.

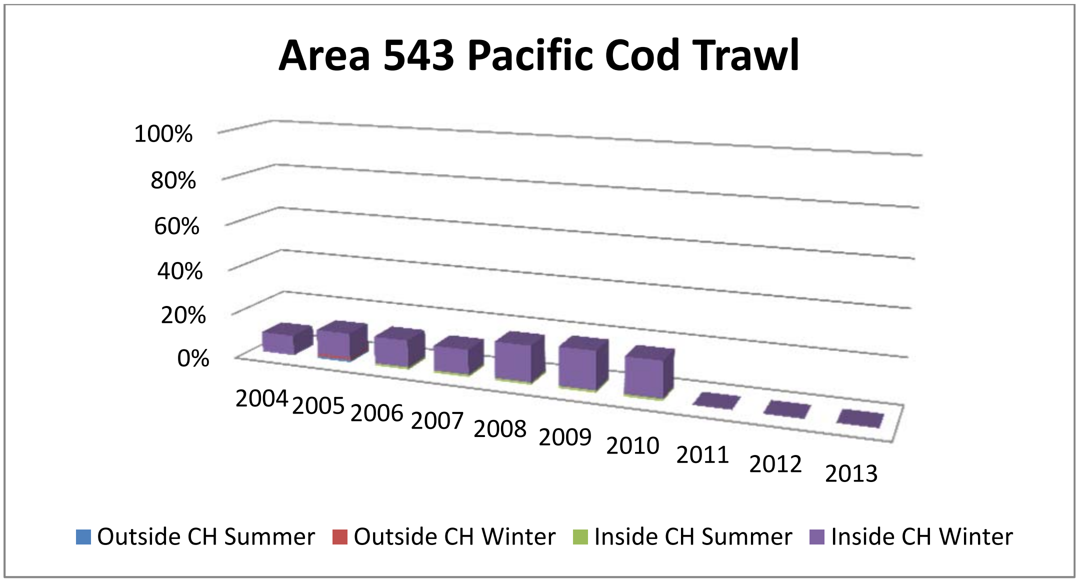
Table 5-40. Summary of 1994-2013 catches (mt) of Pacific cod in the Aleutian Islands, by fishery management area. Catches for 2013 are through October 12. Source: Thompson and Palsson (2013).

	Amount			Proportion		
Year	541	542	543	541	542	543
1994	12,039	7,441	2,059	0.559	0.345	0.096
1995	9,735	5,086	1,713	0.589	0.308	0.104
1996	23,077	4,509	4,023	0.730	0.143	0.127
1997	19,830	4,440	894	0.788	0.176	0.036
1998	21,940	9,299	3,487	0.632	0.268	0.100
1999	20,532	5,276	2,322	0.730	0.188	0.083
2000	21,812	8,799	9,073	0.550	0.222	0.229
2001	14,082	7,358	12,767	0.412	0.215	0.373
2002	21,408	7,133	2,259	0.695	0.232	0.073
2003	22,748	6,713	2,997	0.701	0.207	0.092
2004	18,391	6,825	3,657	0.637	0.236	0.127
2005	14,879	3,552	4,268	0.655	0.157	0.188
2006	14,967	4,661	4,583	0.618	0.193	0.189
2007	24,377	4,660	5,008	0.716	0.137	0.147
2008	18,185	5,555	7,319	0.586	0.179	0.236
2009	13,752	6,899	7,929	0.481	0.241	0.277
2010	14,496	6,291	8,213	0.500	0.217	0.283
2011	9,066	1,768	24	0.835	0.163	0.002
2012	15,377	2,816	29	0.844	0.155	0.002
2013	10,491	2,869	53	0.782	0.214	0.004

Pacific Cod Trawl

Figure 5-35 through Figure 5-37 show the change in the seasonal (summer: April through September and winter: October through March) and spatial distribution (inside/outside critical habitat) of Pacific cod trawl directed fishing catch as a proportion of the estimated Aleutian Islands ABC. Historically, the federal Pacific cod trawl fishery has operated primarily in winter in Area 541 in the Aleutian Islands with the majority of catch being caught inside critical habitat (Figure 5-37, Table 5-41). The amount of Pacific cod caught with trawl gear in Areas 543 and 542 was less than 20% of the estimated Aleutian Islands ABC from 2004 through 2013. Pacific cod catch inside of critical habitat in winter increased from 2004 through 2010 with corresponding decreases in catch in Area 541. There has been no Pacific cod trawling in Area 543 since the RPA from the 2010 FMP BiOp was implemented in 2011. The Pacific cod trawl fishery harvested a small percentage of the estimated Aleutian Islands ABC in Area 542 from 2004 through 2013 and most of this catch was inside of critical habitat (Figure 5-36, Table 5-41).

Figure 5-35. Percentage of the estimated Aleutian Islands Pacific cod ABC caught with trawl gear in Area 541 from 2004 through 2013.



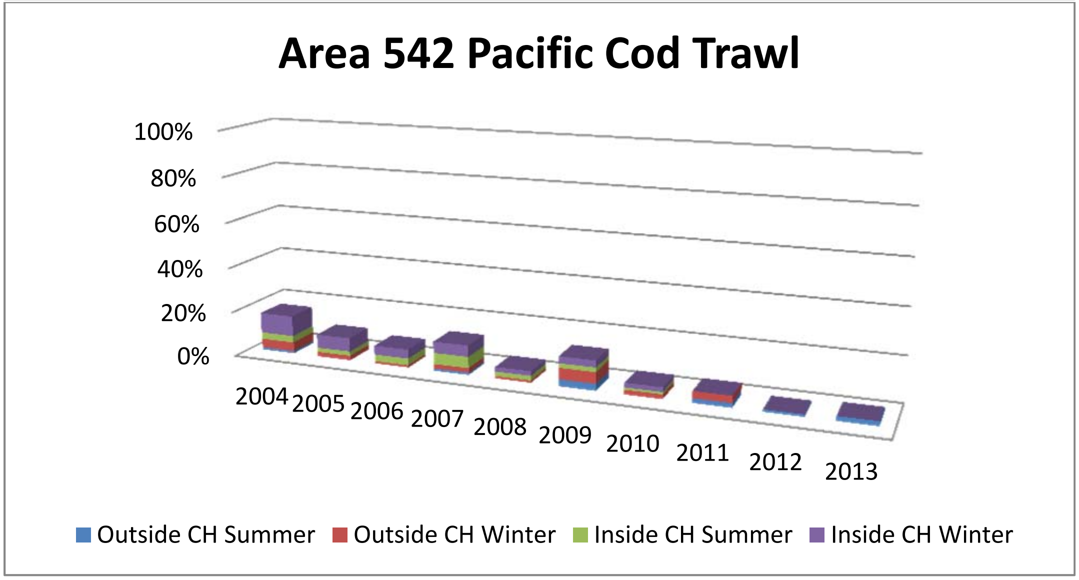


Figure 5-36. Percentage of the estimated Aleutian Islands Pacific cod ABC caught with trawl gear in Area 542 from 2004 through 2013.

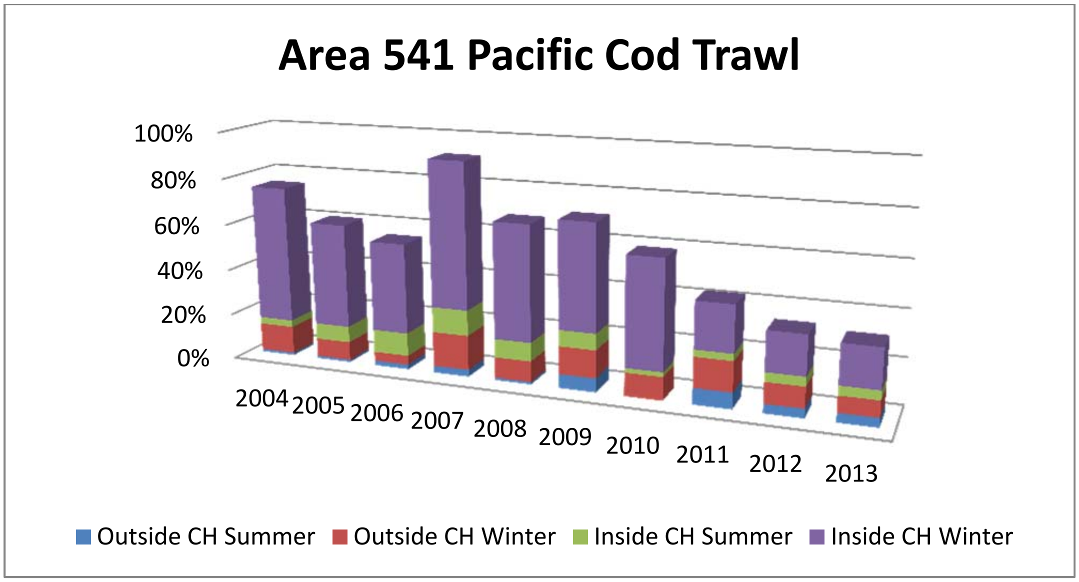


Figure 5-37. Percentage of the estimated Aleutian Islands Pacific cod ABC caught with trawl gear in Area 541 from 2004 through 2013.

Table 5-41. Pacific cod trawl catch amounts from 2004 through 2010 in Areas 543, 542, and 541 and the amount of historic catch inside Steller sea lion critical habitat (CH). Source: NMFS (2013)

	543		542/541	542	541
Year	Catch	Catch In CH	Catch	Catch In CH	Catch In CH
2004	3,657	3,021	25,216	1,761	16,657
2005	4,268	3,447	18,431	1,112	11,914
2006	4,474	3,938	16,024	1,089	10,323
2007	4,998	3,151	25,219	1,528	18,800
2008	7,162	4,685	19,435	790	13,019
2009	7,923	5,054	18,576	903	11,695
2010	7,993	4,642	17,171	616	10,457

Assuming that the proportion of catch taken by the Pacific cod trawl fleet in 2014 and beyond is similar to the proportion from 2008 through 2012 (71%), we estimate that approximately 4,968 mt of Pacific cod would be taken by the trawl fishery in 2014 and 2015. Given historic fishing patterns, we expect most of this catch would occur in critical habitat in winter (February) in Area 541. The amount of directed fishing by the trawl sector is expected to be limited in 2014 and beyond as their Pacific cod allowance is needed to cover their incidental Pacific cod catch in other target fisheries. Daily Pacific cod trawl catch rates averaged 188 mt ± 40 mt from 2008 through 2013 with an average maximum daily catch rate of 768 mt ± 280 mt.

Pacific Cod Non-Trawl

Overall, the Pacific cod non-trawl fleet harvested a lot less of the estimated Aleutian Islands ABC from 2004 through 2012 (20% ± 10%) than the trawl fleet (80% ± 18%) (Figure 5-38). For perspective, the Pacific cod catch by trawl gear inside of critical habitat in Area 541 always exceeded the total amount of Pacific cod caught by the non-trawl fleet in the entire Aleutian

Islands (Table 5-41 and Table 5-42). Overall catch rates are lower in the non-trawl fishery and the harvest is more dispersed temporally (Figure 5-39 through Figure 5-41).

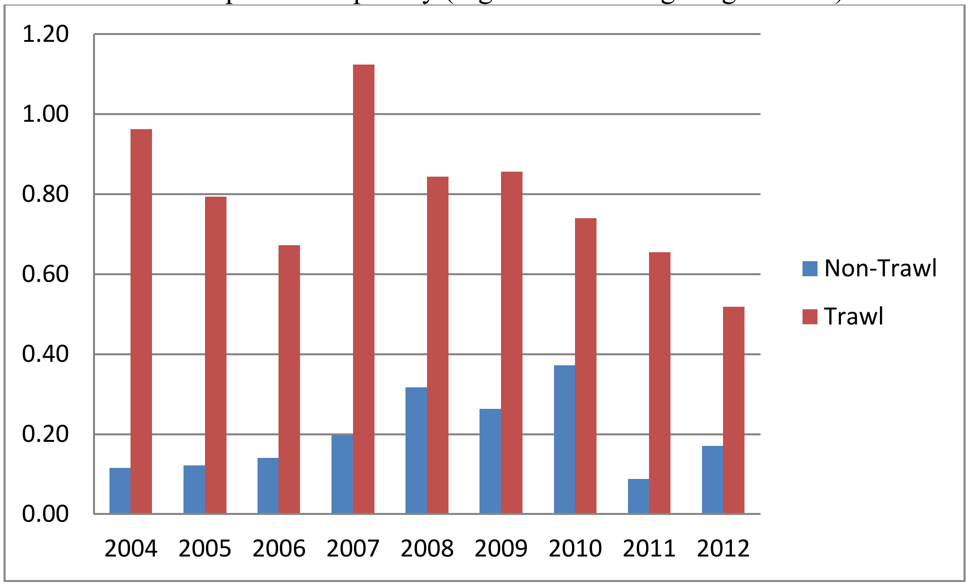


Figure 5-38. Proportion of the estimated Aleutian Islands Pacific cod ABC caught by trawl and non-trawl gear from 2004 through 2012.

Figure 5-39 through Figure 5-41 show the change in the seasonal (summer: April through September and winter: October through March) and spatial distribution (inside/outside critical habitat) of Pacific cod non-trawl directed fishing catch as a proportion of the estimated Aleutian Islands ABC. The highest catches of Pacific cod with non-trawl gear occurred in 2000 and 2001 (Table 5-42) which are not shown in the figures below. Catch of Pacific cod with non-trawl gear was most consistent in Area 541 from 2004 through 2010. The average catch of non-trawl Pacific cod averaged 2,234 mt ± 616 mt in Area 541; 1,347 mt ± 1,029 mt in Area 542; and 1,563 mt ± 1,304 mt in Area 543 from 2004 through 2010. Since 2004, the highest amount of catch by the Pacific cod non-trawl fleet occurred in 2010 (Table 5-42). On average, from 2004 through 2010, the largest non-trawl catches occurred in Area 541 with approximately 70% ± 8% of the catch coming from inside critical habitat. While the non-trawl sector catches less Pacific cod in Area 542 than in 541, almost all of this catch occurred inside critical habitat (e.g., 98% ± 3%) from 2004 through 2010 with a similar proportion being caught in summer and winter (Figure 5-40).

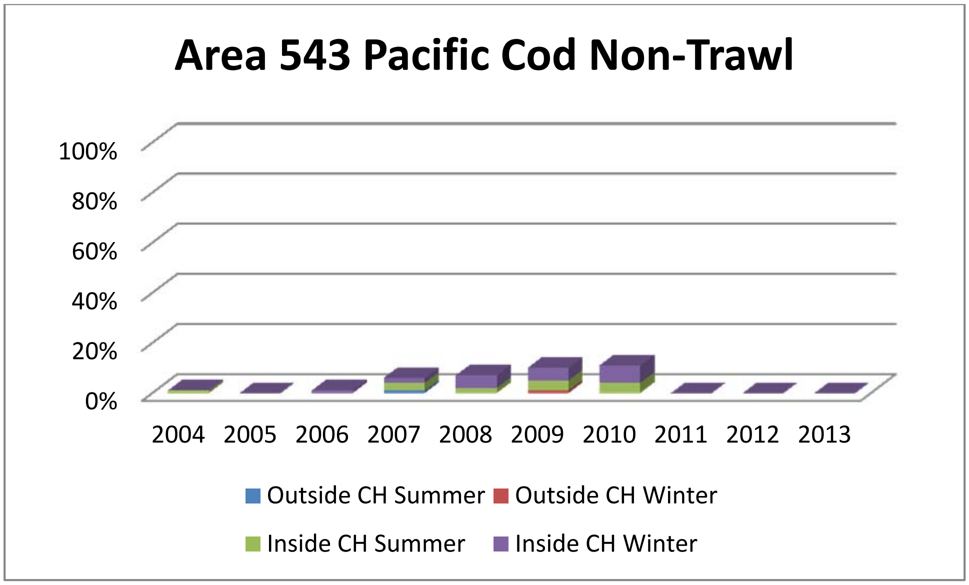


Figure 5-39. Percentage of the estimated Aleutian Islands Pacific cod ABC caught with non-trawl gear in Area 543 from 2004 through 2013.

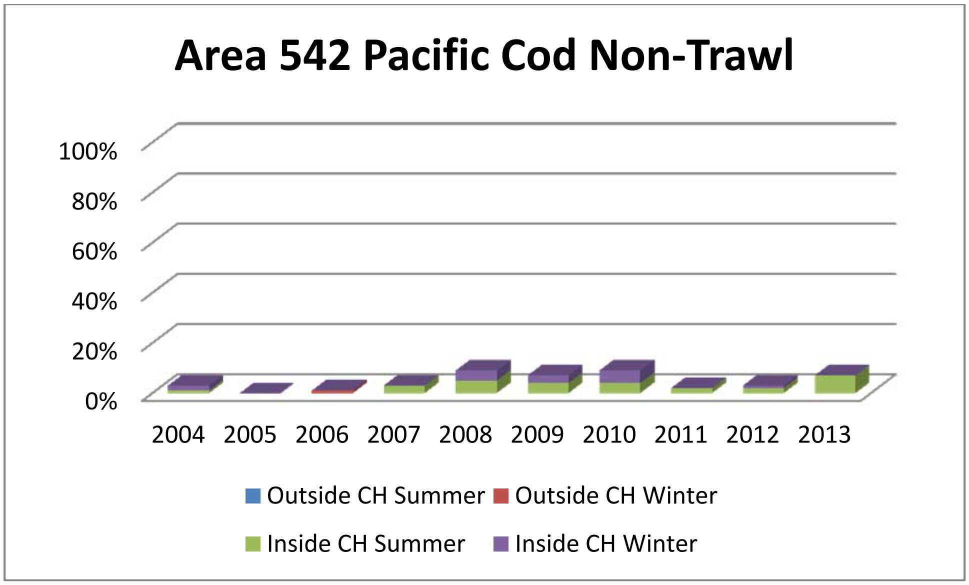


Figure 5-40. Percentage of the estimated Aleutian Islands Pacific cod ABC caught with non-trawl gear in Area 542 from 2004 through 2013.

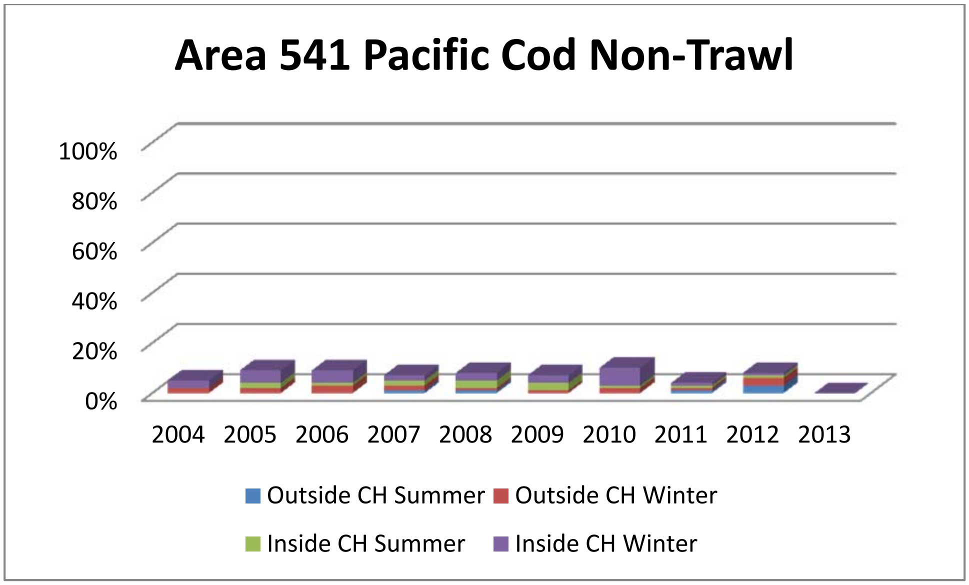


Figure 5-41. Percentage of the estimated Aleutian Islands Pacific cod ABC caught with non-trawl gear in Area 541 from 2004 through 2013.

Table 5-42. Amount (mt) of Pacific cod non-trawl catch by fishery management area from 1994 through 2013. CH = inside critical habitat. Source: NMFS Catch Accounting System (February 2014).

	541		542		543		
Year	CH	Total	CH	Total	CH	Total	Grand Total
1994	797	797	1,724	1,724	300	385	2,906
1995	709	1,180	2	2	0	0	1,182
1996	457	485	15	16			500
1997	12	16	10	12			28
1998	7	9	4	5			14
1999	1,798	1,843	418	418			2,262
2000	6,132	7,055	5,493	5,573	4,737	6,694	19,322
2001	2,888	4,087	2,622	2,651	10,831	11,552	18,289
2002	767	2,061	413	423	323	381	2,865
2003	346	462	437	440	68	76	979
2004	1,067	1,680	1,021	1,021	350	399	3,099
2005	2,180	2,962	33	33	1	4	3,000
2006	1,674	2,672	404	443	421	421	3,536
2007	1,244	2,028	772	791	1,483	1,676	4,495
2008	1,861	2,296	2,628	2,635	2,173	2,312	7,243
2009	912	1,259	2,031	2,033	2,643	2,931	6,222
2010	2,063	2,739	2,471	2,474	3,044	3,195	8,408
2011	405	726	482	506	6	6	1,238
2012	542	2,196	994	997	10	11	3,203
2013	57	172	1,515	1,515	29	33	1,720

Thompson and Palsson (2013) showed that, on average, 29% of the Pacific cod was caught by the non-trawl gear sectors from 2008 through 2012. Thus, we estimate that approximately 1,231 mt of Pacific cod will be caught by the non-trawl fleet in 2014 and 2015. This is likely an overestimate because it does factor in the Aleutian Islands TAC. We estimated the probable Area 543 limit for trawl and non-trawl gear as 1,469 mt for the first year of harvest under the proposed action. Because directed fishery for Pacific cod by trawl vessels typically starts earlier than the directed fishery for Pacific cod by non-trawl vessels, it is plausible that the Area 543 limit will be reached before the non-trawl vessels begin fishing. We anticipate that catches of Pacific cod with non-trawl gear in Area 543 will be very small to nil under the proposed action. It is possible that most of the catch by the Pacific cod non-trawl sector will be taken inside of critical habitat in Area 541 and 542. The total removals by this fleet are anticipated to be similar to the harvest amounts observed between 2011 and 2013 (Table 5-42).

5.3.7.3 Pollock

In the Aleutian Islands, critical habitat has been closed to pollock fishing since 1999. As shown in Table 5-43, the amount of pollock harvested in the Aleutian Islands has been very small in the areas outside of critical habitat open to the fishery (e.g. 5% to 13% of TAC since 2005). Historically, most of the Aleutian Islands pollock harvest was taken in Area 541 (Table 5-43). Aleutian Islands pollock fishery management is described in Section 3.4.2 of NMFS (2013). According to Figure 3-18 in NMFS (2013), most of the pollock in the Aleutian Islands from 1991 through 1998 was caught in three large areas in Area 541—north and outside of critical habitat in deep water along the eastern edge of Area 541, near Amutka Pass, and north of Atka Island. The largest pollock catches in one area were taken north of Kanaga Island inside critical habitat in Area 542 and a small amount of pollock was caught north of Hawadax Island (Area 542) and near Shemya Island inside critical habitat in Area 543 (see Figure 4-14). The Aleutians Islands pollock TAC is set equal to 19,000 mt when ABC > 19,000 mt and lower than 19,000 mt if the ABC is < 19,000 mt. The recommended ABCs for 2014 and 2015 are 35,048 mt and 39,412 mt, respectively (Barbeaux et al. 2013). The proposed action would open a portion of the critical habitat in Area 542 and 543 to fishing for pollock and 72% of the area inside critical habitat in Area 541 (Table 5-18 through Table 5-20).

Based on the 2015 ABC and the A season catch limits under the proposed action, it is estimated that a maximum of 1,970, 5,911, and 11,823 mt of pollock would be harvested in Area 543, 542, and 541, respectively in 2015. The A season catch is limited to 40% of the Aleutian Islands ABC, so the fishery would be unable to harvest the entire area-specific limit in each area in the A season. Those values sum to more than 19,000 mt, so the catch would also be lower due to the TAC constraint. We expect the pollock fishery to be most active in the A season which runs from January 20 through June 10. The B season fishery runs from June 10 through November 1. Given the history of the fishery and the structure of the proposed action, we expect most pollock fishing to occur inside critical habitat in winter in Area 541, up to a limit of 30% of the ABC—we know that the maximum TAC will always be 19,000 mt, so the ABC would have to be greater than 47,500 mt for the full 19,000 mt to be taken in the A season and greater than 63,333 mt for the full TAC to be taken in Area 541 in the A season. The highest Aleutian Islands pollock ABC from 1992 through 2013 was 58,700 mt in 1993 (Table 5-43).

Statutory and logistical constraints may prevent the Area 543 directed pollock fishery from being realized. By statute, 50% of the Aleut Corporation's pollock allocation (the entire Aleutian Islands pollock fishery) must be harvested by catcher vessels < 60 ft. in length. Thus, the maximum amount of Aleutian Islands pollock that may be harvested by trawl catcher/processors is 9,500 mt given the 19,000 mt TAC limit. In the event that ABC is less than 23,750 mt, catcher/processors would be limited to an even smaller amount of harvest. The statute permits the Aleut Corporation to authorize AFA catcher/processors to harvest the catcher/processor portion of the Aleutian Islands pollock TAC. NMFS projects an extremely low likelihood of a catcher vessel < 60 ft. in length fishing for pollock in Area 543, unless there was a catcher/processor acting as a mothership to process the catch due to the long distance to the nearest shoreside processing plant. The weather in the western Aleutian Islands in winter also precludes small catcher vessels from participating in the pollock fishery in Area 543. Thus, the Area 543 pollock TAC may be taken by an AFA catcher/processor if authorized by the Aleut Corporation. However, based on the best available information, it is unlikely that an AFA catcher/processor operator would choose to leave the productive EBS pollock fishery during the A season to harvest 5% of the Aleutian Islands ABC in Area 543. NMFS's fishery scientists and managers also note the lack of pollock in Area 543 during recent summer biomass surveys and during an experimental fishing project (EFP 07-01). Thus, the unknown biomass in Area 543, the fact that unharvested Aleutian Islands pollock TAC is rolled-over to the EBS, the small available Area 543 catch limit, and the distance to steam to Area 543 make it unlikely that the Area 543 pollock TAC will be harvested.

A realistic worst case scenario for the Aleutians Island pollock fishery is that all 19,000 mt will be harvested in the A season inside critical habitat in Areas 542 and 541. This could only occur if the ABC is higher than projected for 2014 and 2015. A maximum of 15% of the Aleutian Islands ABC could be harvested in Area 542. Based on the 2015 ABC, we estimated a maximum of 5,911 mt of pollock would be harvested in Area 542 in the winter. If a large proportion of this were harvested by catcher/processors, it would reduce the amount of pollock they could catch inside critical habitat in Area 541 (e.g. it would be limited to 3,589 mt). The remainder of the catch could be taken by catcher vessels < 60 ft in length which have lower harvest rates than larger trawl vessels. With the statutory constraints on the Aleutian Islands pollock fishery combined with the area limits under the proposed action, NMFS expects substantially lower pollock harvests inside of Steller sea lion critical habitat in Areas 542 and 541 relative to the harvests in 1996 and 1997 when the ABC was lower than projected for 2015. Moreover, NMFS has the assurance that the Aleutian Islands pollock catch will not exceed 19,000 mt, regardless of the ABC and that the amount of harvest by catcher/processors will not exceed 9,500 mt in any year. These constraints were not imposed on the fishery the last time that critical habitat was open to the Aleutian Islands pollock fishery.

Table 5-43. Aleutian Islands pollock catch limits and total catch (mt).

Year	Biomass	OFL	ABC	TAC	Catch	541	542	543	% catch 541	% catch 542	% catch 543
1992	537,631	62,400	51,600	47,730	52,352	52,140	206	6	100%	0%	0%
1993	464,358	62,600	58,700	51,600	57,132	54,512	2,536	83	95%	4%	0%
1994	384,318	60,400	56,600	56,600	58,659	58,091	554	15	99%	1%	0%
1995	319,261	60,400	56,600	56,600	64,925	28,109	36,714	102	43%	57%	0%
1996	259,626	47,000	35,600	35,600	29,062	9,226	19,574	261	32%	67%	1%
1997	232,659	38,000	28,000	28,000	25,940	8,110	16,799	1,031	31%	65%	4%
1998	209,891	31,700	23,800	23,800	23,822	1,837	3,858	18,127	8%	16%	76%
1999	184,714	31,700	23,800	2,000	1,010	484	420	105	48%	42%	10%
2000	178,971	31,700	23,800	2,000	1,244	615	461	169	49%	37%	14%
2001	183,570	31,700	23,800	2,000	824	332	386	105	40%	47%	13%
2002	208,034	31,700	23,800	1,000	1,156	842	180	133	73%	16%	12%
2003	225,577	52,600	39,400	1,000	1,666	577	760	329	35%	46%	20%
2004	227,923	52,600	39,400	1,000	1,158	397	513	248	34%	44%	21%
2005	225,232	39,100	29,400	19,000	1,621	689	415	517	43%	26%	32%
2006	215,559	39,100	29,400	19,000	1,745	1,036	488	220	59%	28%	13%
2007	200,870	54,500	44,500	19,000	2,519	1,919	476	124	76%	19%	5%
2008	192,595	34,040	28,160	19,000	1,278	872	290	116	68%	23%	9%
2009	196,174	32,553	26,873	19,000	1,779	1,136	400	243	64%	22%	14%
2010	201,785	40,000	33,100	19,000	1,285	754	382	150	59%	30%	12%
2011	208,144	44,500	36,700	19,000	1,208	695	447	66	58%	37%	5%
2012	250,905	42,900	35,200	19,000	970	501	427	42	52%	44%	4%
2013	265,591	45,588	37,295	19,000	2,964	2,342	309	313	79%	10%	11%

5.3.8 Conceptual Model for Steller Sea Lion Exposure to Groundfish Harvest

NMFS developed a conceptual model to illustrate the pathways through which Steller sea lions are exposed to the stressor of reduced prey resources as a result of the groundfish fisheries, as shown in Figure 5-42. On the first tier, fisheries may modify food web dynamics and remove important prey resources. The modified food web dynamics are discussed in detail in the FMP BiOp (NMFS 2010). The exposure analysis in this biological opinion focused on evaluating the exposure pathway that starts with fishing (harvest of TAC) for important sea lion prey species. In the Environmental Baseline (Section 4), we identified the principal prey species, which we defined as those that occur in at least 10% of sea lion scats in summer and winter. In this section we analyzed the amount of overlap in size, place, time, and depth to the extent possible with the available data.

For the proposed Atka mackerel fisheries we found a qualitatively high degree of time (summer and winter) and size overlap. With respect to place overlap, there would be no direct overlap between the fishery and sea lions inside the 10 nm trawl exclusion zone around rookeries and the 3 nm trawl exclusion zone around haulouts. There may be some direct place overlap between the fishery and sea lions in the 24%, 8%, and 3% of critical habitat open to the Atka mackerel fishery in Areas 543, 542, and 541, respectively, and in areas where the two co-occur outside of critical habitat. There appears to be some depth partitioning between the Atka mackerel fishery and sea lion diving, though it is unknown whether sea lions forage on the same sub-population of Atka mackerel either at night when the fishery is active or during the day when Atka mackerel are higher in the water column – or if the apparent depth differences are due to targeting of different sub-populations.

For the proposed Pacific cod fisheries we found a qualitatively high degree of time (winter) and depth overlap and the least amount of size overlap among all of the fisheries analyzed, though some overlap with the smallest cod taken by the fisheries is expected based on the available data. Anecdotal accounts report that sea lion prey size in the literature (e.g., Zeppelin et al. (2004), McKenzie and Wynne (2008) may be underestimated since sea lions may not eat the heads of larger fish (NMML, personal communication, March 10, 2014). Of all the fisheries analyzed under the proposed management structure, the greatest extent of direct spatial (see Table 5-12 through Table 5-17) and depth overlap is expected to occur between sea lions and the Pacific cod fisheries.

For the proposed pollock fishery we found a qualitatively high degree of time (winter) and size overlap and an apparent low degree of depth overlap in Area 543, with more potential depth overlap in Areas 542 and 541. Overall, the least amount of depth overlap is expected between the pollock fishery and sea lions according to this analysis. The extent of direct place overlap inside critical habitat is expected to be lowest for the pollock fishery in Area 543 because 95% of the critical habitat would be closed to the fishery (see Table 5-18). In Areas 542 and 543, direct place overlap may occur in 13% and 72% of the area designated as critical habitat (Table 5-19 and Table 5-20).

Based on the available quantitative and qualitative data to evaluate extent of overlap in this analysis, our best understanding is that some amount of partitioning can be expected between the three fisheries and Steller sea lions, with the principal type of inferred partitioning being as follows for each fishery: Atka mackerel – place; Pacific cod – size; and pollock – depth. Some extent of direct overlap is also expected, with the principal type of inferred overlap being as follows for each fishery: Atka mackerel – size; Pacific cod – place; and pollock – size (and place in Area 541).

With respect to the next step in the conceptual pathway– low biomass levels and replenishment rates–we have the least amount of information about winter Pacific cod and pollock biomass in the Aleutian Islands. Our best data for this component of the exposure pathway is for Atka mackerel in summer in all areas and in Areas 541 and 542 in winter (McDermott and Haist In Review). Thus, the initial biomass for Atka mackerel in Area 543 and pollock and Pacific cod in winter is unknown. Atka mackerel exhibit less horizontal movement in general compared to Pacific cod and pollock (Conners et al. 2013b) and may be more susceptible to localized depletion (Lowe et al. 2013). Pollock and Pacific cod may have high replenishment rates making stocks less susceptible to localized depletion (e.g., (Conners and Munro (2008), Walline et al. (2012) compared to Atka mackerel, though, given potentially high localized exploitation rates, it is unknown whether the fisheries cause local and temporal depletion of pollock and Pacific cod.

With respect to, "reduced prey biomass overall," the FMP BiOp (NMFS 2010) analyzed the potential for global depletion of prey and reduction of the Steller sea lion carrying capacity as a result of fishery removal of prey. As discussed in section 3.10 of this biological opinion, NMFS and the NRC (2003) hypothesize that on a global scale there appears to be sufficient prey for a recovered Steller sea lion population (e.g., larger than today's population) and that groundfish populations appear to be maintained on an annual scale.

With respect to modified prey size and age distribution, Lowe et al. (2013) conclude that natural fluctuations dominate over fishing effects for Atka mackerel. Environmental effects also dominate the amount of interannual variability in pollock recruitment (Jim Ianelli, Alaska Fisheries Science Center, personal communication March 26, 2014) and likely dominate over fishing effects for Pacific cod as well (Grant Thompson, Alaska Fisheries Science Center, personal communication March 26, 2014).

We lack data to determine conclusively whether the fisheries fragment the prey patches, modify the proportion of prey at depth, and ultimately result in reduced prey resources. We demonstrate partial overlap combined with unknown initial biomass and replenishment rates for all four fisheries, resulting in some potential for reduced prey resources. The only exceptions to this conclusion are for the Atka mackerel fishery near Seguam Pass, Kanaga Island, and Kiska Island where trawl exclusion zones in combination with high initial biomass of Atka mackerel likely reduce the potential that the fishery will locally deplete Atka mackerel in these three areas (see section 5.4.2).

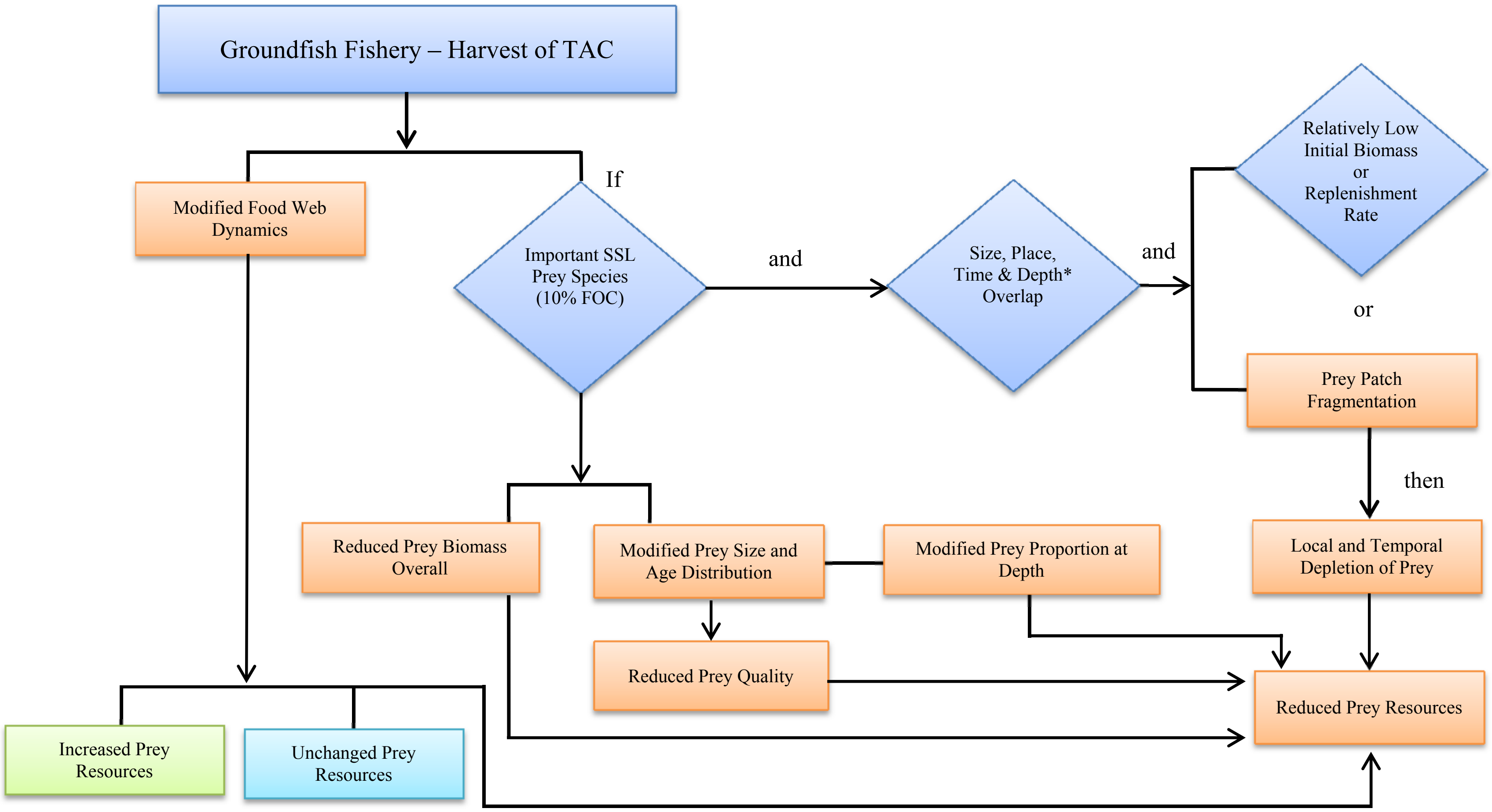


Figure 5-42. NMFS's conceptual model for exposure of Steller sea lions to the effects of prey removal in the groundfish fisheries.

* Accounting for prey daily and seasonal vertical migrations, fishery depth, and SSL foraging depth

5.4 Risk Analysis

In this section we assess the effects of exposure of Steller sea lions and critical habitat to the removal of prey as a result of the proposed action and the probability of harm and the severity of the consequence on Steller sea lion populations in the western and central Aleutian Islands and critical habitat. In section 3.10 we reviewed the available information to evaluate the prevalence of nutritional stress in the western DPS, including information available for the western and central Aleutian Island sub-regions. From that review, based on apparent delayed weaning and high year-1 survival, we hypothesized that western DPS Steller sea lions are exhibiting a life history strategy of high maternal investment in pups at the expense of high natality. As discussed in section 3.7.2, no data are available to infer natality for the western and central Aleutian Islands.

Winship et al. (2002) developed a bioenergetic model to estimate seasonal food requirements of Steller sea lions by age, sex, and season (Table 5-44). The results of that work indicate that the highest food requirements of all sex and age-classes are for young adult females (e.g., ages 3 and 4) nursing a male pup in the spring (Table 5-45). Based on the limited information on age-specific natality available from the Russian portion of the WDPS (Trukhin and Burkanov 2004), we expect the percent of females giving birth to increase with age from age 4 to age 7. Trukhin and Burkanov (2004) reported that 12% of 4 year old females gave birth, 64% of 5 year olds gave birth, and 75% of 7 year olds gave birth based on resightings of marked individuals in the Kuril Islands. The bioenergetic model predicted slightly lower requirements for older adult females who were no longer growing. The highest food requirements for an age 6 pregnant female nursing a pup are predicted to be in the winter and spring, however the model suggested that food requirements of pregnant females were only marginally greater than the predicted food requirement of non-pregnant females of the same age (Table 5-45).

Table 5-44. Total energy requirements (GJ) of individual Steller sea lions in each season. The seasons are: Summer (1 June to 31 August), Autumn (1 September to 30 November), Winter (1 December to 28 February), and Spring (1 March to 31 May). Fetus and pup energy requirements represent the amount of energy a female would require to support a fetus and a pup respectively. Note: for a given age (or year of life) summer includes the first 2.5 mo (15 June to 31 August) and the last 2 wk (1 June to 14 June). Source: Winship et al. (2002).

	Male				Female			
Age	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
Fetus	0.035	0.046	0.21	0.51	0.026	0.04	0.193	0.439
Pup	4.34	4.91	7.06	9.49	3.48	3.89	5.52	7.36
1	7.76	7.72	7.76	8.15	6.37	6.49	6.69	7.13
2	8.2	8.39	8.66	8.93	7.18	7.33	7.54	7.78
3	8.84	9.08	9.35	9.6	7.76	9.39	9.62	9.84
4	9.46	9.75	10.02	10.23	7.8	9.37	9.47	9.61
5	11.15	11.75	12.04	12.22	7.57	9.05	9.06	9.14
6	11.69	12.37	12.63	12.71	7.15	8.52	8.46	8.49
7	12.06	12.78	12.96	12.9	6.59	7.83	7.72	7.7
8	12.51	13.3	13.74	14.09	6.16	7.38	7.5	7.73
9	13.85	14.38	14.54	14.91	6.31	7.56	7.66	7.89
10	14.6	14.87	14.78	15.17	6.45	7.71	7.8	8.03
11	14.86	15.03	14.84	15.23	6.56	7.83	7.92	8.15
12	14.93	15.07	14.85	15.24	6.65	7.94	8.02	8.25
13	14.95	15.08	14.85	15.25	6.73	8.03	8.1	8.34
14	14.95	15.08	14.85	15.25	6.8	8.11	8.17	8.41
15	–	–	–	–	6.86	8.17	8.23	8.47
16	–	–	–	–	6.91	8.23	8.29	8.53
17	–	–	–	–	6.95	8.28	8.33	8.57
18	–	–	–	–	6.99	8.32	8.37	8.61
19	–	–	–	–	7.02	8.35	8.4	8.65
20	–	–	–	–	7.05	8.38	8.43	8.67
21	–	–	–	–	7.07	8.41	8.46	8.7
22	–	–	–	–	7.09	8.43	8.48	8.72

Table 5-45. Examples of total energy requirements (GJ) of adult females nursing a pup and supporting a fetus in each season. Based on estimates from Winship et al. (2002).

		Summer	Autumn	Winter	Spring
Age 3 Female Nursing					
	Male Pup	12.1	14.3	16.7	19.3
	Female Pup	11.2	13.3	15.1	17.2
Age 6 Female Nursing					
	Male Pup	11.5	13.4	15.5	18.0
	Female Pup	10.6	12.4	14.0	15.9
Pregnant and Nursing					
Age 6	Male Pup/Male Fetus	11.5	13.5	15.7	18.5
	Female Pup/Female Fetus	10.7	12.5	14.2	16.3

Figure 5-43 shows NMFS's conceptual model for how Steller sea lions respond behaviorally and physiologically when exposed to reduced prey resources. According to our conceptual model, if a sea lion exposed to reduced prey resources leaves the area or is able to attain sufficient prey without increasing its foraging effort, then the sea lion would not experience a deleterious consequence (nutritional stress) as a result of the exposure. If a sea lion increases foraging effort and is able to attain sufficient prey to support all physiological processes for growth and reproduction, then we do not expect a nutritional stress response. The pathways shown in Figure 5-43 depict the response pathways expected for acute (insufficient prey for survival) and chronic (insufficient prey to support all functions) nutritional stress and for how that nutritional stress is likely to result in reduced survival or reproduction.

As discussed in section 3.10, the available data do not indicate that Steller sea lions in the western and central Aleutian Islands are experiencing acute nutritional stress, nor do the data indicate an increased incidence of disease. Given the available data, NMFS's conceptual model indicates that if nutritional stress is occurring in the western and central Aleutian Islands, the most likely path is via insufficient nutrition for adult females which results in increased maternal investment. Weaned juveniles may also be experiencing reduced growth which could cause a delay in age-at-maturity. NMFS's conceptual model indicates that reproduction may be reduced via either of these pathways. As discussed throughout this biological opinion, NMFS does not have data to evaluate the prevalence of chronic (long term) nutritional stress and how it may be manifesting as reduced reproduction in the western and central Aleutian Islands.

As discussed in section 3.10, NMFS has estimated global prey availability in several biological opinions on the groundfish fisheries and has consistently concluded that, based on our best (though admittedly incomplete) understanding of sea lion food requirements, the amount of prey available on an ecosystem-wide spatial scale and an annual temporal scale is more than needed to meet the food requirements of a recovered Steller sea lion population (i.e., larger than today's population). The NRC (2003) concurred with this conclusion. Thus, in prior biological opinions on the groundfish fisheries, NMFS has concluded that fisheries may be causing localized depletions of prey, on a fine spatial and temporal scale relevant to foraging Steller sea lions. The NRC (2003) concurred with this conclusion as well. As discussed in section 4.4, NMFS implemented many changes to the Atka mackerel, Pacific cod, and pollock fisheries in the 1990s and 2000s to disperse harvests in space and time and to exclude or reduce fishing in important sea lion foraging areas.

The focus of this risk analysis is to determine whether the fisheries as prosecuted under the proposed action are likely to result in spatial and temporal depletions of prey in areas and times that are important to sea lions, with an emphasis on animals with the highest anticipated food requirements–nursing, pregnant adult females in winter and spring.

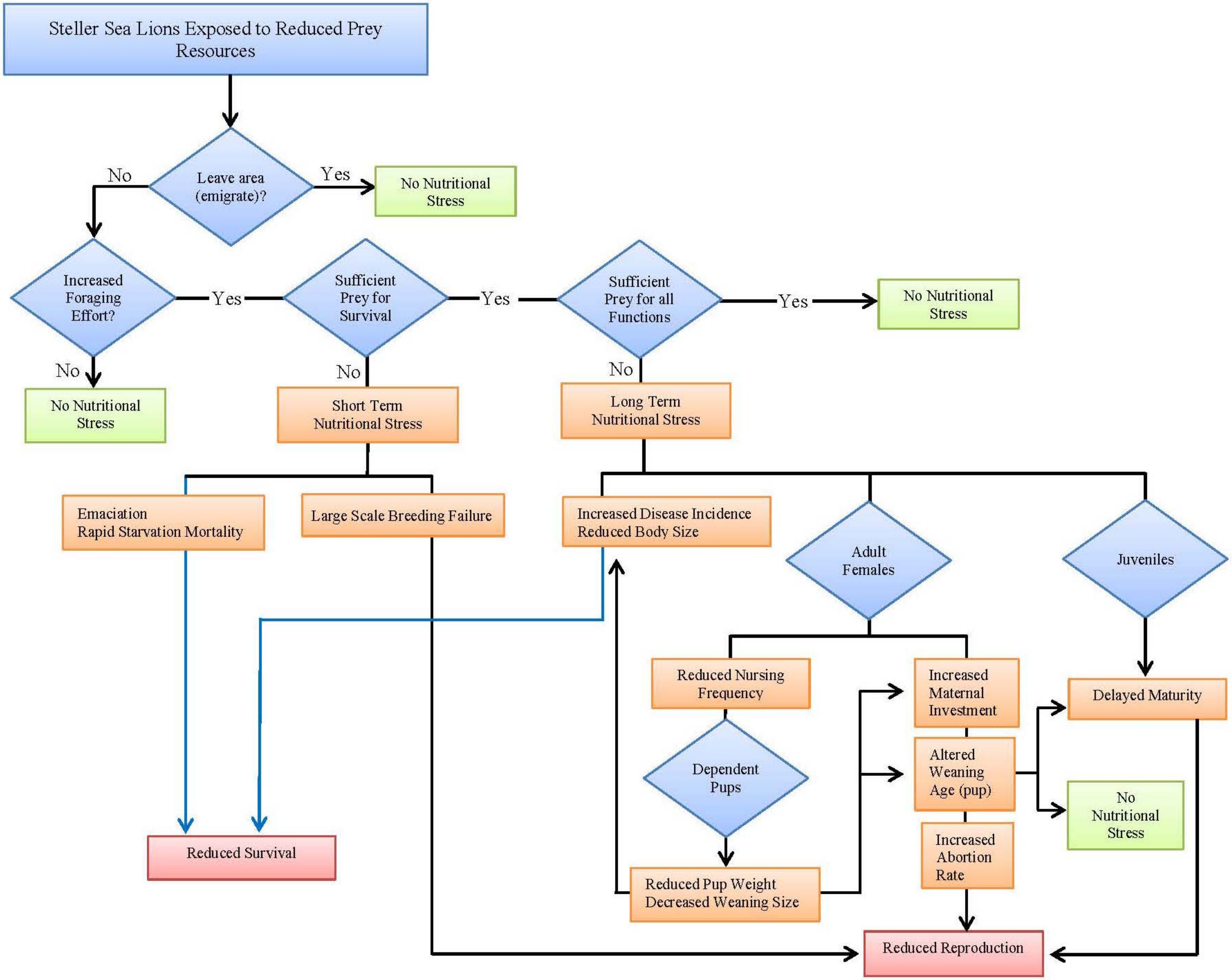


Figure 5-43. NMFS's conceptual model for Steller sea lion behavioral and physiological responses to reduced prey resources.

5.4.1 Fishery Simulation Analysis

Knowledge about the relative magnitude of natural and anthropogenic factors in inducing nutritional stress would facilitate Steller sea lion recovery planning and consultations under section 7 of the ESA. Despite their value, logistical difficulties and prohibitive costs associated with the large-scale and long-term study design have precluded experiments that directly test for effects of the groundfish fisheries on Steller sea lion population dynamics through a prey availability mechanism. In the absence of experiments, a series of studies have attempted to use regression-like analyses to test the hypothesis that Steller sea lion abundance or changes in population trajectory can be explained by the commercial groundfish fishery (Loughlin and Merrick 1989, Ferrero and Fritz 1994, Sampson 1995, Dillingham et al. 2006, Hennen 2006, Soboleff 2005, Calkins 2008, AFSC 2010, Trites et al. 2010, Hui 2011).

The external scientific reviews of the FMP BiOp (NMFS 2010) highlighted statistical tests to assess the effects of fishing on Steller sea lions. Bowen (2012) and (Stokes 2012) concluded that fine-scale statistical analyses are needed to assess the effects of fishing on Steller sea lions. Bernard et al. (2011) were critical of the FMP BiOp for not rejecting the scientific hypothesis that a negative relationship exists between fishing and sea lion populations given the results of the correlative studies that sought to find statistical associations between commercial fishing and Steller sea lion demographics. The (Bernard et al. 2011) panel concluded that, "without some plausible reason for failing to find any statistical outcomes consistent with negative impacts for the last 10 to 20 years, the statement that, '*it is not possible…to conclude that commercial fisheries are not having a significant impact on the recovery'*…is simply wrong."

Several obstacles complicate interpreting the available evidence regarding the effect of prey population on Steller sea lion vital rates. Bernard et al. (2011) recognize one of these−that overstated power can result from a violation of the assumption of independence of observed responses. However, there is also a potential mismatch between the hypotheses that are ultimately of interest and the data streams that are available to assess evidence for such hypotheses. For instance, the ultimate effect of prey limitation on Steller sea lions (if such an effect exists) would come through a decrease in survival, a decrease in fecundity, or some combination thereof (Fay and Punt 2006, Wolf and Mangel 2008). Unfortunately, detailed demographic data (e.g., through mark-recapture studies) are not available to estimate Steller sea lion vital rates, nor do we understand the relevant independent variables (i.e., fish abundance or density). Instead, existing data streams include various noisy estimates of Steller sea lion abundance via aerial surveys (e.g., adult counts, pup counts), measures of fishery effort or removals, and fish relative abundance indices. However, until recently the effectiveness of these surrogate variables in illuminating relationships between sea lions and prey abundance had not been examined.

In response to the Bernard et al. (2011) review of the FMP BiOp, NMFS conducted a simulation experiment to investigate the power of statistical tests using the types of survey variables available in existing data streams to correctly diagnose a relationship between Steller sea lion vital rates and fish abundance, provided that such a relationship exists (Conn et al. 2013). In particular, Conn et al. generated idealized predator-prey time series for cases where (a) sea lion declines were ultimately attributable to a prey availability effect on fecundity, and (b) sea lion declines were attributable to a prey availability effect on non-pup survival. They then used different combinations of dependent (e.g., non-pup counts, pup counts, the ratio of successive counts) and independent (e.g., fishery catch, fishery effort, a relative index of fish abundance) variables to try to detect effects of fishing on sea lions using similar analyses to studies referenced in the Bernard et al. (2011) review. Even under an idealized simulation framework designed to maximize power to detect prey removal effects (e.g., independent island populations, potentially random allocation of treatments to experimental units), Conn et al. (2013) showed that many of the combinations of dependent and independent variables resulted in little to no power to detect prey removal effects on Steller sea lion populations. In particular, analyses that used non-pup aerial survey counts as dependent variables performed extremely poorly. Analyses using fishing metrics as independent variables (e.g., catch or fishing effort) also exhibited anemic power, and in some cases (e.g., when fishing effort was allocated in proportion to fish abundance) had a tendency to lead to statistically significant positive regression coefficients between fishery catch or effort and sea lion abundance. Typically, only significantly negative regression coefficients have been interpreted as providing evidence of an effect of fishing on sea lion abundance when fishery catch or effort are used (see Bernard et al. 2011).

Conn et al. (2013) found that several combinations of dependent and independent variables available in existing data streams have potential to diagnose prey removal effects on sea lion vital rates. In particular, they found that analyses relating successive ratios of non-pup counts to an unbiased relative fish abundance index (hereafter CPUE), had potential to diagnose a relationship between non-pup survival and prey availability. They also found that analyses relating annual pup counts to CPUE had reasonable power to detect a prey removal effect on sea lion fecundity, at least given the idealized simulation design.

These results suggest that some hypothesis tests relating Steller sea lion variables to fish or fishery variables seem to have little to no power to detect a prey limitation effect, while others appear sufficient (again, within the limitations of the idealized nature of the simulation analysis). In light of these results, Conn et al. (2013) suggest disregarding previous hypothesis tests that use (1) non-pup counts as a dependent variable, or (2) measures of fishery effort or catch as independent variables. This suggestion leaves considerably fewer studies than referenced in Bernard et al. (2011) to assess evidence for prey availability hypotheses. In fact, no existing studies to date have used the right combination of available dependent (pup counts) and independent (fish CPUE) variables to assess whether there is a relationship between sea lion fecundity (natality and survival of young animals) and prey availability. Regarding non-pup survival, only Dillingham et al. (2006) and Hui (2011) simultaneously used recommended dependent (ratios of successive non-pup counts) and independent (fish CPUE) variables.

Dillingham et al. (2006) found limited support for a weak negative relationship between Steller sea lion population growth rates and pollock abundance, but no relationship for Atka mackerel, arrowtooth flounder, or Pacific cod. The negative relationship between Steller sea lions and pollock abundance in Dillingham et al. (2006) was the result of 4.8-fold decrease in pollock density between 1984 and 2001 that was not matched by a commensurate decline in Steller sea lion population growth rate (λ). In particular, a general estimating equation analysis indicated that the observed decrease in pollock abundance had the potential to increase λ by 0.029. Dillingham et al. (2006) suggested that variation in commercial groundfish abundance could not explain the large historical declines in the rate of Steller sea lion population change observed.

Hui (2011) conducted a large number of statistical tests on Atka mackerel, Pacific cod, and pollock based on the summer groundfish survey data and found only 3 out of 304 tests indicated that Steller sea lion growth rate depended on fish availability (e.g., pollock biomass in summer in the Aleutian Islands and Pacific cod biomass in the Gulf of Alaska). Hui (2011) concluded that, because the majority of the relationships explored were insignificant, it seems unlikely that the availability of pollock, Pacific cod or Atka mackerel was limiting sea lion populations from 2000-2008. The variable trajectories of sea lion populations appeared to be unrelated to the biomass of groundfish accessible near rookeries, and trends in sea lion numbers were similar with or without fishery removals. Hui (2011) conjectured that sea lions were not prey limited and that their populations were largely unaffected by fishery removals during this period.

Reinterpreting the results of Dillingham et al. (2006) and Hui (2011) in light of the Conn et al. (2013) power analysis, the overwhelming lack of statistically significant positive regression coefficients appears to suggest that local availability of groundfish stocks has a minimal effect on non-pup survival, at least over observed levels of sea lions and prey availability. However, Conn et al. (2013) argue that the actual strength of evidence would be better measured if a more realistic simulation study were conducted, including features such as spatial and temporal autocorrelation and animal movement.

In summary, the power analysis revealed that a lack of statistical significance in previous studies cannot necessarily be useful as credible scientific evidence against the prey availability hypothesis, at least as far as fecundity is concerned. Given the concern of decreasing fecundity in the WDPS, Conn et al. (2013) recommend future work relating pup counts to the relative abundance of prey. They also suggest a need for experimental or adaptive management (sensu Walters (1986) to disentangle the effects of prey availability on Steller sea lion population dynamics.

5.4.2 Fishery Interaction Studies

As described in the FMP BiOp, NMFS conducts biennial bottom trawl surveys to estimate groundfish biomass in the Aleutian Islands. Atka mackerel are a difficult species to survey because: (1) they do not have a swim bladder, making them poor targets for hydroacoustic surveys; (2) they prefer hard, rough and rocky bottom which makes sampling with survey bottom trawl gear difficult; (3) their schooling behavior and patchy distribution result in survey estimates associated with large variances; and (4) Atka mackerel are thought to be very responsive to tide cycles. During extremes in the tidal cycle, Atka mackerel may not be accessible which could affect their availability to the survey (Lowe et al. 2013b). Despite these shortcomings, the U.S.-Japan cooperative trawl surveys conducted in 1980, 1983, 1986, and the 1991, 1994, 1997, 2000, 2002, 2004, 2006, 2010, and 2012 domestic trawl surveys, provide the only direct estimates of population biomass throughout the Aleutian Islands region. The biomass estimates from the early U.S-Japan cooperative surveys are not directly comparable with the biomass estimates obtained from the U.S. trawl surveys because of differences in the net, fishing power of the vessels, and sampling design (Barbeaux et al.2003).

Atka mackerel biomass estimates fluctuate widely among surveys (see Figure 5-44; Lowe et al. 2013). A comparison of the spawning biomass trend from the current and previous stock assessments indicates consistent trends throughout the time series, i.e., biomass increased during the early 1980s and again in the late 1980s to early 1990s. After the estimated peak spawning biomass in 1993, spawning biomass declined for nearly 10 years until 2001. Thereafter, spawning biomass began a steep increase which continued to 2005. The abundance trend has been declining since the most recent peak in 2005 which represented a build-up of biomass from the exceptionally strong 1999-2001 year classes (Lowe et al. 2013).

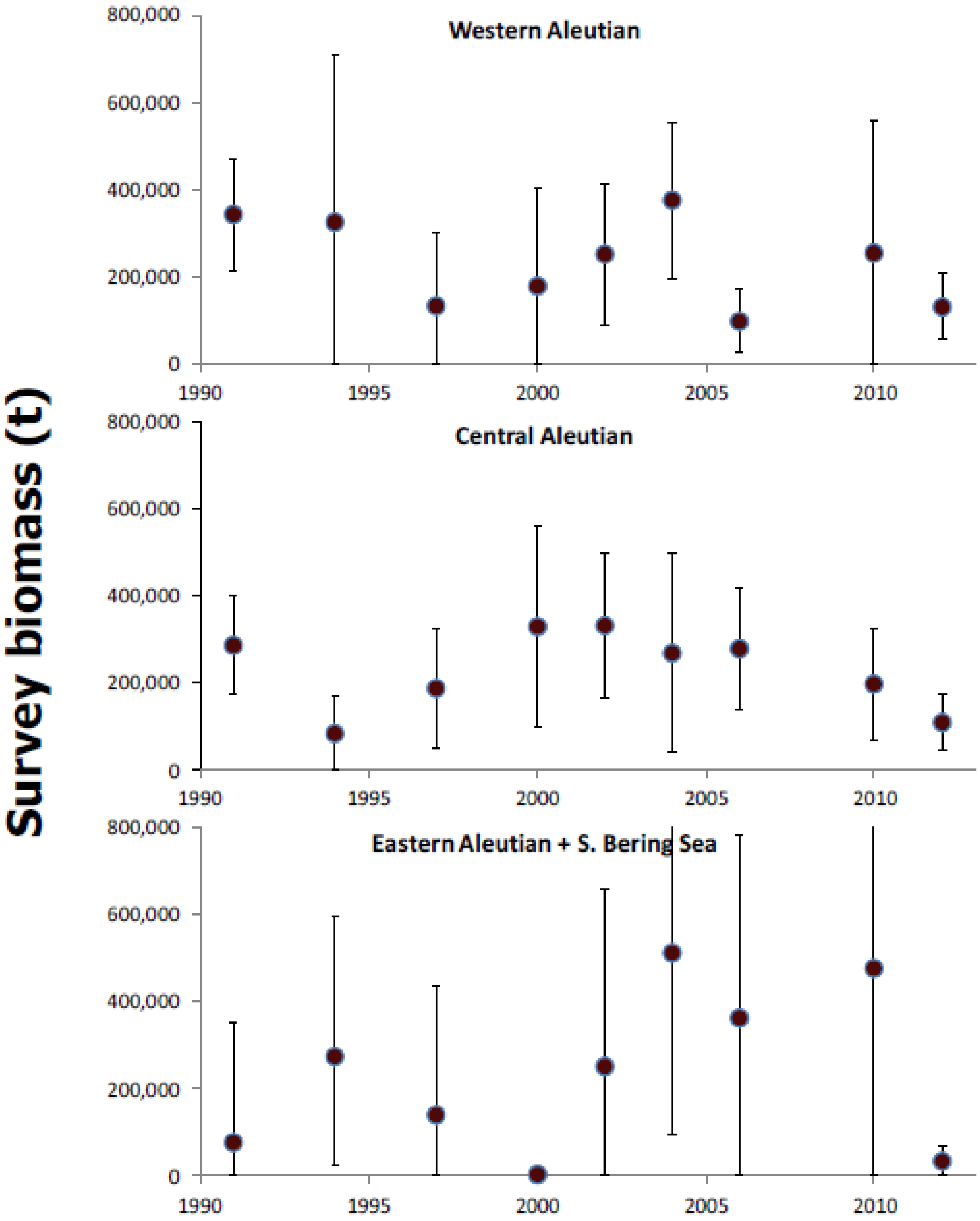


Figure 5-44. Atka mackerel Aleutian Islands survey biomass estimates by area and survey year. Bars represent 95% confidence intervals based on sampling error. Source: Lowe et al. (2013).

NMFS commenced research in 2000 to estimate local abundance and movement of Atka mackerel and to evaluate the potential for the commercial fisheries to cause localized depletions of Atka mackerel. These studies are referred to as the Fishery Interaction Team (FIT) studies and include the work described as part of the research component of the proposed action. Atka mackerel are patchily distributed in dense aggregations centered around passes and areas of high current. From 2000 through 2006, NMFS tagged, released, and recovered 58,654 Atka mackerel to understand local movement and abundance and to evaluate the efficacy of trawl exclusion zones in conserving prey for Steller sea lions (McDermott and Haist In Review). Mark recapture studies are advantageous for Atka mackerel due to low handling and tagging mortality and because variance estimates in tagging studies are less sensitive to patchiness (compared to variance estimates based on bottom trawl surveys).

Trawl exclusion zones (TEZ) work well at preserving prey for Steller sea lions in areas of high Atka mackerel abundance and low movement from inside to outside the trawl exclusion zones, and they do not work well in areas of low Atka mackerel abundance and high movement from inside to outside the TEZ (McDermott and Haist In Review). McDermott and Haist (In Review) estimated local abundance and movement of Atka mackerel and local fishery exploitation rates at four sites where the majority of fishing occurred from 1995 through 2005 in the eastern and central Aleutian Islands—Segaum Pass, Amchitka Island, Tanaga Pass, and Kiska Islands.

Of the tags that were recovered, 2.3% were from fish that moved outside the study area. Based on these results, McDermott and Haist (In Review) concluded that Atka mackerel have high fidelity to local areas. The highest population size and biomass were found at Seguam Pass and the lowest were found at the south end of Amchitka Island. In all areas, biomass inside the TEZ was greater than or similar to biomass outside of the TEZ. In all areas except for Amchitka Island south, movement of Atka mackerel from inside to outside of the TEZ was less than or similar to movement from outside to inside the TEZ. There was greater movement at Amchitka Island relative to the other 3 areas studied and greater movement of Atka mackerel from inside to outside the TEZ at Amchitka Island south.

There were differences in exploitation rates among areas. The exploitation rate at Seguam Pass was estimated to be 2% while the rate at Amchitka Island south was estimated to be 60% (McDermott and Haist In Review). They estimate slightly higher Atka mackerel biomass at Seguam (334,917 mt) compared to the average of the 2002 through 2006 groundfish survey estimates of 261,688 mt, thus it is possible that NMFS's survey estimate is conservative for Area 541. The groundfish survey biomass estimates were similar to the tagging study estimates at Tanaga Pass, Amchitka Island, and Kiska Islands.

Other important results from McDermott and Haist (In Review) are as follow:

- Even though the Atka mackerel population is spread out along the entire Aleutian Island chain, subpopulations can be found that center around island passes and they seem to have discrete boundaries as shown by low occurrence of large scale movement of tagged individuals.
- Results suggest Akta mackerel biomass varies greatly among local aggregations, with Seguam Pass exhibiting a large biomass with very dense aggregations in the center of the pass—Tanaga Pass and Amchitka Islands have smaller aggregations with biomass an order of magnitude less than Seguam.
- Each study has large amounts of untrawlable grounds– mostly in water less than 70 m depth. With the use of underwater cameras Atka mackerel spawning grounds have been found in areas that are unavailable to trawl gear (Lauth et al. 2007). The percentage of the population that occupies those areas is unknown.
- The TEZs are effective at preserving prey at Seguam Pass, Tanaga Pass, and Kiska Islands. Amchitka Island south TEZs are less effective as the zones bisect Atka mackerel habitat on both ends of Amchitka Island.
- Amchitka Island is susceptible to localized depletion. In contrast, exploitation rates are low at Seguam Pass, Tanaga Pass, and Kiska Island (1%, 3%, and 5%, respectively) and McDermott and Haist (In Review) conclude that no danger of localized depletion is expected at these sites.
- It can be hypothesized that Steller sea lion mothers and young might preferentially forage on nest guarding males which are usually located in shallower waters closer to rookeries relative to the

densely schooled females. Thus, protecting Atka mackerel spawning grounds might protect preferred sea lion foraging areas within local Atka mackerel aggregations.

- Atka mackerel abundance, movement, and fishing patterns vary throughout the Aleutian Islands and exploitation can be high in local areas. Thus, each local area needs to be evaluated to understand area-specific variations in abundance and movement patterns. The conclusions from Seguam, Tanaga, Amchitka, and Kiska are not transferrable to other areas because Atka mackerel aggregations are patchy and abundance and movement may vary substantially between areas.

5.4.3 Future Research

The research component of the proposed action aims to expand the number of sites sampled for Atka mackerel abundance and movement to help understand the danger of localized depletions among areas. These data are essential to our ESA section 7 consultations on effects of the Atka mackerel fishery on critical habitat. As more sites are studied, we recommend scientists explore use of the mark-recapture generated biomass estimates as an unbiased biomass index for the work recommended by Conn et al. (2013). From a glance, the trend in Steller sea lion pup counts near the sites sampled by McDermott and Haist (In Review) do not appear to be related to local Atka mackerel biomass and a rigorous inquiry could relate biomass estimates from the FIT studies with annual pup counts as recommended by Conn et al. 2013. This work would be more meaningful with the addition of sites proposed for study by the FIT in the coming years.

In 2014, the FIT plans to conduct Atka mackerel tagging and recovery in the western Aleutian Islands near Attu Island, Agattu Island, Ingenstrem Rock, the Aleutian Island seamounts, and Buldir Island in addition to more work around Seguam. The Atka mackerel harvest from the proposed research will be included as supplemental catch in the annual SAFE. The amount of Akta mackerel caught for the FIT studies is expected to be negligible relative to the variability in the catch that is taken by the commercial fishery. Appendix 17B in the 2013 SAFE notes that the 2% of the ABC removed from activities other than directed fishing represent a very low risk to the stock and the removals would have very little effect on the recommended ABCs if they were accounted for in the stock assessment model (Lowe et al. 2013). Thus, while the FIT research will remove Steller sea lion prey species from inside and outside of critical habitat, it is expected to occur in only two to three years per Area, in low amounts, and to have negligible impacts on the Atka mackerel stock. We thus expect the effects of this research to be insignificant to Steller sea lions and designated critical habitat.

5.4.4 General Habitat in the Aleutian Islands

The Aleutian Islands are the tips of a submerged volcanic mountain chain that stretches over 1,600 km (1,000 mi). Both benthic and pelagic fish habitats around the islands reflect this mountainous structure. Bottom habitats are highly complex, with primarily rough bottom (rock, boulders, and corals), steep slopes and drop-offs, and few areas of fine sediments. Both bottom and pelagic habitats are subject to strong currents and tidal movements funneled through the many passes in the chain. Because of this difficult topography, a large fraction of the benthic habitat around the Aleutian Islands is not suitable for fishing with trawl gear, either commercially or by the groundfish survey. The groundfish survey uses a sampling frame of known trawlable habitat which covers approximately 19% of the total area of the Aleutian Islands. Commercial trawlers use heavier fishing gear than the survey and are able to work in some areas where the survey cannot, but most rely on past fishing history to locate and select fishable sites (Conners et al. 2013b).

Due to the steepness of the slopes in the Aleutian Islands, potential groundfish habitat occurs primarily in narrow bands around the island chain, with the majority of habitat within the 20 nm critical habitat buffer around Steller sea lion haulouts and rookeries. Approximately 80% of the area that is less than 200 m in depth is within critical habitat in all three management areas. In Area 543, there are two offshore areas

200 to 400 m deep that are outside critical habitat: Tahoma Reef seamounts south of Buldir Island and Stalemate Banks at the far western end of the chain. In management Area 541, the only shelf area outside of critical habitat is part of the southern side of Atka Island, which is an area with historically low groundfish catches. In Area 542, depths less than 200 m are almost entirely within critical habitat, except for parts of Petrel Bank (Conners et al. 2013b).

5.4.5 Review of the Base Status of Critical Habitat in the Action Area

The essential features of Steller sea lion marine critical habitat include prey species. For Alaska groundfish fishery section 7 consultations, NMFS uses a threshold of 10% frequency of occurrence of prey hard parts in scat samples to determine the essential prey species. As shown in Figure 4-5, essential features of marine critical habitat in the western and central Aleutian Islands in winter include pollock, Pacific cod, cephlapods, Atka mackerel, Irish Lord, sandlance, rockfish, and salmon. In summer, salmon, Atka mackerel, and cephlapods are the essential features of marine critical habitat. Here we review information from section 4.4 and summarize what is known about the baseline status of the essential features of sea lion critical habitat in the western and central Aleutian Islands.

Sandlance is a forage fish distributed in depths less than 50 m, suggesting near shore distribution. Sandlance feed and school diurnally and burrow nocturnally into sand substrate. This species also burrows into substrate to pass the winter in a dormant state. Sandlance is found in abundance in the Aleutian Islands groundfish survey, with the highest concentrations in the western Aleutian Islands beyond Amchitka Pass (Ormseth 2013b). Spawning occurs in dense formations in late summer and early fall (Robards et al. 2002). Though, interestingly, frequency of occurrence of sandlance in sea lion scats is higher in winter than summer in the Aleutian Islands. NMFS implemented a ban on directed fishing for forage fish in 1998 and incidental catch of sandlance in the groundfish fisheries is rare. There is no current estimate of sandlance biomass.

Rockfish are abundant throughout the Aleutian Islands, with particularly large biomass in Area 543. Rockfish in the Aleutian Islands primarily consist of Pacific Ocean perch (POP) and northern rockfish. POP are fairly evenly distributed throughout the Aleutian Islands, but northern rockfish are more common in the western Aleutian Islands. In recent surveys, estimated rockfish biomass has also been high north of Seguam. Trend testing shows that estimated biomass of rockfish generally increased from 1991-2012, with significant increases in the Aggatu (Area 543), south Tanaga (Area 542), and north Seguam (Area 541). The increases in rockfish abundance include recent increases in POP and northern rockfish (Conners et al. 2013b). POP is a strongly schooling species and there is large variability in survey catches. The 2013 Aleutian Islands age 3+ POP biomass estimate is 638,991 mt (Spencer and Ianelli 2013). POP is caught incidental to pollock and Atka mackerel fisheries.

Irish Lord is the most abundant species of sculpin in the Aleutian Islands. Sculpin occupy all benthic habitats and depths in the Aleutian Islands though they are a small component of the Aleutian Islands groundfish biomass. There is no directed fishery for sculpins though sculpins are taken incidental to other fisheries. The SAFE does not break out Irish Lord but estimates the 2014 biomass of all sculpins in the Aleutian Islands as 215,713 mt (Spies et al. 2012). Irish Lord comprised 64% of the sculpin survey biomass in 2012 (Spies et al. 2012). The subareas with highest sculpin biomass are south Seguam (Area 541), Petrel Bank (Area 542), and Aggatu (Area 543). Estimated sculpin biomass shows a significant decreasing trend in the Aggatu subregion (due largely to a high biomass in 1991), but increasing trends in several other sub-regions, especially south Adak and south Seguam (Area 541) (Conners et al. 2013b).

A review of salmon migration studies indicates that several salmon species from North America, Asia, and Russia migrate seasonally through the Aleutian Islands or congregate in the north Pacific just south of the Aleutian Islands in winter (Groot and Margolis 1991, Myers et al. 2006). Large pink salmon runs occur in summer during even-numbered years in streams on Atka, Amlia, Adak Islands (Area 541), and Attu Island (Area 543). Kiska, Kanaga, and Tanaga Island (Area 542) each have at least one important pink salmon stream (Poetter and Nichols 2013). There is no escapement information available for pink salmon in the western and central Aleutian Islands and no commercial harvests. Salmon are taken as bycatch in the Aleutian Islands pollock fishery.

At least seven species of octopus are found in the BSAI. The species composition of the octopus community is not well documented, but data indicate that the giant Pacific octopus, *Enteroctopus dofleini*, is most abundant in shelf waters and predominates in commercial catch. Octopuses are taken as incidental catch in trawl, longline, and pot fisheries throughout the BSAI. The highest octopus catch rates are from Pacific cod fisheries in the three reporting areas around Unimak Pass. The BSAI trawl surveys produce estimates of biomass for octopus, but these estimates are highly variable and do not reflect the same sizes of octopus caught by industry. The state of knowledge about octopus in the BSAI is poor and research is underway to improve our understanding. Bottom trawl surveys likely underestimate octopus biomass as trawl gear does not efficiently capture octopus.

Atka mackerel are found in all of the subareas in the central and western Aleutian Islands, but are abundant in the eastern Aleutian Islands only in the areas around Seguam Pass. Based on the groundfish survey data, subareas with the highest estimated biomass of Atka mackerel are the eastern side of Area 543 around Buldir Island, the southern shores of Amchitka and Tanaga Island in Area 542, and the eastern side of Area 541 around Seguam Pass (Conners et al. 2013b). Examination of individual survey tows and underwater video data (Lauth et al. 2007) suggests that Atka mackerel habitat is very specific to small areas with rocky substrates and higher current velocities. Atka mackerel is a strongly schooling species and survey tows tend to have either very small catches or very large catches when a school is encountered (Conners et al. 2013b). The locations encountering a high catch of Atka mackerel are consistent in the sense that survey tows with very large catch tend to re-occur at the same locations in different years, although tows may also encounter low catches in these locations. The number of locations with historically high Atka mackerel tows increases toward the western end of the Aleutian Island chain (Logerwell et al. 2005). Trend testing of the subarea biomass estimates for Atka mackerel generally shows no significant trends for most areas over the period from 1991 – 2012; there has been a small but steady increasing trend in the Petrel Bank subarea and a significant decreasing trend in the south Amchitka subarea which includes some fishing areas outside of critical habitat (Conners et al. 2013b).

Pacific cod are more consistently distributed across the Aleutian Islands than Atka mackerel or rockfish but at a much smaller biomass. The subarea with the highest estimated biomass of cod is north Seguam (Area 541). Trend testing indicates that Pacific cod are generally decreasing in biomass across the Aleutian Islands, especially around Buldir, Petrel Bank, and north Amchitka (Conners et al. 2013b).

Pollock are much less abundant in the Aleutian Islands than in the Bering Sea and are a fairly minor component of Aleutian Island groundfish biomass. Occasional catches of pollock result in higher biomass estimates in different regions and years; the only survey subarea with a consistent higher biomass of pollock is north Seguam (Area 541). Trend testing indicates that estimated pollock biomass decreased from 1991-2012 in most subareas, especially at Buldir (Area 543), south Amchitka (Area 542), and south Adak (Area 541) (Conners et al. 2013b).

Table 5-46 shows the most recent (2012) groundfish survey estimated biomass of Steller sea lion prey species in the Aleutian Islands. This table includes all prey species above the 10% frequency of occurrence threshold with the exception of salmon and sandlance for which we have no biomass estimates. The sum of the 2012 groundfish survey estimated biomass of Steller sea lion prey species in the Aleutian Islands is 1,652,470 mt. These estimates should be considered indices of abundance rather than absolute abundance due to survey limitations such as terrain, size selectivity, fish vulnerability, and other factors (Britt and Martin 2001).

Table 5-46. Results of the 2012 Aleutian Islands bottom trawl survey. Steller sea lion prey species are shown in descending order of estimated biomass. The percentage of survey hauls where each species was present and a 95% confidence interval on the biomass estimate are also shown. Source: Conners et al. (2013).

	Percentage	Estimated	95% Conf Interval	
Common Name	of hauls	Biomass (mt)	Low_CI	Hi_CI
POP	69%	902,398	592,377	1,212,419
northern rockfish	44%	285,164	-	578,273
Atka mackerel	48%	276,877	176,849	376,904
Pacific cod	66%	65,858	47,432	84,284
pollock	65%	57,518	6,251	108,784
shortraker rockfish	10%	16,230	7,385	25,074
shortspine thornyhead	21%	14,895	10,016	19,774
yellow Irish lord	40%	14,166	8,919	19,412
blackspotted rockfish	24%	12,614	2,494	22,734
magistrate armhook squid	32%	4,011	378	7,643
giant octopus	16%	2,739	-	6,430

In this risk assessment we aim to understand whether the groundfish fisheries compete with sea lions by creating localized depletions of fish stocks. Steller sea lions depend on temporally and spatially reliable concentrations of prey near rookeries and haulouts, thus localized depletion of prey in important sea lion foraging areas could result in deleterious population-level consequences. If we had perfect knowledge about the stocks exploited by fisheries and sea lions and localized effects of fishing on the stocks we would then aim to understand with some degree of precision the effects of the competition on local sea lion populations. Our section 7 risk analyses have always been hampered by incomplete data to understand these interactions. As it stands, we have more complete knowledge about the fisheries (what they catch (species/size), where they fish (depth/area), when they fish, and how fast they fish) than we do about localized fish abundance throughout the year. We have some knowledge of where sea lions forage, though more samples of weaned juveniles and adult females are needed in summer and winter to improve our understanding of their at-sea habitat use from which we infer foraging. We have some knowledge of the Steller sea lion diet, though refinements through stable isotope or genetic analysis will improve our knowledge of age and area-specific diets in the future as these data become available.

The groundfish surveys and annual stock assessments produce biomass estimates on a large scale ranging from a fishery management area to the entire BSAI or GOA ecosystem. These data comprise the best available for understanding fish biomass. Two recent studies have used the groundfish survey data to estimate localized biomass—Hui (2011) and Dillingham et al. (2006). Dillingham et al. (2006) estimated fish abundance within a 74 km radius of each Steller sea lion census location (rookery, haulout, or cluster) based on the summer groundfish survey data and Hui (2011) used data predicted by spatial models based on the summer groundfish survey data to estimate biomass in 81 km^2 cells. Scientists at the AFSC recommend the survey strata as the finest spatial scale for which biomass can be estimated (Conners et al. 2013b). Thus, we do not have fishery exploitation rates (i.e., amount of harvest relative to amount of available biomass) specific to critical habitat in the Aleutian Islands for this biological opinion.

Recent studies have provided information on localized exploitation rates for select areas and have confirmed that exploitation rates in some localized areas exceed the overall target fishing mortality rate (McDermott and Haist In Review, Barbeaux et al. 2014). Barbeaux et al. (2014) used opportunistically collected acoustic backscatter data from 4 commercial fishing vessels to generate a local pollock abundance index (finest spatial resolution 100 km^2) from January to March in the EBS. They found a greater proportion of high pollock exploitation rates inside critical habitat than outside critical habitat in the EBS.

It is the opinion of NMFS that the preponderance of available data do not support a conclusion that the groundfish fisheries and groundfish abundance are limiting Steller sea lion population growth rates. NMFS has no direct evidence that Steller sea lions are experiencing nutritional stress in the western and central Aleutian Islands and the NRC (2003) found the available indirect evidence to be inconsistent with bottom-up drivers. However, the western Aleutian Islands population continues to decline at a steep, significant rate, the central Aleutian Islands population is decreasing slightly at a non-significant rate (see section 4.2), and important data gaps hinder our ability to rule out bottom-up drivers, including effects of fishing, as contributing to the continued decline in the western Aleutian Islands and the lack of recovery in the central Aleutian Islands. Data gaps, including extremely limited winter biomass information, hinder our ability to measure prey distribution and abundance at the temporal and spatial scales important to individual Steller sea lions. We also lack a complete understanding of Steller sea lion energetic requirements and foraging behavior. Given the pervasive uncertainty about the effects of the groundfish fisheries on localized fish stocks and subsequent effects on Steller sea lions, NMFS has previously implemented management measures to limit the overall catch, disperse catch in time in space, and reduce direct spatial overlap between foraging sea lions and the fisheries. Given these important data gaps, NMFS maintains that a cautionary approach to fishing for prey species in Steller sea lion critical habitat is warranted, especially in winter when we have the least information about biomass, and that catch should be dispersed in time and space to prevent localized depletion− at least until such time as we have better local biomass and exploitation rate estimates.

The proposed action would retain the harvest control rule implemented in 2001 (66 FR 7276) to prohibit directed fishing for Atka mackerel, pollock, or Pacific cod when spawning biomass falls below 20% of the projected, unfished spawning biomass to protect prey availability for Steller sea lions. The proposed action also retains closure of the Seguam Foraging Area in Area 541 to directed fishing for Atka mackerel, pollock, and Pacific cod by all gear types to protect prey availability for Steller sea lions.

5.4.6 Effects of the Atka mackerel fishery

The interim final rule that implemented the RPA from the FMP BiOp (NMFS 2010) closed fishing for Atka mackerel in all of Area 543. In section 5.2 we conclude that groundfish fishing closures are not needed outside of critical habitat based on new information available since the FMP BiOp (see section 5.2). Due to the patchy distribution of Atka mackerel and the potential for the fisheries to create localized depletion of Atka mackerel, NMFS PRD recommends dispersing the catch in time and space and limiting harvest inside critical habitat in winter. Under the proposed protection measures, 76% of the critical habitat in Area 543 would be closed to Atka mackerel fishing; however as shown in Figure 5-7 and Figure 5-8, the Atka mackerel fishery has historically operated in only two small areas from 10-20 nm inside critical habitat in Area 543 though fishing has occurred outside of critical habitat. In the exposure analysis (section 5.3) we assume that the Area 543 Atka mackerel fishery would likely resemble fishing from 2007 through 2010 with greater temporal dispersion due to removal of the HLA and the extension of the end of the B season from November 1 to December 31. Figure 5-30 shows the seasonal and temporal dispersion of the Atka mackerel catch in Area 543 from 1991 through 2013. As discussed in the exposure analysis, prior to the closure in 2011, only a small portion of the catch and ABC was taken inside critical habitat in winter in Area 543 and the fishery was fairly evenly dispersed spatially and temporally. In Area 543 the proposed action includes measures that were in place in 2010 including fishery management area-specific ABCs and TACs (to disperse catch spatially), a critical habitat harvest limit of 60% of the TAC split evenly across seasons (to disperse catch spatially and temporally), and a 50:50 seasonal apportionment of catch (to disperse catch temporally). The proposed action would add an extension of the B season end date (to disperse catch temporally), require that any rolled over TAC be caught outside of critical habitat, and add an overall harvest limit of ≤ 65% of the ABC for Area 543 (to limit overall catch).

NMFS has not yet conducted Atka mackerel tagging studies in Area 543—this work is planned for 2014 and 2015. Thus, NMFS PRD recommends a cautionary approach to fishing for Atka mackerel inside Steller sea lion critical habitat, especially in winter, until we have a better understanding of sea lion foraging distribution and local biomass and exploitation rates. Based on the information presented in the exposure analysis, assuming spatial/temporal distribution of catch resembles the 2007 through 2010 distribution as we expect, NMFS concludes that the Akta mackerel fishery would not be likely to cause localized depletions of Atka mackerel inside Steller sea lion critical habitat in Area 543 in winter. Should the small amount of the ABC taken from critical habitat in winter result in a localized depletion, this biological opinion has presented data on factors that likely mitigate the effects on the western Aleutian Islands sea lion population. As mentioned above, 81% of the groundfish habitat in the Aleutian Islands is unsuitable for fishing with the survey trawl gear, more area may be accessible to the commercial fishery due to the heavier gear used; however a large portion of the habitat in the Aleutian Islands is not accessible to bottom-trawl gear. This habitat is available to sea lions and not the fishery.

The available depth data (see section 5.3) indicate some partitioning between sea lion dive depth and Atka mackerel fishing depth. The available sea lion diving and fishery depth information combined with information on Atka mackerel vertical migration behavior indicate that sea lions may forage on nest-guarding males in shallower waters (July through November only) near the rookeries and the fishery may target densely schooled females at greater depths (McDermott and Haist In Review), in which case sea lions and the fishery would not be competing for the same localized population. Steller sea lions have a more diverse diet in winter which may mitigate potential effects of a localized depletion of Atka mackerel should one occur.

Based on the diet data (Sinclair et al. 2013), the Atka mackerel fishery is the only fishery considered in this biological opinion expected to adversely affect Steller sea lions in summer in the western and central Aleutian Islands. Based on the limited diet information and the 10% frequency of occurrence threshold we use in our groundfish fishery consultations to indicate the major prey species, Steller sea lions are assumed to forage predominantly on Atka mackerel, salmon, and cephlapods in summer in the western and central Aleutian Islands. The spatial and temporal restrictions of the proposed action would limit the amount of catch taken from inside critical habitat in summer to 20% of the Area 543 ABC. Rookeries would be closed to fishing out to 10 nm and haulouts would be closed out to 3 nm. The proposed action would close the 0-10 nm zone of critical habitat around the Buldir Island rookery to directed fishing for Atka mackerel, consistent with the protections for other rookeries in Area 543, though this rookery is currently closed out to 15 nm.

Atka Mackerel Area 542

The proposed Steller sea lion protection measures for the Atka mackerel fishery in Area 542, designed based on the results of the FIT study (McDermott and Haist In Review), would allow fishing outside of 3 nm from haulouts and 10 nm from rookeries where the FIT studies indicate low likelihood of localized depletion and would close critical habitat out to 20 nm where the FIT studies indicate that the 2003 to 2010 TEZs were likely ineffective at preserving prey for Steller sea lions. Nintey-two percent of critical habitat would be closed to Atka mackerel fishing in Area 542. The proposed action would retain the critical habitat catch limit (60% of TAC; 30% in each season) that was in effect from 2003 through 2010.

The spatial and temporal distribution of harvest changed substantially between the 1990s and 2000s in Area 542 (see section 5.3.1). The amount of Atka mackerel caught inside critical habitat in winter dropped substantially from 1999 through 2010 relative to the amount taken from 1995 through 1998. From 2001 through 2010 Atka mackerel catch was distributed fairly evenly between outside and inside critical habitat in summer and winter, though not much Atka mackerel was harvested outside of critical habitat in summer in 2009 and 2010.

The amount of Atka mackerel fishery harvest was a high percentage of the groundfish survey estimated biomass at Petrel Bank in 2000 (96%), 2002 (26%), 2004 (32%), 2006 (27%) and 2012 (24%) (Conners et al. 2013b, NMFS Catch Accounting System). A small sliver of critical habitat would be open from approximately 17 to 20 nm around Semisopochnoi Island/Pochnoi directly east of 180° longitude near Petrel Bank. The remainder of Petrel Bank inside of critical habitat would be closed to Atka mackerel fishing. The telemetry data show some direct overlap between the fishery and Steller sea lions outside of critical habitat on Petrel Bank. FIT data are needed to understand the efficacy of the TEZ at conserving prey for sea lions using the haulouts at Semisopochnoi and to validate local exploitation rates.

Atka mackerel Area 541
Critical habitat east of 178° W has been closed to directed fishing for Atka mackerel since 2003 (68 FR 204). Due to the FIT research around Seguam Pass that indicates high Atka mackerel biomass, an effective TEZ, and no danger of localized depletion (McDermott and Haist In Review), the proposed action would open a small portion of critical habitat from 12 to 20 nm to the southeast of Seguam Island to directed fishing for Atka mackerel. Atka mackerel fishing would not be allowed in 97% of critical habitat under the proposed action in Area 541 and no Atka mackerel fishing would be allowed inside the Seguam Foraging Area. The Steller sea lion protection measures implemented in 2003 limited the critical habitat catch to 60% west of 178° W and closed critical habitat to Atka mackerel fishing east of 178° W. The proposed action would allow fishing in less than 3% of the critical habitat east of 178° W (one degree of longitude in Area 542 and all of 541) though it does not include a limit on the amount of the Area 541 TAC that may be taken inside of small open area of critical habitat. The proposed action retains the 50:50 seasonal TAC split to temporally disperse catch. NMFS does not expect the proposed revisions to the Area 541 Atka mackerel fishery to reduce the reproduction or survival of Steller sea lions or adversely modify critical habitat due to the high local biomass of Atka mackerel in the small open area of critical habitat and the effectiveness of the TEZ at conserving Atka mackerel inside of critical habitat near Seguam Island (McDermott and Haist In Review).

5.4.7 Effects of the Pacific Cod Fishery

The biomass of Pacific cod in the Aleutian Islands is much lower than in the EBS or GOA and much lower than the Atka mackerel biomass in the Aleutian Islands (Table 5-46). Arguably, Pacific cod may not be as important to sea lions as more abundant species, though Pacific cod are distributed throughout the Aleutian Islands and not just in patches, which may make them more available to Steller sea lions. Pacific cod occur in more than 10% of sea lion scats in the winter (Sinclair et al. 2013). Historically, the Pacific cod fishery has been a winter fishery (see section 5.3.7.2) though the non-trawl fishery is dispersed temporally to a greater extent than the trawl fishery (section 5.3.7.2).

The available data suggest some partitioning in the size of Pacific cod taken by the fishery in the central and western Aleutian Islands and the size of cod in Steller sea lion scats in the GOA (see section 5.3.6) though it is unknown if the GOA data are representative of the size of cod consumed in the Aleutian Islands. It seems reasonable to assume some size partitioning between the fishery and sea lions with sea lions taking some proportion of smaller cod than caught by the fishery with some overlap in the mid-sizes and an unknown extent of overlap for larger cod.

The trawl fishery consistently operates primarily in Area 541, though an increasing amount of the Pacific cod trawl catch was taken inside critical habitat in Area 543 from 2007 through 2010. Pacific cod trawl fisheries are the most temporally compressed fisheries and occur during the critical period for pregnant, lactating Steller sea lions (mid-February to mid-March). The amount of the estimated Aleutian Islands ABC taken by non-trawl gear inside critical habitat in Area 543, 542, and 541 has been relatively small though located within 10 nm of rookeries and haulouts (section 5.3.7.2). The data reveal depth overlap between the Pacific cod fisheries and Steller sea lions (see section 5.3.5). The greatest amount of direct spatial overlap is expected between the proposed Pacific cod non-trawl fishery (77% of critical habitat in the action area would be open to fishing) and trawl fishery (48% of the critical habitat in the action area would be open to fishing) and the historic fishing data show broad dispersion of Pacific cod fishing inside critical habitat (Figure 5-13 through Figure 5-18).

The proposed action for Pacific cod is identical to the Steller sea lion protection measures implemented in 2003 with the exception of the addition of an Area 543 catch limit. However, other changes have been made to the management of the Aleutian Islands Pacific cod fisheries that are expected to protect Steller sea lions from localized depletion of Pacific cod as discussed in section 5.3.7.2.

NMFS has consistently implemented protection measures to limit fishing for Steller sea lion prey species in the immediate vicinity of important rookeries and haulouts (e.g., 65 FR 3892; 66 FR 7327, 68 FR 204). However, given the narrow shelf in the Aleutian Islands, the Council has previously recommended, and NMFS has permitted, directed fishing for Pacific cod with non-trawl gear within 0 to 20 nm from haulouts west of 172.59° W (i.e., all of Areas 543, 542, and approximately 67% of Area 541). The proposed action would relax the spatial Pacific cod measures implemented in 2011 and permit fishing with non-trawl and trawl gear within 0-20 nm and 3-20 nm, respectively, from haulouts in winter in the areas where Steller sea lion populations continue to decline.

NMFS lacks the data to estimate Pacific cod harvest rates in winter or in critical habitat and the Pacific cod fishery operates predominantly in critical habitat in winter. Because the fisheries are dependent on the habitat inside of sea lion critical habitat, there are no critical habitat catch limits. The seasonal TAC apportionments apply to the combined BSAI TAC and since the EBS TAC dominates the Aleutian Islands TAC, a significant proportion of the Aleutian Islands Pacific cod TAC is expected to be taken in the A season.

Pacific cod Area 543

In Area 543, 7% of critical habitat would be closed to Pacific cod fishing with non-trawl gear—rookeries would be closed from 0-3 nm with the exception of critical habitat around the Buldir Island rookery which would be closed to 10 nm. We note that these closures are the same as the 2003 protection measures and include the greatest area closure around the one rookery in Area 543 where no animals have been observed in recent surveys (Buldir Island). As mentioned above, the proposed action limits the proportion of the catch in Area 543 to the estimated Area 543 abundance based on the annual stock assessment. In section 5.3.7.2 we used the 75th percentile of the historic estimated biomass to estimate this amount at 35% of the estimated Aleutian Islands Pacific cod ABC.

Seventy-six percent of the Area 543 critical habitat would be closed to directed fishing for Pacific cod with trawl gear. As discussed in section 5.3.7.2, not much of the historic Pacific cod trawl harvest was taken inside of critical habitat in Area 543, though the small amount that was taken was taken in critical habitat in winter.

In this biological opinion, the major changes relative to the 2010 Pacific cod fishery are the Aleutian Islands-specific ABC and TAC and the Area 543 harvest limit. The 2015 TAC is expected to reduce the Aleutian Islands Pacific cod harvest by 72% relative to historic levels. Given the fishing patterns discussed in section 5.3.7.2, NMFS expects most of the Pacific cod to be caught by trawl gear in Area 541. Area 543 harvests are expected to resemble harvest amounts under the interim final rule and as such, the Area 543 Pacific cod fishery is not likely to result in localized depletions of Pacific cod.

Pacific cod Area 542

Only 2% of the Area 542 critical habitat is closed to Pacific cod fishing with non-trawl gear. Critical habitat would be closed from 0-3 nm from rookeries. There would be no critical habitat-specific catch limits in Area 542. The highest Pacific cod non-trawl catch amounts occurred from 2008 through 2010 when 5% of the estimated Aleutian Islands ABC was caught inside critical habitat in winter. Pacific cod are an important sea lion prey item in winter. NMFS does not have local biomass estimates for Pacific cod in winter. Nonetheless, given the large reduction in Aleutian Islands Pacific cod harvest due to the TAC split and the small amount of Pacific cod historically taken by the Pacific cod non-trawl fishery over an extended time, and the fact that historically, the highest amount of the Pacific cod TAC taken in the Aleutian Islands has been caught by trawl gear in Area 541, the Pacific cod non-trawl fishery is not likely to create local depletions of Pacific cod in critical habitat in Area 542 under the proposed action.

Eighty-two percent of the Area 542 critical habitat would be closed to Pacific cod fishing with trawl gear. Pacific cod fishing would be closed 0-3 nm from haulouts and 3-10 nm from rookeries. Historically, the Pacific cod trawl fishery has not operated to a large extent in Area 542 (Figure 5-36). The historically low Pacific cod trawl harvests in Area 542 indicate that not much (if any) directed fishing with trawl gear is likely to occur in Area 542. Given the large reductions in harvest due to the BS and AI Pacific cod TAC split and the historically low levels of Pacific cod trawling in Area 542, the Pacific cod trawl fishery is not likely to locally deplete Pacific cod stocks in Area 542.

Pacific cod Area 541

Non-trawl fisheries are subject to different critical habitat closures east and west of 172.59° W longitude in Area 541. To the west of 172.59° W longitude, critical habitat around rookeries would be closed 0-3 nm to directed fishing for Pacific cod with non-trawl gear. Critical habitat would be closed to Pacific cod non-trawl fishing east of 172.59° W longitude. The Seguam foraging area would continue to be closed to fishing. In all, 54% of critical habitat would be closed to directed fishing for Pacific cod with non-trawl gear.

Pacific cod fishing with trawl gear would not be allowed in 75% of critical habitat in Area 541. Critical habitat would be closed 0-3 nm from haulouts and 0-10 from rookeries except for a 0-20 nm closure at Agligadak (the one area that would be open to pollock fishing and is used by sea lions in summer). The Seguam foraging area would continue to be closed to Pacific cod fishing. We expect the majority of the Pacific cod TAC to be taken with trawl gear in Area 541 similar to 2004-2010 (Figure 5-37). Most of this Pacific cod will be taken from critical habitat in a temporally compressed fashion in February and March. Due to the Pacific cod TAC split in 2014, Area 541 Pacific cod harvest amounts are expected to be less than 50% of harvests from 2007 through 2010 (Table 5-41). Steller sea lion populations are increasing (at a non-significant rate) in the eastern portion of the Central Aleutian Islands (Area 541), and were increasing (at a non-significant rate) when the 2011 protection measures were put in place. The overall amount of harvest will be reduced in Area 541 relative to pre-2014 fisheries due to the TAC split and most of the Aleutian Islands Pacific cod TAC is expected to be caught with trawl gear in Area 541 under the proposed action with the TAC split. Thus, not only is the Area 541 trawl fishery not likely to reduce WDPS Steller sea lion recovery or adversely modify designated critical habitat, it is likely to substantially limit the amount of harvest that comes out of Area 542 or 543 by non-trawl gear where sea lion populations are not doing well.

5.4.8 Effects of the Pollock Fishery

Since 1992 there has been no trawling for pollock (or Atka mackerel or Pacific cod) within 10 nm of rookeries in the Aleutian Islands. In 1999, NMFS prohibited directed fishing for pollock in the Aleutian Islands to protect the waters surrounding rookeries and major haulouts and these closures were maintained under the 2001 Steller sea lion protection measures (66 FR 7327). For the first time since 1999, the proposed action would open select portions of critical habitat to the directed pollock fishery, presumably to increase the viability of the Aleutian Islands pollock fishery given the dismal catches outside of critical habitat since 2005. In structuring the proposed action for pollock relative to concerns for Steller sea lions and critical habitat, the Steller Sea Lion Mitigation Committee and Council were attentive to the performance standards from the RPAs in the 2010 FMP BiOp (NMFS 2010) for the Pacific cod and Atka mackerel fisheries. The proposed action is structured to be most conservative for Steller sea lions in the western Aleutian Islands with decreasing protection for critical habitat to the east.

As explained in the exposure analysis (section 5.3.7), NMFS expects a high amount of overlap in the size of pollock taken by the fishery and eaten by Steller sea lions in the Aleutian Islands. The entire range of sizes taken by the fishery are eaten by Steller sea lions, though sea lions also eat smaller pollock than taken by the fishery with the least amount of overlap occurring in Area 543 (based on the limited number of trawls from 1998). There is more apparent overlap in size in Area 542, with sea lions eating pollock from 4 to 25 cm that are not taken in the fishery and even more overlap in Area 541 with sea lions eating pollock from approximately 4 to 10 cm that are not taken by the fishery. Thus, NMFS expects some partitioning in the size of pollock taken by the fishery and sea lions with the greatest size overlap occurring in the east.

The available data indicate a great extent of depth partitioning between the Aleutian Islands pollock fishery and Steller sea lions (section 5.3.5). The Aleutian Islands pollock fishery occurs at a mean depth of approximately 300 m and varies depending on the location, with fishing occurring deeper and shallower in various areas. The few trawl hauls conducted in Area 543 in 1998 were deeper than in Areas 542 or 541, though the mean fishery depth was greater than 300 m in these Areas. Pollock may exhibit daily horizontal and vertical movements, though the thermocline appears to be a barrier to upward migration in winter which would constrain pollock to depths around 200 m. Preliminary information indicates that pollock migrate up through the thermocline during spawning (approximately March through June; (Conners et al. 2013b) as they deposit their eggs at the surface (Steve Barbeaux, National Marine Fisheries Service, pers. comm. February 18, 2014). Figure 5-22 indicates that the majority of Steller sea lion dives occur to depths of less than 50 m, though sea lions are capable of diving deeper from a young age. There may be some overlap between the shallow to mean depths of the pollock fishery with foraging adult female and juvenile Steller sea lions, though given the available data, NMFS expects this overlap to be the exception rather than the rule. Thus, NMFS expects some depth partitioning between the fishery and Steller sea lions for pollock in the Aleutian Islands with the highest potential depth overlap occurring in spring when pollock are dispersed higher in the water column for spawning. Thus, pollock harvests in late January and February would not likely have substantial overlap with Steller sea lions given observed differences in depth distribution of the two. More overlap would be expected in March, a time when the fishery may still be active and when pregnant, lactating sea lions have high energy requirements. The observed partitioning of depth likely mitigates any localized depletion on the shortest temporal and spatial scale.

The proposed action would maintain the closure for pollock fishing from November 1 through noon January 20. The amount of the pollock that can be harvested in the A season, when pollock is important in the sea lion diet, is limited to 40% of the ABC. (In the Bering Sea the A season limit is 40% of TAC).

Pollock Area 543

Pollock fishing would not be allowed in 95% of the critical habitat in Area 543. Pollock fisheries are temporally compressed fisheries. The pollock fishery primarily operates in the A season and the Area 543 A season catch limit is 5% of the ABC. The exposure analysis estimates that 1,970 mt of pollock could be harvested in critical habitat in winter in Area 543 in 2015. The proposed action would open a portion of the area outside of 3 nm from all three sites designated as haulouts in Area 543 to pollock with pelagic trawl gear. Of the three listed haulouts in Area 543 (Table 4-3) only Alaid is used year-round; the other two haulouts are used only in the summer months. The four sites designated as rookeries in Area 543 would continue to be closed to pollock fishing from 0-20 nm year-round.

Because the proposed action would allow pollock fishing in only a small section of critical habitat in Area 543, we expect the Area 543 A season pollock limit, 5% of ABC (1,970 mt), to be harvested from this open patch of critical habitat. There are no localized exploitation estimates for this area and no winter biomass estimates. It is unknown if this amount (1,970 mt) of pollock biomass occurs in the area proposed to be open to the fishery. Depletion occurs when removals occur faster than immigration and recruitment can replace removed individuals (Battaile and Quinn 2006). Battaile and Quinn (2006) analyzed local depletion in the EBS pollock fisheries and found that areas with low initial biomass are more susceptible to depletion than areas with higher initial biomass, even considering the proportionally smaller amounts of effort and total catch. Depleted pollock stocks appeared to be replenished with a break in fishing of approximately 7 days. Battaile and Quinn (2006) concluded that pollock stocks may be able to bounce back from localized depletion relatively quickly and that depletions can be reduced by dispersing catch in time and space.

Without local, winter biomass estimates it is unknown whether the initial pollock biomass is low around the Alaid Island haulout that would be open to pollock fishing from 3 nm. Groundfish survey biomass estimates are available for pollock around Aggatu Island and Buldir Island (Conners et al. 2013b). In Area 543, the estimated pollock biomass around Buldir Island declined significantly from 1991 through 2012 ($p = 0.001$) and increased at an insignificant rate around Aggatu Island ($p = 0.460$). However, as noted in Conners et al. (2013b), the groundfish survey pollock biomass estimates are highly uncertain with CVs ranging from 35% to 100%. Overall, the pollock biomass in the Aleutian Islands is believed to be near historic low levels. Like Pacific cod, pollock are a minor component of the Aleutian Islands groundfish biomass (Table 5-46).

Thus, with the available data, NMFS cannot rule-out the potential for the Area 543 pollock fishery to create a localized depletion of pollock, despite the low level of proposed harvest. The fishery would occur in an apparent critical time and area for Steller sea lions (3 nm from Alaid Island in winter). However, NMFS expects a high degree of depth partitioning between adult female and juvenile sea lions and the pollock fishery in Area 543 based on the available data. The high movement rate of pollock (especially compared to Atka mackerel) is expected to replenish any local depletion of pollock over a period of a few days and this harvest amount (1,970 mt) is expected to be harvested in less than a week's time, if any attempt is made to harvest it at all (see section 5.3.7.3). Therefore, given the numerous catch limits in place for the Aleutian Islands pollock fishery (including the 5% ABC limit for Area 543), the small amount of critical habitat proposed to be open to the pollock fishery, substantial inferred depth partitioning, and the rapid expected replenishment of pollock, NMFS does not expect the proposed Area 543 pollock fishery to reduce the prey resources available to foraging adult female and juvenile Steller sea lions in Area 543 to an extent that reduces the reproduction or survival of the Steller sea lion sub-population in the western Aleutian Islands.

Pollock Area 542

Pollock fishing would not be allowed in 87% of the critical habitat in Area 542. The proposed action would open a portion of critical habitat to trawling for pollock in Area 542. The A season catch limit would be 15% of the Aleutian Islands pollock ABC. West of 178° W longitude: a portion of critical habitat would be open outside of 3nm from Tanadak Island, Segula Island, and Krysi Point. Of these haulouts, Krysi Point and Segula are used in the winter (November through April) when pollock are an important part of the sea lion diet in the central Aleutian Islands. Both of these sites would be closed to Atka mackerel fishing under the proposed action. Tanadak Island is the only site that would be open to pollock trawling in a portion of critical habitat outside of 3 nm that is also proposed to be open to Atka mackerel trawling. The best available data indicate that sea lions do not use Tanadak Island to a great extent (Table 4-3).

The proposed action would also open a portion of critical habitat outside of 10 nm from one rookery (Ayugadak Point) and one haulout (Little Sitkin Island) to pollock trawling in the western portion of Area 542. The rookery is used by sea lions in the summer and pollock are an important component of the sea lion diet in winter in the central Aleutian Islands. The Little Sitkin Island haulout is used by sea lions in the winter. Ayugadak Point and Little Sitkin Island would be closed to trawling for Atka mackerel under the proposed action.

There are three haulouts and one rookery (Kanaga Island/Ship Rock) east of 178° W longitude in Area 542. The proposed action would open critical habitat to pollock trawling 3 – 20 nm from the three haulouts (Tanaga Island/Bumpy Point, Bobrof Island, and Kanaga Island/North Cape). This includes Kanaga Island/Ship Rock rookery which was open to the Atka mackerel fishery under the pre-2011 fishery management measures, but which would be closed to Atka mackerel under the proposed action. An important difference, however, is that Atka mackerel are important in the sea lion diet in summer and winter in the central Aleutian Islands and pollock are important in the sea lion diet in winter.

In sum, the pollock fishery may adversely affect sea lions at 4 haulouts used in winter from 3-20 nm (Krysi Point, Segula Island, Bobrof Island, and Kanaga Island/North Cape) and at one winter haulout from 10-20 nm of critical habitat (Little Sitkin Island) in Area 542. There would be no pollock fishing in critical habitat around the remaining 10 important winter sea lions sites in Area 542 (Table 4-3) under the proposed action.

The proposed pollock fishery is subject to several spatial and temporal harvest limits. At the stock assessment level, the setting of ABC is constrained by the global harvest control rule. Next, the Aleutian Islands pollock TAC is limited to a maximum of 19,000 mt, when ABC ≥ 19,000 mt (see section 5.3.7.3). The Aleutian Islands pollock TAC is allocated to the Aleut Corporation and 50% of the TAC must be harvested by trawl catcher vessels < 60 ft. in length. The A season harvest is limited to 40% of the ABC. The Area 542 A season harvest would be limited to 15% of the Aleutian Islands ABC. None of these harvest constraints were in effect the last time critical habitat was open to pollock fishing in the Aleutian Islands.

In section 5.3.7.3 we estimate that a maximum of 5,911 mt of pollock may be harvested inside critical habitat in Area 542 in winter in 2015 under the proposed action. Similar to 1992 through 1998, most of this harvest is expected to occur 3-10 nm from the four haulouts mentioned above. Assuming the full allowed amount is harvested, harvests would be higher than they were from 1992 through 1994 and 1998 and substantially lower than they were from 1995 through 1997 (Table 5-47).

Table 5-47. Amount (mt) of pollock harvested in Area 542 in each zone of critical habitat from 1992 through 1998. Source: NMFS CIA-Trends Database.

Year	0-3nm	3-10nm	10-20nm	Outside CH	Total 542
1992	1	81	38	31	151
1993	16	2,702	175	101	2,993
1994	1	113	207	135	455
1995	3,018	34,012	441	275	37,746
1996	1,431	17,912	214	17	19,575
1997	1,554	14,953	113	123	16,743
1998	299	1,995	141	163	2,599

Similar to Area 543, it is unknown whether the pollock fishery would cause local depletions of pollock inside critical habitat in Area 542. However, a high degree of partitioning in depth between the pollock fishery and sea lions is expected (Figure 5-22 and Figure 5-28), though to a lesser extent than expected in Area 543. The extent of the fishery impact on foraging sea lions and critical habitat depends on the execution of the fishery, if the full catch allowance is concentrated in one area in a short time, the fishery may reduce prey resources for foraging sea lions, at least for the duration of the fishery. While this could have deleterious effects on the local sea lion population, it would not be expected to affect sea lion populations foraging from terrestrial sites without pollock fishing and would not likely have population-level effects on the central Aleutian Islands sub-population. If fishing is spread out among the areas open to the fishery, there is a lower chance of local depletion, and pollock harvests would not be likely to have population-level effects on the central Aleutian Islands sub-population of sea lions or to result in adverse modification of the 23% of designated critical habitat that would be open to fishing.

Pollock Area 541

Pollock fishing would not be allowed in 28% of the critical habitat in Area 541. The proposed action would open critical habitat to trawling for pollock from 10 to 20 nm from rookeries and from 3 to 20 nm from haulouts. As with the status-quo, fishing would be prohibited in the Seguam Foraging area. The A season catch limit would be 30% of the Aleutian Islands pollock ABC. As described in section 5.3.7.3, NMFS expects that 11,823 mt of pollock may be harvested in Area 541 in 2015 and we assume that this total amount would be taken inside of critical habitat. Fifty percent of the pollock TAC must be caught by catcher vessels less than 60 ft. in length which have slower harvest rates than larger catcher vessels and catcher/processors and are less likely to cause localized depletions of pollock. A maximum of 9,500 mt of pollock may be harvested by catcher/processors over all 3 management areas. The historic harvest data show high amounts of pollock fishing in Area 541 from 1992 through 1995 (Table 5-48) and high amounts in Area 542 from 1995 through 1997. Thus, NMFS expects the fishery to harvest the maximum allowable amount in Area 541 and 542 under the proposed action, including the 9,500 mt which may be taken by trawl catcher/processors from 3-20 nm of critical habitat in Area 541.

Table 5-48. Amount (mt) of pollock harvested in Area 541 in each zone of critical habitat from 1992 through 1998. Source: NMFS CIA-Trends Database.

Year	0-3nm	3-10nm	10-20nm	Seguam	Total CH 541	Outside CH	All 541
1992	0	5,098	13,489	3	18,591	14,540	33,130
1993	3	6,634	16,744	3	23,383	16,477	39,860
1994	344	7,596	16,618	7,181	31,740	26,086	57,826
1995	2,896	9,896	9,132	0	21,925	5,082	27,007
1996	646	2,471	1,043	0	4,160	4,399	8,558
1997	164	2,315	4,376	0	6,855	1,235	8,089
1998	0	214	755	0	969	376	1,345

Less than 1,000 mt of pollock was harvested in Area 541 from 1998 through 2012 (except for 2006 when 1,226 mt were harvested). Recall this harvest was all outside of critical habitat. Thus, the sea lion population trends in this area are not explained by the pollock fishery during this time frame, however, trends may be related to pollock biomass which has declined steadily over this time frame (Conners et al. 2013).

Because we do not have winter biomass data for pollock in Area 541, it is unknown whether the proposed pollock fisheries are likely to cause local depletions of pollock. However, any local depletions that may be caused by the proposed pollock fishery in Area 541 are expected to be short-term, with stocks being replenished in about a week's time due to high movement of pollock (Battaile and Quinn 2006). Moreover, the available data suggest substantial depth partitioning between the pollock fishery (Figure 5-28) and Steller sea lions (Figure 5-22) in Area 541. Steller sea lions have a more diverse diet in winter when the pollock fishery is likely to be most active, including several species which are not targeted in the fisheries. Thus, the proposed Area 541 pollock fishery is not likely to adversely modify the conservation value of critical habitat for foraging adult female or juvenile sea lions.

6 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions, not involving federal activities, that are reasonably certain to occur in the action area considered in this Biological Opinion (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act. Past and present impacts of non-Federal actions are part of the environmental baseline discussed in Section 4 of this Biological Opinion. Cumulative effects that reduce the capacity of listed species in the action area to meet their biological requirements increase the risk to the viability of the species, and consequently increase the risk that the proposed action on the species or its habitat will result in jeopardy (USFWS and NMFS 1998). The cumulative effects of future state, tribal, local, and private actions on Steller sea lions and their critical habitat and other affected species, including both lethal and nonlethal direct and indirect effects, are considered below.

In the FMP BiOp (NMFS 2010), we provided a comprehensive discussion of cumulative effects on Steller sea lions and on designated Steller sea lion critical habitat. We incorporate this analysis by reference. Herein, we update that analysis with new information about cumulative effects within the action area.

6.1 Subsistence Harvest

The most recent data regarding the levels and patterns of subsistence take of Steller sea lions in the Aleutian Islands, and in the western DPS as a whole, were collected in 2008 and are presented in (Wolfe et al. 2009b). Wolfe et al. (2009b:60) reported that the Steller sea lion subsistence "…take in the Aleutian Islands area (48 animals) was the lowest since 1993 (37 animals)" and was "considerably below the 135 animals taken in 1992". In the Aleutian Islands, Wolfe et al.'s data (2009b:table 24) indicate that subsistence take of Steller sea lions is typically highest in Atka, followed by Unalaska and Akutan, with very low levels of take occurring at Nikolski and Adak. The take at Atka in 2008 was the lowest level since 2000. Data presented in Table 24 of Wolfe et al. (2009b) indicated a total take of 508.2 Steller sea lions were taken at Atka between 2000-2008, with an average estimated annual take for that period of 56.5. These data are most relevant when viewed in the context of local abundance of Steller sea lions. Based on data in Fritz et al. (2013) and earlier reports, non-pup counts at North Cape on Atka have been highly variable since 2000 (2000: 76; 2002: 224; 2004:383; 2006: 279; 2007: 140; 2008:34; 2010: 206; and 2011: 94). At Cape Korovin on Atka, the total numbers of non-pups counted are consistently fairly small (2000:12; 2002:1; 2004: 4; 2006: 0; 2007: 30; 2008:39; 2010: 6; 2011:0). We do not have sufficient data on harvest areas associated with a given village, or on the origin of animals that are taken by hunters from a given village, to draw conclusions about the effects of harvest on recovery in a particular subarea. However, this level is high enough that it could conceivably affect local abundance and recovery and possibly contribute to the overall lack of recovery in the central Aleutian subarea.

Based on data in Wolfe et al. (2009b: Table 11) the vast majority of the Steller sea lions harvested in Alaska in 2008 were from the WDPS. Based on annual data for the years 2004-2008 (Wolfe et al. 2008, Wolfe et al. 2009a, 2009b, Wolfe et al. 2005, 2006), (Allen and Angliss 2013) reported that the mean annual take of Steller sea lions by subsistence hunters in all areas of the WDPS except St. Paul Island was 172.3. Based on data from (Lestenkof et al. 2008, Jones 2009, Zavadil 2010, Lestenkof 2011) Allen and Angliss (2013) summarized that, based on data from 2007-2011, the average annual total take of Steller sea lions by subsistence hunters collected for St. Paul Island (which also represents take of animals from the WDPS) was 26.9. Thus, based on the most recent 5 years of data from both subareas (St. Paul and the rest of the western DPS as a whole), Allen and Angliss (2013) reported a mean annual subsistence take of 199 Steller sea lions for the WDPS. This mean level of take represents a large proportion (.73) of the potential biological removal (PBR) calculated for the western DPS (PBR was calculated as 274 in the draft Stock Assessment Report for 2013) (Allen and Angliss 2013). Based on the best available scientific information discussed above, and assuming that the patterns observed until 2008 are likely to continue for at least the next decade, we conclude that: a) most of the harvest of Steller sea lions for subsistence will continue to occur west of Cape Suckling, in the breeding range of the WDPS; b) subsistence harvest levels will continue to constitute the largest known source of human-caused mortality for the WDPS; and c) levels of harvest in the Aleutians could potentially affect local or subarea abundance and recovery. The overall future impact of subsistence harvest on the WDPS will be determined by the number of animals taken, their sex and age class, and the location where they are taken. As with other sources of mortality, the significance of subsistence harvesting may increase in the action area if Steller sea lion abundance continues to decline but subsistence harvest levels remain stable or increase. Future subsistence harvest could contribute to subarea-wide or localized declines of Steller sea lions and/or contribute to delayed recovery if the harvest is concentrated geographically in an area of decline and does not track population abundance. NMFS recognizes the importance of this subsistence take to Alaska Native communities in the Aleutians. NMFS, co-managers and subsistence hunters in the Aleutians have taken steps to improve communication and collaboration. These efforts will facilitate the acquisition of better information in the future that should reduce uncertainty about harvest levels and their potential future effects.

6.2 State Managed Commercial Fisheries

Regarding indirect effects, NMFS concludes based on available information that State managed fisheries for pollock, Pacific cod, herring, and salmon may compete with foraging Steller sea lions for fish. Given the importance of near shore habitats to Steller sea lions and the nearshore execution of State fisheries, this potential competition may have consequential effects for sea lions. Specifically, these potential interactions may contribute to nutritional stress for Steller sea lions, and may reduce the value of the marine portions of designated Steller sea lion critical habitat. State managed fisheries will likely continue to reduce the availability of prey within these marine foraging areas and may alter the distribution of certain prey resources in ways that reduce the foraging effectiveness of Steller sea lions. More data on the foraging habits of Steller sea lions from research in key geographic areas could aid our understanding of where and when these effects might be most important.

6.3 Sport, Subsistence, and Tribal Fisheries

We expect that sport and tribal/subsistence fisheries have a very small effect on Steller sea lions relative to commercial fisheries. In the 2010 Biological Opinion, we summarized that in 1998 Alaska's sport fisheries harvested about 1% (4,000 mt) and subsistence fisheries harvested about 2% (8,000 mt) of the annual State of Alaska total fish harvests, while commercial fisheries accounted for 97% (900,000 mt). Based on this relatively small level of harvest, we concluded that impacts are likely limited to minor removals of the potential foraging base, but in such small volumes that we expect only incremental adverse effects, if any. We noted that the effects due to lost gear and potential entanglements and ingestion are documented but we have uncertainty about the magnitude of the current levels. This is especially true in the Aleutians, where the remoteness of area results in many fewer opportunities for humans to observe Steller sea lions, and thus, our ability to receive reports of entangled animals is much lower than in other areas. We noted that Steller sea lions can also be disturbed in key areas by sport fishermen and be attracted to sport-fishery related cleaning areas in harbors. We summarized that sport and subsistence fisheries are expected to continue into the foreseeable future throughout the action area and may increase in the future as tourism and population increases. Based on available information, these statements still appear to be true. However, the level of effects of such fishing may change, at least in some areas. For example, according to the number of vessels registered to provide saltwater sport fishing charter services steadily declined between 2007 and 2011 (2007:1666; 2008: 1601; 2009: 1444; 2010:1389; and 2011: 1259). Logbook data indicate that charter vessels will target all possible species of bottomfish, salmon, and both during a fishing season (Sigurdsson 2013). Thus, effort in the registered and active sport-fishing charter vessels appears to be declining.

The sport fisheries in the action area are managed as part of the Alaska Division of Sport Fish Southcentral Management area (http://www.adfg.alaska.gov/index.cfm?adfg=fishingSportByArea.main). Based on information from the Alaska Department of Fish and Game, Kodiak Area office(Podum 2013), virtually all of the sportfishing effort in the Aleutians occurs on and around Unalaska Island, with some effort on Adak Island. General bag-limits apply to a given fishery for the whole Alaska Peninsula and Aleutians region. Harvest information is available for saltwater areas of Unalaska Island and Unalaska Bay freshwaters. Saltwater species harvested include the five species of Pacific salmon, Pacific cod, rockfish, lingcod, halibut, and Dungeness and tanner crab. Coho, pink and sockeye salmon are the primary species harvested in freshwater sport-fisheries in the Aleutians, with limited chum harvest also occurring. Based on estimated harvest data for this area from the Statewide Harvest Survey provided by ADF&G (T.Podum, email to L. Rotterman, Nov. 14, 2013; available upon request) for both fresh and saltwater for the last ten years, reported harvests of Pacific cod rose significantly in 2012 (3154) over the average estimated harvest (499.4) for the years 2005-2011, as did the estimated salt water harvests of red salmon. Estimated rockfish harvests were also atypically high in 2012. Whether these data indicate a trend toward increased saltwater finfish sport-fishing in the eastern Aleutians is not clear. ADF&G summarized that "The harvest of saltwater species is so small compared to the nearby commercial fisheries we have no concern about the sport fishery impacting fish populations. For freshwater, the only area of concern is Unalaska Bay and most of the streams are closed to sportfishing as the local population has grown too large for the small salmon runs to be sustainable with a sport fishery. Sportfishing is allowed off many beaches and in Unalaska Lake". There are not harvest estimates from Adak due to the small number of fishers. ADF&G summarized that sport fisheries west of Adugak Island are "…virtually non-existent and pose little threat to local fish populations." Thus, the best available data indicate that, within the action area, the likely relative impact of sport fisheries compared to commercial fisheries is much smaller than in the State as a whole, and is likely to remain so for the foreseeable future. We expect little or no change in levels of sport fishing in the foreseeable future.

Current levels of subsistence fisheries are discussed in the baseline section. NMFS expects the existing state-managed subsistence and recreational fisheries and their direct and indirect effects on Steller sea lions to continue into the foreseeable future. We conclude that they are likely to pose little threat to Steller sea lions or their critical habitat in the foreseeable future.

6.4 State Oil and Gas Activity

The (Alaska 2013) stated that its "Five-Year Oil and Gas Leasing Program provides a stable and predictable schedule of proposed lease sales." The State updates this program annually. The most recent document describing this program, published January 2013, is the best available source regarding foreseeable State oil and gas leasing and provides the plan for the State of Alaska's proposed lease sales for 2013 through 2017.

According to this document (State of Alaska 2013:7) "[A] total of 25 proposed areawide lease sales are scheduled over the next five years with one sale scheduled annually for each of the following areas: Alaska Peninsula, Cook Inlet, Beaufort Sea, North Slope, and North Slope Foothills". There are no lease sales proposed within the action area. The Alaska Peninsula is the area closest to the action area in which lease sales are scheduled to occur in the foreseeable future. No bids were received during the June 2011 or May 2012 Alaska Peninsula Areas lease sales (State of Alaska 2013). Based on information in the Five-Year Program (State of Alaska 2013), there are also no current active oil and gas exploration licenses or pending applications for such licenses in the action area or in adjacent areas.

There is oil and gas leasing, exploration, development, and production activity on State land and in State waters in the arctic and in the Cook Inlet region (State of Alaska 2013). While oil released during any exploration, development or production activities in these areas is not likely to contact the action area, any large release of oil in Cook Inlet would be likely to travel south towards areas in which there is critical habitat for the western DPS and where Steller sea lions are likely to occur. We discuss cumulative effects of oil spills below in a separate section.

Oil and gas-related vessel activity such as drill ships, ice-breakers, tankers, seismic vessels, tugs, barges, drill rigs, and a myriad of smaller support vessels is likely to increase in the future due to increased oil and gas activity (including state-permitted activities) in the arctic and Cook Inlet. We discuss shipping effects separately below. While such activities have effects that contribute to cumulative adverse impacts on Steller sea lions and their critical habitats, effects are too unpredictable as to place, time, and magnitude for us to forecast likely impacts.

6.5 Shipping

Shipping will occur within portions of the action area in the future and the overall level of shipping is likely to increase due to: increased industrial activity in the Chukchi and Beaufort Seas (Arctic Council 2009) and related shipping in and out of these arctic regions; increased shipping through the Northern Sea Route; growth of economies in Asia and related shipping of fuel (e.g., Zweig and Jianhai 2005), agricultural products, and other product to the far east from the United States and Canada; and increasing shipping along the existing common routes. While the Northwest Passage is not expected to become a viable route through the arctic through 2020, shipping to destinations in the Canadian arctic is expected to increase (Arctic Council 2009). As noted by the Transportation Research Board (2008) major commercial marine shipping routes intersect areas within the Aleutian Islands. They characterize the fleet of ships that carry a variety of cargoes to Asia from the west coast of North America along the North Pacific Great Circle Route as "large" (providing a round number of 4,500 vessels that transit Unimak Pass), "growing", and "international". Large vessels include bulk carriers, container ships, car carriers, tankers and others. The Transportation Research Board (2008:4) reported that the vessels "carry large quantities of fuel oil and various cargoes, including chemicals and other hazardous materials." These authors noted that most of these ships transit through or near the Aleutians but only stop for emergencies. Oil and gas associated seismic vessels, icebreakers, tankers, tugs towing exploration structures, and other support vessels en route following summer or fall work in the arctic have joined the fleet transiting in the Aleutians.

Shipping activities can adversely affect Steller sea lions and/or their critical habitat due to disturbance, ship strikes, modification of the marine acoustic environment, introduction of alien species, accidents that release pollutants and other cargoes (e.g., the spillage of soybeans), and can result in the loss of the ship itself (e.g., see discussions in Arctic Council 2009). All of these kinds of effects are expected to increase in the foreseeable future due to increases in shipping. Disturbance related to shipping could potentially affect local sea lion abundance and/or habitat use, and if it occurred very near a major rookery could potentially have a population-level effect. However, disturbance of animals on rookeries is mitigated due to the 3 nm no-entry zone protections NMFS placed around most of the rookeries in the western DPS (50 CFR 223.202). We do not have data to evaluate frequencies or probabilities of boat strikes either now or in the future. With respect to spills from shipping, the Transportation Research Board (2008:vii) summarized that "Some accidents involving these ships have resulted in oil spills that have had serious environmental consequences. Indeed, history has shown that oil spill accidents in the Aleutians are not uncommon, in large part because of the frequent and sudden storms, high winds, and severe sea conditions to which the region is subject. Response to these events is often ineffective because of the severe weather and a lack of appropriate infrastructure." They stated (Transportation Research Board 2008:21-22) that accidents and near accidents with potential significant environmental and economic impacts occur in the Aleutians each year. By example, they reported that there were 41 oil spill incidents in the Aleutian Islands between 1981 and 1999 in which the U.S. Coast Guard requested the assistance of NOAA's Hazardous Materials Response Unit (NOAA 2000). They cite NOAA (2007:1) as stating that "for the past 25 years, the Aleutian Islands have averaged nearly one oil spill of 1,000 gallons or more per year." They concluded that the spill risk posed by vessels transiting the Aleutians will grow as new routes are established related to resource development in the Arctic and elsewhere and as traffic volume increases. While they characterized the example of the 2004 grounding and breakup of the *M/V Selendang Ayu* and the resulting spill of 336,000 gallons of heavy fuel oil as "particularly severe," they noted that "…other accidents, spills, and near misses have taken place and continue to occur in the region" (Transportation Research Board 2008:2). Thus, we conclude that such shipping accidents are likely to occur in the future. What is not foreseeable is what the accident will be, where it will occur, when it will occur, and what the effects will be.

Spills of Petroleum Products

Petroleum product spills could affect western DPS Steller sea lions or critical habitats in the action area due to shipping accidents (the most likely cause of an oil spill in the Aleutian Islands), spills from shore facilities (e.g., pipeline ruptures or fuel tank ruptures on land or in harbors), fishing vessel accidents, and oil and gas exploration. We expect the frequencies of such spills to increase in the future due primarily to increases in shipping and oil and gas activity.

Sea lions may be exposed to spilled oil while in the water, on rookeries or haulouts (wave action can drive the oil into high intertidal zones), through contaminated prey, through contact with their young, or through contact other conspecifics while socializing. “There are few post spill studies with sufficient details to reach firm conclusions about the effects, especially the long-term effects, of an oil spill on free-ranging populations of marine mammals” (MMS 2006)The effects of exposure to spilled oil will depend on many factors including the type of oil, the location and extent of contamination, the animals’ behavior after exposure, the freshness of the oil (i.e., freshly spilled oil versus weathered), the age of the animal at the time of exposure, the route of exposure, and other factors. Sea lions exposed to oil spills may become contaminated with petroleum aromatic hydrocarbons (PAHS) through inhalation, skin contact and absorption, direct ingestion, or by ingestion of contaminated prey (e.g., (Engelhardt et al. 1977, Geraci 1990, Geraci and T.D. 1990, St. Aubin 1990) and such exposure can be harmful. Surface contact with the low-molecular weight fractions can cause temporary or permanent damage of the mucous membranes and eyes, and/or epidermis (MMS 2006). Contact with crude oil can damage eyes of seals and at least some other marine mammals (e.g., Rotterman and Monnett (2002)). Ingestion of petroleum hydrocarbons can lead to subtle and progressive organ damage or to rapid death. Inhalation of volatile hydrocarbon fractions of fresh crude oil can damage the respiratory system, cause neurological disorders or liver damage, have anesthetic effects, and if accompanied by excessive adrenalin release, can cause sudden death (e.g., Geraci 1988). Rotterman and Monnett (2002:987) summarized that “[I]ngestion of petroleum hydrocarbons can irritate or destroy epithelial cells lining the intestine and stomach, and can affect food absorption, digestion, and motility (St. Aubin 1990). Ingestion of high doses of oil causes diarrhea (Hartung 1995). Inhaled volatile hydrocarbons are quickly transferred to the bloodstream and may accumulate in, and damage various organs, including the liver (Neff 1990). Organ damage can negatively impact metabolism.” Marine mammals can be negatively affected by cleanup-related disturbance and by chemicals used in cleanup activities (Rotterman and Monnett 2002; also see Sharp et al. 1996). Tar can become lodged in the throats, around the lips, jaw, neck of Steller sea lions (FOC 2011, citing Calkins and Pitcher 1982). Many PAHs are teratogenic and embryotoxic in at least some mammals. Ingestion of oil by pregnant females can negatively affect the birth weight of their young. Steller sea lions would be particularly vulnerable if large amounts of crude oil coated rookeries when young pups were on the rookeries or oil contaminated concentrations of prey. Given the ongoing decline in sea lion abundance and reproduction in parts of the action area, a spill affecting one or more rookeries in the action area during the breeding season could result in a significant adverse effect on recovery. The vulnerability of Steller sea lions on rookeries to large oil spills was oil spills was also pointed out by FOC (2011). FOC (2011) also rated the “…potential for mitigation of this threat…low to medium due to the inherent difficulty in, and low success of, post-spill clean-up measures (Graham 2004), particularly in isolated, remote areas.”

7 SYNTHESIS AND CONCLUSIONS

In this section, NMFS summarizes the effects identified in the preceding sections and details the consequences of the risks posed to sea lions and features of critical habitat. Finally, this section concludes whether NMFS has insured that the proposed action is not likely to jeopardize the continued existence of any endangered or threatened species, nor result in the destruction or adverse modification of critical habitat.

7.1 Jeopardy Standard

Jeopardize the continued existence of [a listed species] means to engage in an action that reasonably would be expected, directly, or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02).[17]

The purpose of the analysis is to determine whether appreciable reductions are reasonably expected, but not to precisely quantify the amount of those reductions. Our assessment often focuses on whether a reduction is expected, but need not contain detailed analyses designed to quantify the absolute amount of reduction or the resulting population characteristics (abundance, for example) that could occur as a result of implementing the proposed action.

The parameters of productivity, abundance, and population spatial structure are important to consider because they are predictors of extinction risk, the parameters reflect general biological and ecological processes that are critical to the survival and recovery of the listed species, and these parameters are consistent with the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR 402.02). NMFS uses the demographic recovery criteria (NMFS (2008) see section 3.5) to assess whether the WDPS of Steller sea lions can be expected to survive with an adequate potential for recovery (e.g., trending toward recovery) under the effects of the action, the effects of the environmental baseline, and any cumulative effects.

7.2 Destruction or Adverse Modification of Critical Habitat Standard

NMFS does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02 because the Ninth Circuit Court of Appeals determined that definition was facially invalid (*Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service*, 378 F.3d 1059, 9th Cir. 2004). Instead, we rely upon the statutory provisions of the ESA to complete the analysis with respect to critical habitat. NMFS will evaluate "destruction or adverse modification" of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species. Thus, NMFS must determine whether affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species both in the near and long term under the effects of the action, environmental baseline, and any cumulative effects.

7.3 Integrating the Effects

NMFS has conducted numerous biological opinions on the effects of the Alaska groundfish fisheries on the WDPS and critical habitat (see Chapter 1). The most recent programmatic consultation on the Alaska groundfish fisheries concluded in 2010 with the completion of the FMP BiOp (NMFS 2010). The FMP BiOp concluded that the groundfish fisheries were likely to adversely affect the WDPS of Steller sea lions through direct disturbance from vessel activity and take incidental to commercial fishing. The FMP BiOp also concluded that the groundfish fisheries likely reduce the overall availability of prey for marine mammals and may have lowered the carrying capacity of Steller sea lions. The FMP BiOp concluded that overall prey biomass appeared to be sufficient to support a recovered population of sea lions, but that fisheries may cause local depletions of prey to the extent that sea lion foraging success is compromised. NMFS concluded that it could not insure that the groundfish fisheries as proposed were not likely to jeopardize the continued existence of the WDPS of Steller sea lions or result in the destruction or adverse modification of critical habitat due to the strong decline of the western Aleutian Islands sub-population and the decline of the central Aleutian Islands sub-population (NMFS 2010). As explained in the FMP BiOp, the cause of the continued declines in these areas is unknown, and reduced reproduction due to local depletion of prey (chronic nutritional stress) is a hypothesis to explain the decline. Other hypotheses

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[17] For purposes of this opinion, NMFS interprets this definition consistent with the court's opinion in *National Wildlife Federation v. NMFS*, 524 F.3d 917 (9th Cir. 2008). NMFS's jeopardy analysis considers how the proposed action may affect the likelihood of survival of the species and how it may affect the likelihood of recovery of the species.

include environmental regime change (that reduces prey availability or quality and results in chronic nutritional stress) and killer whale predation (NMFS 2010). Recent information since the completion of the Recovery Plan (NMFS 2008) also suggests mercury contamination may be a threat (see section 3.8.2).

The FMP BiOp contained an RPA to mitigate the potential effects of the groundfish fisheries on Steller sea lions and critical habitat in the western and central Aleutian Islands. The RPA addressed removal of Atka mackerel and Pacific cod in Fishery Management Areas 543, 542, and 541. Because the proposed action may affect the potential for the groundfish fisheries to compete with sea lions for prey via measures that were not considered in the FMP BiOp (NMFS 2010), the focus of this biological opinion has been on the effects of prey removal by the Alaska groundfish fisheries in the Aleutian Islands. The direct effects of incidental take and disturbance that were considered in the FMP BiOp are not likely to affect the WDPS of Steller sea lions in a manner or to an extent not considered in the FMP BiOp (NMFS 2010).

This biological opinion presents new information on Steller sea lion biology and ecology that has emerged since the FMP BiOp (NMFS 2010)) (e.g., Fritz et al. (2013), Sinclair et al. (2013), Lander et al. (2013), (Hoopes et al. 2014), Bowen and Iverson (2012), Rea et al. (2013), Castellini et al. (2013), Calkins et al. (2013), and Horning and Mellish (2012) among many others). This biological opinion also presents new information on finer scale sea lion prey distribution and abundance (e.g., Conners et al. (2013b), McDermott and Haist In Review) and several new analyses of the groundfish fishery data. NMFS also conducted several new analyses in response to external reviews of the FMP BiOp (e.g., Johnson and Fritz (In Review), Conn et al. (2013), Johnson and Fritz (2013), Lander et al. (2013)).

In Chapter 3 we reviewed the current status of the WDPS of Steller sea lions and designated critical habitat and summarized the existing knowledge of the factors affecting the current status. The conclusions of that chapter are similar to the species status described in the FMP BiOp (NMFS 2010). The WDPS in Alaska appears to be increasing at a rate of 1.67% per year (95% credible interval: 1.01, 2.38) and the WDPS in Russia is also estimated to be increasing overall. In Russia and Alaska, there are regional differences in the population growth rate with apparent declines occurring from the central Aleutian Islands through eastern Kamchatka (see section 3.3). As discussed in section 3.6, recent forecasting shows a virtually nil probability of the WDPS reaching quasi-extinction in 100 years, but a near certain probability of quasi-extinction of the western Aleutian Islands sub-population in less than 100 years due to the continued strong decline of pups and non-pups in this sub-region.

As explained in Chapter 3, our understanding of the prevalence of the various threats to the continued existence of the WDPS remains incomplete. Geographic variation in environmental conditions across the range may mean that different factors are responsible for local population dynamics to varying degrees. Observations at one site may not apply to others or even to nearby rookeries (NRC 2003). The available data do not suggest that direct anthropogenic sources of mortality are limiting population growth in the WDPS. Indirect anthropogenic threats such as contaminants and fishing for Steller sea lion prey may be limiting population growth in the WDPS today and ocean acidification may pose threats to the population in the future. Direct killer whale predation or indirect effects of climate change/environmental variability may also be limiting WDPS population growth. The extent to which these drivers are influencing population dynamics in each sub-region is not well understood, though the evidence suggests that the occurrence and intensity of these threats likely varies among sub-regions.

The Recovery Plan (NMFS 2008) ranked competition with fisheries as a potentially high threat to the recovery of the WDPS. The Recovery Team determined adult females and juvenile sea lions to be the most vulnerable age-classes to the effects of competition with fisheries, though, as explained in NMFS (2008) the Recovery Team did not reach consensus about the impact of fishing on the recovery of the WDPS. Our conceptual model in Figure 5-42 shows how the commercial groundfish fisheries may reduce

Steller sea prey resources and our conceptual model in Figure 5-43 shows our understanding of the responses of Steller sea lions when exposed to the effects of reduced prey resources. The response conceptual model is discussed in the Risk Analysis in section 5.4.

The Risk Analysis in section 5.4 evaluated whether the proposed groundfish fisheries are likely to result in local depletions of prey in times and areas that are important to sea lions, with an emphasis on adult females in winter and spring. The available data suggest that if nutritional stress is acting on the WDPS it is likely due to localized limitation of important prey resources or low-diet diversity or a combination of the two. The evidence also suggests that the mechanism would be chronic nutritional stress where reduced food resources result in increased maternal investment into juveniles at the expense of high reproduction (see section 3.10). However, there are extensive gaps in the available information which prevent understanding the causal relationships affecting Steller sea lions in the western and central Aleutian Islands. In section 5.4.5 NMFS explains why a cautionary approach to fishing for prey species in Steller sea lion critical habitat is warranted, especially in winter when we have the least information about groundfish biomass. NMFS PRD also recommends that catch be dispersed in time and space to prevent localized depletion− at least until such time as we have better local biomass and exploitation rate estimates.

The proposed action analyzed in this biological opinion would modify the RPA from the FMP BiOp that was implemented in 2011 to ensure that the Alaska groundfish fisheries were not likely to jeopardize the continued existence of the WDPS or adversely modify designated critical habitat. The RPA closed the entire EEZ in Area 543 to retention of Pacific cod and Atka mackerel. The proposed action would allow fishing for Atka mackerel, Pacific cod, and pollock inside critical habitat in Area 543, which corresponds with the western Aleutian Islands sub-region. In section 5.2, NMFS concludes that the area inside marine critical habitat is more important to foraging adult female and juvenile Steller sea lions than the area outside of critical habitat, consistent with prior biological opinions (NMFS 2000, 2001, 2003, and 2010) and based on new analyses conducted since completion of the FMP BiOp.

The proposed action includes several important changes to the Atka mackerel, Pacific cod, and pollock fisheries relative to the proposed action analyzed in the FMP BiOp (see Chapters 2 and 5). As described in section 5.4.6, the Area 543 Akta mackerel fishery is subject to several provisions to disperse harvest in space and time and to several area closures (e.g., 3 nm from haulouts and 10 nm from rookeries) to conserve prey in the vicinity of important sea lion sites. Relative to the action analyzed in the FMP BiOp, the Area 543 Atka mackerel TAC would be limited to 65% of the Area 543 ABC in any year and the Buldir Island rookery would be closed from 0-10 nm instead of 0-15 nm.

Because the action area in this biological opinion is limited to Areas 543, 542, and 541, NMFS was able to conduct a more in-depth analysis of the spatial and temporal distribution of the Atka mackerel harvest than was available for the FMP BiOp (see section 5.3.7.1). This analysis revealed that only a small proportion of the Area 543 ABC was harvested inside critical habitat in winter. Approximately 30% of the ABC was taken inside critical habitat in summer, though the fishery was limited to fishing outside of 10 nm from rookeries. The majority of the Area 543 harvest occurred outside of critical habitat and was distributed fairly evenly between summer and winter (Figure 5-30). Under the proposed action, a maximum of 20% of the Area 543 Atka mackerel ABC could be harvested inside critical habitat in each season. Of the fisheries considered in this analysis, the Aleutian Islands Atka mackerel fishery is the only fishery with area-specific ABCs. The area closures, area-wide TAC limit, 50:50 seasonal TAC apportionment, 60% critical habitat limit, and historical distribution of the fishery (from 2007 through 2010) which is likely to reflect fishing under the proposed action, substantially decrease the likelihood that the proposed Atka mackerel fishery in Area 543 will reduce the numbers or reproduction of the western Aleutian Islands sub-population of the WDPS.

The proposed Area 542 and 541 Atka mackerel fisheries would be modified relative to the action analyzed in the FMP BiOp (NMFS 2010). The proposed open areas inside of critical habitat are based on the results of the FIT studies (see section 5.4.2) to reduce the chances of causing localized depletion of sea lion prey. Areas with relatively low initial biomass would be closed to the fishery to conserve prey for Steller sea lions and areas with high initial biomass and low movement would be open to the fishery as the trawl exclusion zones are likely to conserve prey for sea lions in these areas. The closure areas (trawl exclusion zones), and measures to spatially and temporally disperse Atka mackerel harvest (50:50 seasonal apportionment, and 60% critical habitat catch limit in Area 542), substantially decrease the likelihood that the proposed Area 542 and 541 Atka mackerel fisheries will reduce the numbers or reproduction of the central Aleutian Islands sub-population of the WDPS.

The risk analysis for the Pacific cod fisheries (see section 5.4.7) highlights that the biggest change relative to the action analyzed in the FMP BiOp is the TAC split between the BS and AI which is expected to reduce Pacific cod harvest by 72% in the Aleutian Islands in 2014 and 2015 relative to the annual average harvest from 2004 through 2010. Most of the Aleutian Islands Pacific cod TAC is expected to be taken with trawl gear in Area 541 under the proposed action. NMFS expects Pacific cod harvest in Area 543 and 542 to be substantially reduced under the proposed action relative to harvests from 2004 through 2010 (see section 5.4.7). The determination that the proposed Pacific cod fisheries are not likely to reduce the numbers or reproduction of the western or central Aleutian Islands sub-populations of the WDPS of Steller sea lions is based primarily on the substantial projected reduction in harvest in Areas 543 and 542 and the projected reduction in harvest in Area 541 relative to the Pacific cod fishery analyzed in the 2010 FMP BiOp. The proposed action also includes an Area 543 catch limit in proportion to the annual estimated biomass in Area 543.

The proposed action would allow pollock fishing inside of Steller sea lion critical habitat in the Aleutian Islands for the first time since 1999. The risk analysis for the proposed Aleutian Islands pollock fishery is in section 5.4.8. The Area 543 A season catch limit would be 5% of the Aleutian Islands ABC (this is less restrictive for Area 543 inside critical habitat and more restrictive outside critical habitat relative to the proposed action analyzed in the FMP BiOp). We estimate that approximately 1,970 mt of pollock could be harvested in the 5% of the critical habitat area that would be open to the fishery in Area 543 under the proposed action. As discussed in section 5.4.8, NMFS does not know the initial biomass in the area that would be open to the fishery within 3-10 nm of critical habitat near the Alaid Island haulout. NMFS expects any local depletion of prey to be short-term due to the high degree of movement of pollock and expects some depth partitioning between the pollock fishery and foraging sea lions in Area 543.

The effects of the proposed pollock fishery in Area 542 and 541 are less certain than for the Area 543 pollock fishery. Several components of the proposed action are likely to mitigate effects of pollock harvest on Steller sea lions including the overall TAC limit of 19,000 mt, the requirement that 50% of the TAC be harvested with vessels less than 60 ft. in length (which harvest fish at a slower rate than larger vessels), closure of 87% of critical habitat to the pollock fishery in Area 542, closure from 0-3 nm from haulouts and 0-10 nm from rookeries in Area 541, continued closure of the Seguam Foraging Area to directed fishing, and Area 542 and 541 A season catch limits of 15% and 30% of ABC, respectively. The exposure analysis revealed some likely depth partitioning between the pollock fishery and foraging adult female and juvenile Steller sea lions that is not explained by diel vertical migration of pollock, suggesting that sea lions and the fishery may target different sub-populations of pollock to some extent (see section 5.3.5). As with Area 543, NMFS does not have data to estimate the initial biomass of pollock in winter in Areas 542 and 541. The fishery is expected to be concentrated in the open areas of critical habitat in winter, and we cannot determine whether the fishery will cause localized depletions of pollock. The fishery might not find sufficiently dense concentrations of pollock for harvest given the unsuccessful attempts to date at prosecuting such a fishery outside of critical habitat (see section 4.4.4). The pollock fishery in Area 542 and 541 may create temporary localized depletion of pollock inside critical habitat in winter that may reduce the numbers and reproduction of sea lions in the immediate vicinity of the fishery. Even if that happens, we do not expect serious consequences for the western DPS of Steller sea lions because of the mitigating factors discussed above (low overall TAC, requirement that 50% of the TAC be harvested by smaller vessels that harvest at a slower rate, closures of large areas of critical habitat, and temporal dispersion of catch).

7.3.1 Jeopardy Assessment

To evaluate whether the proposed fisheries would reasonably be expected to reduce appreciably the likelihood of the survival and recovery of the WDPS of Steller sea lions, we developed a conceptual model for how Steller sea lions are likely to be exposed to the effects of prey removal by the fisheries (Figure 5-42) and how sea lions exposed to the effects of reduced prey resources are likely to respond (Figure 5-43). The results of the exposure analysis (see section 5.3) demonstrate that some partitioning may occur between the fisheries and Steller sea lions targeting Atka mackerel, Pacific cod, and pollock and that some amount of overlap is also expected. As discussed in the exposure analysis, we lack sufficient information for a comprehensive understanding of many of the base or resulting states in the exposure pathway (i.e., many of the existing conditions and potential changes). Given the complexity of the dynamic marine environment in the Aleutian Islands, we may never have a firm grasp on the contribution of anthropogenic versus natural causes for population fluctuation in Steller sea lions, including the consequences of variations in prey availability. The response conceptual model shows several pathways by which Steller sea lions exposed to reduced prey resources may avoid a nutritional stress response (Figure 5-43). Individual sea lions that are not able to avoid a nutritional stress response are expected to suffer acute (short term) nutritional stress which results in death or chronic nutritional stress which may indirectly result in death or reduced reproduction. For the death or reduced reproduction to be expected to appreciably reduce the survival or recovery of the species, the nutritional stress would have to be sufficiently prevalent to reduce the birth rate and/or increase the death rate of the sub-population and that sub-population would have to be of significance to the continued existence of the species.

The Recovery Plan (NMFS 2008) established the significance of each sub-population (i.e., the seven sub-regions defined in that plan) to the continued existence of the WDPS. In establishing the recovery criteria in the 2008 Recovery Plan, the Steller Sea Lion Recovery Team concluded that the WDPS should be maintained across its range since there are currently no gaps in its range. Thus, the Recovery Plan includes the criterion that no sub-region could have declined in abundance by more than 50% relative to the abundance in 2000 for the western DPS to be down-listed from endangered to threatened. The Recovery Plan also concluded that continued, significant declines in two adjacent sub-regions would signal that there were unabated threats to the continued existence of the DPS as a whole. In the FMP BiOp, NMFS concluded that if it were not for the continued, significant declines in Steller sea lion abundance in the western Aleutian Islands, the WDPS would be on the path to recovery (NMFS 2010). The analysis in this biological opinion also supports this conclusion such that if the proposed action is likely to reduce the survival or recovery of any sub-population (sub-region), then we would conclude that NMFS SFD had not ensured that the proposed action was unlikely to reduce the survival and recovery of the WDPS. In this section of the analysis we evaluate whether the proposed action is likely to affect the survival or recovery of the WDPS of Steller sea lions by affecting the population growth rate of the western Aleutian Islands or central Aleutian Islands sub-populations.

The western Aleutian Islands sub-region boundaries correspond with fishery management Area 543. When the proposed fisheries are examined in aggregate, Area 543 has the least amount of area from 0-20 nm around sea lion rookeries and haulouts open to the fisheries relative to Areas 542 and 541 (see section 5.3.3.1), and the greatest extent of overlap in terms of expected active fisheries could occur in a maximum of 5% of the critical habitat in Area 543 (see section 5.3.3.1). As summarized above in this chapter and in section 5.4, the Atka mackerel fishery is expected to have a low amount of direct spatial overlap with foraging adult female and juveniles sea lions given our best understanding of habitat use by these age- and sex-classes and the closures to fishing from 0-3 nm from haulouts and 0-10 nm from rookeries in addition to the existing Aleutian Islands Habitat Conservation Area closures, though telemetry data from more animals in all seasons are needed for a more complete understanding of sea lion at-sea habitat use. In addition to the area closures, we expect fishing to occur in a smaller portion of the open critical habitat given the available historic fishing data (see Figure 5-7 and Figure 5-8). Also, many measures have been implemented in the Atka mackerel fishery to temporally disperse fishing and limit the amount of catch that may be taken in the small area inside critical habitat where the fishery under the proposed action would operate. Our analysis acknowledges some uncertainty about the potential for the fisheries to reduce prey resources for Steller sea lions in Area 543 and one component of the proposed action is research aimed at improving our understanding of local Atka mackerel biomass and movement. The Pacific cod fishery in Area 543 is expected to be very small relative to the Pacific cod fishery that existed prior to the 2011 RPA. The Area 543 pollock fishery is also expected to be small since it would be limited to 5% of the Aleutian Islands ABC, though we would expect the fishery to be spatially and temporally compressed in the small area of open critical habitat where it operates. The potential for competition between the pollock fishery and sea lions may be reduced or eliminated due to the different depths observed between the two and an expected rapid replenishment of pollock.

Given our assessment of the proposed fisheries in Area 543 and the measures to reduce potential competition between the fisheries and sea lions overall and in critical habitat, NMFS does not expect that the proposed fisheries are likely to appreciably reduce the survival or recovery of the western Aleutian Islands Steller sea lion sub-population. Based on our assessment of the available data, NMFS concludes that a decline in numbers of the western Aleutian Islands sub-population is likely to continue for unknown reasons, even apart from any changes in the fisheries, and that the proposed measures are unlikely to yield population level effects that would appreciably change the likelihood of survival or recovery of the western Aleutian Islands sub-population.

Areas 542 and 541 overlap the central Aleutian Islands Steller sea lion sub-region. Steller sea lion pup and non-pup production is decreasing in Area 542. Pup production is increasing at a non-significant rate in Area 541 (see RCAs 4 and 5 in Fritz et al. (2013)) and non-pup production in increasing at a significant rate in the eastern portion of Area 541 and increasing at a non-significant rate in the western portion (Fritz et al. (2013)). Overall, the central Aleutian Islands sub-population appears to be declining at a non-significant rate (see section 3.3.2). In aggregate, in Area 542 the proposed action would likely be more protective for Steller sea lions than the action analyzed in the FMP BiOp due to the specification of an Aleutian Islands Pacific cod ABC and TAC and closures to the Atka mackerel fishery based on the results of the FIT research described in section 5.4.2. The proposed action would open a portion of critical habitat in Area 542 to pollock fishing. Our analysis in section 5.4.8 concludes that the pollock fishery in Area 542 may be compressed in a short period of time around one or two of the winter haulouts in areas that would be open to pollock fishing from 3-10 nm, or may be dispersed around four winter haulouts. The available information is equivocal as to whether these removals would have a short-term effect on the foraging success of adult female and juvenile sea lions, though we expect the effects would be localized if the fishery occurs in one area and reduced if the fishery is more spatially dispersed. In the worst case scenario that the Area 542 pollock fishery results in adverse impacts to sea lion prey availability during February and March around one to two haulouts, then reproduction may be reduced at these haulouts (if the conditions in Figure 5-42 and Figure 5-43 are met). However, it is NMFS's opinion that any such local effect would be of insufficient magnitude to appreciably reduce the reproduction of the central Aleutian Islands sub-population.

The levels of fishing expected to occur in Area 541 are projected to be similar to the levels from 2000 through 2013 with decreases in the amount of Pacific cod harvest and increases in pollock. Atka mackerel fishing would also be allowed in a 12-20 nm band of critical habitat in the southern portion of Seguam Pass in Area 541. Given the high initial biomass of Atka mackerel in Seguam Pass and the apparent efficacy of the trawl exclusion zone, the Atka mackerel fishery is not likely to reduce the available prey resources for sea lions in Area 541. The pollock and Pacific cod fisheries may adversely affect Steller sea lions in winter when these species are important in the sea lion diet in the central Aleutian Islands. While the Pacific cod fishery is expected to be concentrated in Area 541 under the proposed action, it is expected to be substantially reduced relative to harvest levels prior to 2014 (see section 5.4.7). The impact of the proposed pollock and Pacific cod fisheries combined in Area 541 is estimated to be similar to the impact of the Pacific cod fishery in Area 541 prior to 2014 (see Table 5-41). Even with temporally concentrated Pacific cod fishing in Area 541 from 2004 through 2010, Steller sea lion pup production increased in Area 541 at a non-significant rate (RCA 4: 2.56% (95% CI:-0.15, 5.39); RCA 5: 0.45 (95% CI: -1.48, 2.48) from 2000 through 2011 and non-pups increased at a non-significant rate (RCA 4: 0.51 (95% CI: -1.23, 2.39); RCA 5: 2.25% (0.44, 4.11)) (Fritz et al. (2013)). Because the effects of the proposed fisheries in Area 541 are expected to be similar to the fisheries from 2004 through 2010 in Area 541, a period with apparent increases in pup and non-pup abundance, NMFS does not expect the proposed fisheries to reduce the survival or recovery of the central Aleutian Islands sub-population.

Because the effects of the proposed fisheries in Areas 542 and 541 are not likely to reduce the survival or recovery of the central Aleutian Islands sub-population, it is NMFS's opinion, based on the best available information, that the proposed fisheries in Areas 542 and 541 are not likely to reduce the survival or recovery of the WDPS of Steller sea lions.

7.3.2 Adverse Modification Assessment

In this section we evaluate the risk to critical habitat posed by the proposed action. Specifically we evaluate whether the proposed action is reasonably expected to reduce the value of critical habitat for the conservation of the WDPS of Steller sea lions. NMFS must determine whether affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in both the near and long term considering the effects of the action, the environmental baseline, and any cumulative effects. The discussion in section 7.3.1 above is incorporated here by reference because the jeopardy analysis in this biological opinion is primarily a habitat-based assessment of effects on the WDPS.

Prey resources are the most essential feature of marine critical habitat for Steller sea lions. The status of critical habitat is best described as the status and availability of the most important prey resources contained within those areas, which include pollock, Atka mackerel, salmon, Pacific cod, Irish lord, rockfish, herring, sandlance, squid, and octopus in the western and central Aleutian Islands (see section 4.4). The exposure analysis (Figure 5-42) shows how fishery harvest may result in reduced prey resources. The rectangles in that figure depict how the fisheries may adversely modify designated critical habitat.

A worst case scenario based on the percentage of critical habitat that would be open to the fisheries shows that the Atka mackerel fishery could occur in 9% of the critical habitat in the action area, the Pacific cod trawl fishery could occur in 48% of the critical habitat in the action area, the Pacific cod non-trawl fishery could occur in 77% of the critical habitat in the action area, and the pollock fishery could occur in 34% of the critical habitat in the action area. In aggregate across each of the fisheries, the least amount of critical habitat area would be open to the fisheries in Area 543, followed by Area 542, with the highest amount of critical habitat open to the fisheries in Area 541 (see section 5.3.3.1).

The proposed Aleutian Islands Pacific cod fisheries are projected to be substantially reduced relative to historic harvests due to the split in the BS and AI TAC (see section 5.4.7). Given the large reductions in anticipated Pacific cod harvests combined with the historic spatial distribution of the fishery (see sections 5.3.7.2 and 5.4.7), it is NMFS's opinion that the Pacific cod fisheries will not reduce the conservation value of critical habitat, despite the fact that almost all of critical habitat (except 0-3 nm from rookeries) would be open to the non-trawl fishery and 48% of critical habitat would be open to the trawl fisheries.

It is our biological opinion that the proposed Atka mackerel fisheries will not reduce the conservation value of critical habitat for three reasons. First, the seasonal and critical habitat catch limits in Area 543 combined with the historic fishing patterns (which are expected to reflect fishing patterns under the proposed action) indicate that a small percentage of the Area 543 catch is likely to be taken from a small fraction of critical habitat. These harvests are likely to be temporally dispersed relative to fishing patterns before 2007. Second, the proposed Atka mackerel fishery in Area 542 would be closed in areas inferred to have low initial biomass and open in areas where local depletion of Atka mackerel is unlikely based on results of the FIT studies (see section 5.4.2). Third, the proposed Atka mackerel fishery inside critical habitat in Area 541 is limited to a small patch outside of 12 nm to the southeast of Seguam Island—a designated rookery that is also used as a haulout year-round. The FIT research indicates high biomass of Atka mackerel in this area and a small amount of Atka mackerel movement from inside to outside the trawl exclusion zone. This Atka mackerel fishery that would be allowed inside 3% of the Area 541 critical habitat is not expected to reduce the conservation value of critical habitat in Area 541.

NMFS has less information about the initial biomass distribution and abundance of pollock in the winter in the Aleutian Islands and expects the fisheries to operate in a temporally and spatially compressed manner. At worst, the pollock fishery may affect 5% of the critical habitat in Area 543, and this effect is expected to last for about a week due to the harvest rate of trawl gear and the expected rate of replenishment of pollock (see section 5.4.8). Given the low anticipated depth overlap between sea lions and the pollock fishery in Area 543, it is possible that sea lions and the fishery may target different pollock sub-populations in this area though more information is needed to increase the certainty about this potential separation. It is NMFS's opinion that the short-term, localized removal of 5% of the Aleutian Islands pollock ABC in 5% of the Area 543 critical habitat will not reduce the conservation value of critical habitat.

As discussed in the jeopardy analysis, the pollock fishery may cause depletions in pollock in a few localized areas of critical habitat in Areas 542 and 541, though this is expected to be a worst case scenario. Because we do not have initial biomass estimates for pollock in winter, it is unknown if the pollock fishery will create local depletions on a short-term scale (hours to days) that is important to foraging sea lions, but the fishery is unlikely to create depletions on a long-term scale (weeks to months). Given the low biomass of pollock relative to other groundfish in the central Aleutian Islands and the numerous layers of harvest constraints for the Aleutian Islands pollock fishery, it is NMFS's opinion that the Area 542 and 541 pollock fishery is not likely harvest sufficient quantities of fish at a sufficient rate to reduce the conservation value of designated critical habitat in the central Aleutian Islands.

Because the proposed fisheries are not likely to reduce the conservation value of critical habitat in the western or central Aleutian-Islands sub-regions, NMFS concludes that the proposed fisheries are not likely to reduce the conservation value of designated critical habitat for the WDPS of Steller sea lions.

7.4 Conclusions

The analyses in the preceding sections of this biological opinion form the basis for conclusions as to whether NMFS has insured that the proposed Aleutian Islands Atka mackerel, Pacific cod, and pollock fisheries are not likely to jeopardize the continued existence of the WDPS of Steller sea lions or adversely modify critical habitat.

After reviewing the current status of the endangered WDPS of Steller sea lions, the environmental baseline for the action area, the proposed action for the Aleutian Islands Atka mackerel, Pacific cod, and pollock fisheries, and the cumulative effects, it is NMFS's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the WDPS of Steller sea lions.

After reviewing the current status of the endangered WDPS of Steller sea lions, the environmental baseline for the action area, the proposed action for the Aleutian Islands Atka mackerel, Pacific cod, and pollock fisheries, and the cumulative effects, it is NMFS's biological opinion that the action, as proposed, is not likely to destroy or adversely modify designated critical habitat.

8 INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by NMFS so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. NMFS has a continuing duty to regulate the activity covered by this incidental take statement. If NMFS (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, NMFS must report the progress of the action and its impacts on the species as specified in the incidental take statement (50 CFR §402.14(i)(3)).

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

A marine mammal species or population stock that is listed as threatened or endangered under the ESA is, by definition, also considered depleted under the Marine Mammal Protection Act (MMPA). The ESA allows takings of threatened and endangered marine mammals only if authorized by section 101(a)(5) of the MMPA. Before incidental take of listed marine mammals may be exempt from the taking prohibition of ESA section 9(a), incidental taking must be authorized under section 101(a)(5)(E) of the MMPA, otherwise known as a "negligible impact determination" (NID).

On December 29, 2010, NMFS issued a final NID and published a notice of issuance of an MMPA permit authorizing the incidental take of marine mammals by the Alaska groundfish fisheries (75 FR 81972). The authorization was based on a determination that the fisheries will have a negligible impact on marine mammals stocks, that recovery plans have been developed for listed species, that a monitoring program has been established, and that vessels in the fisheries are registered.

Amount or Extent of Incidental Take

In the FMP Biological Opinion NMFS determined that direct take of WDPS Steller sea lions is reasonably likely to occur in both the Federal and Alaska State managed parallel fisheries for pollock, Pacific cod, Atka mackerel, and flatfish (NMFS 2010). The 2012 Marine Mammal Stock Assessment Report (Allen and Angliss 2013) estimates that approximately 14 individuals from the WDPS of Steller sea lions are killed annually incidental to commercial groundfish fisheries in the Bering Sea and Aleutians Islands (BSAI). For example, less than 1 sea lion per year is estimated to be taken in the BSAI Atka mackerel trawl fishery (point estimate = 0.25, CV = 0.23); more than 6 sea lions per year are estimated to be taken incidental to the BSAI flatfish trawl fishery (point estimate = 6.14, CV = 0.07); less than 2 sea lions per year are estimated to be taken incidental to the BSAI Pacific cod trawl fishery (point estimate = 1.32, CV = 0.29); more than 6 sea lions per year are estimated to be taken incidental to the BSAI pollock trawl fishery (point estimate = 6.16, CV = 0.11); and no sea lions are estimated to be taken incidental to the BSAI Pacific cod hook-and-line fishery (point estimate = 14, CV = 0.67) (Allen and Angliss 2013). These are minimum estimates as they are based on observed takes and fisheries are observed at a rate of less than 1.0. The Council, working with industry, has made extensive efforts to reduce the amount of direct take of Steller sea lions to the extent practicable, and therefore NMFS expects similar direct take levels to continue. The scope of this incidental take statement extends to the parallel fisheries authorized by the State of Alaska in accordance with the requirements contained below.

NMFS determined that specifying a take limit over a period of three consecutive years is warranted based on demonstrated interannual variability in the rate of interactions between the fisheries and sea lions and because the best available empirical data on the extent of annual take have been used in estimating expected levels of incidental take. Over a period of three consecutive years, the likelihood of the fishery exceeding the specified level of take on an average annual basis is extremely low. In contrast, if incidental take levels were specified on an annual basis without averaging, the likelihood that the level of interactions occurring in the fishery in a given year could exceed the levels specified in the paragraph above is higher. NMFS expects interaction levels to hover around the annual levels listed above and not to exceed the values in the table below over a period corresponding to three consecutive fishing years.

NMFS SFD should evaluate take levels following the 2015 fishery based on the sum of the estimated serious injuries and mortalities incidental to the 2013, 2014, and 2015 fisheries. This level should be reevaluated following the 2016 fishery based on the sum of the 2014, 2015, and 2016 direct takes, and so on. If during the course of the fisheries, the level of take specified in the table below is exceeded, SFD must immediately reinitiate formal consultation pursuant to Criterion 2 of the section 7 regulations (50 CFR 402.16 (a)).

Population/Stock	Incidental Take (Serious Injury or Mortality)
Western DPS of Steller sea lions	42

The number of sea lions expected to be captured or killed in the groundfish fisheries off Alaska over a period of three consecutive years. Calculated by rounding-up the estimated annual incidental serious injury or mortality for each stock to the nearest integer and multiplying by three.

Effect of the Take

Incidental serious injury and mortality refers only to direct mortality and serious injury, such as from entanglement or hooking by fishing gear, and does not include indirect effects through competition for resources. Levels of direct take expected to occur incidental to the BSAI groundfish fisheries are not likely to jeopardize the continued existence of the WDPS of Steller sea lions.

Reasonable and Prudent Measure

The following Reasonable and Prudent Measure is necessary and appropriate to minimize the impact of incidental take of western DPS Steller sea lions. In order for any incidental takes to be exempt from the prohibitions of section 9 of the ESA, NMFS SFD must comply with the associated terms and conditions below, which implement the Reasonable and Prudent Measure.

1. NMFS will monitor the take of ESA-listed marine mammals in the BSAI groundfish fisheries.

Associated Terms and Conditions

1. NMFS-trained observers will be deployed on vessels in these fisheries per the North Pacific Groundfish Observer Program's Annual Deployment Plan.

2. NMFS will use observer data to estimate the minimum mean annual mortality for each fishery.

3. NMFS will evaluate the observer coverage to determine if changes in coverage are warranted to better assess take of listed marine mammals.

9 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS has determined that the following conservation recommendations should be implemented by the appropriate entities in order to facilitate the recovery of listed Steller sea lion populations. In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

1. NMFS PRD recommends dispersing the commercial Atka mackerel, Pacific cod, and pollock catch in time and space and limiting harvest inside critical habitat in winter until we have a better understanding of sea lion foraging distribution and local biomass and exploitation rates.

2. Assess nutritional stress in the WDPS. Design studies and collect data to confirm or reject chronic nutritional stress (e.g., body condition and individual growth rates).

3. Continue to conduct FIT research to understand areas of high potential for localized depletion of Steller sea lion prey by fisheries.

4. Collect pollock, Pacific cod, and Atka mackerel biomass information inside and outside of critical habitat and in winter in addition to summer.

5. To extent practicable, standardize telemetry methods and establish clear objectives for telemetry work. Produce a technical memorandum that provides a compendium of available telemetry data across the WDPS and synthesizes what is known based on all available data and limitations of the data. Collect telemetry information on additional adult females and juveniles in winter and summer to achieve an effective sample size.

6. Commission another review by the National Research Council to evaluate the available information on the decline of the WDPS of Steller sea lions and update conclusions relative to the 2003 review based on new information.

10 REINITIATION NOTICE

This concludes formal consultation on the proposed modification of the federal groundfish fisheries and State of Alaska parallel groundfish fisheries for Atka mackerel, Pacific cod, and pollock primarily in the Aleutian Islands subarea and the proposed research to better understand the potential effects of these fisheries on Steller sea lions and on the efficacy of conserving prey in areas closed to fishing. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of the incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

For example, reinitiation of formal consultation may be required if the Aleutian Islands Pacific cod harvest is concentrated in Areas 542 or 543 under the proposed action. The information available for this consultation indicates that the Aleutian Islands Pacific cod fishery will likely occur primarily in Area 541. Concentration of Pacific cod fishing effort in Area 542 or 543 would constitute new information that may result in effects to the WDPS of Steller sea lions or critical habitat in a manner or to an extent not considered in this biological opinion.

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APPENDIX I

Appendix I: Catch-In-Areas TRENDS database

The Trends database was developed to provide NMFS analysts with consistent spatial data on groundfish harvests from 1992 to 2013. The spatial resolution of Trends is approximately 7.5 km, the same spatial resolution as the Catch-In-Areas production database.

The Trends database is based on two existing databases: the Blend, a processor-based database covering the years from 1992 to 2002; and the Catch Accounting database, a similar but more detailed database that covers the years from 2003 to the present. The Blend catalogs data on harvests by date of haul and week-ending date and identifies the processer, target species, weight of catch, species retained, species discarded, harvest sector, gear, and NMFS reporting area. The Catch Accounting database adds to these categories data on specific vessels (catcher vessels and catcher-processors) while retaining statistics on the processors. The Blend and Catch Accounting databases have the spatial resolution of a NMFS Reporting Area.

To increase the spatial resolution to 7.5 km, we used a combination of data from the Observer Program and from Alaska Department of Fish and Game Fish Tickets. Earlier attempts to increase the spatial resolution met with limited success, as many of the fishing areas for the smaller catcher vessels were not captured by observer data alone. This limitation occurs for two reasons: first, vessels less than 60 feet are not observed; and second, the larger, observed vessels frequently use trawl gear and are therefore restricted from areas where the smaller vessel fishing fleets fish with hook-and-line, pot, and jig gear.

To capture both the observed and unobserved fleets, we used Fish Ticket and Observer datasets made available by AKFIN along with their respective user guides.

Observer Data

About the dataset: The dataset includes observer locations of fishing recorded by latitude and longitude along with species caught, target fisheries, data and time, harvest sector, processor id, gear type and more.

The observer data was processed by a geographic information system using the deploy location (when available) and the retrieve location. These latitude and longitude points were connected via a line and then intersected (overlaid) onto the Catch-In-Area's grid ID polygons. This line-to-polygon overlay operation assigned the grid-IDs to the observed catch locations.

If a single grid-ID was assigned to a line during the overlay operation, the percent-in-grid is 1. If more than one grid-ID was assigned in the overlay operation, the database calculated the percent of the line in each grid-ID based on line length in each of the grid-iIDs; if one grid-ID holds ¼ of the total line length and another ¾, the percentages of catch associated with the grid-IDs were respectively .25 and .75.

Integrating ADF&G Fish Ticket Data and Essential Fish Habitat (EFH) Data

Essential Fish Habitat (EFH) data.

About the dataset: Essential Fish Habitats (EFH) are species-related areas that were identified as EFH in the 2006 EFH EIS. Trends selected the EFH of each of these species and related the EFH species to a respective target fishery. For instance Pacific cod EFH was related to the Pacific cod target fishery. Since observer and survey data were heavily relied upon when building the EFH areas, Trends appends the state statistical inside waters to EFH. Note that these inside waters state statistical areas were only selected when the fish ticket references that statistical area.

ADF&G Fish Ticket data

About the dataset: Data includes Alaska Department of Fish and Game Fish Tickets by state statistical areas from 1992 to 2013. Two subsets of fish ticket data were created due to a State Statistical Area change in 2001; one set of fish ticket data was created for 1992 – 2000 and another set for 2001 to 2013. Data has similar variables to the observer data such as vessel id, target fishery, gear, harvest sector, and date period but instead of reporting a latitude and longitude, only state statistical areas are reported. A state statistical area is one degree in longitude and ½ degree in latitude – an area approximately 30x33 nautical miles wide. Approximately sixty-four grid ids fit inside one outside waters state statistical area.

To prepare the fish ticket data for Trends, we selected the grid-IDs by state statistical area by each of the target fisheries. We then sub-selected the grid-ids but only when they overlapped Essential Fish Habitat for the specified target-species. This process created a database by target fishery when 1) a fish ticket's state statistical area was listed; and 2) the grid-IDs overlaps the EFH target-species as indicated on the fish ticket.

In order to apply the catch from the fish ticket grid-IDs (with the sub-selection for EFH as identified above), we programmatically counted the number of grid-IDs selected by each state statistical area and created a divisor. If eight grid-IDs were selected for a given state statistical area, then 1/8 of the catch was apportioned to each of the grid-ids in that state statistical area. If all 64 grid-IDs were selected for a given state statistical area, then 1/64 was applied to each of the 64 grid-IDs in that state statistical area.

Matching to the Blend-CA using Observer and Fish Ticket data.

Data was matched to the Blend-CA by in an iterative manner. Data was grouped by set of variables such as vessel id, week, target, NMFS reporting area, and gear type. When the variables match, exactly, between the Blend-CA and the Observer or Fish Ticket data, the grid-IDs are applied for those records. Not all the data was matched in first set of groupings. In fact, thirty-two sets of groupings were made to match all the data; with each iteration a slightly more granular set of grouping variables were applied. When data is matched, it no longer is a candidate for matching within the Blend-CA. Each iterative step was cataloged and annotated in a metadata column that resides in the final table.

Matching data by Observer data when source is observed

The first sets of grouping variables used to match the observer data to the Blend-CA data were selected when the report type in Blend-CA was observed and the haul-date, vessel-id, target, harvest sector, gear type, and reporting area match the same set of observed variables. The next grouping was slightly more granular – dropping the requirement for the actual haul-date and replacing it with week-ending-date. The next grouping is even more granular. Here the data was grouped by haul date, reporting area, target, gear type, processor-id, and harvest sector but without the vessel-id. Ever more granular groupings continue until almost the entire observer database was matched to the Blend-CA. Keep in mind that the Blend data (1992-2002) was a processor based dataset and did not include a vessel-id for catcher vessels.

Matching data by Fish Ticket Data when source is Fish Ticket

The Fish Ticket data was matched in a similar way to the observer data but instead of the source in Blend-CA having a requirement to be observed; only unobserved fish tickets were selected as the data source. The grouping variables remain nearly the same as the observer data. They are also applied in an iterative fashion with increasing granularity. The matching iterations were applied until the process was exhausted and no more group matching could be made.

Matching data by Observer data

The final step matched the last of the unmatched catch in the Blend-CA by a series of extrapolations using only the observer data. This was handled in the same way as observer and fish ticket data but without a restriction on the source of the data in Blend-CA. This final step accounts for the unobserved catcher-processors.

Testing TRENDS

The testing procedure was a design element of Trends from its inception. Testing was implemented by consistently running the Trends database creation procedures from 1992 – 2013, even though our production Catch-In-Areas database already provided us with peer reviewed data from 2003 to present. Producing this comprehensive Trends database through 2013 provided us with an entire decade of overlapping catch. This overlap was an excellent comparative testing platform. Further, Trends, like the production Catch-In-Ares, incorporates an embedded metadata column that specifies what step (1-32) was used to capture the data.

The final testing procedure involved querying both Trends and the production Catch-In-Areas datasets by the same set variables such as date, target fishery, gear type, harvest sector, reporting area, inside and outside state waters, steller sea lion zone at 0-3nm, 3-10nm, 10-20nm, outside of Critical Habitat by the sum of catch. The tables below provide a summary of those testing results for the Aleutian Islands sub area. In short the Trends database closely matches the production Catch-In-Area database and accounts for the catch in the Blend and Catch Accounting.

Aleutians Islands ALL Groundfish Fisheries: Average 2004-2012

Trends Tons	**Catch In Areas Tons**	**Steller Zone**	Difference	% of Total
611	521	0-3	-15%	0.45%
39,689	40,933	10-20nm	3%	35.49%
15,625	14,835	3-10nm	-5%	12.86%
57,709	58,484	OutsideCH	1%	50.70%
934	579	Sequam	-38%	0.50%
114,568	**115,352**	**Total**	1%	100.00%

Aleutians Islands Atka Mackerel Fishery: Average 2004-2012

Trends Tons	**Catch In Areas Tons**	**Steller Zone**	Difference	% of Total
13	2	0-3	-87%	0.00%
19,195	19,205	10-20nm	0%	28.69%
816	658	3-10nm	-19%	0.98%
46,759	46,936	OutsideCH	0%	70.12%
154	137	Sequam	-11%	0.21%
66,937	**66,937**	**Total**	0%	100.00%

Aleutians Islands Pacific Cod Fishery - ALL Gear Types: Average 2004-2012

Trends Tons	**Catch In Areas Tons**	**Steller Zone**	Difference	% of Total
409	289	0-3	-29%	1.12%
12,031	12,719	10-20nm	6%	49.19%
8,426	8,433	3-10nm	0%	32.62%
3,973	4,403	OutsideCH	11%	17.03%
314	11	Sequam	-96%	0.04%
25,152	**25,856**	**Total**	3%	100.00%

Aleutians Islands Pacific Cod Fishery-HAL and Pot: Average 2004-12

Trends Tons	**Catch In Areas Tons**	**Steller Zone**	Difference	% of Total
138	225	0-3	63%	3.48%
1,842	1,784	10-20nm	-3%	27.62%
2,732	3,417	3-10nm	25%	52.91%
1,038	1,032	OutsideCH	-1%	15.98%
6	1	Sequam	-86%	0.01%
5,755	6,459	**Total**	12%	100.00%

Aleutians Islands Pacific Cod Fishery - Trawl: Average 2004-2012

Trends Tons	**Catch In Areas Tons**	**Steller Zone**	Difference	% of Total
268	63	0-3	-77%	0.32%
10,179	10,925	10-20nm	7%	56.40%
5,677	5,000	3-10nm	-12%	25.82%
2,935	3,371	OutsideCH	15%	17.40%
308	10	Sequam	-97%	0.05%
19,366	19,369	**Total**	0%	100.00%