NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL OPINION

Title:	Biological Opinion on the Environmental Protection Agency's National Coastal Condition Assessment Program Pursuant to Section 7(a)(2) of the Endangered Species Act
Consultation Conducted By:	Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
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1 INTRODUCTION

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) for threatened or endangered species (ESA-listed), or designated critical habitat that may be affected by the action that are under NMFS jurisdiction (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS concurs with that determination for species under NMFS jurisdiction, consultation concludes informally (50 C.F.R. §402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, NMFS provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If an incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures.

This opinion considers the effects of the Environmental Protection Agency's (EPA's) National Coastal Condition Assessment program (NCCA). The NCCA is a reoccurring survey that takes places every five years as part of the National Aquatic Resource Surveys (NARS). The NCCA provides a comprehensive assessment for coastal waters across the United States. Survey work is limited to June through the end of September. The manages and coordinates these surveys between EPA, states, territories, and other partners.

This consultation, biological opinion, and incidental take statement (ITS), were completed in accordance with section 7(a)(2) of the statute (16 U.S.C. 1536 (a)(2)), associated implementing regulations (50 C.F.R. §§401-16), and agency policy and guidance was conducted by NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division (hereafter referred to as "we"). This biological opinion (opinion) and ITS were prepared by NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 C.F.R. §402.

This document represents the NMFS opinion on the effects of these actions on ESA-listed species and designated critical habitat. A complete record of this consultation is on file at NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The NCCA provides a comprehensive assessment for coastal waters across the United States. The NCCA is a reoccurring survey that takes places every five years as part of the NARS. The NARS program also includes rivers and streams, lakes and wetland condition surveys, which are undergoing separate analysis. The 2020 survey represents the third NCCA since the inception of NARS.

The NCCA collects a variety of physical, chemical and biological measurements and samples from preselected sampling sites that are located at predetermined coordinates. As a probability-based survey of United States (US) coastal and estuarine waters. The NCCA is designed to 1) assess the conditions of the US's estuarine and nearshore Great Lake waters at national and regional scales; 2) identify the relative importance of selected stressors to coastal and estuarine water quality; 3) evaluate changes in condition from previous coastal assessments starting in 2005; and 4) help build State and Tribal capacity for monitoring and assessment and promote collaboration across jurisdictional boundaries.

The national and regional estimates of condition in the NCCA reports offer coastal managers insight on how well coastal conservation efforts may be working to protect and restore water quality and biological communities. The information can contribute to decisions on how to focus resources in the future. Coastal managers can use the information from NCCA to evaluate current restoration and protection efforts, place site-specific data into a broader context, and initiate additional exploration and research into why certain patterns or changes exist. Already, States and others are using NCCA data and results to plan coastal management actions, supplement their existing coastal water monitoring programs and address Clean Water Act reporting requirements. Researchers have used these data in a variety of ways, such as analyzing how benthic communities are changing along the Atlantic coast and developing tools to quantify the benefits from living in healthy coastal communities.

The NCCA is ultimately guided by four primary aspects: project 1) management, 2) design, 3) methods, and 4) standards. These are described in the Field Operations Manual (FOM). The FOM contains detailed instructions for the field sampling methods including: water chemistry and hydrographic profile (grabs and in situ measurements); benthic macroinvertebrates; sediment contaminants; toxicity and composition; fish tissue; pathogens; microcystin; and general site assessments. These methods are based on the guidelines developed and followed in the Coastal 2000 and National Coastal Assessment Monitoring and Assessment Program (EPA 2001). Several ESA related revisions were added to the NCCA 2020 FOM to define the appropriate actions when listed species are encountered in the field, increase crew awareness of listed species, and minimize potential impacts to listed species and their critical habitat.

1.2 Consultation History

The following dates are important to the history of the current consultation:

- On July 3, 2019, EPA contacted NMFS to begin pre-consultation and technical assistance for the NCCA program.

- On August 2, 2019, NMFS and EPA worked together to data sources for threatened and endangered species that may be present in the sampling areas of the NCCA.
- On October 22, 2019, EPA provided NMFS and US Fish and Wildlife Service (USFWS) with a draft of the proposed action section of the draft biological evaluation.
- On December 12, 2019, EPA provided a draft species list with request for species information. NMFS provided that information on January 6, 2020.
- On February 7, 2020, EPA provided a final draft biological evaluation to NMFS and USFWS.
- NMFS provided comments on February 26, 2020.
- On March 3, 2020, EPA requested formal consultation on the NCCA program. The same day, NMFS initiated consultation.
- On April 30, 2020, EPA and NMFS agreed to include smalltooth sawfish and hawksbill sea turtles as species in the action area, given the proposed research in Florida, but outside of their critical habitat designations.

2 THE ASSESSMENT FRAMEWORK

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species; or adversely modify or destroy their designated critical habitat.

"Jeopardize the continued existence of" 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 an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 C.F.R. §402.02).

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat as a whole for the conservation of an ESA-listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 C.F.R. §402.02).

An ESA section 7 assessment involves the following steps:

Description of the Proposed Action (Section 3), *Stressors Associated with the Action* (Section 12), and *Action Area* (Section 5): We describe the proposed action, identify any consequences of the action, and describe the action area with the spatial extent of those stressors.

Status of Endangered Species Act Protected Resources (Section 6): We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time and evaluate the status of those species and habitat. In this Section, we also identify those *Species and Designated Critical Habitat Not Likely to be Adversely Affected* (Section 6.1), and those *Species and Designated Critical Habitat Likely to be Adversely Affected* (Section 6.2).

Environmental Baseline (Section 7): We describe the environmental baseline in the action area as the condition of the ESA-listed species or designated critical habitat prior to considering the consequences to the listed species or critical habitats caused by the proposed action such that this section includes: past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of all proposed Federal projects that have already undergone formal or early section 7 consultation; and impacts of state or private actions that are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

To comply with our obligation to use the best scientific and commercial data available, we collected information identified through searches of google scholar, web of science, literature cited sections of peer reviewed articles, species listing documentation, and reports published by government and private entities. This opinion is based on our review and analysis of various information sources, including:

- Information submitted by the Marine Mammal and Sea Turtle Conservation Division and the applicant
- Government reports (including NMFS biological opinions and stock assessment reports)
- NOAA technical memos
- Peer-reviewed scientific literature

These resources were used to identify information relevant to the potential stressors and responses of ESA-listed species and designated critical habitat under NMFS' jurisdiction that may be affected by the proposed action to draw conclusions on risks the action may pose to the continued existence of these species and the value of designated critical habitat for the conservation of ESA-listed species.

Effects of the Action (Section 8): We identify the number, age (or life stage), and gender of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. We also consider whether the action "may affect" designated critical habitat. This is our exposure analysis. We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. We also consider how the action may affect designated critical habitat. This is our response analyses. We assess the consequences of these responses of individuals that are likely to be exposed to the populations those individuals represent, and the species those populations comprise. This is our risk analysis. The adverse modification analysis considers the consequences of the proposed action on the essential habitat features and conservation value of designated critical habitat.

Cumulative Effects (Section 9): Cumulative effects are the effects to ESA-listed species and designated critical habitat of future state or private activities that are reasonably certain to occur within the action area 50 C.F.R. §402.02. Effects from future Federal actions that are unrelated to the proposed action are not considered because they require separate ESA section 7 compliance.

Integration and Synthesis (Section 10): In this section, we integrate the preceding sections in the opinion to summarize the consequences to ESA-listed species and designated critical habitat under NMFS' jurisdiction.

Conclusion (Section 11); With full consideration of the status of the species and the designated critical habitat, we consider the effects of the action within the action area on populations or subpopulations and on essential habitat features when added to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

- Reduce appreciably the likelihood of survival and recovery of ESA-listed species in the wild by reducing its numbers, reproduction, or distribution, and state our conclusion as to whether the action is likely to jeopardize the continued existence of such species; or
- Appreciably diminish the value of designated critical habitat for the conservation of an ESA-listed species, and state our conclusion as to whether the action is likely to destroy or adversely modify designated critical habitat.

If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, then we must identify reasonable and prudent alternative(s) to the action, if any, or indicate that to the best of our knowledge there are no reasonable and prudent alternatives. See 50 C.F.R. §402.14.

In addition, we include an *Incidental Take Statement* (Section 12) that specifies the amount or extent of take anticipated, reasonable and prudent measures to minimize the impact of the take, and terms and conditions to implement the reasonable and prudent measures. ESA section 7 (b)(4); 50 C.F.R. §402.14 (i). We also provide discretionary *Conservation Recommendations* (Section 13) that may be implemented by action agency. 50 C.F.R. §402.14 (j). Finally, we identify the circumstances in which *Reinitiation of Consultation* is required (Section 14). 50 C.F.R. §402.16.

3 DESCRIPTION OF THE PROPOSED ACTION

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. The proposed action in this Opinion is EPA's NCCA program that assesses the health of U.S. estuaries every 5 years through a weighted randomized sampling design. Our analysis considers the legal framework in which the NCCA operates as well as the likely duration, intensity, and extent of impacts to threatened and endangered species that may be incidentally affected by water quality and benthic sampling in our national estuaries. The program samples coastal estuaries and rivers with salinities ranging from sea water to approximately 0.5 parts per thousand (ppt). Depths sampled range from shallow, nearshore habitat to as much as 30 m deep.

3.1 Program Framework

The discussion of programmatic framework considers the various aspects of the NCCA program. This explains the sampling anticipated in 2020 and how the NCCA program will be carried out in 2025 and beyond.

3.1.1 Legal Framework

The EPA, under Section 305(b) of the Clean Water Act is required to assess the condition of the nation's waters. The EPA carries out the National Rivers and Streams Assessment on freshwater systems and the NCCA in estuaries and the Great Lakes. Both of these programs are managed under the National Aquatic Resource Surveys program at EPA.

NCCA is conducted in partnership by the EPA (Office of Wetland Oceans and Watershed (OWOW), Office of Research and Development (ORD), and Regional offices), states, territories, and other partners. The survey coordination, project management, logistics, and quality assurance are managed by OWOW staff with contractor and ORD technical support. Field sampling is primarily conducted by State/territory field crews and EPA contractors (Great Lakes Environmental Center and associated sub-contractors). Additionally, field work associated with enhancement and intensification studies will be conducted by the EPA Regional or ORD Mid-Continent Ecology Division (Duluth, Minnesota) staff.

3.1.2 Collection Locations

The survey target population defines the aquatic habitat type and characteristics where field measurements and samples will be collected. The target population for the NCCA has the following two components.

1. Estuarine (Coastal Regions): The target population for the estuarine resources consists of all coastal waters of the conterminous United States from the head-of-salt to confluence with the ocean, including inland waterways, tidal rivers and creeks, lagoons, fjords, bays, and major embayments such as Florida Bay and Cape Cod Bay. Head-of-salt is generally defined as 0.5 parts per thousand (ppt). For the purposes of NCCA, the head-of-salt represents the landward or upstream boundaries. The seaward boundary extends out to where an imaginary straight-line intersecting two land features would fully enclose a body of coastal water (Figure 1). All waters within the enclosed area are defined as estuarine, regardless of depth or salinity.

   The estuarine target population is not defined by a maximum depth; however, the maximum depth that can be sampled is limited by the length of the sample cables. Most crews carry cables that can sample to a depth of 30 meters. The sediment dataset from previous surveys provides insight on estuarine depths that are expected to be sampled in 2020 and future surveys. In past surveys, sample depth associated with estuarine sampling ranged from less than 1 meter to 100 meters, with a median depth of 7.0 m in the northeast region, 2.9 m in the southeast region, 2.5 m in the Gulf of Mexico region, 4.4 m on the west coast. Sampling locations with a depth greater than 30 m were associated with Puget Sound, Long Island Sound, and a few bays in Maine. Of 699 sites sampled in estuaries, 34 were at locations with a depth greater than 30 m. Sixteen were within Puget Sound, 8 within Long Island/Block Island Sounds or Narragansett Bay, 9 were throughout Maine and one was in Cape Cod Bay.

2. Great Lakes Nearshore: The target population is waters within a fringing, shallow nearshore band that is heavily used by humans and most vulnerable to human

activities within adjacent coastal watersheds. More specifically, the target population is limited to waters along the shoreline buffer within 5 kilometers (km) from shore or up to 30 meters (m) in depth, whichever is reached first. The nearshore uniquely "coastal" land-water interface zone includes: open and semi-enclosed bays and embayments with greater than a 200 m wide connection to open water, and the more open waters adjacent to shorelines. It does not include the connecting channels of the Great Lakes (i.e., between the Lakes and the St. Lawrence River outlet).

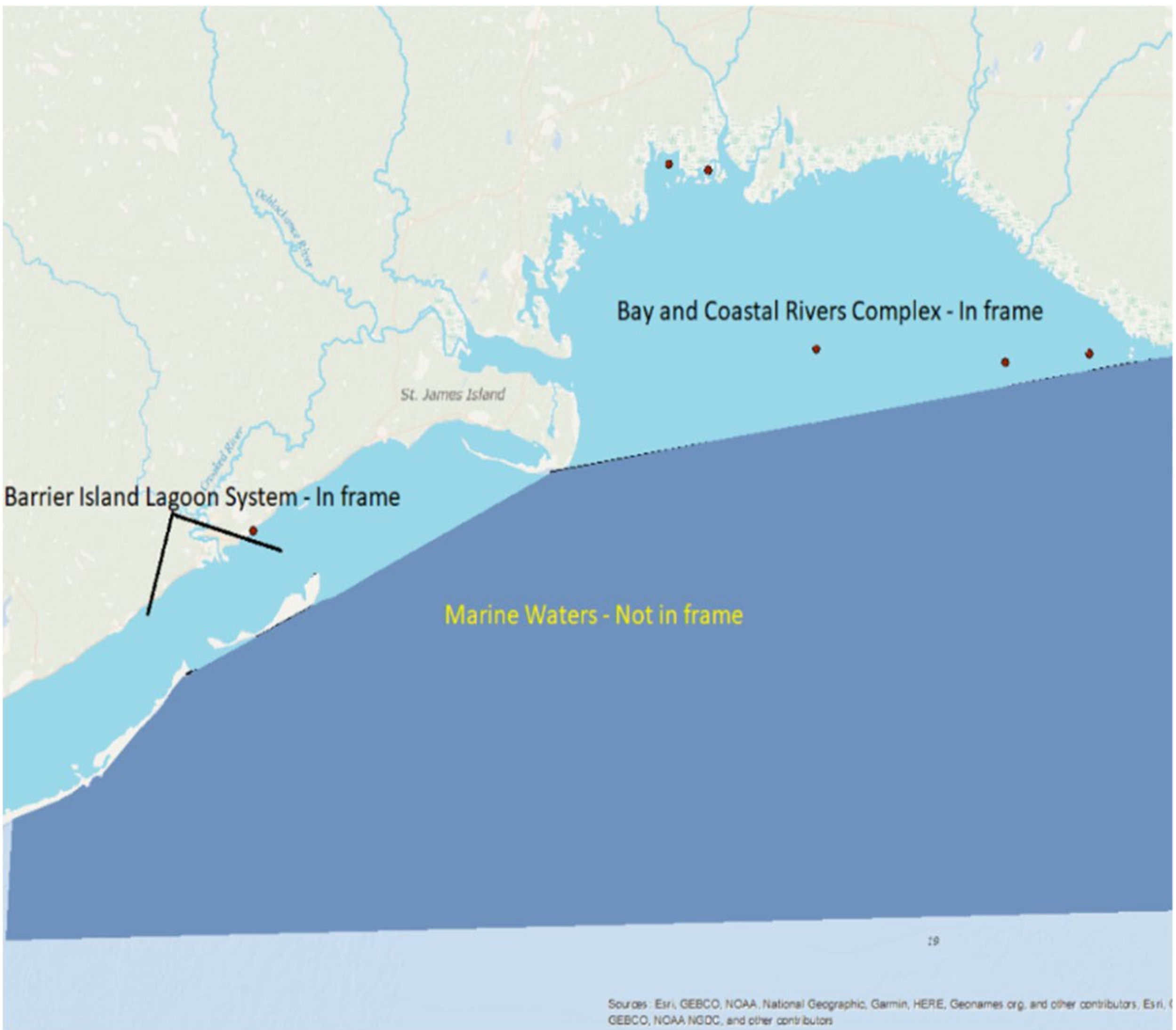


Figure 1. Examples of estuarine systems (lighter blue area, in frame) and nearshore or offshore marine waters (dark blue area, not in frame). Figures obtained from the NCCA 2020 biological evaluation.

The EPA Design Team (as described in the final biological evaluation as part of the initiation package) gives each site a unique identifier which identifies it throughout the pre-field, field, lab, analysis, and data management phases of the project. The EPA Project Lead distributes the list of sampling locations to the EPA Regional Coordinators, states, and tribes. With the sampling location list, state and tribal field crews can begin site reconnaissance on the primary sites and alternate replacement sites and begin work on obtaining access permission to each site. EPA provides specific procedures for evaluating each sampling location and for replacing non-sampleable sites. Each crew is responsible for procuring, as needed, scientific collecting permits from State/Tribal and Federal agencies, and if necessary, permission from landowners. The field teams will use standard field equipment and supplies as identified in the Equipment and Supplies List (Appendix A of the FOM). Field crews will work with Field Logistics Coordinators to coordinate equipment and supply requests. This helps to ensure comparability of protocols across all crews. EPA has documented detailed lists of equipment required for each field protocol, as well as guidance on equipment inspection and maintenance, in the FOM.

The site verification process is shown in Figure 2. Upon arrival at a site, crews verify the location by a Global Positioning System receiver, landmark references, and/or local residents. Crews collect samples and measurements for various parameters in a specified order (See the FOM). This order has been set up to minimize the impact of sampling for one parameter upon subsequent parameters. All methods are fully documented in step-by-step procedures in the NCCA FOM. The manual also contains detailed instructions for completing documentation, labeling samples, any field processing requirements, and sample storage and shipping. Field communications will be through Field Logistics Coordinator and may involve regularly scheduled conference calls or contacts.

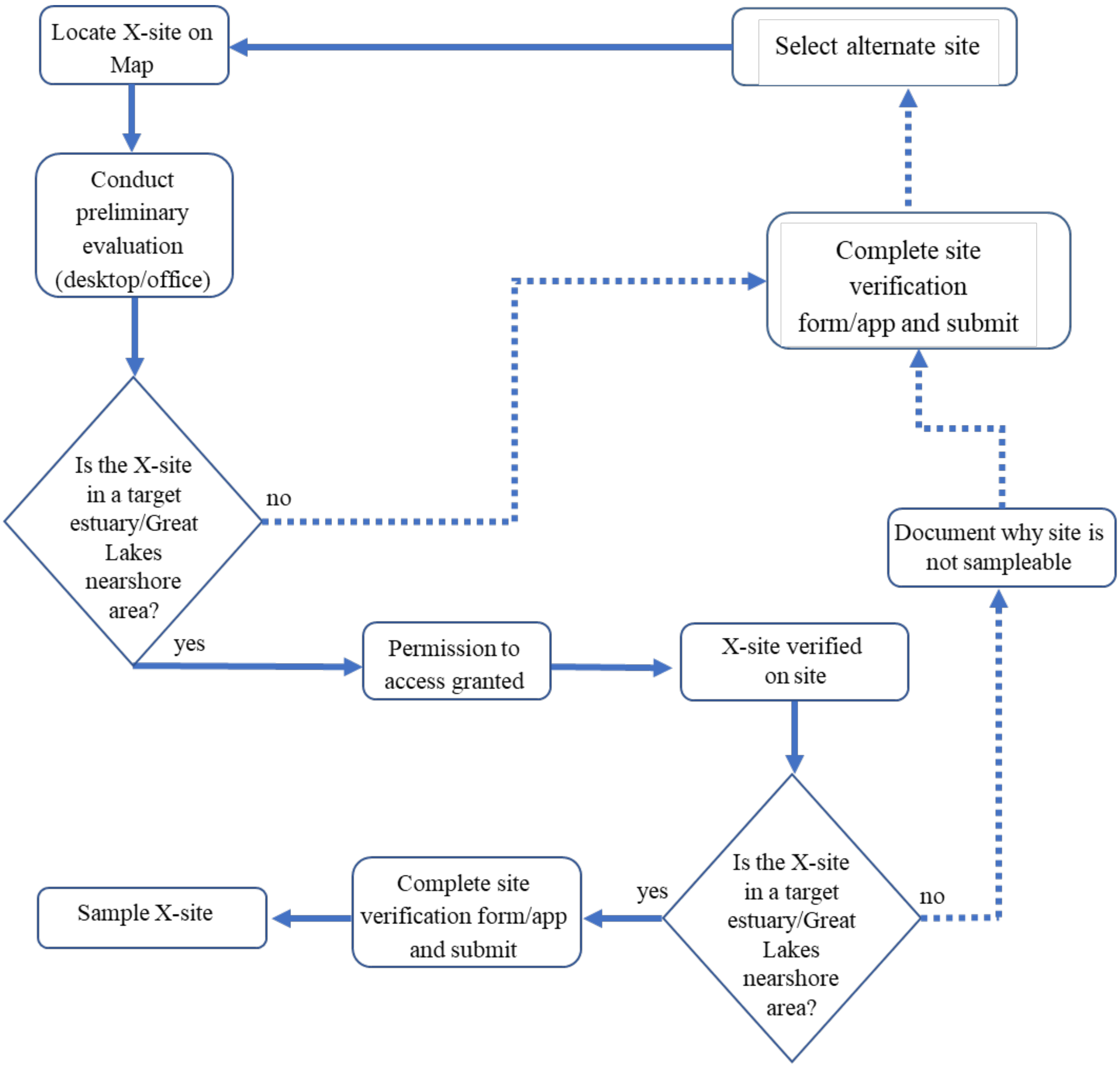


Figure 2. Decision matrix for site selection and alternative site selection in the NCCA program.

3.1.2.1 Site Selection

The EPA field crew activities that will apply to the action area for NCCA 2020 include sampling in all five Great Lakes (New York, Illinois, Indiana, Michigan, Wisconsin; 326 base sites and 39 oversample sites) and estuarine sampling associated with Rhode Island, Massachusetts, New York, Louisiana, Mississippi, California and Washington (348 base sites and 43 oversample sites located in the New England/Mid-Atlantic, Southeast, and West Coast NOAA Fisheries regions). The coordinates of the base sampling sites, a reasonable number of the oversample sites (discussed below), and the maximum potential area of disturbance associated with the sampling protocols (Great Lakes = 1,500 m radius; Estuarine = 1,000 m radius) were used to determine adequate sampling saturation. To determine an appropriate number of oversample sites, the EPA reviewed base and oversample sites that were sampled in the 2015 survey. In 2015, 1060 sites were sampled and 86 of these, or 8%, were oversample sites. The number of oversample sites ranged from 0-6 per stratum, with a mean of 2. The stratum with 6 replacements was in Maine and base sites were dropped due to unsafe sampling conditions. Given this replacement rate, a minimum of 2 or up to 10% of oversample sample sites were included in the species screen and addressed in the action area. Although the oversample sites were included in the screening, the total number of sites sampled in a given state will not exceed the number of base sites identified in Tables 4.1 and 4.2.

Candidate sampling locations are selected by EPA using a weighted probability-based survey design from the population of Great Lakes and estuarine resources. Using this survey design allows data from the subset of sampled sites to be applied to the larger target population, and assessments with known confidence bounds can be made. Candidate sites are GIS located, field verified, and then sampled if they meet the target population criteria. The field crews evaluate if the site meets the target population and the sampleability requirements (e.g., physically accessible, safe, landowner access). For the NCCA 2020, the EPA has a good understanding of the sites that will be sampled by the EPA field crews at the beginning of the field season because several steps of the site evaluation process are conducted in the office and the replacement rate is typically low (8% in 2015). However, sites are not verified as sampleable until they are visited by the field crew in the field (Figure 2). If a base site is not sampleable, an oversample, or alternative site within the same target population, stratum, and panel is picked to replace it in the specified order. The site evaluation and oversample selection process are important for maintaining the integrity of the study design and were considered when defining the action area for this consultation.

As shown in Figure 2 above, the x-site is the targeted coordinates selected. The area where field crews collect samples is defined by collection zones surrounding the x-site. Crews attempt to collect all water, benthos, sediment, and fish samples at the same location (the y-location), which is as close to the x-site as possible (within the 100 meter radius around the x-site). The y-location encompasses two sampling zones: the primary and secondary zones. The primary sampling zone is within 37 m of the x-site. This zone is targeted for in situ measurements of water, benthos, and sediment. The secondary zone spans from 37 to 100 m from the x-site. If circumstances require the field crew to relocate from the primary zone to acquire benthos or sediment samples, they may be collected in the secondary zone. If benthos, sediment, and/or fish are collected from the secondary zone, in situ measurements and water collections do not need to be resampled. As a last resort, the sampling protocols allow for benthic and sediment samples to be collected from a tertiary sampling zone if samples cannot be collected from the primary or secondary zones. The tertiary zone spans from 100 to 500 m from the x-site.

Secondary fish tissue collection sites may be selected up to an additional 500 m beyond the original 500 m radius at all estuarine and Great Lakes sites when crews are unsuccessful at obtaining target fish during a reasonable portion of the three hours allotted to fishing (at least 30 minutes and no more than two hours) within the original 500 m radius. For the collection of the human health fish tissue sample, crews may move out to a maximum of 1500 meters from the x-site, however this only happens on a rare basis.

3.1.3 Methods

Field measurements and samples are collected by trained teams/crews. The field crews' leaders must be trained at an EPA-sponsored training session. Ideally, all members of each field crews should attend one EPA-sponsored training session before the field season. The training program stresses hands-on practice of methods, consistency among crews, collection of high-quality data and samples, and safety. Training documentation will be maintained by the Project Quality Assurance (QA) Coordinator. Field Crew leaders will maintain records indicating that members of their team that did not attend and EPA training were properly trained to follow the NCCA protocols. Field crew leaders will provide EPA with this documentation if requested by the NCCA Project Leader or QA Coordinator. EPA or other designated personnel (e.g. contractors) will conduct field sampling assistance visits for each field crew early in the sampling season.

Field crews collect a variety of chemical, physical, and biological measurements and samples to support the NCCA objectives: in situ water column measurements, water chemistry, sediment samples, benthic macroinvertebrates, fish tissue, and general site assessment. Nearly all observations, measurements and samples are collected from a boat (in the rare event, crews may wade while seining for fish tissue or collect sediment by wading in very shallow water). Field methods reflect freshwater and saltwater matrices to account for estuarine and Great Lakes sampling.

3.1.3.1 Fish Tissue Collection

Crews collect fish for tissue samples at all NCCA sites. The NCCA FOM (EPA FOM 2020) identifies the target taxa by geographic region and indicator (i.e., ecological and human health). At all sites and for all sample types, crews are directed to never collect federally listed species for tissue samples.

Ecological fish tissue collection protocols require crews to collect at least five individuals of the target species, yielding a minimum of 300 g total mass from each site. These fish are to be collected within a 500-meter radius of the x-site (may expand to 1,000 meters if needed). Crews may collect these samples using any reasonable fish collection method that is most efficient and the best use of available time on station. Crews may use more than one method at a site if the first method is unsuccessful. The fish collection methods typically used by contracted field crew in 2015 NCCA survey included trawling, hook and line, gillnet and seining. For each attempted fish collection method, field crews record equipment details, start and stop times, and fishing location(s) as well as sample ID, species retained, and specimen lengths.

Target fish species will be collected with otter trawls, seine nets, long lines, hoop nets, gill nets, and/or hook and line. Samples will be taken within each x-site. Sampling is conducted as quickly as possible, but no longer than three hours. At least 5 individuals of the target species must be collected with a cumulative weight of at least 300 grams.

A number of mitigation measures are in place as part of the standard collection protocols that will benefit listed species (Appendix 1). Because the samples for environmental contaminants need to be processed quickly after death, all collection methods for target species are intended to be non-lethal and expected to have non-lethal consequences in the event an ESA-listed species is captured as bycatch. Furthermore, all crews will have a marine animal spotter on the boat to look for marine mammals and sea turtles visible at the surface, all vessels will be operated as “no wake” or “minimal wake” to minimize the likelihood of vessel strikes, and are required to shut down when protected species are observed in the area.

If a full composite sample is not collected after 3 hours of effort, crews may terminate the sampling, record the details of the sample, and submit as many fish as possible. If the target species are unavailable, the crews are directed to select an alternative available species (i.e., a species that is commonly present in the study area and in sufficient numbers to yield a composite) to obtain a fish composite sample. Target species for the different geographic regions are identified in Tables 1-4.

Table 1. Northeast Region primary and secondary marine target species.

Family	Scientific Name	Common Name	Target Rank
Ictaluridae	*Ameiurus catus*	White catfish	Primary
	Ictalurus punctatus	Channel catfish	Primary
Moronidae	*Morone americana*	White perch	Primary
Paralichthyidae	*Paralichthys dentatus*	Summer flounder	Primary
Pleuronectidae	*Pseudopleuronectes americanus*	Winter flounder	Primary
Sciaenidae	*Cynoscion regalis*	Gray weakfish	Primary
	Sciaenops ocellatus	Red drum	Primary
Sparidae	*Stenotomus chrysops*	Scup	Primary
Achiridae	*Trinectes maculatus*	Hogchoaker	Secondary
Anguillidae	*Anguilla rostrata*	American eel	Secondary
Atherinopsidae	*Menidia menidia*	Atlantic silverside	Secondary
Batrachoididae	*Opsanus tau*	Oyster toadfish	Secondary
Ephippidae	*Chaetodipterus faber*	Atlantic spadefish	Secondary
Moronidae	*Morone saxatilis*	Rock fish	Secondary
Mugulidae	*Mugil cephalus*	Black mullet	Secondary
Pomatomidae	*Pomatomus saltatrix*	Bluefish	Secondary
Sciaenidae	*Bairdiella chrysoura*	Silver perch	Secondary
	Menticirrhus saxatilis	Northern kingfish	Secondary
Serranidae	*Centropristis striata*	Black sea bass	Secondary
Triglidae	*Prionotus carolinus*	Northern searobin	Secondary
	Prionotus evolans	Striped searobin	Secondary

Table 2. Southeast region primary and secondary marine target species.

Family	Scientific Name	Common Name	Target Rank
Ariidae	*Ariopsis felis*	Hardhead sea catfish	Primary
	Bagre marinus	Gulftopsail sea catfish	Primary
Paralichthyidae	*Paralichthys albigutta*	Gulf flounder	Primary
	Paralichthys dentatus	Summer flounder	Primary
	Paralichthys lethostigma	Southern flounder	Primary
Sciaenidae	*Cynoscion arenarius*	Sand weakfish (or seatrout)	Primary
	Cynoscion nebulosus	Speckled trout	Primary
	Cynoscion regalis	Gray weakfish	Primary
	Leiostomus xanthurus	Spot croaker	Primary
Sparidae	*Lagodon rhomboides*	Pinfish	Primary
Cichlidae	*Tilapia mariae*	Spotted tilapia	Secondary
Haemulidae	*Haemulon aurolineatum*	Tomtate	Secondary
Sciaenidae	*Bairdiella chrysoura*	Silver perch	Secondary
	Menticirrhus americanus	Southern kingfish	Secondary
Serranidae	*Centropristis striata*	Black sea bass	Secondary

Table 3. Gulf of Mexico region primary and secondary marine target species.

Family	Scientific Name	Common Name	Target Rank
Ariidae	*Ariopsis felis*	Hardhead sea catfish	Primary
	Bagre marinus	Gafftopsail sea catfish	Primary
Paralichthyidae	*Paralichthys albigutta*	Gulf flounder	Primary
	Paralichthys dentatus	Summer flounder	Primary
	Paralichthys lethostigma	Southern flounder	Primary
Sciaenidae	*Cynoscion arenarius*	Sand weakfish (or seatrout)	Primary
	Cynoscion nebulosus	Speckled trout	Primary
	Cynoscion regalis	Gray weakfish	Primary
	Leiostomus xanthurus	Spot croaker	Primary
	Micropogonias undulatus	Atlantic croaker	Primary
	Sciaenops ocellatus	Red drum	Primary
Sparidae	*Lagodon rhomboides*	Pinfish	Primary
Carangidae	*Caranx hippos*	Crevalle jack	Secondary
	Chloroscombrus chrysurus	Atlantic bumper	Secondary

Diodontidae	*Chilomycterus schoepfii*	Burrfish	Secondary
Gerreidae	*Eucinostomus gula*	Silver jenny	Secondary
Haemulidae	*Orthopristis chrysoptera*	Pigfish	Secondary
Ictaluridae	*Ictalurus furcatus*	Blue catfish	Secondary
Lepisosteidae	*Lepisosteus oculatus*	Spotted gar	Secondary
Lutjanidae	*Lutjanus griseus*	Gray snapper	Secondary
Sciaenidae	*Pogonias cromis*	Black drum	Secondary
Serranidae	*Diplectrum formosum*	Sand perch	Secondary
Triglidae	*Prionotus scitulus*	Leopard searobin	Secondary

Table 4. Western region primary and secondary marine target species.

Family	Scientific Name	Common Name	Target Rank
Atherinopsidae	*Atherinops affinis*	Topsmelt silverside	Primary
Cottidae	*Leptocottus armatus*	Pacific staghorn sculpin	Primary
	Oligocottus rimensis	Saddleback sculpin	Primary
Cynoglossidae	*Symphurus atricaudus*	California tonguefish	Primary
Embiotocidae	*Cymatogaster aggregata*	Shiner perch	Primary
	Embiotoca lateralis	Striped seaperch	Primary
Gasterosteidae	*Gasterosteus aculeatus*	Three-spined stickleback	Primary
Paralichthyidae	*Paralichthys californicus*	California flounder	Primary
	Citharichthys sordidus	Pacific sanddab	Primary
	Citharichthys stigmaeus	Speckled sanddab	Primary
Pleuronectidae	*Isopsetta isolepis*	Butter sole	Primary
	Parophrys vetulus	English sole	Primary
	Psettichthys melanostictus	Pacific sand sole	Primary
	Platichthys stellatus	Starry flounder	Primary
Sciaenidae	*Genyonemus lineatus*	White croaker	Primary
Serranidae	*Paralabrax nebulifer*	Barred sand bass	Primary
	Paralabrax maculatofasciatus	Spotted sand bass	Primary
Batrachoididae	*Porichthys notatus*	Plainfin midshipman	Secondary

	Porichthys myriaster	Specklefin midshipman	Secondary
Embiotocidae	*Amphistichus argenteus*	Barred surfperch	Secondary
Paralichthyidae	*Xystreurys liolepis*	Fantail sole	Secondary
Pleuronectidae	*Pleuronichthys guttulatus*	Diamond turbot	Secondary
	Microstomus pacificus	Dover sole	Secondary
	Lepidopsetta bilineata	Rock sole	Secondary
	Lyopsetta exilis	Slender sole	Secondary
Sciaenidae	*Umbrina roncador*	Yellowfin croaker	Secondary

The NCCA 2020 FOM identifies that crews are expected to know and be able to identify the federally listed species and state species of concern that have the potential to occur at a given sampling site. If a listed species is encountered while sampling for fish tissue (stunned, netted, hooked, etc.), crews are expected to:

- immediately release the fish following identification in an area where it is unlikely to be captured again;
- cease sampling for five minutes to allow the fish to safely leave the area;
- evaluate whether any alternative fishing methods are less likely to encounter listed fish prior to restarting fish collection; and
- record the encounter with the listed species.

3.1.3.2 Sediment Collection

Crews collect sediments for biological (benthic macroinvertebrates), chemical, and general quality analyses. The total area of disturbance associated with a sediment grab varies with each sampler. A 1/25 (0.04) m^2, stainless steel, Young-modified Van Veen Grab (or similar) sampler is appropriate for collecting sediment samples for both biological and chemical analyses. The top of the sampler is either hinged or otherwise removable so the top 2 cm of sediment can be easily removed for chemical and toxicity sample collection. This gear is relatively easy to operate and requires little specialized training. For crews sampling in the Great Lakes, a standard Ponar grab (box size 22.9 cm x 22.9 cm with depth of 9 cm) with removable top screens should be used for collecting sediments for benthic invertebrate analysis (USEPA 2001); other sediment grab devices may be used for sediment toxicity and contaminant samples at the crew's discretion. All crews record the dimensions and sample area of the grab used since the area of sediment the grab is used in data analysis. If the grab sampler size is less than 0.03 m^2, crews will take two grabs for the benthic macroinvertebrate collections and composite the sediment into the sieve. Furthermore, in order to provide the minimum volume of sediment for all analyses (2L), crews may need to collect different numbers of grabs at different sites, based on sediment characteristics.

Sediment samples for benthic macroinvertebrates are emptied into a clean basin (plastic tub or bucket) and then into a 0.5 mm mesh sieve (1.0 mm mesh in CA, OR, WA). The sample is gently rinsed in the sieve to wash away sediments and leave organisms, detritus, sand particles, and pebbles larger than 0.5 mm or 1.0 mm, where relevant. In the rare event a species that has the potential to be federally listed is observed in the grab or the sieve (e.g., listed freshwater mussels, black or white abalone), field crews are directed to:

- gently remove the individual from the sample;
- return it to an area where is it unlikely to be sampled again as fast a possible to minimize stress to the individual;
- do not preserve individuals that have the potential to be a listed species when processing the benthic macroinvertebrate samples; and
- make notes regarding any organisms removed from the sample in the comments area.

3.1.3.3 Equipment Cleanup and Disinfection

Field crews must take appropriate precautions to avoid transfer of national and regional invasive species of concern. Nuisance species of concern in the US include zebra mussels (*Dreissena polymorpha*), mitten crabs (*Eriocheir sinensis*) and Eurasian ruffe (*Gymnocephalus ceinuus*). In the Great Lakes, Viral Hemorrhagic Septicemia is an invasive and deadly fish virus that is threatening Great Lakes fish. Viral Hemorrhagic Septicemia was identified as the cause of large fish kills in lakes Huron, St. Clair, Erie, Ontario and the St. Lawrence River in 2005 and 2006. To reduce the risk of transferring nuisance species and pathogens, all sampling equipment and gear must be cleaned and disinfected prior to traveling over land from one field site to another. Generally, field crews will perform the following steps to ensure their sampling equipment and gear do not transfer invasive species and pathogens of concern.

1. Load the boat on the trailer.
2. Drain all bilge water from the boat.
3. Inspect the boat, motor, and trailer for evidence of weeds and other macrophytes.
4. Clean the boat, motor, and trailer as completely as possible before leaving the launch site.
    - Follow any state or other requirements associated with nuisance species, pathogens and/or viruses.
5. Inspect sampling gear (seines, dip nets, sieves, foul weather gear, boots, etc.) for evidence of mud, snails, plant fragments, algae, animal remains or debris. Rinse and remove using brushes or other tools. Use one of the procedures below to disinfect gear if necessary. Let dry.

Additional precautions are needed in the Great Lakes to prevent transfer of Whirling Disease spores, New Zealand mudsnails, and amphibian chytrid fungus. Therefore, the NCCA Field Operations Manual identifies Great Lakes specific site reconnaissance and decontamination techniques. Before visiting the site, crews are to research the site, determine if it is in an area where one of these organisms are known to exist and contact the local or State fishery biologist to confirm the presence or absence of these organisms.

If the site is listed as “positive” for any of the organisms, or no information is available, crews should avoid using felt-soled wading boots. After sampling, crews are directed ot disinfect all fish and benthos sampling gear and all other equipment that came into contact with water or sediments (i.e., waders, boots, etc.) by one of the following procedures:

Option A:

1. Soak gear in a 10% household bleach solution for at least 10 minutes, or wipe or spray on a 50% household bleach solution and let stand for 5 minutes.
2. Rinse with tap water (do not use sea or lake water) and remove remaining debris.
3. Place gear in a freezer overnight, soak in a 50% solution of Formula 409® antibacterial cleaner for at least 10 minutes or soak gear in 120°F (49°C) water for at least 1 minute.
4. Dry gear in direct sunlight (at least 84 °F) for at least 4 hours.

Option B:

1. Soak gear in a solution of Sparquat® (4-6 oz. per gallon of water) for at least 10 minutes (Sparquat is especially effective at inactivating whirling disease spores).
2. Place gear in a freezer overnight or soak in 120°F (49°C) water for at least 1 min.
3. Dry gear in direct sunlight (at least 84 °F) for at least 4 hours.

Crews are direct to handle and dispose of disinfectant solutions properly and take care to avoid damage to lawns or other property.

3.1.4 Participants and Coverage (EPA, contractors – who is covered and who is under the programmatic but needs authorization)

The responsibilities and accountability of the various principals and cooperators are described here. Overall, the project will be coordinated by the Office of Water (OW) in Washington, DC, with support from EPA ORD. Specifically, OW is working with ORD’s Pacific Ecological Systems Division (PESD), the EPA Gulf Ecosystem Measurement and Modeling Division, the EPA Atlantic Coastal Environmental Sciences Division (ACESD) and the Great Lakes Toxicology and Ecology Division (GLTED). Each EPA Regional Office has identified a Regional EPA Coordinator who is part of the EPA team providing a critical link with state and tribal partners. Cooperators will work with their Regional EPA Coordinator to address any technical issues. A comprehensive QA program has been established to ensure data integrity and provide support for the reliable interpretation of the findings from this project.

Contractor support is provided for all aspects of this project. Contractors will provide support ranging from implementing the survey, sampling and laboratory processing, data management, data analysis, and report writing. Cooperators will interact with their Regional EPA Coordinator and the EPA Project Leader regarding contractual services.

The primary responsibilities of the principals and cooperators are as follows:

Project Leader

- Provides overall coordination of the project and makes decisions regarding the proper functioning of all aspects of the project.

- Makes assignments and delegates authority, as needed to other parts of the project organization.
- Leads the NCCA Steering Committee and establishes needed technical workgroups.
- Interacts with EPA Project Team on technical, logistical, and organizational issues on a regular basis.

EPA Field Logistics Coordinator

- EPA employee who functions to support implementation of the project based on technical guidance established by the EPA Project Leader and serves as point-of-contact. for questions from field crews and cooperators for all activities.
- Tracks progress of field sampling activities.

EPA Project QA Coordinator

- Provides leadership, development, and oversight of project-level quality assurance for NARS.
- Assembles and provides leadership for a NCCA 2020 Quality Team.
- Maintains official, approved Quality Assurance Project Plan.
- Maintains all training materials and documentation.
- Maintains all laboratory accreditation files.

EPA Technical Advisor

- Advises the Project Leader on the relevant experiences and technology developed within ORD that may be used in this project.
- Facilitates consultations between NCCA personnel and ORD scientists.

Laboratory Review Coordinator

- Ensures participating laboratories complete sample analysis following LOM.
- Ensures participating laboratories follow QA activities.
- Ensures data submitted within the specified timelines.
- Coordinates activities of individual lab Task Order Project Officers to ensure methods are followed and QA activities take place.

QA Assistance Visit Coordinator

- The EPA employee who will supervise the implementation of the QA audit program.
- Directs the field and laboratory audits and ensures the field and lab auditors are adequately trained to correct errors immediately to avoid erroneous data and the eventual discarding of information from the assessment.

Human Health Fish Tissue Indicator Lead

- The EPA Employee who will coordinate implementation of the human health fish tissue effort on the Great Lakes.
- Interacts with the EPA Project Leads, EPA regional coordinators, contractors and cooperators to provide information and respond to questions related to the human health fish tissue indicator.
- Responsible for lab analysis phase of the project.

Great Lakes Enhancement Coordinator

- The EPA Employee who will coordinate the embayment enhancement component of the Great Lakes NCCA.
- Interacts with the EPA Project Leads, EPA regional coordinators, contractors and cooperators to provide information and respond to questions related to embayment enhancement effort.

Information Management Coordinator

- A contractor who functions to support implementation of the project based on technical guidance established by the EPA Project Leader and Alternate EPA Project Leader.
- Under scope of the contract, oversees the NARS Information Management team.
- Oversees all sample shipments and receives data forms from the Cooperators.
- Oversees all aspects of data entry and data management for the project.

OWOW QA Officer: Bernice L. Smith, EPA Office of Water

- Functions as an independent officer overseeing all QA and quality control activities.
- Responsible for ensuring that the QA program is implemented thoroughly and adequately to document the performance of all activities.

Endangered Species Act (ESA) Lead

- Primary ESA contact for the USFWS and NMFS.
- Works with the EPA Project Lead to ensure that survey manuals and protocols include appropriate responses and reporting requirements in the event that a crew encounters federally listed species when conducting field work.
- Prepares the initiation package to support Section 7 consultations.
- Works with the survey logistics lead to implement the conservation measures, reasonable and prudent measures, and reporting requirements identified in the Biological Opinion.
- Maintains library of NCCA ESA documents.

Regional EPA Coordinators

- Assists EPA Project Leader with regional coordination activities.
- Serves on the Technical Experts Workgroup and interacts with Project Facilitator on technical, logistical, and organizational issues on a regular basis.
- Serves as primary point-of-contact for the Cooperators.

3.1.5 Collection Timing (seasons)

The NCCA is designed to be completed during the index period of June through the end of September. EPA uses an unequal probability design to select 725 estuarine sites along the coasts of the continental United States and 225 freshwater sites from the shores of the Great Lakes. Enhancement studies will occur in the Great Lakes. The enhancement studies planned for 2020 are: Green Bay/Lake Michigan enhancement, a Lake Erie Basin Special Study, and a combined National Park Service and Great Lakes Islands enhancement. Additionally, related sampling will occur on reef flat (coastal areas) of American Samoa, Guam and the Northern Mariana Islands.

3.1.6 Data Quality Objectives

It is a policy of the U.S. EPA that Data Quality Objectives (DQOs) be developed for all environmental data collection activities following the prescribed DQO Process. DQOs are qualitative and quantitative statements that clarify study objectives, define the appropriate types of data, and specify the tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions (EPA 2006B). Data quality objectives thus provide the criteria to design a sampling program within cost and resource constraints or technology limitations imposed upon a project or study. DQOs are typically expressed in terms of acceptable uncertainty (e.g., width of an uncertainty band or interval) associated with a point estimate at a desired level of statistical confidence. The DQO Process is used to establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. As a rule, performance criteria represent the full set of specifications that are needed to design a data or information collection effort such that, when implemented, generate newly-collected data that are of sufficient quality and quantity to address the project's goals. Acceptance criteria are specifications intended to evaluate the adequacy of one or more existing sources of information or data as being acceptable to support the project's intended use (EPA 2006B).

NCCA has established target DQOs for assessing the current status of selected indicators of condition for the conterminous US coastal resources as follows:

- For each indicator of condition, estimate the proportion of the nation's estuaries and combined area of the Great Lakes in degraded condition within a ± 5% margin of error and with 95% confidence.
- For each indicator of condition, estimate the proportion of regional estuarine (Northeast, Southeast, Gulf of Mexico, and West Coast) or Great Lake resources in degraded condition within a ± 15% margin of error and with 95% confidence.
- For estimates of change, the DQOs are: Estimate the proportion of the nation's estuaries and combined area of the Great Lakes (± 7%) that have changed condition classes for selected measures with 95% confidence.

4 Stressors Associated with the Action

4.1 Capture during sampling

The EPA intends to capture target species. All of the sampling gear proposed for this research could result in the incidental capture of listed species. Different gears have different levels of stress associated with the capture. Capture methods like hoop nets are very safe when set for short times because they essentially create small aquariums. They can however become dangerous if small fish are trapped in the same hoop net as larger predatory fish. Seine nets are also relatively safer than gill nets. However, sampling for this project is of short duration, meaning gill nets may remove some scales but are unlikely to kill listed species. Salmonids are more adversely affected by gill nets than acipenserids. Hook and line sampling rarely results in the capture of a sturgeon species, but could capture salmonids depending on the bait used. It is very unlikely that any of the capture methods proposed would incidentally capture marine mammals or sea turtles because of the observers and the short duration of the sampling.

4.2 Vessel interaction

Vessels interactions with abalone, fish, turtles, and mammals can be lethal. Vessels can strike fish, sea turtles, and mammals. Sea turtles and mammals breathe air and therefore can be observed near the surface. The vessels are small and have minimal draft, meaning benthic species like sturgeon are unlikely to be near vessels.

Benthic species could be subject to anchor strikes if they are in the wrong place at the wrong time. Anchors will be used to hold the vessels at the x-site. Species like abalone are less mobile and could be struck by anchors.

Vessel noise could also elicit a stress response. Small research vessels generate a minimal amount of sound, but as that sound source moves through the water, listed species are expected to detect it and respond in some way. The response may range from minimal movements to stay in the area but away from the sound source, moving towards the sound source, or leaving the area all together.

4.3 Interaction with benthic sampling gear

The proposal intends to sample benthic sediment with ponar grabs and benthic species with trawls. Ponar grabs are dropped via a metal wire to the sediment surface, where the impact triggers the jaws to shut, collecting a sediment sample. As the sediment sample is brought back to the vessel, some sediment is washed out. Between the small amount of sample that is lost on the way up and the disturbance of the benthos, some turbidity is associated with ponar samples. It is possible this turbidity disturbs benthic fish or abalone. The ponar could also be deployed over hard bottom substrate, collecting no sediment samples, and possibly landing on an abalone. Ponar grabs often collect small shells or rocks, so it is possible an abalone could be collected unintentionally.

In addition, ponars are deployed on metal wires, which will temporarily be in the water column from the vessel to the benthos. It is unlikely marine mammals or sea turtles would be affected by the wire because observers would have been watching for those species. Had a marine mammal or sea turtle been observed, sampling would have been temporarily halted until the animal left the area. Furthermore, the wire is very small and taught while deployed, making the risk of entanglement minimal. Likewise, fish may be exposed to a metal wire in their habitat, but the wire is wide enough to be visible so it can be avoided.

4.4 Introduction of Non-Native species

Operation of vessels or wearing submergible clothing in multiple water bodies poses the risk of moving species between systems. In locations where a species is introduced where it did not previously exist, a new population could be established, altering food web dynamics, interspecies competition, and resource allocation or availability. It is particularly easy to transfer species on boots or waders with felt soles (Root and O’Reilly 2012), where animals can be unknowingly moved from one location to another. The other main vector of introduction is from bilge tanks of small vessels or fouling on the hulls (Johnson et al. 2001).

Aquatic invasive species can pose a wide range of effects to listed species. It is possible some introduced species are a food resource for some species with beneficial effects. Others may be competitors, predators, or have no ecological interactions at all. The range of effects caused by invasive species can span from beneficial to catastrophic. Because of the potentially adverse effects of introducing non-native species, the EPA has established an entire document for Field Operating Procedures that details how to treat vessels, gear, and personnel from one location before moving on to the next.

5 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 C.F.R. §402.02). The proposed action is a program that in sampling iterations in the future could occur in any coastal estuary and/or river mouth from an invisible line drawn between two coastal land formations across an open area of water upstream to the freshwater/saltwater interface anywhere in the United States. The sampling design is randomly sampled every five years, but the locations to sample are weighted, increasing the likelihood of sampling some locations over others. The sampling is also divided into regions to ensure adequate coverage nationwide.

The 2020 sampling locations include 391 sites in Florida, Rhode Island, Massachusetts, New York, Louisiana, Mississippi, Washington, and California (Table 5). An additional 365 sites will be sampled in the Great Lakes. In 2015, 1146 sites were sampled in both the Great Lakes and coastal estuaries. The number of sampling locations depends on the DQOs and the anticipated variability in sample results. As more sampling years pass, the variability will be well understood and the number of samples per year will be more consistent in the future. The 2020 coastal sampling locations are shown for the Gulf Coast (Figure 3), Northeast US (Figure 4), California (Figure 5), and Washington (Figure 6).

Table 5. The 2020 planned sampling locations for the NCCA. Future sampling locations will be similar with similar frequency.

State	Base Sites	Oversample Sites	Total Site Visits (Base + Revisits)	Total Sites in Habitat for Listed Species
Rhode Island	15	4	17	19
Massachusetts	36	5	38	41
New York	27	4	29	31
NY/CT (Long Island Sound)	60	6	60	66
Florida (Pensacola and Perdido Bay)	10	--	10	10
Mississippi	17	4	19	21
Louisiana	78	8	80	84

California	51	6	53	57
Washington	54	6	56	60
Total	348	43	362	389

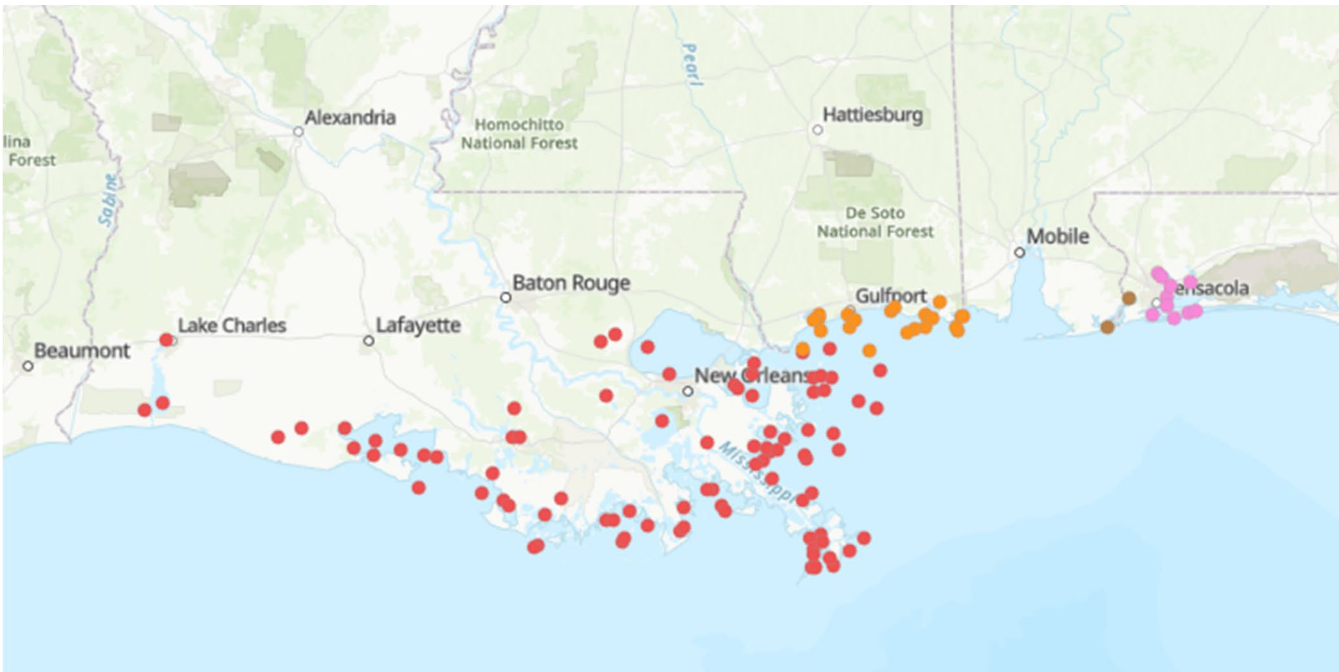


Figure 3. 2020 sampling locations along the Gulf Coast in Louisiana, Mississippi, and Florida.

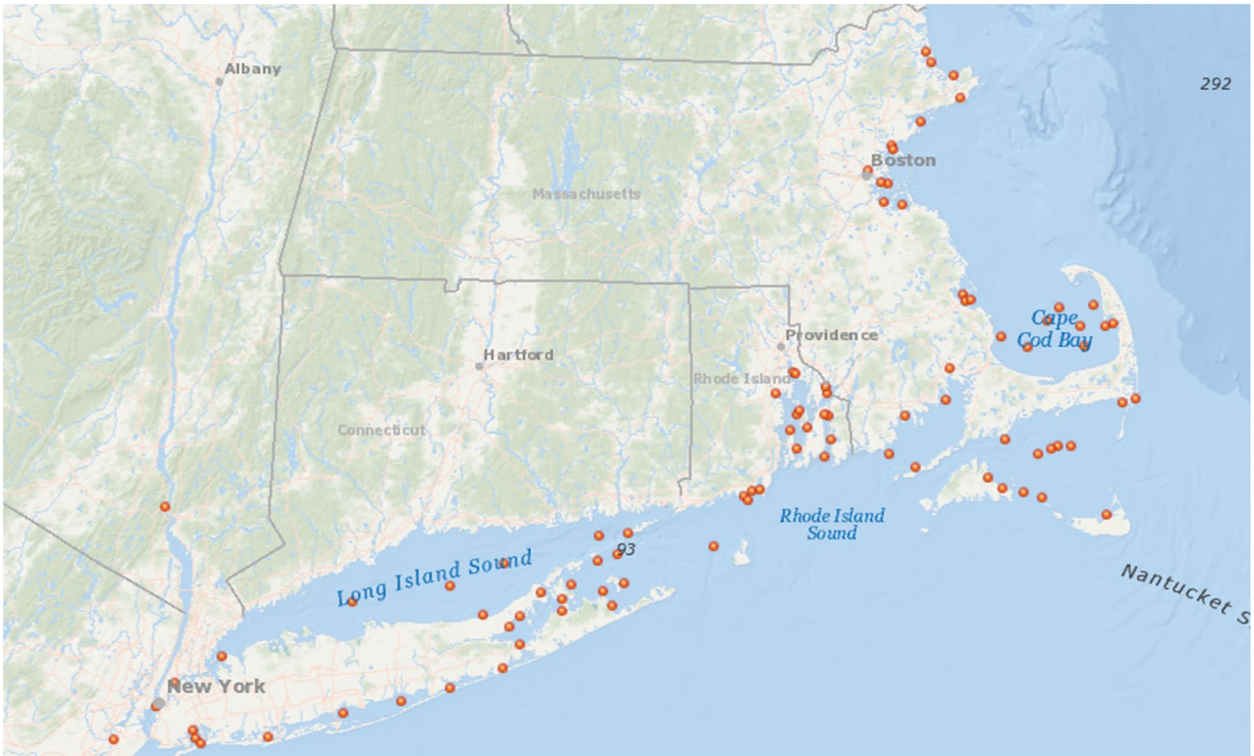


Figure 4. 2020 sampling locations in the Northeastern region in Massachusetts, Rhode Island, and Long Island Sound.

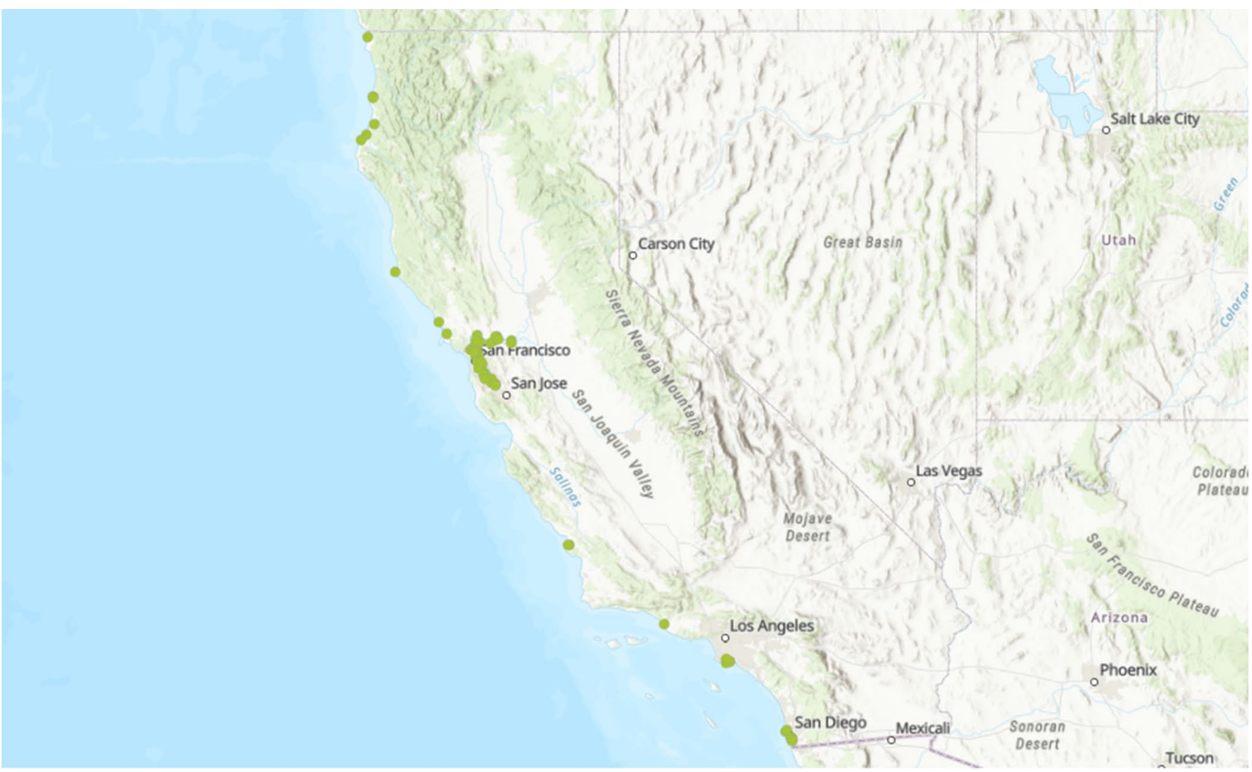


Figure 5. 2020 sampling locations in California.

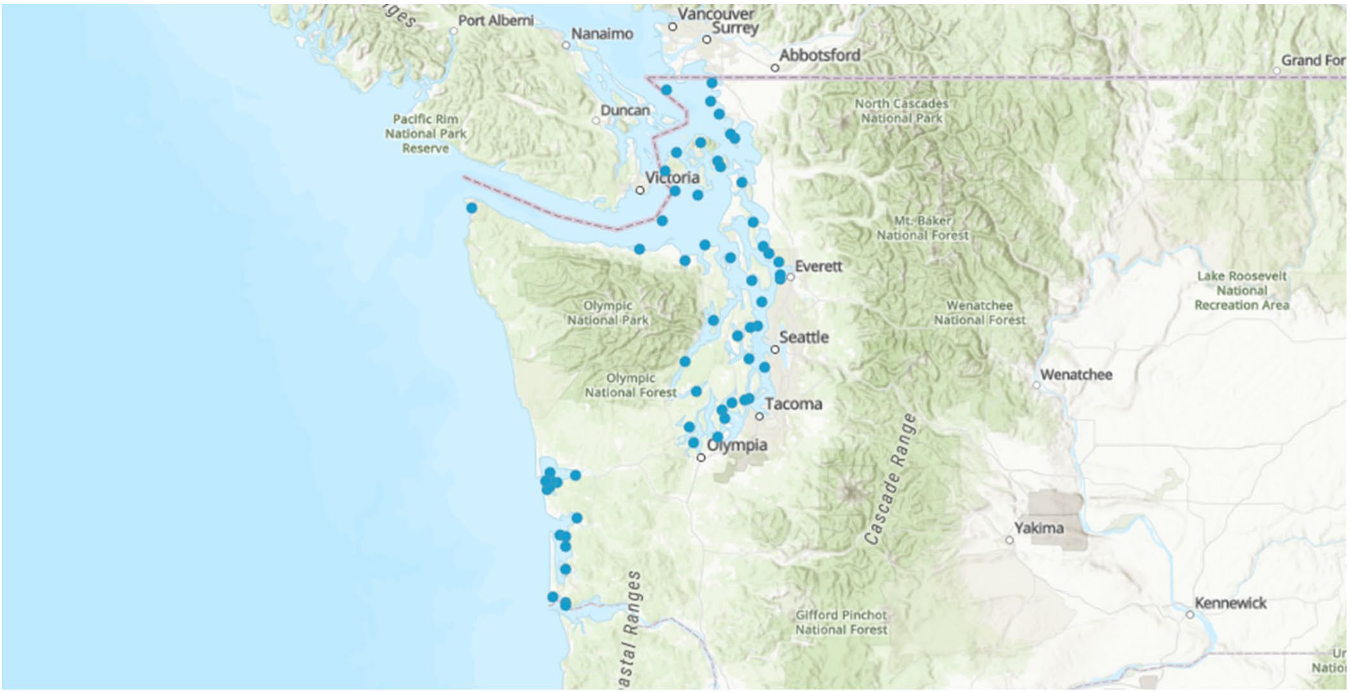


Figure 6. 2020 sampling locations in Washington.

6 Status of Endangered Species Act Protected Resources

This section identifies the ESA-listed species that potentially occur within the action area affected by the NCCA program. It then summarizes the biology and ecology of those species and what is known about their life histories in the action area. The ESA-listed species and designated critical habitat potentially occurring within the action area are shown in Table 2 along with each regulatory status.

Table 6. ESA-listed species and designated critical habitat that may be affected by the issuance of Incidental Take Permit No. 21316.

Species	ESA Status	Critical Habitat	Recovery Plan
Invertebrates			
White abalone	66 FR 29046	66 FR 29046	73 FR 62257
Black abalone	74 FR 1937	76 FR 66806	-- --
Fish			
Gulf sturgeon (Page: 26 *Acipenser oxyrinchus desotoi*)	T – 56 FR 49653	68 FR 13369	Recovery Plan
Shortnose sturgeon (*Acipenser brevirostrum*)	E – 32 FR 4001	-- --	63 FR 69613
Southern DPS green sturgeon (*Acipenser medirostris*)	T – 71 FR 17757	74 FR 52299	Recovery Plan
Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)			

Gulf of Maine DPS	T – 77 FR 5880	82 FR 39160	-- --
New York Bight DPS	E - 77 FR 5880	82 FR 39160	-- --
Chesapeake Bay DPS	E - 77 FR 5880	82 FR 39160	-- --
Carolina DPS	E – 77 FR 5914	82 FR 39160	-- --
South Atlantic DPS	E – 77 FR 5914	82 FR 39160	-- --
Gulf Grouper (*Mycteroperca jordani*)	E – 81 FR 72545	-- --	-- --
salmon, coho (*Oncorhynchus kisutch*)			
Central California coast	E – 79 FR 20802	65 FR 7764	Recovery Plan
Oregon coast	T – 73 FR 7815	73 FR 7815	78 FR 41911
Southern Oregon & Northern California coasts	T – 62 FR 24588	64 FR 24049	-- --
Lower Columbia River	T – 70 FR 37160	81 FR 9251	78 FR 41911
salmon, Chinook (*Oncorhynchus tshawytscha*)			
California coastal	T – 64 FR 50393	70 FR 52488	-- --
Central Valley spring-run	T – 64 FR 50393	70 FR 52488	79 FR 42504
Lower Columbia River	T – 64 FR 14308	70 FR 52630	78 FR 41911
Upper Columbia River spring-run	E – 64 FR 14308	70 FR 52630	72 FR 57303
Puget Sound	T – 64 FR 14308	70 FR 52630	72 FR 2493
Sacramento River winter-run	E – 59 FR 440	58 FR 33212	79 FR 42504
Snake River fall-run	T – 59 FR 42529	58 FR 68543	-- --
Snake River spring/summer-run	T – 59 FR 42529	64 FR 57399	-- --
Upper Willamette River	T – 64 FR 14308	70 FR 52630	76 FR 52317b
salmon, chum (*Oncorhynchus keta*)			
Columbia River	T – 64 FR 14507	70 FR 52630	78 FR 41911

Hood Canal summer-run	T – 64 FR 14507	70 FR 52630	72 FR 29121
salmon, sockeye (*Oncorhynchus nerka*)			
Ozette Lake	E – 70 FR 37160	70 FR 52630	74 FR 24706
Snake River	E – 56 FR 58619	58 FR 68543	-- --
trout, steelhead (*Oncorhynchus mykiss*)			
California Central Valley	T – 71 FR 834	70 FR 52488	79 FR 42504
Central California coast	T – 71 FR 834	70 FR 52488	-- --
South-Central California coast	T – 71 FR 834	70 FR 52488	-- --
Southern California	E – 71 FR 834	70 FR 52488	-- --
Northern California	T – 71 FR 834	70 FR 52488	-- --
Lower Columbia River	T – 71 FR 834	70 FR 52630	74 FR 50165
Middle Columbia River	T – 71 FR 834	70 FR 52630	-- --
Upper Columbia River	T – 74 FR 42605	70 FR 52630	72 FR 57303
Upper Willamette River	T – 71 FR 834	70 FR 52630	76 FR 52317b
Snake River Basin	T – 71 FR 834	70 FR 52630	-- --
Puget Sound	T – 72 FR 26722	81 FR 9251	-- --
Smalltooth sawfish (*Pristis pectinata*)	E – 68 FR 15674	74 FR 45353	74 FR 3566
Bocaccio *(Sebastes paucispinis)*	E – 75 FR 22276	79 FR 68041	-- --
Yellow Eye Rockfish *(Sebastes ruberrimus)*	T – 75 FR 22276	79 FR 68041	-- --
Pacific eulachon (*Thaleichthys pacificus*)	T – 75 FR 13012	76 FR 65323	-- --
Marine Mammals			
Guadalupe fur seal	T – 50 FR 51252	-- --	-- --
Southern resident killer whale	E – 70 FR 69903	71 FR 69054	Proposed 84 FR49214
Sea Turtles			
Green sea turtle (*Chelonia mydas*)			
North Atlantic DPS	E - 81 FR 20057	63 FR 46693	63 FR 28359
East Pacific DPS	E - 81 FR 20057	63 FR 46693	63 FR 28359

Kemp's ridley sea turtle (*Lepidochelys kempii*)	E - 35 FR 18319	-- --	75 FR 12496
Leatherback sea turtle (*Dermochelys coriacea*)	E - 61 FR 17	44 FR 17710	63 FR 28359
Hawksbill sea turtle (*Eretmochelys imbricata*)	E – 35 FR 8491	63 FR 46693	63 FR 28359
Loggerhead sea turtle (*Caretta caretta*)			
Northwest Atlantic Ocean DPS	T - 76 FR 58868	79 FR 39855	74 FR 2995
North Pacific Ocean DPS	T – 76 FR 58868	-- --	63 FR 28359
Olive ridley sea turtle (*Lepidochelys olivacea*)			
Pacific Coast of Mexico breeding populations	E – 43 FR 32800	-- --	63 FR 28359
All other populations	T – 43 FR 32800	-- --	-- --

6.1 Species and Designated Critical Habitat Not Likely to be Adversely Affected

NMFS uses two criteria to identify the ESA-listed or critical habitat that are not likely to be adversely affected by the proposed action, as well as the effects of activities that are consequences of the Federal agency's proposed action. The first criterion is exposure, or some reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed species or designated critical habitat. If we conclude that an ESA-listed species or designated critical habitat is not likely to be exposed to the proposed activities, we must also conclude that the species or critical habitat is not likely to be adversely affected by those activities.

The second criterion is the probability of a response given exposure. ESA-listed species or designated critical habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action. We applied these criteria to the species ESA-listed in Table 6 (see Table 7) and we summarize our results below.

Table 7. Summary table of stressor effects on ESA-listed species and designated critical habitat in the action area (LAA, likely to adversely affect; NLAA, not likely to adversely affect; NE, no effect; "-- --," not applicable).

Species	Bycatch	Interact with gear but not caught	Turbidity	Vessel strike	Anchor strike	Vessel noise	Non-native species	Critical habitat
White abalone	NLAA	NLAA	NLAA	NE	NLAA	NE	NLAA	-- --
Black abalone	NLAA	NLAA	NLAA	NE	NLAA	NE	NLAA	NLAA
Shortnose sturgeon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	-- --
Gulf sturgeon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA

Southern DPS green sturgeon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Gulf of Maine DPS Atlantic sturgeon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
New York Bight DPS Atlantic sturgeon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
Chesapeake Bay DPS Atlantic sturgeon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
Carolina DPS Atlantic sturgeon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
South Atlantic DPS Atlantic sturgeon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
Gulf grouper	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	-- --
Central CA coastal ESU coho salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Oregon Coast ESU coho salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Sourther OR/northern CA coast ESU coho salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Lower Columbia River ESU coho salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
California coastal ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Central valley spring run ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Lower Columbia River ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Upper Columbia River spring-run ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Puget Sound ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA

Sacramento River winter-run ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Snake River fall-run ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Snake River spring/summer-run ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Upper Willamette River ESU Chinook salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Columbia River ESU chum salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Hood Canal summer-run ESU chum salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Ozette Lake ESU sockeye salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Snake River ESU sockeye salmon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
California Central Valley DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Central California coast DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
South-Central California coast DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Southern California DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Northern California DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Lower Columbia River DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Middle Columbia River DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA

Upper Columbia River DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Upper Willamette River DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Snake River Basin DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Puget Sound DPS steelhead	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Smalltooth Sawfish	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
Bocaccio	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Yellow Eye Rockfish	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
Pacific eulachon	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Guadalupe fur seal	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	-- --
Southern resident killer whale	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
North Atlantic DPS green sea turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
East Pacific DPS green sea turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
Kemp’s ridley sea turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	-- --
Leatherback sea turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
Hawksbill sea turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	-- --
Northwest Atlantic Ocean DPS loggerhead sea turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
North Pacific Ocean DPS loggerhead sea turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	-- --
Pacific Coast of Mexico breeding populations of olive ridley sea turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	-- --
All other populations of	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	-- --

olive ridley sea turtle								

An action warrants a "may affect, not likely to adversely affect" finding when its effects are completely beneficial, insignificant or when effects are extremely unlikely to occur. Beneficial effects have an immediate positive effect without any adverse effects to the species or habitat. Beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs and consultation is required because the species may be affected. Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. That means the ESA-listed species may be expected to be affected, but not harmed or harassed.

If the effects of an action are determined to be wholly beneficial, insignificant, or when effects are extremely unlikely to occur, we conclude that the action is not likely to adversely affect ESA-listed species or designated critical habitat. This same decision model applies to individual stressors associated with the proposed action, such that some stressors may be determined to be not likely to adversely affect ESA-listed species or critical habitat because any effects associated with the stressors will not rise to the level of take under the ESA.

6.1.1 Marine Invertebrates

Capture methods, sampling for target species, create the chance that an ESA-listed species is incidentally captured. The most often used sampling gear is a benthic trawl, but sampling can also occur with gill nets, seines, hoop nets, and hook and line. Hoop nets, gill nets, seines, and hook and line sampling pose no bycatch risk for white abalone or black abalone. Trawls could pose a risk to white and black abalone; however, trawls will be conducted over sandy bottoms at shallow locations (no more than 30 meters and often 5 to 6 meters). It is extremely unlikely white or black abalone will be exposed to trawling gear. Furthermore, trawls rarely ever capture shellfish or rocks because the mouth has rolling weights to keep the trawl opening suspended approximately 15 centimeters above the benthos. Therefore, white abalone and black abalone are unlikely to be exposed to or to have any response to incidental capture or incidental interaction with capture gear. Because of this, these species may be affected, but are not likely to be adversely affected by capture gear.

Abalone can be adversely affected by increased turbidity. Studies have shown suspended sediment can affect larval survival and settlement (Phillips and Shima 2006, Onitsuka et al. 2008) and mucus production (Raea 2013). Larval settlement is a critical step in the recruitment process. Mucus production can be physiologically stressful to produce (Davies and Hawkins 1998). However, abalone should be over hard bottom habitat, with a very small proportion of the population adjacent to soft bottom habitat that may produce increased turbidity. Any turbidity associated with ponar samples or benthic disturbance from trawls will last for seconds to minutes. Because at most a small proportion of the population is exposed and because the exposure duration is so short, responses are not expected to rise to the level reported in these studies of long-term turbidity exposure. Because of this, abalone may be affected but are not likely to be adversely affected by turbidity.

When anchors are deployed, it is possible that one could fall and land on an abalone. White and black abalone are endangered with very low abundances. Anchors are deployed to land over soft bottom. Is some instances, if the bottom type is unknown, it is possible the anchor is dropped on abalone habitat. In the circumstance that anchors are dropped into abalone habitat, it is extremely unlikely that the anchor would land on one. Because of this, abalone may be affected but are not likely to be adversely affected by anchor strike.

All animals can have a range of responses to aquatic invasive species from beneficial to extirpation. Because of the uncertainty around abalone response to a wide variety of introduced species, EPA has established explicit equipment clean up guidelines. The guidelines are based on recommendations from the Aquatic Nuisance Species Task Force, the US Geological Survey Nonindigenous Species website, the Sea Grant Program, and the US Department of Agriculture Animal and Plant Health Inspection Service. Guidelines are established for cleaning vessels, sampling equipment, any other research equipment or clothes that came into contact with water. Because of the mitigation measures in place, it is not probable that any non-native species will be introduced to new environments as a result of this research. Therefore, the risk from non-native species may affect, but is not likely to adversely affect white or black abalone.

Critical habitat has been considered for white abalone, but because the only reason white abalone populations declined is over-exploitation, NMFS believed designating critical habitat would put the species at greater risk. Critical habitat for black abalone has been designated in five locations along the California coast ranging from Sonoma County to Los Angeles. The primary constituent elements identified in the critical habitat designation are 1) rocky substrate, 2) food resources, 3) juvenile settlement habitat, 4) suitable water quality, and 5) suitable nearshore circulation patterns. The sampling proposed here will not affect rocky substrate, food resources, or suitable nearshore circulation. As addressed above, turbidity caused by sediment grabs and trawls could have short term effects on juvenile settlement habitat and suitable water quality. As above, the effects of the turbidity will be very brief and have no lasting impact on designated critical habitat. As such, this research may affect but is not likely to adversely affect black abalone designated critical habitat.

6.1.2 Marine Mammals

Capture methods, sampling for target species, create the chance that an ESA-listed species is incidentally captured. The most often used sampling gear is a benthic trawl, but sampling can also occur with gill nets, seines, hoop nets, and hook and line. Hoop nets, seines, and hook and line sampling pose no bycatch risk for Guadalupe fur seals, or southern resident killer whales.

Southern resident killer whale will only possibly be encountered while sampling in Puget Sound. Sampling locations will all be under 30 meters deep. Given the steep drop-offs from shore, the 30-meter sampling zone will be very close to shore, where southern resident killer whales are not expected to be found often. However, in the event that southern resident killer whales do come near the sampling location, observers will be present to notify researchers to stop sampling. It is extremely unlikely southern resident killer whales will ever enter the sampling areas, if they do, mitigation is in place to ensure the chances of exposure to sampling gear is also minimized. Gill nets could incidentally capture Guadalupe fur seals because they swim near shore where the sampling will take place. However, the mitigation measures of observers being present, nets being attended at all times, and the rarity of gill net samples coupled with Guadalupe fur seals being a foreign species that is rarely seen in California make any risk of exposure to gill nets extremely unlikely. Trawls could also interact with Guadalupe fur seals. The trawls themselves are small enough to not be able to incidentally capture a Guadalupe fur seal, but it is possible the trawl could disturb individuals to such an extent that they leave the area and are at increased risk of being harmed as a result. However, trawl sampling for target species should last no longer than 3 hours, observers will be present, and Guadalupe fur seals are rare visitors to California. The likelihood of exposure to trawls is minimal and the likelihood of a response to the trawl's presence that could put a fur seal at risk of being injured is extremely unlikely. Therefore, southern resident killer whales and Guadalupe fur seals are unlikely to be exposed to or to have any response to incidental capture or incidental interaction with capture gear. Because of this, these species may be affected, but are not likely to be adversely affected by capture gear.

Turbidity can affect marine mammal's vision. Weiffen et al. (2006) showed the visual acuity of harbor seals decreases rapidly as turbidity increases. Small toothed whales rely on echolocation in turbid systems until they are in close to their prey (Wells 2019). The turbidity generated by sediment sampling and trawls will be minimal, of short duration, and localized. It is unlikely that Guadalupe fur seals or southern resident killer whales will be in the vicinity of the sampling because observers will be on board watching for marine mammals. If either of these mammals were to be in the area undetected, it is unlikely they would be affected by any turbidity generated by sampling and if they were affected, could easily move out of the area of increased turbidity. Because it is unlikely Guadalupe fur seals or southern resident killer whales will be exposed to increased turbidity or that the increase in turbidity would be in an area large enough to cause their behavior to change, the probability of exposure or response are extremely unlikely. Because of this, these species may be affected, but are not likely to be adversely affected by turbidity.

Vessel strikes are a major threat to marine mammals. Every year, marine mammals from a variety of species are killed by vessel strikes (Carretta et al. 2019). This project will use small, recreational-sized vessels and proposes "no wake" and "minimal wake" speeds coupled with marine mammal and turtle observers. Leaper (2019) showed reducing vessel speeds by 10% could reduce the risk of ship strikes by 50%, but in this case, speed reductions will be much greater. Additionally, at slow speeds with observers, we expect the probability of vessels interacting with any marine mammals to be exceedingly slim. Because the probability of exposure to vessel strikes is so unlikely, these species may be affected, but are not likely to be adversely affected by vessel strikes.

There is a chance that when dropping anchor to sample the x-site, the anchor could be dropped onto a Guadalupe fur seal or southern resident killer whale. This is extremely unlikely. There has never been a report of an anchor striking a marine mammal that we can find. It is possible that a marine mammal could become entangled in the anchor line or ponar line during sampling

(Johnson et al. 2005, Winn et al. 20008). Sampling each location is of short duration. Marine mammal and turtle observers are present on each sampling vessel. If a marine mammal enters the research area during the brief time sampling is taking place, observers should be able see the individual, remove anchors and research gear from the water, and allow the marine mammals to pass without incident. Because of the mitigation measures included in the project, it is extremely unlikely a Guadalupe fur seal or southern resident killer whale are exposed to anchor strike or lines in the water. Because of this, anchors or ponars may affect, but are not likely to adversely affect marine mammals.

Vessel noise has a long, well-documented history of affecting marine mammals (Weilgart 2007, Merchant 2014, Putland et al. 2018). Killer whales have been documented to increase their call amplitude in response to vessel noise (Holt et al. 2009). Environmental noise has been identified as one cause of southern resident killer whale decline (Weilgart 2007). For this project, vessels will operate at low speeds, minimizing engine noise output, for short durations, in disparate locations within each geographic sampling area. The design of the project will minimize prolonged exposure to noise and minimize the amount of noise at each location. Sound levels above background volumes are expected to be indiscernible. Further, marine mammal observers will be onboard to see when a marine mammal is in the area so activities can be suspended until it leaves. In the unlikely event a marine mammal is not observed and subjected to recreational vessel noises, it is unlikely there would be any response. If there were a response, it would likely be to leave the area because the recreational vessel is a relatively small source of sound and easily avoidable. Exposure to elevated noises is unlikely and the duration of noise generated by this research will be of such short duration as to not affect any behaviors that may be important during the summer (feeding for example). Because the exposure will be of such short duration and impact, vessel noise may affect, but is not likely to adversely affect marine mammals.

All animals can have a range of responses to aquatic invasive species from beneficial to extirpation. Because of the uncertainty around marine mammal response to a wide variety of introduced species, EPA has established explicit equipment clean up guidelines. The guidelines are based on recommendations from the Aquatic Nuisance Species Task Force, the U.S. Geological Survey Nonindigenous Species website, the Sea Grant Program, and the U.S. Department of Agriculture Animal and Plant Health Inspection Service. Guidelines are established for cleaning vessels, sampling equipment, any other research equipment or clothes that came into contact with water. Because of the mitigation measures in place, it is not probable that any non-native species will be introduced to new environments as a result of this research. Therefore, the risk from non-native species may affect, but is not likely to adversely affect Guadalupe fur seals or southern resident killer whales.

Southern resident killer whale critical habitat has been designated in Puget Sound and in 2019, proposed revision to the critical habitat were published. The proposed physical and biological features essential to the conservation of southern resident killer whales are 1) water quality to support growth and development, 2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development as well as population growth, 3) passage conditions to allow for migrating, resting, and foraging. This research will have no effect on passage. There will be small localized effects from turbidity. Food resources for southern resident killer whales are primarily salmonids (Ford and Ellis 2005, Ford et al. 2009, Ward et al. 2013), which may be affected by bycatch. However, as discussed in Section 8, only 2 salmonids every 5 years are expected to be captured, not necessarily in southern resident killer whale habitat, and all salmonids captured incidentally by this program will be released immediately. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect southern resident killer whale proposed critical habitat.

6.1.3 Marine Fish Stressors

A number of threatened and endangered fish may be affected by the EPA NCCA program. All four listed sturgeon species, all salmonid species, smalltooth sawfish, bocaccio, yelloweye rockfish, Pacific eulachon, and Gulf grouper. Bycatch and gear interactions will be discussed in Section 8.

Capture is a defined form of take under the ESA (Section 3(19)). For most fish species considered here, there is a likelihood that one could be captured incidentally and will be covered in Section 8 of this biological opinion. However, Gulf grouper range along the Pacific Coast into California, but typically well south of proposed sampling activities under the NCCA program. Because of this, it is extremely unlikely that Gulf grouper will be encountered during research activities for target species. Therefore, this program may affect, but is not likely to adversely affect Gulf grouper.

Turbidity is a well-known stressor to fish that can affect the gills and eyes, leading to reduced growth and survival (Sigler et al. 1984, Martin and Servizi 1993, Sutherland and Meyer 2007, Lowe et al. 2015). However, the effects of turbidity are caused by chronic turbidity or for anadromous fish, seasonal spikes in turbidity in their natal systems. The proposed project will generate small plumes of turbidity around ponar samples and trawls are used to capture target fish. These sediment plumes will be of short duration and intensity because the areas disturbed will be very small, the disturbance will only happen once, and only affect the upper, biologically accessible sediment layers. Natural long-shore currents are expected to distribute the sediment plume as it settles back to the benthos. Most importantly, they will also affect small areas, where it is quite likely no listed fish will be exposed. While extreme responses to sediment are possible under chronic conditions, brief exposure to turbidity plumes would not be expected to elicit any growth response. Turbidity, even in large amounts, does not appear to affect oxygen uptake (Cumming and Herbert 2016). The probability of exposure is highly unlikely and the response to brief exposure would be undetectable. Because of this, turbidity may effect, but is not likely to adversely affect shortnose or Gulf sturgeon; any DPS of Atlantic or green sturgeon; any DPS of steelhead, any ESU of Chinook, coho, chum, or sockeye salmon; or smalltooth sawfish; bocaccio; yelloweye rockfish; Pacific eulachon; or Gulf grouper.

Vessel strikes and anchor strikes could harm listed fish in the US. There are numerous documented sturgeon killed by vessel propellers (Brown and Murphy 2010, Balazik et al. 2012, Demetrus et al. 2020). Sturgeon become vulnerable in navigable waters where the channels are dredged to the approximate depth of vessels or during migratory periods when they come off the benthos to swim pelagically. The species struck by vessels are generally larger species that are more likely to interact with the propellers. In the case of the studies above, the reported mortalities were of adults. Recreational vessels can also strike fish and cause injuries (Figures 7 and 8), but there are no studies on the frequency of strikes or effects. There are also no reports of vessel strikes of smaller, more pelagic species like salmonids, but they are possible. Likewise, in shallow, nearshore areas, large species like smalltooth sawfish could be struck by small craft, but because of the clarity of water in habitats they occupy, this is highly unlikely. The concept of anchor strike has also not been explored in the literature but is extremely unlikely to affect any fish in this study because the species considered are larger and able to easily move out of the way of a falling anchor. Because this study proposes to have vessels travel at "no wake" or "minimal wake" speeds, it is expected that all fish in the action area will be able to avoid being struck by moving away from the research vessels. Because the probability of vessel and anchor interactions is minimal and further mitigated with reduced vessel speeds, the threat of these stressors is insignificant. Therefore, vessel and anchor strike may affect listed fish, but are not likely to adversely affect shortnose or Gulf sturgeon; any DPS of Atlantic or green sturgeon; any DPS of steelhead, any ESU of Chinook, coho, chum, or sockeye salmon; or smalltooth sawfish; bocaccio; yelloweye rockfish; Pacific eulachon; or Gulf grouper.

Figure 7. Adult Atlantic sturgeon with evidence of propeller strike to its face, but alive and functioning normally (Photo: J.E. Kahn).

Figure 8. Scar through the dorsal scutes of an Atlantic sturgeon (Photo: J.E. Kahn).

Studies on the impacts of noise on fish have become more common in recent years. Vessel noise is now commonly recognized as a stressor to fish when it is loud enough to be detected and persistent enough to become stressful (Mitson and Knudsen 2003, De Robertis and Handegard 2013, Celi et al. 2016, Putland et al. 2017). Approximately 20% of a school of fish will actively avoid vessel noise (Misund et al. 1996, De Robertis and Handegard 2013) and the louder the noise, the greater the stress response and recovery time (Graham and Cooke 2008). Noise generated by a recreational vessel occurs along a spectrum, where generated noise is lowest by non-motorized vessels, slightly more by low horse power combustion engines, increasing to the most from commercial vessels (Graham and Cooke 2008, De Robertis and Handegard 2013). Operating research vessels in "no wake" or "low wake" status will minimize vessel noise generated during research activities. Because the research activities will be brief and fish are able to move out of the ensonified area, the probability of exposure is minimal and the probability of a response if exposed is extremely unlikely. Because of this, vessel noise may affect listed fish, but is not likely to adversely affect shortnose or Gulf sturgeon; any DPS of Atlantic or green sturgeon; any DPS of steelhead, any ESU of Chinook, coho, chum, or sockeye salmon; or smalltooth sawfish; bocaccio; yelloweye rockfish; Pacific eulachon; or Gulf grouper.

All animals can have a range of responses to aquatic invasive species from beneficial to extirpation. Because of the uncertainty around different species of fish's response to a wide variety of introduced species, EPA has established explicit equipment clean up guidelines. The guidelines are based on recommendations from the Aquatic Nuisance Species Task Force, the US Geological Survey Nonindigenous Species website, the Sea Grant Program, and the US Department of Agriculture Animal and Plant Health Inspection Service. Guidelines are established for cleaning vessels, sampling equipment, any other research equipment or clothes that came into contact with water. Because of the mitigation measures in place, it is not probable that any non-native species will be introduced to new environments as a result of this research.

Therefore, the risk from non-native species may affect, but is not likely to adversely affect shortnose or Gulf sturgeon; any DPS of Atlantic or green sturgeon; any DPS of steelhead, any ESU of Chinook, coho, chum, or sockeye salmon; or smalltooth sawfish; bocaccio; yelloweye rockfish; Pacific eulachon; or Gulf grouper.

Critical habitats and primary constituent elements/essential physical and biological features are different for each species, DPS, or ESU. Below, we address the effects to critical habitat for the species with critical habitat designated in the action area. Smalltooth sawfish designated critical habitat is entirely outside of the action area.

6.1.3.1 Gulf Sturgeon Critical Habitat

Gulf sturgeon critical habitat is designated along the Gulf Coast in estuaries and rivers from Cedar Key, Florida to New Orleans, Louisiana. The primary constituent elements are:

- Abundant food items, such as detritus, aquatic insects, worms, and/or mollusks, within riverine habitats for larval and juvenile life stages; and abundant prey items, such as amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, mollusks and/or crustaceans, within estuarine and marine habitats and substrates for subadult and adult life stages.
- Riverine spawning sites with substrates suitable for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay;
- Riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adult, subadult, and/or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during freshwater residency and possibly for osmoregulatory functions;
- A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of- change of fresh water discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging, and for maintaining spawning sites in suitable condition for egg attachment, egg sheltering, resting, and larval staging;
- Water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;
- Sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and
- Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., an unobstructed river or a dammed river that still allows for passage).

The research protocols are likely to remove food resources, temporarily impair water quality, and affect sediment quality. The research will have no effect on spawning habitat, aggregation areas, flow regimes, or migratory pathways. Food resources and sediment quality will be affected similarly, as sediment samples and macroinvertebrate samples will affect small numbers and area of habitat. In either case, the effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995) and removed soft-bottom substrate will be replaced by natural sediment transport during the next high flow event. The water quality will be impaired during an even shorter time than the macroinvertebrates or sediment quality as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect Gulf sturgeon designated critical habitat.

6.1.3.2 Green Sturgeon Critical Habitat

Green sturgeon critical habitat is designated in estuarine areas of the Sacramento-San Joaquin Delta, Suisun River, and San Francisco Bays. The primary constituent elements of green sturgeon in estuaries are:

- Abundant food resources
- Sufficient water flow to allow adults to orient to upstream spawning grounds
- Good water quality
- Unobstructed migratory corridor

The research proposed will have no effect on water flow or migratory corridors. There may be impacts on food resources and water quality. Food resources will be affected by macroinvertebrate samples. The effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995). The water quality will be impaired during an even shorter time than the macroinvertebrates as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect green sturgeon designated critical habitat.

6.1.3.3 Atlantic Sturgeon Critical Habitat

Atlantic sturgeon critical habitat is designated in estuarine and riverine areas of the East Coast from Florida to Canada. The primary constituent elements of Atlantic sturgeon are:

- Hard bottom substrate for spawning
- Aquatic habitat for gradual downstream salinity gradient
- Water of appropriate depth and free of passage barriers
- Water from river mouths to spawning habitat of sufficient quality (temperature, salinity, and dissolved oxygen) to support all life stages

The research proposed will have no effect on any of these primary constituent elements.

6.1.3.4 Chinook Salmon Critical Habitat

Chinook salmon critical habitat is designated for each individual ESU. The primary constituent elements or essential physical and biological features are identified below:

Sacramento winter-run ESU:

- Access from Pacific Ocean to spawning habitat
- Availability of clean, clear gravel for spawning
- Adequate river flows
- Appropriate water temperatures
- Adequate prey
- Riparian habitat to support juvenile growth
- Juvenile access from spawning grounds to Pacific Ocean

Upper Columbia River, Lower Columbia River, Puget Sound, and Upper Willamette River ESUs:

- Freshwater spawning sites
- Freshwater rearing sites
- Freshwater migration corridors
- Estuarine areas
- Nearshore marine areas
- Offshore marine areas

Central Valley spring-run and California Coastal ESUs:

- Water quality and quantity
- Natural cover
- Forage
- Adequate passage conditions
- Floodplain connectivity

Snake River fall run and Snake River spring/summer run:

- Juvenile rearing areas
- Juvenile and adult migration corridors

The research proposed here will not affect spawning habitat, migratory corridors or passage, floodplain connectivity, temperatures, flows, or cover. There may be effects to food resources and estuarine water quality. Food resources will be affected by macroinvertebrate samples. The effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995). The water quality will be impaired during an even shorter time than the macroinvertebrates as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect any ESU of Chinook salmon designated critical habitat.

6.1.3.5 Coho Salmon Critical Habitat

Coho salmon critical habitat is designated for each individual ESU. The primary constituent elements or essential physical and biological features are identified below:

Southern Oregon/Northern California Coast ESU

- Substrate
- Water quality
- Water temperature
- Water velocity
- Cover/shelter
- Food
- Safe passage

Central California Coast ESU

- Juvenile summer and winter rearing
- Juvenile migration corridors
- Areas for growth to adulthood
- Adult migration corridors
- Spawning areas

Lower Columbia River ESU

- Spawning locations
- Rearing locations
- Freshwater migration corridors
- Estuarine areas
- Nearshore marine areas
- Offshore marine areas

Oregon Coast ESU

- Space for individual and population growth
- Nutritional and physiological requirements
- Cover and shelter
- Sites for breeding, reproducing, and rearing
- Habitats protected from disturbance

The research plan in estuarine habitats will have no effect on freshwater spawning or rearing habitats, migratory corridors, offshore marine areas, space, cover, water temperature, or water velocity. There may be effects to food resources and estuarine water quality. Food resources will be affected by macroinvertebrate samples. The effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995). The water quality will be impaired during an even shorter time than the macroinvertebrates as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect any ESU of coho salmon designated critical habitat.

6.1.3.6 Chum Salmon Critical Habitat

Chum salmon critical habitat is designated for each individual ESU by location, but the primary constituent elements are the same for both:

- Water quality and quantity
- Natural cover
- Forage
- Adequate passage
- Floodplain connectivity

The program will have no effect to water quantity, natural cover, passage, or floodplain connectivity. There may be effects to food resources and estuarine water quality. Food resources will be affected by macroinvertebrate samples. The effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995). The water quality will be impaired during an even shorter time than the macroinvertebrates as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect any ESU of chum salmon designated critical habitat.

6.1.3.7 Sockeye Salmon Critical Habitat

Sockeye salmon critical habitat is designated for each individual ESU. The essential habitat categories or essential physical and biological features are identified below:

Snake River Sockeye ESU:

- Spawning and juvenile rearing areas
- Juvenile migration corridors
- Areas for growth and development to adulthood
- Adult migration corridors

Ozette Lake ESU:

- Freshwater spawning water quality and quantity
- Freshwater rearing locations
- Freshwater migration corridors
- Estuaries with water quality, quantity, and salinity
- Nearshore marine areas
- Offshore marine areas

The program will have no effect on freshwater habitat, water quantity, migratory corridors, or offshore marine areas. There may be effects to food resources and estuarine water quality. Food resources will be affected by macroinvertebrate samples. The effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995). The water quality will be impaired during an even shorter time than the macroinvertebrates as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect any ESU of sockeye salmon designated critical habitat.

6.1.3.8 Steelhead Critical Habitat

Steelhead critical habitat is designated for each individual DPS geographically, but the essential physical and biological features for all DPSs are identified below:

- Freshwater spawning sites
- Freshwater rearing sites
- Freshwater migratory corridors
- Estuarine areas
- Nearshore marine areas
- Offshore marine areas

The program will have no effect on freshwater habitat or offshore marine areas. There may be effects to estuarine areas and nearshore marine areas to food resources and water quality. Food resources will be affected by macroinvertebrate samples. The effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995). The water quality will be impaired during an even shorter time than the macroinvertebrates as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect any DPS of steelhead designated critical habitat.

6.1.3.9 Bocaccio and Yelloweye Rockfish Critical Habitat

Adult bocaccio and all life stages of yelloweye rockfish critical habitat is designated for waters deeper than 30 meters deep. Juvenile bocaccio critical habitat is present in nearshore marine waters. The physical and biological features essential to their conservation are:

Greater than 30m deep

- Quantity, quality, and availability of prey
- Water quality with sufficient dissolved oxygen
- Structure and rugosity of the benthos

Less than 30m deep

- Sand, rock, or cobble habitat that supports kelp
- Quantity, quality, and availability of prey
- Water quality with sufficient dissolved oxygen

There may be effects to estuarine areas and nearshore marine areas to food resources and water quality. Food resources will be affected by macroinvertebrate samples. The effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995). The water quality will be impaired during an even shorter time than the macroinvertebrates as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect bocaccio designated critical habitat.

6.1.3.10 Pacific Eulachon Critical Habitat

Pacific eulachon critical habitat is designated in the action area and includes physical and biological features essential for the conservation of the species as follows:

- Space for individual and population growth
- Nutritional and physiological requirements available
- Cover or shelter
- Sites for breeding, reproduction, and juvenile rearing
- Habitats that are protected from disturbance

There will be no effects to space, cover, shelter, or sites for breeding, reproduction, and juvenile rearing. There may be effects to estuarine areas and nearshore marine areas to food resources and water quality. Food resources will be affected by macroinvertebrate samples. The effect is expected to be insignificant as macroinvertebrates will re-inhabit modified habitat quickly (Johnson and Vaugn 1995). The water quality will be impaired during an even shorter time than the macroinvertebrates as minor turbidity will be generated during the ponar sampling or trawling, but that sediment will immediately resettle to the bottom of the habitat. Because of this, designated critical habitat may be affected, but the extent of effects will be insignificant and therefore not likely to adversely affect Pacific eulachon designated critical habitat.

6.1.4 Sea Turtle Stressors

The NCCA program may incidentally capture sea turtles. This stressor will be investigated in more detail in Section 8.

A review of sources of literature produced no studies on the effects of turbidity on sea turtles. Narazaki et al. (2013) noted that loggerhead sea turtles rely on vision for foraging, but other studies have shown chemical cues are also important (Southwood et al. 2008). Most importantly, sediment plumes caused by this program will be extremely localized (immediately around the trawl or ponar) and of short duration. It is unlikely that the turbidity produced during this research will occur in the vicinity of a sea turtle, but if it did, the plume would likely not be large enough to impair feeding behaviors. Because of this, turbidity may affect sea turtles, but the extent of effects will be insignificant and therefore not likely to adversely affect North Atlantic DPS green sea turtles, East Pacific DPS green sea turtles, Kemp’s ridley sea turtles, leatherback sea turtles, hawksbill sea turtles, Northwest Atlantic Ocean DPS loggerhead sea turtles, North Pacific Ocean DPS loggerhead sea turtle, Pacific Coast of Mexico breeding populations of olive ridley sea turtles, or all other populations of olive ridley sea turtles.

Vessel strikes are a documented source of sea turtle mortality (Hazel et al. 2007, Denkinger et al. 2013). Lower speeds have been shown to reduce collision risk (Hazel et al. 2007). This research program will implement “no wake” and “low wake” speeds during research activities.

Additionally, observers will be present and searching for sea turtles near the surface. Because of these mitigation measures, we expect the probability of vessels interacting with any sea turtle to be exceedingly slim. Because the probability of exposure to vessel strikes is so unlikely, these species may be affected, but are not likely to be adversely affected by vessel strikes.

Anchor strikes are less likely to occur than vessel strikes because anchors are deployed once at each research stop and their speeds through the water as they fall are not very fast. Furthermore, striking a sea turtle with a deployed anchor doesn't just depend on the number of anchor drops and speed of the anchor, but also whether a sea turtle is present at the time of anchor deployment. As above, observers are located on vessels to minimize the chances an anchor is dropped if a sea turtle is present. Therefore, the probability of exposure or response to anchors is extremely unlikely and discountable, therefore this may effect, but is not likely to adversely affect North Atlantic DPS green sea turtles, East Pacific DPS green sea turtles, Kemp's ridley sea turtles, leatherback sea turtles, hawksbill sea turtles, Northwest Atlantic Ocean DPS loggerhead sea turtles, North Pacific Ocean DPS loggerhead sea turtle, Pacific Coast of Mexico breeding populations of olive ridley sea turtles, or all other populations of olive ridley sea turtles.

Sea turtles have been shown to display avoidance behavior when confronted with loud noises (O'Hara and Wilcox 1990, Samuel et al. 2005, DeRuiter and Doukara 2012). For this project, vessels will operate at low speeds, minimizing engine noise output, for short durations, in disparate locations within each geographic sampling area. The design of the project will minimize prolonged exposure to noise and minimize the amount of noise at each location. Sea turtles are not considered to rely heavily on hearing in the underwater environment. Sound levels above background volumes are expected to be indiscernible. Sea turtles are expected to avoid the sampling locations if sound levels are detectable. Exposure to elevated noises is unlikely and the duration of noise generated by this research will be of such short duration as to not affect any behaviors that may be important during the summer (feeding for example). Because the exposure will be of such short duration and impact, vessel noise may affect, but is not likely to adversely affect sea turtles.

All animals can have a range of responses to aquatic invasive species from beneficial to extirpation. Because of the uncertainty around sea turtle response to a wide variety of introduced species, EPA has established explicit equipment clean up guidelines. The guidelines are based on recommendations from the Aquatic Nuisance Species Task Force, the US Geological Survey Nonindigenous Species website, the Sea Grant Program, and the US Department of Agriculture Animal and Plant Health Inspection Service. Guidelines are established for cleaning vessels, sampling equipment, any other research equipment or clothes that came into contact with water. Because of the mitigation measures in place, it is not probable that any non-native species will be introduced to new environments as a result of this research. Therefore, the risk from non-native species may affect, but is not likely to adversely affect North Atlantic DPS green sea turtles, East Pacific DPS green sea turtles, Kemp's ridley sea turtles, leatherback sea turtles, hawksbill sea turtles, Northwest Atlantic Ocean DPS loggerhead sea turtles, North Pacific Ocean DPS loggerhead sea turtle, Pacific Coast of Mexico breeding populations of olive ridley sea turtles, or all other populations of olive ridley sea turtles.

6.1.4.1 Northwest Atlantic DPS Loggerhead Sea Turtle Critical Habitat

Critical habitat and essential physical and biological features for the northwest Atlantic DPS loggerhead sea turtle occur in offshore areas from Texas to Florida and along the coast adjacent to estuarine areas in Louisiana, Florida, and North Carolina. Leatherback, hawksbill, and all DPSs of green sea turtle designated critical habitat are entirely outside of the action area. The northwest Atlantic DPS of loggerhead sea turtles require: 1) nearshore reproductive habitat, 2) winter habitat, 3) breeding habitat, 4) migratory habitat, and 5) Sargassum habitat. The NCCA program will not affect any of these physical or biological features and therefore this program will have no effect on northwest Atlantic DPS loggerhead sea turtles.

6.2 Species Likely to be Adversely Affected

During consultation we examined the status of each species that is likely to be affected by the proposed action. The status is determined by the level of risk that the ESA-listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 C.F.R. 402.02. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on NMFS Web site. The designated critical habitats of every species have been addressed in section 6.1 and are not considered further in this biological opinion.

6.2.1 Shortnose sturgeon

We used information available in the Shortnose Sturgeon Recovery Plan (NMFS 1998), the 2010 NMFS Biological Assessment (SSSRT 2010), and the listing document to summarize the status of the species. Shortnose sturgeon were listed as endangered throughout its range on March 11, 1967 pursuant to the Endangered Species Preservation Act of 1966. Shortnose sturgeon remained on the list as endangered with enactment of the ESA in 1973. Shortnose sturgeon occur along the Atlantic Coast of North America, from the Saint John River in Canada to the Saint Johns River in Florida. The Shortnose Sturgeon Recovery Plan describes 19 shortnose sturgeon populations that are managed separately in the wild. Two additional geographically separated populations occur behind dams in the Connecticut River (above the Holyoke Dam) and in Lake Marion on the Santee-Cooper River system in South Carolina (above the Wilson and Pinopolis Dams).

6.2.1.1 Status

Shortnose sturgeon spawning has been documented in several rivers across its range (including but not limited to: Kennebec River, Maine, Connecticut River, Hudson River, Delaware River, Pee Dee River, South Carolina, Savannah, Ogeechee, and Altamaha rivers, Georgia), status for many other rivers remain unknown. Populations in the Kennebec, Hudson, Delaware, and Altamaha Rivers are relatively large and stable. Populations in other rivers are smaller if they are still extant, with a large gap in their range through the mid-Atlantic region where little to no reproduction occurs from the Chesapeake Bay through Pamlico Sound. The Connecticut River population appears stable, though is adversely impacted by the presence of a series of dams separating optimal spawning habitat from optimal foraging habitat.

6.2.1.2 Threats

The viability of sturgeon populations is highly sensitive to juvenile mortality resulting in lower numbers of sub-adults recruiting into the adult breeding population. The 1998 recovery plan for shortnose sturgeon (NMFS 1998) identify Habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges), and mortality (for example, from impingement on cooling water intake screens, dredging, and incidental capture in other fisheries) as principal threats to the species' survival. Introductions and transfers of indigenous and nonindigenous sturgeon, intentional or accidental, may threaten wild shortnose sturgeon populations by imposing genetic threats, increasing competition for food or habitat, or spreading diseases. Sturgeon species are susceptible to viruses enzootic to the west coast and fish introductions could further spread these diseases. Shortnose sturgeon populations are at risk from incidental bycatch, loss of habitat, dams, dredging and pollution.

6.2.2 Gulf sturgeon

The Gulf sturgeon is a sub-species of the Atlantic sturgeon that can be found from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi to the Suwannee River in Florida. Hatched in the freshwater of rivers, Gulf sturgeon head out to sea as juveniles, and return to the rivers of their birth to spawn (lay eggs) when they reach adulthood.

6.2.2.1 Status

Because Gulf sturgeon spawn in the rivers in which they were born, a breeding population can be defined as the individuals natal to a particular river, and abundance is calculated as the number of individuals within that breeding population. Estimates of the largest population, the Suwannee River, suggest an increase from approximately 2200 individuals in 1986 to about 9,500 at present (Sulak and Clugston 1999, Pine et al. 2001). Approximately 60% of the current population are adults but only approximately 5% of females participate in spawning each year (Sulak and Clugston 1999, Pine et al. 2001). The Apalachicola River supports a small population of approximately 100 individuals (Zehfuss et al. 1999), which is very similar in size to other small Gulf sturgeon populations like the Pearl River (Morrow et al. 1998).

6.2.2.2 Threats

Gulf sturgeon were listed due to overfishing. However, since being protected under the ESA, they still face threats from contaminants, dredging, dams, and climate change. A number of recent fish kills due to chemical spills and hurricanes have claimed Gulf sturgeon along with other fish species. Dredging can disturb foraging habitat and also directly kill Gulf sturgeon. Dams block access to spawning habitat. Gulf sturgeon already exist near the upper edge of their thermal tolerance, so while the effects of climate change are uncertain, temperatures may increase to a point where Gulf sturgeon are no longer able to spawn or grow in certain rivers.

6.2.3 Green sturgeon

6.2.3.1 Status

We used information available in the 2002 Status Review and Status Review Updates (Adams et al. 2002, BRT 2005, NMFS 2015), and the proposed and final listing rules to summarize the status of the species. The Southern DPS of green sturgeon is listed as threatened. On June 2, 2010, NMFS issued a 4 (d) Rule for the Southern DPS, applying certain take prohibitions. The most recent 5-year status review was published in August of 2015. Green sturgeon occur in coastal Pacific waters from San Francisco Bay to Canada. The Southern DPS of green sturgeon includes populations south of (and exclusive of) the Eel River, coastal and Central Valley populations, and the spawning population in the Sacramento River, California (Adams et al. 2007).

The 2015 status update indicates that DPS structure of the North American green sturgeon has not changed and that many of the principle factors considered when listing Southern DPS green sturgeon as threatened are relatively unchanged. Loss of spawning habitat and bycatch in the white sturgeon commercial fishery are two major causes for the species decline. Spawning in the Feather River is encouraging and the decommissioning of Red Bluff Diversion Dam and breach of Shanghai Bench makes spawning conditions more favorable. The prohibition of retention in commercial and recreational fisheries has eliminated a known threat and likely had a very positive effect on the overall population, although recruitment indices are not presently available.

6.2.3.2 Threats

The 2015 status review (NMFS 2015) for the southern DPS of green sturgeon indicates that many of the principle factors considered when listing Southern DPS green sturgeon as threatened are relatively unchanged. Current threats to the Southern DPS include entrainment by water projects, contaminants, incidental bycatch and poaching. Given the small population size, the species' life history traits (e.g., slow to reach sexual maturity), and that the threats to the population are likely to continue into the future, the Southern DPS is not resilient to further perturbations. The spawning area for the species is still small, as the species still encounters impassible barriers in the Sacramento, Feather and other rivers that limit their spawning range. Entrainment threat includes stranding in flood diversions during high water events.

6.2.4 Atlantic sturgeon

The range of Atlantic sturgeon ranges from the St. John River in Canada to the St. Johns River in Florida. Five DPSs of Atlantic sturgeon were designated and listed under the ESA on February 6, 2012 (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic). The Gulf of Maine was listed as threatened while the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered.

6.2.4.1 Status

Limited information on the status of Atlantic sturgeon populations is available. Atlantic sturgeon juveniles congregate near the saltwater interface in salinities from 0 to 10 parts per thousand. After leaving their natal rivers, they range widely in nearshore and estuarine habitats, returning as adults to their natal rivers to spawn. There are no abundance estimates of any life stage of the Gulf of Maine DPS. The New York Bight DPS has estimates available from the Hudson and Delaware Rivers. The Hudson juvenile abundance may be as low as 4,600 individuals (Peterson et al. 2000) while more recent estimates from the Delaware River suggest juvenile abundance is approximately 3,600 individuals (Hale et al. 2016). The Hudson River total adult population before the commercial fishery was closed was approximately 870 individuals (Kahnle et al. 2007) while more recent estimates of annual spawning abundance are of approximately 460 individuals (Kazyak et al. 2020). Abundance estimates for the Chesapeake Bay populations are relatively well defined in the York River with annual spawning abundances ranging between approximately 150 to 250 individuals (Kahn et al. 2019) and a total population abundance of approximately 310 (95% confidence limits, 285-485; Kahn 2019). No abundance estimate exists for the James River. Side scan sonar estimates of estuarine habitat in the Pee Dee River, South Carolina suggest just under 2,000 sub-adult Atlantic sturgeon occupy this estuary in the summer (Flowers and Hightower 2015). Juvenile and adult estimates are available in the Altamaha River of approximately 1,000 to 2,000 (Schueller and Peterson 2010) and approximately 1,000 spawning adults each year (Peterson et al. 2008, Ingram and Peterson 2016).

6.2.4.2 Threats

Of the stressors evaluated in the 2007 status review (ASSRT 2007), bycatch mortality, water quality, lack of adequate state and/or Federal regulatory mechanisms, and dredging activities were most often identified as the most significant threats to the viability of Atlantic sturgeon populations. Additionally, some populations were affected by unique stressors, such as habitat impediments (e.g., Cape Fear and Santee-Cooper rivers) and apparent ship strikes (e.g., Delaware and James rivers).

6.2.5 Gulf grouper

Gulf grouper are large fish that live in shallow, coastal areas during their first 2 years of their life, before moving on to rocky reefs and kelp beds. They are late-maturing, long-lived, top-level predators found in the Gulf of California and the eastern Pacific Ocean. Interestingly, gulf grouper are born female and transition to males later in life when they are larger.

6.2.5.1 Status

Gulf grouper were once considered abundant but are now considered rare. Their abundance has severely declined since the mid-20th century primarily because of direct harvest by commercial and artisanal fisheries. In the Gulf of California, gulf grouper represented approximately 45 percent of the artisanal fishery in 1960. This number declined to 10 percent by the 1970s, and gulf grouper now make up less than 1 percent of the fishery. Commercial landings of gulf grouper from the Pacific Ocean (U.S. vessels fishing in Mexican waters) peaked in the early 1950s, before the population declined to near commercial extinction by 1970. Based on recent fishery independent surveys and fisheries data, the gulf grouper has not recovered and is still considered very rare in the Pacific Ocean portion of its range. Outside of a known population in Bahía Magdalena, there is no published evidence of gulf grouper along the Pacific coast of the

Baja California peninsula. Current gulf grouper distribution appears to be much more limited than their historical range.

6.2.5.2 Threats

Gulf grouper were overfished by direct harvest and are now relatively rare. Fishing typically target spawning aggregations. As a long-lived, late maturing species that gathers predictably in large aggregations, it was easily fished in unsustainable ways. Fishermen typically targeted the larger males, skewing the sex ratio and creating Alee effects. In addition to fishing, gulf grouper are also threatened by bycatch, habitat degradation, and habitat loss.

6.2.6 Pacific Salmonids

In May 2016, NMFS's West Coast Region completed a five-year status review of all 27 West Coast salmon and steelhead species listed under the ESA (Table 9). The Pacific salmonid species have similar life histories, habitat needs, and threats. Some species, such as Oregon Coast coho salmon, Middle Columbia River steelhead and Hood Canal chum, rebounded from the lows of past decades. Highly endangered Snake River sockeye have benefitted from a captive broodstock program while Snake River steelhead populations are steady. The California drought and unusually high ocean and stream temperatures over the 5-year period hit many populations hard. In the case of Sacramento River winter-run Chinook salmon, for example, drought conditions and high stream temperatures reduced the 2015 survival of juvenile fish in the first stretch of river to just three percent.

6.2.6.1 Status

Table 8. Summary of current ESA listing status and recent trends for the most recent five-year review for Pacific salmonids (Northwest Fisheries Science Center 2015, Williams et al. 2016).

Species	ESU/DPS	Five Year Review Risk Trend	ESA Listing Status
Chinook salmon	Upper Columbia River spring	Stable	Endangered
	Snake River spring/summer	Stable	Threatened
	Snake River fall	Improving	Threatened
	Upper Willamette River spring	Declining	Threatened
	Lower Columbia River	Stable/improving	Threatened
	Puget Sound	Stable/declining	Threatened
	California Coastal	Mixed	Threatened
	Central Valley spring	Decreased risk of extinction	Threatened
	Sacramento River winter	Increased risk of extinction	Endangered
Coho salmon	Lower Columbia River	Stable/improving	Threatened
	Oregon Coast	Improving	Threatened
	Southern Oregon/Northern CA	Mixed	Threatened
	Central California Coast	Mixed	Endangered
	Snake River	Improving	Endangered

Sockeye salmon	Ozette Lake	Stable	Threatened
Chum salmon	Hood Canal summer	Improving	Threatened
	Columbia River	Stable	Threatened
Steelhead	Upper Columbia River	Improving	Threatened
	Snake River	Stable/improving	Threatened
	Middle Columbia River	Stable/improving	Threatened
	Upper Willamette River	Declining	Threatened
	Lower Columbia River	Stable	Threatened
	Puget Sound	Stable	Threatened
	Northern California	Mixed	Threatened
	Central California Coast	Uncertain	Threatened
	South Central California Coast	Declining	Threatened
	Southern California	Uncertain	Endangered

6.2.6.2 Threats

During estuarine and nearshore coastal life stages, salmonids require cool water with plentiful nutrients and prey to increase growth and survival. The major threat identified by the status review that is relevant to this consultation is low marine survival. A number of secondary threats were also identified, including threats to habitat quality and accessibility, commercial and recreational fisheries, disease and predation, inadequacy of regulatory mechanisms related to water withdrawal and water quality, aquaculture, artificial propagation, climate change, competition, and depleted fish communities.

6.2.7 Bocaccio and Yelloweye Rockfish

Bocaccio live along the Pacific Coast of the US and can grow up to 21 pounds. Bocaccio are slow-growing, late to mature, and long-lived. They range from Punta Blanca, Baja California, to the Gulf of Alaska off Krozoff and the Kodiak Islands, but are most common between Oregon and northern Baja California. They can be identified by a long lower jaw that extends past their eye socket.

Yelloweye rockfish are slow growing, late to mature, and among the longest lived of rockfishes, living up to 150 years. Although conservation measures like fishing bans have been put in place in Puget Sound, recovery from threats such as past overfishing and continued bycatch will take many years due to the life history of yelloweye rockfish.

6.2.7.1 Status

According to the 2018 stock assessment, the bocaccio stock on the southern Pacific coast is not overfished, and is not subject to overfishing. The stock rebuilt in 2017, faster than estimated in the rebuilding plan, due in large part to several strong year classes and an improved understanding of the productivity of this stock. Along the northern Pacific coast, bocaccio is part of the northern Pacific coast minor shelf rockfish complex and the status of this complex is unknown.

Like bocaccio, non-listed yelloweye rockfish are still subject to a commercial fishery, but because of their life histories, recovery is expected to be slow. The Puget Sound population is protected by measures that have removed many of the threats such as direct harvest and bycatch.

6.2.7.2 Threats

Yelloweye rockfish and bocaccio were once part of a vibrant recreational and commercial groundfish fishery in Puget Sound. Because all rockfish species are an important part of the food web, actions to support rockfish recovery would benefit the Puget Sound ecosystem. For instance, larval rockfish are a food source for juvenile salmon and other marine fish and seabirds.

Rockfish are vulnerable to overfishing because many species do not begin to reproduce until they are 5-20 years old, and very few of their young survive to adulthood. Bocaccio can live over 50 years, and yelloweye rockfish approach up to 150 years. These traits make them susceptible to overfishing and habitat degradation.

Washington State has closed many commercial fisheries that caught rockfish incidentally, and there is no direct commercial harvest of them in Puget Sound. Recreationally, targeting or retaining any species of rockfish in Puget Sound waters east of the Port Angeles area is not allowed.

6.2.8 Pacific Eulachon

Eulachon are small smelt native to eastern North Pacific waters from the Bering Sea to Monterey Bay, California, or from 61º N to 31º N (Hart and McHugh 1944, Eschmeyer et al. 1983, Minckley et al. 1986, Hay and McCarter 2000). Eulachon that spawn in rivers south of the Nass River of British Columbia to the Mad River of California comprise the southern population of Pacific eulachon.

6.2.8.1 Status

This species status is classified as “at moderate risk of extinction throughout all of its range” (Gustafson et al. 2010) based upon timing of runs and genetic distinctions (Hart and McHugh 1944, McLean et al. 1999, Hay and McCarter 2000, McLean and Taylor 2001, Beacham et al. 2005). Based on a number of data sources, the 2016 Status Review Update for eulachon reports that the spawning population has increased between 2011 and 2015 and that of the size of some sub-populations is larger than originally estimated in 2010 (Gustafson et al. 2016). The status update does not recommend a change in status because it is too early to tell whether recent improvements in the southern DPS of eulachon will persist. Recent poor ocean conditions taken with given variability inherent in wild populations suggest that population declines may again become widespread in the upcoming return years.

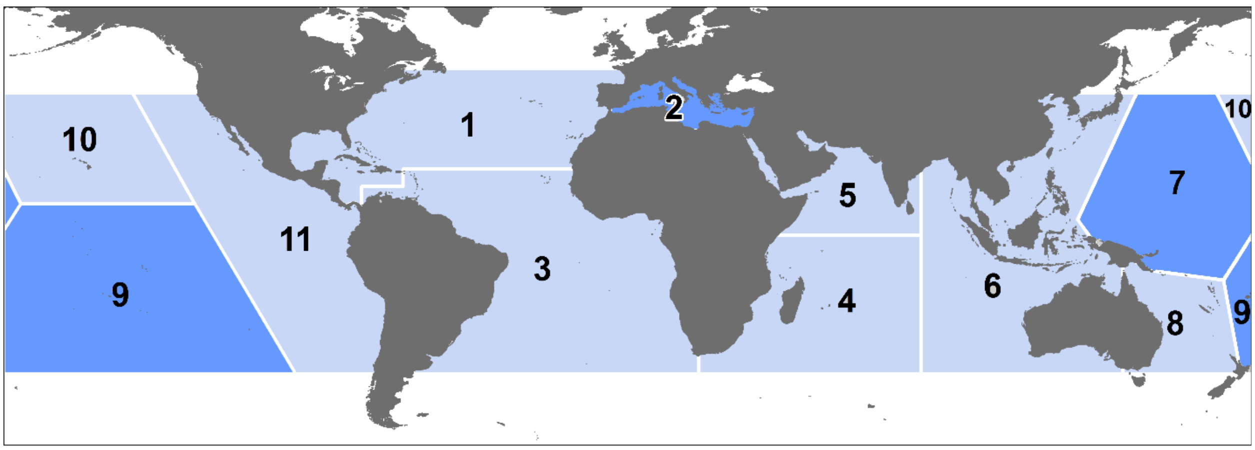
6.2.8.2 Threats

The Biological Review Team 2010 assessment of the status of the southern DPS of eulachon ranked climate change impacts on ocean conditions as the most serious threat to the persistence of eulachon in all four subareas of the DPS: Klamath River, Columbia River, Fraser River, and British Columbia coastal rivers south of the Nass River. Climate change impacts on freshwater habitat and eulachon bycatch in offshore shrimp fisheries were also ranked in the top four threats in all subareas of the DPS. Dams and water diversions in the Klamath and Columbia rivers and predation in the Fraser and British Columbia coastal rivers filled out the last of the top four threats (Gustafson et al. 2010).

6.2.9 Green Sea Turtles

The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters, occurring throughout tropical, subtropical and, to a lesser extent, temperate waters (Figure 10). The north Atlantic and east Pacific DPSs are the two that occur within the action area of this program.

Figure 9. Green sea turtle global distribution and depiction of each DPS range.



Threatened (light blue) and endangered (dark blue) green turtle DPSs:
1. North Atlantic, 2. Mediterranean, 3. South Atlantic, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11. East Pacific.

6.2.9.1 Status

Once abundant in tropical and subtropical waters, globally, green sea turtles exist at a fraction of their historical abundance, as a result of over-exploitation. The North Atlantic DPS is characterized by geographically widespread nesting with eight sites having high levels of abundance (i.e., <1,000 nesters). Nesting is reported in 16 countries and/or U.S. Territories at 73 sites. This region is data rich and has some of the longest running studies on nesting and foraging turtles anywhere in the world. All major nesting populations demonstrate long-term increases in abundance. The prevalence of FP has reached epidemic proportions in some parts of the North Atlantic DPS. The extent to which this will affect the long-term outlook for green turtles in the North Atlantic DPS is unknown and remains a concern, although nesting trends across the DPS continue to increase despite the high incidence of the disease. There are still concerns about future risks, including habitat degradation (particularly coastal development), bycatch in fishing gear, continued turtle and egg harvesting, and climate change.

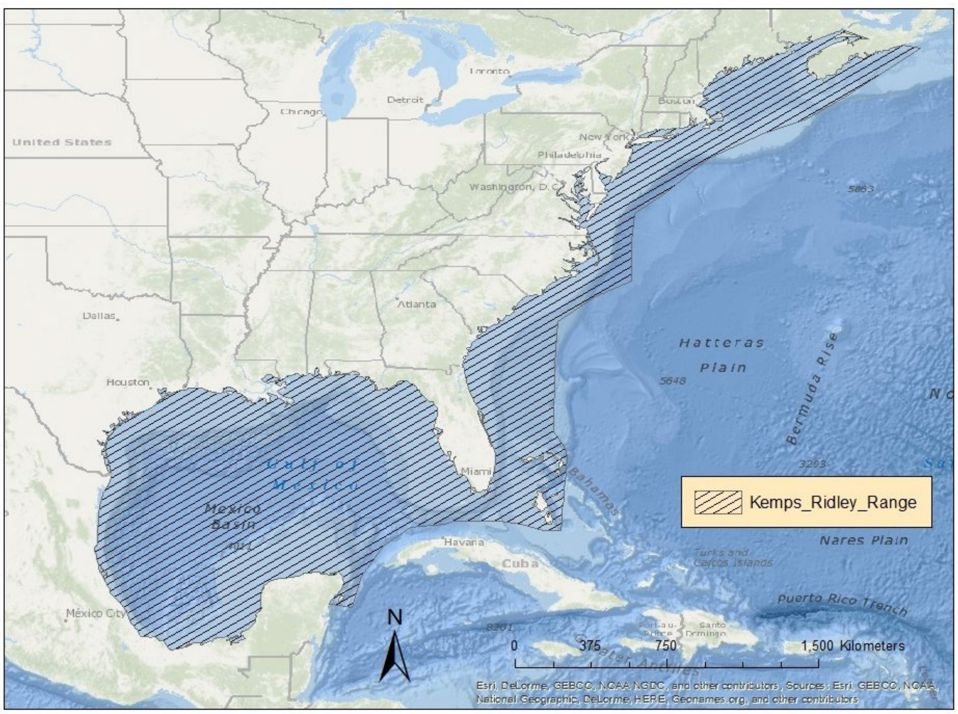
6.2.9.2 Threats

Green sea turtles face a number of threats including harvest of both adults and eggs, disease, bycatch, pollution, and loss of nesting habitat. The biggest of those threats is likely bycatch and occurs worldwide. Nesting habitat is lost when beaches are armored but also when natural beaches have unnatural light sources to disorient hatchlings. Fibropapillomatosis is a common disease that can lead to death if the tumors block the turtle's eyes or mouth.

6.2.10 Kemp's Ridley Sea Turtle

The Kemp's ridley turtle's range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas (Figure 11).

Figure 10. Range of Kemp's ridley sea turtle.



Kemp's ridley sea turtles the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell.

6.2.10.1 Status

The Kemp's ridley is the smallest of all sea turtle species and considered to be the most endangered sea turtle, internationally (Groombridge 1982, TEWG 2000). The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1973. According to the 2015 status review (NMFS and USFWS 2013a), population growth rate (as measured by numbers of nests) stopped abruptly after 2009. Given the recent lower nest numbers, the population is not projected to grow at former rates. An unprecedented mortality in subadult and adult females post-2009 nesting season may have altered the 2009 age structure and momentum of the population, which had a carryover impact on annual nest numbers in 2011 2014. The results indicate the population is not recovering and cannot meet recovery goals unless survival rates improve. The Deep Water Horizon oil spill that occurred at the onset of the 2010 nesting season and exposed Kemp's ridleys to oil in nearshore and offshore habitats may have been a factor in fewer females nesting in subsequent years, however this is still under evaluation. The long-term impacts from the Deep Water Horizon oil spill and response to the spill (e.g., dispersants) to sea turtles are not yet known. Given the Gulf of Mexico is an area of high-density offshore oil exploration and extraction, future oil spills are highly probable and Kemp's ridleys and their habitat may be exposed and injured. Commercial and recreational fisheries continue to pose a substantial threat to the Kemp's ridley despite measures to reduce bycatch. Kemp's ridley sea turtles have the highest rate of interaction with fisheries operating in the Gulf of Mexico and Atlantic Ocean than any other species of turtle.

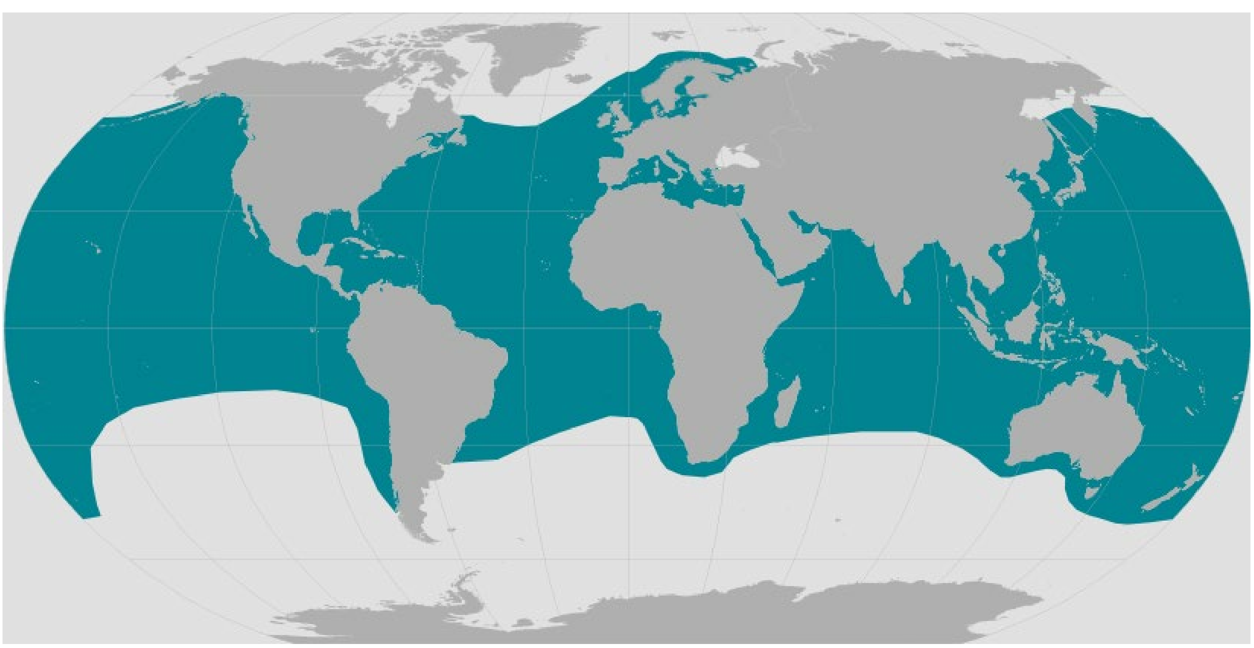
6.2.10.2 Threats

Kemp's ridley sea turtles are primarily captured as bycatch in shrimp trawls, but are also captured by recreational fishermen, gill nets, traps, and pots. They can also be killed by dredges. On nesting beaches in Mexico, their eggs are harvested for food. They also face threats from pollution in the ocean; often resulting in death if they ingest plastics, like balloons and plastic bags, mistakenly.

6.2.11 Leatherback Sea Turtle

The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 13).

Figure 11. Leatherback sea turtle range.



6.2.11.1 Status.

The global population of adult females has declined over 70 percent in less than one generation, from an estimated 115,000 adult females in 1980 to 34,500 adult females in 1995 (Pritchard 1982, Spotila et al. 1996). There may be as many as 34,000 – 94,000 adult leather backs in the North Atlantic, alone (TEWG 2007), but dramatic reductions (> 80 percent) have occurred in several populations in the Pacific, which was once considered the stronghold of the species (Sarti Martinez 2000). The 2013 five-year review (NMFS and USFWS 2013a) reports that the East Pacific and Malaysia leatherback populations have collapsed, yet Atlantic populations generally appear to be stable or increasing. Many explanations have been provided to explain the disparate population trends, including fecundity and foraging differences seen in the Pacific, Atlantic, and Indian Oceans. Since the last 5-year review, studies indicate that high reproductive output and consistent and high quality foraging areas in the Atlantic Ocean have contributed to the stable or recovering populations; whereas prey abundance and distribution may be more patchy in the Pacific Ocean, making it difficult for leatherbacks to meet their energetic demands and lowering their reproductive output. Both natural and anthropogenic threats to nesting and marine habitats continue to affect leatherback populations, including the 2004 tsunami in the Indian Ocean, 2010 oil spill in the U.S. Gulf of Mexico, logging practices, development, and tourism impacts on nesting beaches in several countries.

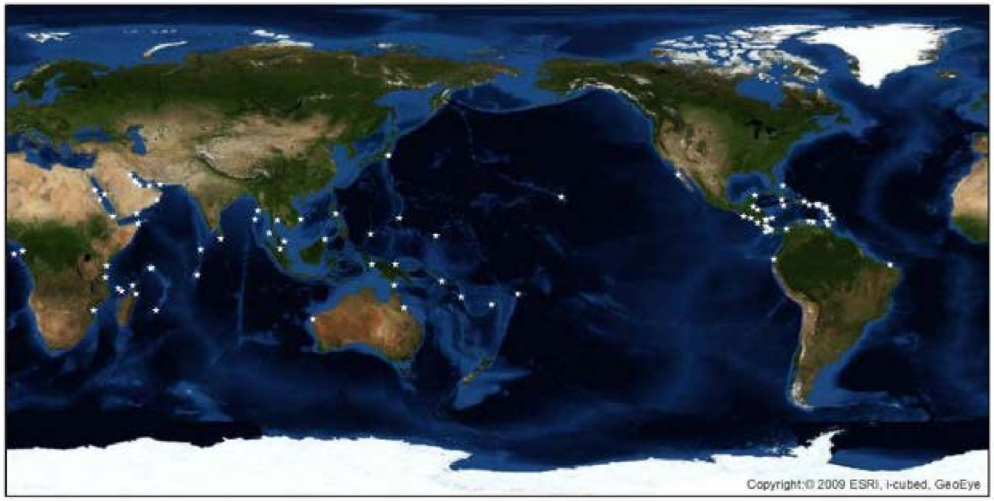
6.2.11.2 Threats

Due to their global distribution, leatherback sea turtles face numerous threats. In many smaller countries, such as Papua New Guinea, Solomon Islands, and Vanuatu, sea turtle eggs are harvested for food. At other times, adult leatherback sea turtles are also killed for food because of their size. But the biggest threats to leatherback sea turtles in the US are likely bycatch, vessel strikes, and loss of nesting beach habitat.

6.2.12 Hawksbill Sea Turtles

The hawksbill sea turtle has a sharp, curved, beak-like mouth. It has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans (Figure 14).

Figure 12. Hawksbill sea turtle global nesting distribution.



6.2.12.1 Status

The hawksbill turtle was once abundant in tropical and subtropical regions throughout the world. Over the last century, this species has declined in most areas and stands at only a fraction of its historical abundance. According to the 2013 status review (NMFS and USFWS 2013b), nesting populations in the eastern Pacific, and the Nicaragua nesting population in the western Caribbean appears to have improved. However, the trends and distribution of the species throughout the globe largely is unchanged. Although greatly depleted from historical levels, nesting populations in the Atlantic in general are doing better than in the Indian and Pacific Oceans. In the Atlantic, more population increases have been recorded in the insular Caribbean than along the western Caribbean mainland or the eastern Atlantic. In general, hawksbills are doing better in the Indian Ocean (especially the southwestern and northwestern Indian Ocean) than in the Pacific Ocean. The situation for hawksbills in the Pacific Ocean is particularly dire, despite the fact that it still has more nesting hawksbills than in either the Atlantic or Indian Oceans.

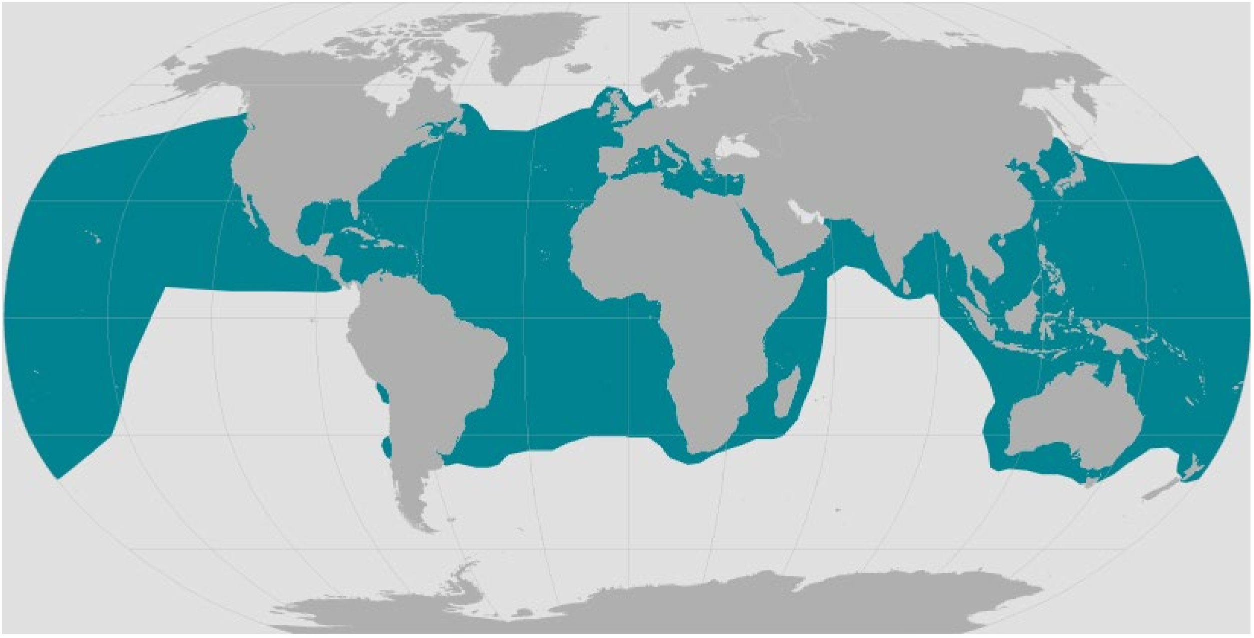
6.2.12.2 Threats

The historical decline of the species is primarily attributed to centuries of exploitation for the beautifully patterned shell, which made it a highly attractive species to target (Parsons 1972). Since that time, like for other sea turtle species, bycatch, habitat loss, intentional harvest, vessel strikes, and pollution threaten their existence. Habitat loss globally is likely the biggest threat, particularly nesting habitat due to loss of beaches.

6.2.13 Loggerhead Sea Turtles

Loggerheads are found throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Figure 15). Nine Distinct Population Segments of loggerhead sea turtles are listed under the Endangered Species Act. Only two DPSs are located in the action area of this program. On the Atlantic Coast, 80% of nesting occurs on a 20 mile stretch of Florida that is not proposed for sampling. On the Pacific Coast, most nesting occurs in Mexico with California supporting important juvenile rearing habitat. They can be found as far north as Alaska.

Figure 13. Global distribution of loggerhead sea turtles.



6.2.13.1 Status

Based on the 2009 status review (Conant et al. 2009), for both populations in the action area (Northwest Atlantic Ocean and North Pacific Ocean), analyses indicate a high likelihood of quasi-extinction. Similarly, threat matrix analysis indicated that all other DPSs have the potential for a severe decline in the future. While there are approximately 70,000 to 90,000 nests per year in the US, most of these are in a 20 mile stretch along Florida's coast.

6.2.13.2 Threats

The greatest threat to loggerhead sea turtles is bycatch in commercial fisheries. They are primarily captured in trawl gears, but also on longlines, gill nets, and pound nets. In some cases, they are intentionally targeted and harvested for their meat. While those are the two primary threats, they also can be seriously injured or killed by pollution and marine debris.

6.2.14 Olive Ridley Sea Turtles

Olive ridley sea turtles are primarily pelagic but will move into bays and estuaries. Olive ridley sea turtles have long migrations between their pelagic locations and nesting locations, sometimes occurring as many as 2,400 miles from shore. Despite the long distances, they nest annually.

6.2.14.1 Status

The olive ridley sea turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution. The species was listed under the ESA on July 28, 1978. The species was separated into two listing designations: endangered for breeding populations on the Pacific coast of Mexico, and threatened wherever found except where listed as endangered (i.e., in all other areas throughout its range). The status review (NMFS and USFWS 2014), indicates that, based on the current number of olive ridleys nesting in Mexico, three populations appear to be stable (Mismaloya, Tlacoyunque, and Moro Ayuta), two increasing (Ixtapilla, La Escobilla) and one decreasing

(Chacahua). Elsewhere in the eastern Pacific, the large scale synchronized nesting populations (i.e., arribada) have declined since the 1970s. Nesting at some arribada beaches continues to decline (e.g., Nancite in Costa Rica) and is stable or increasing at others (e.g., Ostional in Costa Rica). There are too few data available from solitary nesting beaches to confirm the declining trend that has been described for numerous countries throughout the region including El Salvador, Guatemala, Costa Rica, and Panama. Recent at-sea estimates of density and abundance of the olive ridley in the Pacific show a yearly estimate of 1.39 million (Confidence Interval: 1.15 to 1.62 million), which is consistent with the increases seen on nesting beaches as a result of protection programs that began in the 1990s.

Western Atlantic arribada nesting populations are currently very small. The Suriname olive ridley population is currently small and has declined by more than 90 percent since the late 1960s. However, nesting is reported to be increasing in French Guiana. The other nesting population in Brazil, for which no long-term data are available, is small, but increasing. In the eastern Atlantic, long-term data are not available and thus the abundance and trends of this population cannot be assessed at this time. In the northern Indian Ocean, arribada nesting populations are still large, but trend data are ambiguous and major threats continue. Declines of solitary nesting olive ridleys have been reported in Bangladesh, Myanmar, Malaysia, Pakistan, and southwest India.

6.2.14.2 Threats

Olive ridley sea turtles nest in massive gatherings called arribadas. Because of this behavior, females and eggs are concentrated in locations, leading to mass killings of adult females and harvest of eggs. In addition to direct harvest, bycatch, vessel strikes, and ocean pollution are also major threats.

7 ENVIRONMENTAL BASELINE

The "environmental baseline" is the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, 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 which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline. (50 CFR 402.02)

Estuaries and nearshore areas within the Atlantic, Pacific, and Gulf coasts have undergone significant physical, biological, and ecological changes over the past few centuries. These changes are primarily the result of human population growth and associated activities that have drastically altered the natural environment in this region. This section provides an overview of several past and ongoing anthropogenic threats to ESA-listed species within the action area.

7.1 Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Effects of climate change include sea level rise, increased frequency and magnitude of severe weather events, changes in air and water temperatures, and changes in precipitation patterns, all of which are likely to impact ESA resources. NOAA's climate information portal provides basic background information on these and other measured or anticipated climate change effects (see https://www.climate.gov).

In order to evaluate the implications of different climate outcomes and associated impacts throughout the 21st century, many factors have to be considered. The amount of future greenhouse gas emissions is a key variable. Developments in technology, changes in energy generation and land use, global and regional economic circumstances, and population growth must also be considered. Additionally, the effects of global climate change affect abiotic conditions in the action area in specific ways, which must be considered at a global scale, but ultimately focused on localized consequences.

Global annually averaged surface air, land, and ocean surface temperature, as calculated by linear trend, has increased by about 1.8 degrees Fahrenheit (1.0 degrees Celsius) over the last 115 years (1901 to 2016) (Wuebbles et al. 2017, Hayhoe 2018). This period is now the warmest in the history of modern civilization. These global trends are expected to continue over climate timescales. The magnitude of climate change beyond the next few decades will depend primarily on the amount of greenhouse gases (especially carbon dioxide) emitted globally. A set of four scenarios was developed by the Intergovernmental Panel on Climate Change (IPCC) to ensure that starting conditions, historical data, and projections are employed consistently across the various branches of climate science. The scenarios are referred to as representative concentration pathways (RCPs), which capture a range of potential greenhouse gas emissions pathways and associated atmospheric concentration levels through 2100 (IPCC 2014). The RCP scenarios drive climate model projections for temperature, precipitation, sea level, and other variables: RCP2.6 is a stringent mitigation scenario; RCP4.5 and RCP6.0 are intermediate scenarios; and RCP8.5 is a scenario with no mitigation or reduction in the use of fossil fuels. IPCC future global climate predictions and national and regional climate predictions included in the Fourth National Climate Assessment for U.S. states and territories (USGCRP 2018) use the RCP scenarios. The increase of global mean surface temperature change by 2100 is projected to be 0.3 to 1.7°C under RCP2.6, 1.1 to 2.6°C under RCP4.5, 1.4 to 3.1°C under RCP6.0, and 2.6 to 4.8°C under RCP8.5 with the Arctic region warming more rapidly than the global mean under all scenarios (IPCC 2014).

Changes in surface, atmospheric, and oceanic temperatures and other climatic changes have resulted in melting glaciers, diminishing snow cover, shrinking sea ice, rising sea levels, ocean acidification, and increasing atmospheric water vapor. Global average sea level has risen by about seven to eight inches since 1900, with almost half (about three inches) of that rise occurring since 1993. Human-caused climate change has made a substantial contribution to this rise since 1900, contributing to a rate of rise that is greater than during any preceding century in at least 2,800 years (Wuebbles et al. 2017). Global sea level rise has already affected the U.S.; the incidence of daily tidal flooding is accelerating in more than 25 Atlantic and Gulf Coast cities. Global average sea levels are expected to continue to rise by at least several inches in the next 15 years and by one to four feet by 2100. Sea level rise will be higher than the global average on the East and Gulf Coasts of the U.S. (Wuebbles et al. 2017). Climate change has been linked to changing ocean currents as well. Rising carbon dioxide levels have been identified as a reason for a poleward shift in the Eastern Australian Current, shifting warm waters into the Tasman Sea and altering biotic features of the area (Poloczanska et al. 2009). Similarly, the Kuroshio Current in the western North Pacific (an important foraging area for juvenile sea turtles) has shifted southward as a result of altered long-term wind patterns over the Pacific Ocean (Poloczanska et al. 2009).

More locally, impacts of global climate change has led to changes in air and sea surface temperatures, which can affect marine ecosystems in several ways. Direct effects decrease in sea ice and changes in ocean acidity, precipitation patterns, and sea level. Indirect effects of climate change include altered reproductive seasons/locations, shifts in migration patterns, reduced distribution and abundance of prey, and changes in the abundance of competitors and/or predators. Variations in sea surface temperature can affect an ecological community's composition and structure, alter migration and breeding patterns of fauna and flora and change the frequency and intensity of extreme weather events. For species that undergo long migrations, individual movements are usually associated with prey availability or habitat suitability. If either is disrupted, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott. 2009). Over the long term, increases in sea surface temperature can also reduce the amount of nutrients supplied to surface waters from the deep sea leading to declines in productivity and trophic abundance (EPA 2010). Acevedo-Whitehouse and Duffus (2009) proposed that the rapidity of environmental changes, such as those resulting from global warming, can harm immunocompetence and reproductive parameters in wildlife to the detriment of population viability and persistence.

The potential for invasive species to spread may increase under the influence of climatic change. If water temperatures warm in marine ecosystems, native species may shift poleward to cooler habitats, opening ecological niches that can be occupied by invasive species introduced via ships ballast water or other sources (Ruiz et al. 1999, Philippart et al. 2011). Invasive species that are better adapted to warmer water temperatures can also outcompete native species that are physiologically geared towards lower water temperatures (Lockwood and Somero 2011). Altered ranges can also result in the spread of novel diseases to new areas via shifts in host ranges (Simmonds and Eliott. 2009). For example, it has been suggested that increases in harmful algal blooms could result from increases in sea surface temperature (Simmonds and Eliott. 2009). Moore et al. (2011) estimated that the impacts of a dinoflagellate establishment would likely intensify with a warming climate, resulting in roughly 13 more days of potential bloom conditions per year by the end of the 21st century.

Climate change will likely have its most pronounced effects on vulnerable species whose populations are already in tenuous positions (Williams et al. 2008). For instance, climate change poses considerable risk for anadromous species, who return to their natal rivers to spawn. While many species may be able to shift their habitats, if spawning and rearing habitats become inhospitable, an essential component of survival is lost, threatening the long-term survival of salmonids and sturgeon. As such, we expect the risk of extinction to listed species to rise with the degree of climate shift associated with global warming. Increasing atmospheric temperatures have already contributed to documented changes in the quality of freshwater, coastal, and marine ecosystems and to the decline of endangered and threatened species populations (Mantua et al. 1997, Karl 2009).

Changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish), ultimately affecting primary foraging areas of ESA-listed species including marine mammals, sea turtles, and fish. Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2011). Hazen et al. (2013) examined top predator distribution and diversity in the Pacific Ocean in light of rising sea surface temperatures using a database of electronic tags and output from a global climate model. They predicted up to a 35 percent change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses. Notably, leatherback turtles were predicted to gain core habitat area, whereas loggerhead turtles and blue whales were predicted to experience losses in available core habitat. McMahon and Hays (2006) predicted increased ocean temperatures will expand the distribution of leatherback turtles into more northern latitudes. The authors noted this is already occurring in the Atlantic Ocean. MacLeod (2009) estimated, based upon expected shifts in water temperature, 88 percent of cetaceans will be affected by climate change, with 47 percent predicted to experience unfavorable conditions (e.g., range contraction). Willis-Norton et al. (2015) acknowledged there will be both habitat loss and gain, but overall climate change could result in a 15 percent loss of core pelagic habitat for leatherback turtles in the eastern South Pacific Ocean.

Sea turtles occupy a wide range of terrestrial and marine habitats, and many aspects of their life history have been demonstrated to be closely tied to climatic variables such as ambient temperature and storminess (Hawkes et al. 2009). Sea turtles have temperature-dependent sex determination, and many populations produce highly female-biased offspring sex ratios, a skew likely to increase further with global warming (Newson et al. 2009, Patrício et al. 2017). Genetic analyses and behavioral data suggest that populations with temperature-dependent sex determination may be unable to evolve rapidly enough to counteract the negative fitness consequences of rapid global temperature change (Hays 2008 as cited in Newson et al. 2009). Altered sex ratios have been observed in sea turtle populations worldwide (Mazaris et al. 2008, Reina et al. 2008, Robinson et al. 2008, Fuentes et al. 2009a). This does not yet appear to have affected population viabilities through reduced reproductive success, although average nesting and emergence dates have changed over the past several decades by days to weeks in some locations (Poloczanska et al. 2009). Hayes et al. (2010) suggests that because of the increased frequency of male loggerhead breeding (based on visits to breeding sites) versus female breeding, the ability of males to breed with many females and the ability of females to store sperm and fertilize many clutches, skewed sex ratios due to climate change could be compensated for in some turtle populations and population effects may be ameliorated. However, such a fundamental shift in population demographics may cause a fundamental instability in the viability of some populations. In addition to altering sex ratios, increased temperatures in sea turtle nests can result in reduced incubation times (producing smaller hatchling), reduced clutch size, and reduced nesting success due to exceeded thermal tolerances (Fuentes et al. 2009b, Fuentes et al. 2010, Fuentes et al. 2011, Azanza-Ricardo et al. 2017).

Other climatic aspects, such as extreme weather events, precipitation, ocean acidification and sea level rise also have potential to affect marine turtle populations. Changes in global climatic patterns will likely have profound effects on the coastlines of every continent, thus directly impacting sea turtle nesting habitat (Wilkinson and Souter 2008). In some areas, increases in sea level alone may be sufficient to inundate turtle nests and reduce hatching success by creating hypoxic conditions within inundated eggs (Caut et al. 2009, Pike et al. 2015). Flatter beaches, preferred by smaller sea turtle species, would likely be inundated sooner than would steeper beaches preferred by larger species (Hawkes et al. 2014). Relatively small increases in sea level can result in the loss of a large proportion of nesting beaches in some locations. For example, a study in the northwestern Hawaiian Islands predicted that up to 40 percent of green turtle nesting beaches could be flooded with 0.9 meters of sea level rise (Baker et al. 2006). The loss of nesting beaches would have catastrophic effects on sea turtle populations globally if they are unable to colonize new beaches that form, or if the newly formed beaches do not provide the habitat attributes (sand depth, temperature regimes, refuge) necessary for egg survival.

Changing patterns of coastal erosion and sand accretion, combined with an anticipated increase in the number and severity of extreme weather events, may further exacerbate the effects of sea level rise on turtle nesting beaches (Wilkinson and Souter 2008). Climate change is expected to affect the intensity of hurricanes through increasing sea surface temperatures, a key factor that influences hurricane formation and behavior (EPA 2010). The intensity of tropical storms in the Atlantic Ocean, Caribbean, and Gulf of Mexico has risen noticeably over the past 20 years and six of the 10 most active hurricane seasons have occurred since the mid-1990s (EPA 2010). Extreme weather events may directly harm sea turtles, causing “mass” strandings and mortality (Poloczanska et al. 2009). Studies examining the spatio-temporal coincidence of marine turtle nesting with hurricanes, cyclones and storms suggest that cyclical loss of nesting beaches, decreased hatching success and hatchling emergence success could occur with greater frequency in the future due to global climate change (Hawkes et al. 2009). Pike et al. (2006) concluded that warming sea surface temperatures may lead to potential fitness consequences in sea turtles resulting from altered seasonality and duration of nesting. Sea turtles may expand their range as temperature-dependent distribution limits change (McMahon and Hays 2006). Warming ocean temperatures may extend poleward the habitat which sea turtles can utilize (Poloczanska et al. 2009).

7.2 Population Density, Development, and Land Use Changes

Because of the connectivity of rivers, many of the land use changes nationwide affect estuarine and nearshore marine habitat (Vannote et al. 1980). Many stream, riparian, and coastal areas have been degraded by the effects of land and water use associated with urbanization, road construction, forest management, agriculture, mining, transportation, water development, and other human activities. Development activities contribute to a variety of interrelated factors that lead to the impairment of estuarine habitat. These include reduced in-channel and off-channel habitat, restricted lateral channel movement, increased flow velocities, increased erosion, decreased cover, reduced prey sources, increased contaminants, increased water temperatures, degraded water quality, and decreased water quantity.

Urbanization and increased human population density within a watershed result in changes in stream habitat, water chemistry, and the biota (plants and animals) that live there. In many cases, these changes negatively impact species, particularly those with small population sizes. The most obvious effect of urbanization is the loss of natural vegetation, which results in an increase in impervious cover and dramatic changes to the natural hydrology of urban and suburban streams. Urbanization generally results in land clearing, soil compaction, modification and/or loss of riparian buffers, and modifications to natural drainage features. The increased impervious cover in urban areas leads to increased volumes of runoff, increased peak flows and flow duration, and greater stream velocity during storm events.

Runoff from urban areas also contains chemical pollutants from vehicles and roads, industrial sources, and residential sources. Urban runoff is typically warmer than receiving waters and can significantly increase temperatures, particularly in smaller streams. Municipal wastewater treatment plants replace septic systems, resulting in point discharges of nutrients and other contaminants not removed in the processing. Municipalities with combined sewer/stormwater overflows or older treatment systems may directly discharge untreated sewage following heavy rainstorms. Urban and suburban nonpoint and point source discharges affect water quality and quantity in basin surface waters. Dikes and levees constructed to protect infrastructure and agriculture have isolated floodplains from their river channels and restricted fish access. The many miles of roads and rail lines that parallel streams within the action area have degraded stream bank conditions and decreased floodplain connectivity by adding fill to floodplains. Culvert and bridge stream crossings have similar effects and create additional problems for fish when they act as physical or hydraulic barriers that prevent fish access to spawning or rearing habitat, or contribute to adverse stream morphological changes upstream and downstream of the crossing itself.

Coastal development can deter or interfere with sea turtle nesting, affect nest success, and degrade nesting habitat. Many nesting beaches have already been significantly degraded or destroyed. Nesting habitat is threatened by rigid shoreline protection or “coastal armoring” such as sea walls, rock revetments, and sandbag installations. Many miles of once productive nesting beach have been permanently lost to this type of shoreline protection. Nesting habitat can be also reduced by beach nourishment projects, which result in altered beach and sand characteristics, affecting nesting activity and success. In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009). Hawksbill turtles prefer to nest under vegetation and are, therefore, particularly affected by beachfront development and clearing of dune vegetation (Mortimer and Donnelly 2007). The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the sea (Witherington 1992).

In summary, the negative effects of population growth, development, and land use changes on ESA-listed species within the action area are widespread and have continued to increase over time. Stressors associated with these activities will continue to hinder species recovery efforts.

7.3 Dredging

Estuarine and nearshore coastal areas are often dredged to support commercial shipping, recreational boating, construction of infrastructure, and marine mining. Negative indirect effects of dredging include changes in dissolved oxygen and salinity gradients in and around dredged channels (Campbell and Goodman 2004; Jenkins et al. 1993; Secor and Niklitschek 2001). Adult shortnose sturgeon can tolerate at least short periods of low DO and high salinities, but juveniles are less tolerant of these conditions in laboratory studies (Jenkins et al. 1993). Collins et al. (2000) concluded harbor modifications in the lower Savannah River have altered hydrographic conditions for juvenile sturgeon by extending high salinities and low DO upriver.

Dredging and filling operations impact important habitat features of anadromous fish as they disturb benthic fauna, eliminate deep holes, and alter rock substrates (Smith and Clugston 1997). Dredging operations may also pose risks to anadromous fish species by destroying or adversely modifying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments. Nellis et al. (2007) documented that dredge spoil drifted 12 km downstream over a ten-year period in the Saint Lawrence River, and that those spoils have significantly less macrobenthic biomass compared to control sites and are avoided by foraging fish (McQuinn and Nellis 2007).

In addition to indirect impacts, hydraulic dredging can directly harm anadromous fish and sea turtles by lethally entraining them through the dredge drag-arms and impeller pumps. Sturgeon (Hastings 1983, Moser and Ross 1995, Dickerson 2006, ASSRT 2007) and sea turtles (Reine and Clarke 1998, Murray 2011, Goldberg et al. 2015) have been documented being killed by dredges.

7.4 Ship Strikes

Marine habitats occupied by ESA-listed species often feature both heavy commercial and recreational ship traffic. Ship strikes represent a recognized threat to large, air breathing marine species including sea turtles. This threat is increasing as commercial shipping lanes cross important breeding and feeding habitats and as ESA-listed species populations recover and populate new areas or areas where they were previously extirpated (Swingle et al. 1993; Wiley et al. 1995). As ships continue to become faster and more widespread, an increase in ship interactions with ESA-listed species is expected.

Sea turtles must surface to breathe and several species are known to bask at the surface for long periods making them more susceptible to ship strike. Sturgeon and salmonids will swim pelagically for all or part of their lives. Ship strikes of fish depends in large part on the size of the fish, where larger fish are more likely to be hit and injured, while smaller fish are likely to move through the props without being hit. Ship strikes have been identified as one of the important mortality factors in nearshore turtle and sturgeon habitats worldwide (ASSRT 2007, Denkinger et al. 2013). However, available information is sparse regarding the overall magnitude of this threat or the impact on listed species populations. Evidence suggests sturgeon do not move towards or away from vessel traffic (Balazik et al. 2020) and that some sea turtles may rely more heavily on auditory cues than visual, making them more susceptible to strikes by fast moving vessels (Hazel et al. 2007).

High levels of ship traffic in nearshore areas along the US coasts result in frequent sea turtle and sturgeon ship strikes. The incidence of propeller wounds of stranded turtles from the US. Atlantic and Gulf of Mexico doubled from about ten percent in the late 1980s to about twenty percent in 2004. Singel et al. (2007) reported a tripling of boat strike injuries in Florida from the 1980's to 2005. Likewise, increasing vessel traffic appears to affect the number of sturgeon struck by vessels in estuaries (Hudson Riverkeeper 2015, Demetras et al. 2020). These studies suggest that the threat of ship strikes to sea turtles and sturgeon may be increasing over time as ship traffic continues to increase in the US. The lack of reports of salmonids and ship strikes suggests their small body size and quicker maneuverability makes them less likely to be struck.

7.5 Fisheries Bycatch

Commercial bycatch is not thought to be a major source of mortality for Gulf of Maine DPS Atlantic salmon. Beland (1984) reported that fewer than 100 salmon per year were caught incidental to other commercial fisheries in the coastal waters of Maine. A more recent study found that bycatch of Maine Atlantic salmon in herring fisheries is not a significant mortality source (ICES 2004). Commercial fisheries for white sucker, alewife, and American eel conducted in state waters also have the potential to incidentally catch Atlantic salmon.

Recreational angling occurs for many freshwater fish species throughout the range of the Gulf of Maine DPS Atlantic salmon. As a result, Atlantic salmon can be incidentally caught (and released) by anglers targeting other species such as striped bass or trout. The potential also exists for anglers to misidentify juvenile Atlantic salmon as brook trout, brown trout, or landlocked salmon. A maximum length for landlocked salmon and brown trout (25 inches) has been adopted in Maine in an attempt to avoid the accidental harvest of sea-run Atlantic salmon due to misidentification.

Fisheries directed at unlisted Pacific salmonid populations, hatchery produced fish, and other species have caused adverse impacts to threatened and endangered salmonid populations. Incidental harvest rates for listed Pacific salmon and steelhead vary considerably depending on the particular ESU/DPS and population units. Bycatch represents one of the major threats to recovery as incidental harvest rates still remain as high as 50 percent-70 percent for some populations (NWFSC 2015). Freshwater fishery impacts on naturally-produced salmon have been markedly reduced in recent years through implementation of mark-selective fisheries (NWFSC 2015).

Take of Southern DPS green sturgeon in federal fisheries was prohibited as a result of the ESA 4(d) protective regulations issued in 2010 (75 FR 30714; June 2, 2010). Green sturgeon are occasionally encountered as bycatch in Pacific groundfish fisheries (Al-Humaidhi 2011), although the impact of these fisheries on green sturgeon populations is estimated to be small (NMFS 2012). The NMFS (2012) estimates between 86 and 289 Southern DPS green sturgeon are annually encountered as bycatch in the state-regulated California halibut bottom trawl fishery.

Approximately 50 to 250 green sturgeon are encountered annually by recreational anglers in the lower Columbia River (NMFS 2015), of which 86 percent are expected to be Southern DPS green sturgeon based on the higher range estimate of Israel (Israel et al. 2009). In Washington, recreational fisheries outside of the Columbia River may encounter up to 64 Southern DPS green sturgeon annually (Hughes, K, WDFW pers. comm. January 30, 2015 cited in NMFS 2015). Southern DPS green sturgeon are also captured and released by California recreational anglers. Based on self-reported catch card data, an average of 193 green sturgeon were caught and released annually by California anglers from 2007-2013 (green sturgeon 5-year review). Recreational catch and release can potentially result in indirect effects on green sturgeon, including reduced fitness and increased vulnerability to predation. However, the magnitude and impact of these effects on Southern DPS green sturgeon are not well studied.

Directed harvest of Atlantic sturgeon is prohibited by the ESA. However, sturgeon are taken incidentally in fisheries targeting other species in rivers, estuaries, and marine waters along the east coast, and are probably targeted by poachers throughout their range (Collins et al. 1996) (ASSRT 2007). Commercial fishery bycatch is a significant threat to the viability of listed sturgeon species and populations. Bycatch could have a substantial impact on the status of Atlantic sturgeon, especially in rivers or estuaries that do not currently support a large subpopulation (< 300 spawning adults per year). Reported mortality rates of sturgeon (Atlantic and shortnose) captured in inshore and riverine fisheries range from 8 percent to 20 percent (Collins et al. 1996) (Bahn et al. 2012).

Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. Atlantic sturgeon originating from the five DPSs considered in this consultation are at risk of bycatch related mortality in fisheries operating in the action area and beyond. Sturgeon are benthic feeders and as a result they are generally captured near the seabed unless they are actively migrating (Moser and Ross 1995). Atlantic sturgeon are particularly vulnerable to being caught in commercial gill nets, therefore fisheries using this type of gear account for a high percentage of Atlantic sturgeon bycatch and bycatch mortality. An estimated 1,385 individual Atlantic sturgeon were killed annually from 1989-2000 as a result of bycatch in offshore gill net fisheries operating from Maine through North Carolina (Stein et al. 2004b). Sturgeon are also taken in trawl fisheries, though recorded captures and mortality rates are thought to be low.

From 2001-2006 an estimated 649 Atlantic sturgeon were killed annually in offshore gill net and otter trawl fisheries. From 2006-2010 an estimated 3,118 Atlantic sturgeon were captured annually in Northeast fisheries, resulting in approximately 391 mortalities (Miller and Shepherd 2011).

7.6 Non-Native and Invasive Species

When non-native plants and animals are introduced into habitats where they do not naturally occur they are typically less suited to compete in that environment. However, in degraded habitats, non-native species may be better suited to utilize resources as native species struggle to endure changing abiotic conditions. These non-native species can have significant impacts on ecosystems and native fauna and flora. Non-native species can be introduced through infested stock for aquaculture and fishery enhancement, ballast water discharge, and from the pet and recreational fishing industries. Non-native species can reduce native species abundance and distribution, and reduce local biodiversity by out-competing native species for food and habitat. They may also displace food items preferred by native predators, disrupting the natural food web. The introduction of non-native species is considered one of the primary threats to ESA-listed species (Wilcove and Chen 1998). Non-native species were cited as a contributing cause in the extinction of 27 species and 13 subspecies of North American fishes over the past 100 years (Miller et al. 1989).

The introduction of invasive blue and flathead catfish along the Atlantic coast has the potential to adversely affect ongoing anadromous fish restoration programs and native fish conservation efforts, including Atlantic sturgeon restoration in mid-Atlantic and south Atlantic river basins (Brown et al. 2005, Kahn, J., NMFS Office of Protected Resources, presentation at 2016 Atlantic and Shortnose Sturgeon Workshop). Recent studies suggest that invasive species may reduce prey resources for Southern DPS green sturgeon (NMFS 2015). Green sturgeon may have difficulty feeding in substrate that has been invaded by Japanese eelgrass, which negatively impacts habitat for burrowing shrimp a common sturgeon prey item (NMFS 2015). Similarly, the invasive isopod (*U. pugettensis*) could also impact blue mud shrimp, another green sturgeon prey item (NMFS 2015).

Natural predator-prey relationships in aquatic ecosystems in Maine have been substantially altered by non-native species interactions. Several non-native fish species have been stocked throughout the range of Gulf of Maine DPS of Atlantic salmon. Those that are known to prey upon Atlantic salmon include smallmouth bass, largemouth bass, chain pickerel, northern pike, rainbow trout, brown trout, splake, yellow perch, and white perch (Baum 1997). Yellow perch, white perch, and chain pickerel were historically native to Maine, although their range has been expanded by stocking and subsequent colonization. Dams create slow water habitat that is preferred by chain pickerel and concentrate emigrating smolts in these head ponds by slowing migration speeds (McMenemy and Kynard 1988, Spicer et al. 1995). Brown trout, capable of consuming large numbers of stocked Atlantic salmon fry, have contributed to the decline of several native salmonid populations in North America (Moyle 1976, Alexander 1977, Alexander 1979, Taylor et al. 1984, Fay 2006).

Introduction of non-native species on the West Coast has resulted in increased salmonid predation in many river and estuarine systems. Native resident salmonid populations have also been affected by releases of non-native hatchery reared salmonids. The introduced northern pikeminnow is a significant predator of yearling juvenile Chinook migrants. Chinook salmon represented 29 percent of northern pikeminnow prey in lower Columbia reservoirs, 49 percent in the lower Snake River, and 64 percent downstream of Bonneville Dam (Friesen and Ward 1999). An ongoing northern pikeminnow management program has been in place since 1990 to reduce predation-related juvenile salmonid mortality. The rapid expansion of pikeminnow populations in the Pacific Northwest is believed to have been facilitated by alterations in habitat conditions (particularly increased water temperatures) that favor this species (Brown et al. 1994).

7.7 Dams

Dams are used to impound water for water resource projects such as hydropower generation, irrigation, navigation, flood control, industrial and municipal water supply, and recreation. Dams can also have profound effects on anadromous species by fragmenting populations, impeding access to spawning and foraging habitat, and altering natural river hydrology and geomorphology, water temperature regimes, and sediment and debris transport processes (Pejchar and Warner 2001; Wheaton et al. 2004). The loss of historic habitat ultimately affects anadromous fish in two ways: 1) it forces fish to spawn in sub-optimal habitats that can lead to reduced reproductive success and recruitment, and 2) it reduces the carrying capacity (physically) of these species and affects the overall health of the ecosystem (Patrick 2005). Physical injury and direct mortality occur as fish pass through turbines, bypasses, and spillways. Indirect effects of passage through all routes may include disorientation, stress, delay in passage, exposure to high concentrations of dissolved gases, elevated water temperatures, and increased vulnerability to predation. Activities associated with dam maintenance, such as dredging and minor excavations along the shore, can release silt and other fine river sediments that can be deposited in downstream spawning habitat. Dams can also reduce habitat diversity by forming a series of homogeneous reservoirs; these changes generally favor different predators, competitors and prey, than were historically present in the system (Auer 1996).

The detrimental effects of dams on populations of sturgeon are generally well documented (Cooke and Leach 2004; Kynard 1998). Migrations of sturgeon in rivers without barriers are wide-ranging with total distances exceeding 200 km or more, depending on the river system (Kynard 1997). Although some rivers have dams constructed at the fall line that have not impacted sturgeon spawning, in other rivers dams have blocked sturgeon upriver passage, restricting spawning activities to areas below the impoundment and leaving sturgeon vulnerable to perturbations of natural river conditions at different life stages (Cooke and Leach 2004; Kynard 1997). Sturgeon spawning sites remain unknown for the majority of rivers in their range. Observations of sturgeon spawning immediately below dams, further suggests that they are unable to reach their preferred spawning habitat upriver. Overall, 91 percent of historic Atlantic sturgeon habitat seems to be accessible, but the quality of the remaining portions of habitat as spawning and nursery grounds is unknown, therefore estimates of percentages of availability do not necessarily equate to functionality (ASSRT 2007).

Many rivers in California, Oregon, Washington, and Idaho have dams ranging from small, temporary dams to large hydroelectric dams. The resultant impact has been a significant modification in the seasonal flow patterns of area rivers and streams, and the volume and quality of water delivered to downstream habitat. Several rivers have been hydromodified by other means including levees and revetments, and bank hardening for erosion control, and agricultural uses. Dams limit upstream passage of salmonids to spawning locations and then affect juveniles and smolts as they move downstream as they are killed in turbines or from supersaturation of dissolved gases (Mathur et al. 1996, Johnson et al. 2007).

7.8 Marine Debris

Marine debris has become a widespread threat for a wide range of marine species that are increasingly exposed to it on a global scale. Plastic is the most abundant material type worldwide, accounting for more than 80 percent of all marine debris (Poeta et al. 2017). The most common impacts of marine debris are associated with ingestion or entanglement and both types of interactions can cause the injury or death of animals of many different species. Ingestion occurs when debris items are intentionally or accidentally eaten (e.g. through predation on already contaminated organisms or by filter feeding activity, in the case of large filter feeding marine organisms, such as whales) and enter in the digestive tract. Ingested debris can damage digestive systems and plastic ingestion can also facilitate the transfer of lipophilic chemicals (especially persistent organic pollutants) into an animal's body. An estimated 640,000 tons of fishing gear is lost, abandoned, or discarded at sea each year throughout the world's oceans (Macfadyen et al. 2009). These "ghost nets" drift in the ocean and can fish unattended for decades (ghost fishing), killing large numbers of marine animals through entanglement.

Marine debris is a significant concern for ESA-listed species, particularly sea turtles. The initial developmental stages of all turtle species are spent in the open sea. During this time both juvenile turtles and their buoyant food are drawn by advection into fronts (convergences, rips, and drift lines). The same process accumulates large volumes of marine debris, such as plastics and lost fishing gear, in ocean gyres (Carr 1987). An estimated four to twelve million metric tons of plastic enter the oceans annually (Jambeck et al. 2015). It is thought that some sea turtles eat plastic because it closely resembles jellyfish, a common natural prey item (Schuyler 2014). Ingestion of plastic debris can block the digestive tract which can cause turtle mortality as well as sub-lethal effects including dietary dilution, reduced fitness, and absorption of toxic compounds (Lutcavage et al. 1997, Laist et al. 1999).

Santos et al. (2015) found that a surprisingly small amount of plastic debris was sufficient to block the digestive tract of sea turtles and cause death. They reported that 10.7 percent of green turtles in Brazilian waters were killed by plastic ingestion, while 39.4 percent had ingested enough plastic to have killed them. These results suggest that debris ingestion is a potentially important source of turtle mortality, one that may be masked by other causes of death. Gulko and Eckert (2003) estimated that between one-third and one-half of all sea turtles ingest plastic at some point in their lives. A more recent study by Schuyler et al. (2016) estimates that 52 percent of sea turtles globally have ingested plastic debris. Schuyler et al. (2016) synthesized the factors influencing debris ingestion by turtles into a global risk model, taking into account the area where turtles are likely to live, their life history stage, the distribution of debris, the time scale, and the distance from stranding location. They found that oceanic life stage turtles are at the highest risk of debris ingestion. Based on this model, olive ridley turtles are the most at-risk species; green, loggerhead, and leatherback turtles were also found to be at a high and increasing risk from plastic ingestion (Schuyler 2014).

7.9 Non-native Species Introductions

Invasive species have been referred to as one of the top four threats to the world's oceans (Pughiuc 2010, Raaymakers 2003, Raaymakers and Hilliard 2002, Terdalkar et al. 2005, Wambiji et al. 2007). A variety of vectors are thought to have introduced non-native species from aquarium and pet trades, recreation, and ballast water discharges from ocean-going vessels. Common impacts of invasive species are alteration of habitat and nutrient availability, as well as altering species composition and diversity within an ecosystem (Strayer 2010).

There appears to be a correlation between habitat disturbance and the susceptibility to invasions. Jewett et al. (2005) experimentally found that low dissolved oxygen levels (common in the Chesapeake Bay) resulted in invasive species establishing in a new area, to the detriment of dominant native taxa prior to low dissolved oxygen levels. Many researchers have also documented the eutrophic conditions of the Chesapeake Bay influence the propensity of species to invade. This situation tends to lead to low light levels, which make some invasive species, such as the submerged and emergent aquatic plants outlined above more competitive with native varieties (Barko and Smart 1981, Grace and Harrison 1986, Marks et al. 1994, Ruiz et al. 1999).

Shifts in the base of food webs, a common result of the introduction of invasive species, can fundamentally alter predator-prey dynamics up and across food chains (Moncheva and Kamburska 2002), potentially affecting prey availability and habitat suitability for ESA-listed species. For example, the Asian tiger prawn was introduced to the Gulf of Mexico and poses a significant threat to native shrimp, crabs, and mollusks as a predator. It also is known to carry diseases not native to certain areas of the Gulf (e.g., the Texas coast) that could infect and devastate native shrimp and blue crab populations. Since loggerhead sea turtles in coastal waters are omnivorous and known to feed on crabs and mollusks (Graham et al. 2003; NMFS 2010), the invasion of Asian tiger prawn could affect food availability for loggerheads in coastal areas of the Gulf of Mexico.

San Francisco Bay has 234 recorded exotic species (Cohen and Carlton 1998, Foss et al. 2007). Introduced fishes have also greatly affected the San Francisco Bay ecosystem. Striped bass, largemouth bass, smallmouth bass, bluegill, and green sunfish are all introduced species to the area, although largely through means other than ballast water discharge (Cohen and Carleton 1995). Cohen and Carleton (1995) documented that these fishes have led to the extinction of four native fish species not only in the Bay, but throughout their range either directly through predation or indirectly through competition for prey and/or breeding sites. These predatory fish also impact listed salmonids. And ironically, striped bass themselves are impacted by invasive species, with juvenile abundance declining in association with declines in their primary prey species, mysid shrimp, likely due to effects caused by other introduced species in the Bay (Nobriga and Feyrer 2008).

Ruiz et al. (1999) suggest 196 invasive species have established in the Chesapeake Bay. Two invasive aquatic plants, *Hydrilla verticillata* and *Myriophyllum spicatum*, have received significant attention in the Chesapeake Bay. They form dense mats, alter aquatic chemical and habitat characteristics, fish and invertebrate communities, compete with native plants, and change the food base available for local waterfowl and fishes (Ruiz et al. 1999). Also noteworthy is that the cover provided by *Hydrilla* spp. provides additional refuge for smaller fishes, which can increase the populations of larger predatory species (Killgore et al. 1989, Ruiz et al. 1999). *Trapa natans*, a floating plant, at one time also outcompeted native plant species to the detriment of fishes and waterfowl, but has not recovered from an eradication program in the 1930s (Ruiz et al. 1999).

8 EFFECTS OF THE ACTION

Section 7 regulations define "effects of the action" as all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that 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 C.F.R. §402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The destruction and adverse modification analysis considers whether the action produces "a direct or indirect alteration that appreciably diminished the value of critical habitat as a whole for the conservation of a listed species." Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." 50 C.F.R. 402.02.

In this section, we revisit the potential stressors, identified in Section 4, associated with the proposed action, the probability of individuals of ESA-listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in Section 2 of this opinion, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the ESA-listed species those populations represent. For this consultation, we are particularly concerned with the consequences of interactions with research gear. The purpose of this assessment and, ultimately, of this consultation is to determine if it is reasonable to expect the proposed action to have effects on ESA-listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

8.1 Exposure Analysis

Exposure analyses identify the ESA-listed species that are likely to co-occur with the actions' effects on the environment in space and time, and identify the nature of that co-occurrence. The exposure analysis also identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the actions' effects and the population(s) or subpopulation(s) those individuals represent.

The NCCA program intends to sample in estuaries around the US, with a weighted sampling design to prioritize certain high priority estuaries every 5 years. As discussed in Section 6, most activities are benign and are not likely to adversely affect any listed species in the sampling area. However, the methods used to capture target species, identified in Tables 1-4 can use the most effective methods from seine netting, gill netting, trawling, trap netting, or hook and line sampling.

While any sampling method may be used at the discretion of the team leader, in 2015 under the same program, hook and line was used 44% of the time, trawl 39%, gill net 6%, gill net with hook and line 6%, baited scup pots 2%, and seine or cast net the remaining 3%. Gill nets and trawls pose the greatest threats to listed species, though hook and line could affect salmonids.

The program sampling locations for 2020 are identified in Table 5 and should be similar in future NCCA program sampling. The number of sampling locations by state overlapping with listed species habitat are Rhode Island (19), Massachusetts (41), New York (31), Long Island Sound (66), Florida (10), Mississippi (21), Louisiana (84), California (57), and Washington (60). The sampling sites in Rhode Island, Massachusetts, New York, and Long Island Sound overlap with shortnose and Atlantic sturgeon habitats. Perdido Bay and Pensacola, the location of the sampling in Florida, along with Mississippi and Louisiana may have sea turtles, Gulf sturgeon, or smalltooth sawfish. The sampling locations in California and Washington may have salmonids and green sturgeon present. The sampling events that could affect each species group are calculated in Table.

Table 9. Sampling site frequency of overlap with each species.

Species Group	Overlapping Sampling Sites
Atlantic and shortnose sturgeon	157
Gulf sturgeon	115
Green sturgeon	117
Salmonids	117
Sea turtles	115
Smalltooth sawfish	115
Pacific eulachon	117
Boccacio/rockfish	60

Given the frequency of sampling events, calculating the capture probability of each listed species during each sampling event can provide a likely estimate of the number of individuals likely to be captured while carrying out this program. During the previous sampling events associated with the NCCA program, no listed species have been captured. Because of the limited number of sampling sites, the short duration of sampling at each site, and the relative rarity of listed species, the probabilities of interactions are not high, but they are likely. The capture probability for Atlantic and green sturgeon will not exceed 1% and is likely less. Smalltooth sawfish, given their rarity in most of the sampling locations will not have a capture probability exceeding 0.5%. Likewise, shortnose sturgeon being amphidromous and Gulf sturgeon, being primarily resident in freshwater reaches during summer months will have capture probabilities not exceeding 0.5%. Given that summer appears to be when salmonids and Pacific eulachon are rare along the coast, we also anticipate the capture probability not to exceed 0.5%. Bocaccio and yelloweye rockfish are more likely to be present in habitats outside of the sampling depths and therefore the probability of capturing one on any given net set is less than 0.5%. And given the observers stationed on each boat, we do not anticipate the capture probability for sea turtles to exceed 0.5%. Therefore, after rounding to integer counts, we anticipate as many as two Atlantic sturgeon of any DPS, one shortnose sturgeon, one Gulf sturgeon, one green sturgeon, one of any salmon ESU, one of any steelhead DPS, one of any listed entity of sea turtles, and one smalltooth sawfish will be captured.

8.2 Response Analysis

Given the exposure estimated above, in this section we describe the range of responses among that may result from the stressors associated with the research activities.

Sturgeon are susceptible to capture in gillnet and trawl gear. Most sturgeon bycatch occurs in shallow nearshore water (Dunton et al. 2015). Their scutes can become easily entangled in gill net mesh and they have few natural predators due to their size, so they are slow to respond to the capture process during trawling. Trawls for research are typically run for relatively short times compared to those for commercial harvest. Commercial trawling generally has sturgeon bycatch mortality rates of approximately 5% (Stein et al. 2004, Beardsall et al. 2013). Additionally, Dunton et al. (2015) showed that most East Coast bycatch occurs during aggregation periods during the spring and fall. Additionally, Gulf sturgeon move into riverine habitat during the summer, so would only rarely be present in estuarine areas being sampled in the summer.

In the event a green, Gulf, Atlantic, or shortnose sturgeon were captured in trawl or gill net gear, the expected response would be capture and release of a live and healthy fish. This is because soak or trawl times are much less than used for commercial fisheries and because both of these gears have been used successfully for sampling sturgeon during directed research efforts with minimal risks to the individual.

Sea turtles can also be captured in gill nets and trawls (Zollett 2009, Byrd et al. 2011, Casale et al. 2014, Liles et al. 2017). Commercial trawls had such high turtle mortality that turtle excluder devices were developed to minimize bycatch in trawls. In the worst of scenarios, the response is mortality. In gill nets set for long periods of time, entangled turtles will drown. For commercial trawls, turtles can be captured underwater for over an hour and die or in other cases, pull them up too quickly resulting in gas embolism (Garcia-Párraga et al. 2014, Fahlman et al. 2017). However, when gill net soaks or trawl times are of short duration, sea turtles can be harassed or stressed by capture, but no mortality would be expected. Because sampling will be conducted primarily in water less than 30 m deep, gas embolism will also not be a problem.

Smalltooth sawfish are commonly captured by hook and line, so frequently in fact that monitoring recreational bycatch has become a primary way to estimate juvenile abundance (Wiley and Simpfendorfer 2010). They have also been documented as recent bycatch in trawl fisheries (Simpfendorfer 2002) and because of their long saw, are vulnerable to capture in gill nets. Gill nets and long lines are the primary methods used to directly sample for smalltooth sawfish. Because sampling will be of short duration, the anticipated response to capture would only be the capture itself and a stress response that would not exceed harassment (no injuries expected).

Bocaccio and yelloweye rockfish experienced population collapse and ended up being protected because they can be so easily exploited by the fishing gears used to sample the target species (Bjorkland et al. 2015). Because of the depth they are typically captured, bycatch survival is typically low (Drake et al. 2010). However, the NCCA program will not be sampling similar depths as typical groundfish trawls, so any bycaught rockfish species would not be expected to die as a result of capture and would be more likely to be released alive.

Salmon, steelhead, and Pacific eulachon bycatch has been monitored in groundfish trawls for years (Bellman and Hastie 2008, Bellman et al. 2010, Lomeli and Wakefield 2012). These fish typically leave their natal rivers and move offshore quickly or are present in nearshore areas as they return to spawn. This leads to seasonal presence in nearshore areas. Summer tends to be a time of relatively low nearshore abundance, but bycatch is still recorded then. Bycatch tends to be more common around San Francisco Bay than in more northern locations along the US coast (Bellman and Hastie 2008, Bellman et al. 2010). Bycatch rates in these areas tends to be low; approximately 2 salmon per thousand metric tons of target fish. Salmonids are also susceptible to capture in gill nets and during selective gill net efforts in tribal fisheries, bycaught salmon are released alive 95% of the time (Vander Haegen et al. 2004). In addition to responding to being captured, salmonids that escape capture but interact with fisheries gear have been documented to die between 10 and 30% of the time (Ryer 2002). Because of the short duration of the sampling under the NCCA program, salmonid response to capture is expected to be a live release 95% of the time with an additional equal likelihood of interacting with gear and not being captured. Therefore, we expect twice as many salmonids as are captured to be affected by sampling gear and approximately 5% those two interactions to be mortalities while all others will escape or be released alive but stressed.

8.3 Risk Analysis

In this section we assess the consequences of the responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise.

Whereas the *Response Analysis* identified the potential responses of ESA-listed species to the proposed action, this section summarizes our analysis of the expected risk to individuals, populations, and species given the expected exposure to those stressors and the expected responses to those stressors.

We measure risks to individuals of endangered or threatened species using changes in the individuals' fitness, which may be indicated by changes the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect ESA-listed animals exposed to an action's effects to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise.

The NCCA program is likely to capture two Atlantic, one shortnose, one Gulf, and one green sturgeon. The expected responses of those captures are to be increased stress, but released alive. No post-release mortality is expected. The short-term stress response to the capture activity is not likely to affect any individual sturgeon's overall fitness or reproductive potential.

The NCCA program is likely to capture one Pacific anadromous fish from any of the Pacific eulachon, Upper Columbia River spring run Chinook salmon ESU, Snake River spring/summer Chinook salmon ESU, Snake River fall run Chinook salmon ESU, Upper Willamette River spring run Chinook salmon ESU, Lower Columbia River Chinook salmon ESU, Puget Sound Chinook salmon ESU, California Coastal Chinook salmon ESU, Central Valley spring run Chinook salmon ESU, Sacramento River winter run Chinook salmon ESU, Lower Columbia River coho salmon ESU, Oregon Coast coho salmon ESU, Southern Oregon/Northern California Coast coho salmon ESU, Central California Coast coho salmon ESU, Snake River sockeye salmon ESU, Ozette Lake sockeye salmon ESU, Hood Canal summer run chum salmon ESU, Columbia River chum salmon ESU, Upper Columbia River steelhead DPS, Snake River steelhead DPS, Middle Columbia River steelhead DPS, Upper Willamette River steelhead DPS, Lower Columbia River steelhead DPS, Puget Sound steelhead DPS, Northern California steelhead DPS, Central California Coast steelhead DPS, South Central California Coast steelhead DPS, and Southern California steelhead DPS. Additionally, one fish from those ESUs or DPSs is expected to interact with the research gear without being captured. Approximately 5% of these two (salmonids of any listed entity) are expected to be mortalities.

The NCCA program is likely to capture one no more than one bocaccio or yelloweyed rockfish. The expected response of the bycatch event is stress and harassment, but not injury or death. No post release mortality is expected. The short-term stress response to the capture activity is not likely to affect any individual rockfish's overall fitness or reproductive potential.

The NCCA program is likely to capture no more than one of any of the North Atlantic DPS green sea turtle, East Pacific DPS green sea turtle, Kemp's ridley sea turtle, Leatherback sea turtle, hawksbill sea turtle, Northwest Atlantic Ocean DPS loggerhead sea turtle, North Pacific Ocean DPS loggerhead sea turtle, Pacific Coast of Mexico breeding populations of olive ridley sea turtle, and all other populations of olive ridley sea turtles. This bycatch event is expected to cause increased stress, but will be released alive. No post-release mortality is expected. The short-term stress response to the capture activity is not likely to affect any individual sea turtle's overall fitness or reproductive potential.

The NCCA program is likely to capture no more than one smalltooth sawfish. The expected response of being captured is increased stress followed by a live release. No post-release mortality is expected. The short-term stress response to the capture activity is not likely to affect any individual smalltooth sawfish's overall fitness or reproductive potential.

9 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action areas of the Federal actions subject to consultation (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.

During this consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what has already been described in the Environmental Baseline, which we expect will continue in the future. Anthropogenic effects include climate change, ship strikes, sound, fisheries, dams, and pollution. An increase in these activities could result in an increased effect on ESA-listed species; however, the magnitude and significance of any anticipated effects remain unknown at this time. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance.

10 Integration and Synthesis

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the *Effects of the Action* (Section 8) to the *Environmental Baseline* (Section 7) and the *Cumulative Effects* (Section 9) to formulate the agency's biological opinion as to whether the proposed action is likely to reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution. These assessments are made in full consideration of the *Status of the Species and Critical Habitat* (Section 6). Where species determinations were made in the *Status of the Species and Critical Habitat* (Section 6), they are not discussed further here because the stressors associated with this action are not likely to adversely affect those species or critical habitats (see Table 7).

10.1 Survival and Recovery of Sturgeon

The proposed action may non-lethally take up to 2 Atlantic, 1 shortnose, 1 Gulf, and 1 green sturgeon during each 5-year period of the NCCA program. Because the program samples estuarine and nearshore areas and Atlantic sturgeon are highly migratory, aggregating in mixed groups (O'Leary et al. 2014, Wirgin et al. 2015), the 2 Atlantic sturgeon could be from any DPS.

The status of the 5 Atlantic sturgeon DPSs is somewhat varied. There are limited abundance estimates, but estimates of effective population sizes (Waldman et al. 2018) lead us to believe the Hudson and Altamaha rivers may support the largest populations in the US while the York, Roanoke, and Connecticut rivers support the smallest populations. Recent annual spawning run estimates in the Hudson River are likely fewer than 500 individuals (Kazyak et al. 2020) and the spawning abundance in the Altamaha River may be as large as 1,000 individuals (Peterson et al. 2008, Ingram and Peterson 2016). These are extremely imperiled populations. That said, recent survival estimates for these populations are approximately 85-90% per year (ASMFC 2017). There is no indication of increasing or decreasing populations of Atlantic sturgeon. Capturing up to 2 individuals from along the entire coast with no anticipated mortality or effects to individual fitness is unlikely to have meaningful effects to any Atlantic sturgeon population. Because no meaningful effects to populations are anticipated, there are not expected to be measurable effects at the species level either. We do not expect the distribution of any DPS of Atlantic sturgeon to be affected, nor do we anticipate a significant reduction in numbers or reproduction of this species as a result of the action. And therefore, the likelihood of survival and recovery in the wild will not be diminished.

Shortnose sturgeon do not tend to migrate very far from their natal rivers, spending much less time in nearshore waters than Atlantic sturgeon. Therefore, the riverine populations likely to be affected by the NCCA are most likely the Hudson, Connecticut, or Merrimack Rivers. The Hudson River supports the largest population of shortnose sturgeon while the Merrimack River may support the smallest population. Several populations of shortnose sturgeon apper to be at or near carrying capacity, even if well below their historical abundance. However, the non-lethal capture of a single shortnose sturgeon is not expected to have any individual fitness level effects or affect future reproductive success. Therefore, we do not expect the NCCA program to have a measurable effect on shortnose sturgeon. We do not expect the distribution of shortnose sturgeon to be affected, nor do we anticipate a significant reduction in numbers or reproduction of this species as a result of the action. And therefore, the likelihood of survival and recovery in the wild will not be diminished.

Gulf sturgeon, like other sturgeons, have different sized populations with the largest population in the Suwannee River, Florida and the smallest population in the Pearl River, Louisiana. The non-lethal capture of a single Gulf sturgeon is not expected to have any individual fitness level effects or affect future reproductive success. Therefore, we do not expect the NCCA program to have a measurable effect on Gulf sturgeon at the species level. We do not expect the distribution of Gulf sturgeon to be affected, nor do we anticipate a significant reduction in numbers or reproduction of this species as a result of the action. And therefore, the likelihood of survival and recovery in the wild will not be diminished.

The southern DPS of green sturgeon primarily spawns in the Sacramento River system with some possible smaller spawning populations in coastal rivers in northern California. The non-lethal capture of a single green sturgeon is not expected to have any individual fitness level effects or affect future reproductive success. Therefore, we do not expect the NCCA program to have a measurable effect on green sturgeon. We do not expect the distribution of green sturgeon to be affected, nor do we anticipate a significant reduction in numbers or reproduction of this species as a result of the action. And therefore, the likelihood of survival and recovery in the wild will not be diminished.

10.2 Survival and Recovery of Salmonids and Pacific Eulachon

The NCCA is likely to capture one Pacific anadromous fish and affect without capturing another. The two affected fish may be from any of Pacific eulachon, the Upper Columbia River spring run Chinook salmon ESU, Snake River spring/summer Chinook salmon ESU, Snake River fall run Chinook salmon ESU, Upper Willamette River spring run Chinook salmon ESU, Lower Columbia River Chinook salmon ESU, Puget Sound Chinook salmon ESU, California Coastal Chinook salmon ESU, Central Valley spring run Chinook salmon ESU, Sacramento River winter run Chinook salmon ESU, Lower Columbia River coho salmon ESU, Oregon Coast coho salmon ESU, Southern Oregon/Northern California Coast coho salmon ESU, Central California Coast coho salmon ESU, Snake River sockeye salmon ESU, Ozette Lake sockeye salmon ESU, Hood Canal summer run chum salmon ESU, Columbia River chum salmon ESU, Upper Columbia River steelhead DPS, Snake River steelhead DPS, Middle Columbia River steelhead DPS, Upper Willamette River steelhead DPS, Lower Columbia River steelhead DPS, Puget Sound steelhead DPS, Northern California steelhead DPS, Central California Coast steelhead DPS, South Central California Coast steelhead DPS, or Southern California steelhead DPS. Approximately 5% of these two (Pacific anadromous fish of any listed entity) are expected to be mortalities, which amounts to one mortality in the next 50 years.

The five salmonid ESUs or DPSs with declining trends are the Upper Willamette River spring run Chinook salmon ESU, Upper Willamette River steelhead DPS, South Central California Coast steelhead DPS, Sacramento River winter run Chinook salmon ESU, and Puget Sound Chinook salmon ESU. Of those, the Sacramento River winter run Chinook salmon ESU is listed as endangered while the others are threatened. Therefore, if the anticipated take levels are not likely to jeopardize the Sacramento River winter run Chinook salmon ESU, this action would not be expected to compromise the likelihood of survival and recovery of any ESU or DPS of Pacific anadromous fish.

The Sacramento winter run Chinook salmon ESU had an abundance of approximately 7,569 adults spawning in 2019 based on estimates from carcass surveys (PFMC 2020). This number of returning adults is a drastic improvement over the previous 3 years (mean = 1,099) and in line with spawning abundance estimates from 2001-2003. Even if we assume the numbers from earlier years may be similar to the 2020 spawning returns, the non-lethal capture of two individuals would not be expected to have any individual fitness level effects or affect future reproductive success. Their fitness would only be affected by capture if the capture event killed them. It is extremely unlikely that a salmon is killed by the NCCA research program. We anticipate one death is likely every 10 sampling seasons, or every 50 years. The death of one Sacramento River winter run salmon from the NCCA every 50 years is not likely to reduce appreciably the likelihood of both the survival and recovery of the species. But given the relative abundances of the different salmonid species that are typically captured as bycatch, it is likely at this time of year to be either a coho or Chinook salmon from any listed or non-listed population, ESU, or DPS and not necessarily from the most endangered salmon population. We do not expect the distribution of any salmonid ESU or DPS to be affected, nor do we anticipate a significant reduction in numbers or reproduction of this species as a result of the action. And therefore, the likelihood of survival and recovery in the wild will not be diminished.

10.3 Survival and Recovery of Rockfish Species

The NCCA program is likely to incidentally capture no more than one bocaccio or yelloweyed rockfish. None of the listed populations are currently considered overfished and because of their protected status, are also not experiencing overfishing. They are however a very long-lived species group, so any mortality can take a long time from which to recover. However, because sampling is conducted at generally less than 30 m depth, any bycatch of rockfishes would not be lethal and the fish could be released alive. Because no mortality is anticipated, the effects to individual rockfishes would not result in diminished fitness or reproductive capacity. If individuals are not likely to have their fitness jeopardized, then this program will also not have a meaningful effect at the population or species level. We do not expect the distribution of any rockfish species to be affected, nor do we anticipate a significant reduction in numbers or reproduction of this species as a result of the action. And therefore, the likelihood of survival and recovery in the wild will not be diminished.

10.4 Survival and Recovery of Sea Turtles

The NCCA program is likely to incidentally capture no more than one sea turtle during their sampling. Sea turtle populations have been generally increasing, but some populations are still struggling. There is mitigation meant to protect sea turtles in the program itself, minimizing the likelihood of interactions. Further, the short duration of sets and relatively shallow areas sampled will also minimize the risk of any adverse effects to sea turtles in the event one is incidentally captured. Therefore, regardless of which sea turtle population is affected by the NCCA sampling, with no anticipated mortality or effects to individual fitness the program is unlikely to have meaningful effects to any sea turtle population. Because no meaningful effects to populations are anticipated, there are not expected to be measurable effects at the species level either. We do not expect the distribution of any sea turtle population to be affected, nor do we anticipate a significant reduction in numbers or reproduction of this species as a result of the action. And therefore, the likelihood of survival and recovery in the wild will not be diminished.

10.5 Survival and Recovery of Smalltooth Sawfish

The NCCA program is very unlikely to capture a smalltooth sawfish, but the likelihood is too high to consider the risk discountable. Smalltooth sawfish have been slowly increasing in population size and range, with sightings reported as far west as Louisiana and as far north as North Carolina. In the event a smalltooth sawfish is captured, the short soak times will allow the smalltooth sawfish to be released alive and unharmed. Because the expected response is just a stress response to being captured with no anticipated mortality or effects to individual fitness, the program is unlikely to have meaningful effects to any smalltooth sawfish population. Because no meaningful effects to populations are anticipated, there are not expected to be measurable effects at the species level either. We do not expect the distribution of smalltooth sawfish to be affected, nor do we anticipate a significant reduction in numbers or reproduction of this species as a result of the action. And therefore, the likelihood of survival and recovery in the wild will not be diminished.

11 Conclusion

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, effects of the action, and cumulative effects, it is NMFS' biological opinion that the proposed actions are not likely to reduce appreciably the likelihood of both the survival and recovery of the white abalone, black abalone, Guadalupe fur seal, southern resident killer whale, Gulf of Maine Atlantic sturgeon DPS, New York Bight Atlantic sturgeon DPS, Chesapeake Bay Atlantic sturgeon DPS, Carolina Atlantic sturgeon DPS, South Atlantic Atlantic sturgeon DPS, shortnose sturgeon, Gulf sturgeon, southern DPS of green sturgeon, smalltooth sawfish, Pacific eulachon, bocaccio, yelloweyed rockfish, Upper Columbia River spring run Chinook salmon ESU, Snake River spring/summer Chinook salmon ESU, Snake River fall run Chinook salmon ESU, Upper Willamette River spring run Chinook salmon ESU, Lower Columbia River Chinook salmon ESU, Puget Sound Chinook salmon ESU, California Coastal Chinook salmon ESU, Central Valley spring run Chinook salmon ESU, Sacramento River winter run Chinook salmon ESU, Lower Columbia River coho salmon ESU, Oregon Coast coho salmon ESU, Southern Oregon/Northern California Coast coho salmon ESU, Central California Coast coho salmon ESU, Snake River sockeye salmon ESU, Ozette Lake sockeye salmon ESU, Hood Canal summer run chum salmon ESU, Columbia River chum salmon ESU, Upper Columbia River steelhead DPS, Snake River steelhead DPS, Middle Columbia River steelhead DPS, Upper Willamette River steelhead DPS, Lower Columbia River steelhead DPS, Puget Sound steelhead DPS, Northern California steelhead DPS, Central California Coast steelhead DPS, South Central California Coast steelhead DPS, Southern California steelhead DPS, North Atlantic DPS green sea turtle, East Pacific DPS green sea turtle, Kemp's ridley sea turtle, Leatherback sea turtle, hawksbill sea turtle, Northwest Atlantic Ocean DPS loggerhead sea turtle, North Pacific Ocean DPS loggerhead sea turtle, Pacific Coast of Mexico breeding populations of olive ridley sea turtle, or all other populations of olive ridley sea turtles.

Additionally, the NCCA program will not destroy or adversely modify designated critical habitat of black abalone, Gulf sturgeon, southern DPS green sturgeon, bocaccio, Pacific eulachon, Upper Columbia River spring run Chinook salmon ESU, Snake River spring/summer Chinook salmon ESU, Snake River fall run Chinook salmon ESU, Upper Willamette River spring run Chinook salmon ESU, Lower Columbia River Chinook salmon ESU, Puget Sound Chinook salmon ESU, California Coastal Chinook salmon ESU, Central Valley spring run Chinook salmon ESU, Sacramento River winter run Chinook salmon ESU, Lower Columbia River coho salmon ESU, Oregon Coast coho salmon ESU, Southern Oregon/Northern California Coast coho salmon ESU, Central California Coast coho salmon ESU, Snake River sockeye salmon ESU, Ozette Lake sockeye salmon ESU, Hood Canal summer run chum salmon ESU, Columbia River chum salmon ESU, Upper Columbia River steelhead DPS, Snake River steelhead DPS, Middle Columbia River steelhead DPS, Upper Willamette River steelhead DPS, Lower Columbia River steelhead DPS, Puget Sound steelhead DPS, Northern California steelhead DPS, Central California Coast steelhead DPS, South Central California Coast steelhead DPS, Southern California steelhead DPS, or southern resident killer whales.

12 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Harass is further defined as an act that "creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (NMFSPD 02-110-19).

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of an incidental take statement.

This incidental take statement specifies the impact of any incidental taking of endangered or threatened species, as well as the specific levels of incidental take allowed. It also provides reasonable and prudent measures that are necessary or appropriate to minimize impacts of the take, and sets forth mandatory terms and conditions in order to implement the reasonable and prudent measures.

12.1 Amount or Extent of Take

For NCCA program, take is authorized for Gulf of Maine Atlantic sturgeon DPS, New York Bight Atlantic sturgeon DPS, Chesapeake Bay Atlantic sturgeon DPS, Carolina Atlantic sturgeon DPS, South Atlantic Atlantic sturgeon DPS, shortnose sturgeon, Gulf sturgeon, southern DPS of green sturgeon, smalltooth sawfish, Pacific eulachon, bocaccio, yelloweyed rockfish, Upper Columbia River spring run Chinook salmon ESU, Snake River spring/summer Chinook salmon ESU, Snake River fall run Chinook salmon ESU, Upper Willamette River spring run Chinook salmon ESU, Lower Columbia River Chinook salmon ESU, Puget Sound Chinook salmon ESU, California Coastal Chinook salmon ESU, Central Valley spring run Chinook salmon ESU, Sacramento River winter run Chinook salmon ESU, Lower Columbia River coho salmon ESU, Oregon Coast coho salmon ESU, Southern Oregon/Northern California Coast coho salmon ESU, Central California Coast coho salmon ESU, Snake River sockeye salmon ESU, Ozette Lake sockeye salmon ESU, Hood Canal summer run chum salmon ESU, Columbia River chum salmon ESU, Upper Columbia River steelhead DPS, Snake River steelhead DPS, Middle Columbia River steelhead DPS, Upper Willamette River steelhead DPS, Lower Columbia River steelhead DPS, Puget Sound steelhead DPS, Northern California steelhead DPS, Central

California Coast steelhead DPS, South Central California Coast steelhead DPS, Southern California steelhead DPS, North Atlantic DPS green sea turtle, East Pacific DPS green sea turtle, Kemp's ridley sea turtle, Leatherback sea turtle, hawksbill sea turtle, Northwest Atlantic Ocean DPS loggerhead sea turtle, North Pacific Ocean DPS loggerhead sea turtle, Pacific Coast of Mexico breeding populations of olive ridley sea turtle, or all other populations of olive ridley sea turtles. We anticipate the program will result in the take of ESA-listed as shown in Tables 10-14.

Table 10. Anticipated captures and resulting mortalities of sturgeon by the NCCA program during each 5-year cycle.

Species	Captures	Mortalities
Shortnose sturgeon	1	0
Gulf sturgeon	1	0
Southern DPS green sturgeon	1	0
Gulf of Maine DPS Atlantic sturgeon New York Bight DPS Atlantic sturgeon Chesapeake Bay DPS Atlantic sturgeon Carolina DPS Atlantic sturgeon South Atlantic DPS Atlantic sturgeon	2	0

Table 11. Anticipated captures and resulting mortalities of Pacific anadromous fish by the NCCA program during each 5-year cycle.

Species	Captures	Mortalities
Pacific eulachon Central CA coastal ESU coho salmon Oregon Coast ESU coho salmon Sourther OR/northern CA coast ESU coho salmon Lower Columbia River ESU coho salmon California coastal ESU Chinook salmon Central valley spring run ESU Chinook salmon Lower Columbia River ESU Chinook salmon Upper Columbia River spring-run ESU Chinook salmon Puget Sound ESU Chinook salmon Sacramento River winter-run ESU Chinook salmon Snake River fall-run ESU Chinook salmon Snake River spring/summer-run ESU Chinook salmon Upper Willamette River ESU Chinook salmon Columbia River ESU chum salmon Hood Canal summer-run ESU chum salmon Ozette Lake ESU sockeye salmon Snake River ESU sockeye salmon California Central Valley DPS steelhead Central California coast DPS steelhead	2	1 every 10 sampling events (approximately 50 years)

South-Central California coast DPS steelhead	
Southern California DPS steelhead	
Northern California DPS steelhead	
Lower Columbia River DPS steelhead	
Middle Columbia River DPS steelhead	
Upper Columbia River DPS steelhead	
Upper Willamette River DPS steelhead	
Snake River Basin DPS steelhead	
Puget Sound DPS steelhead	

Table 12. Anticipated captures and resulting mortalities of smalltooth sawfish by the NCCA program during each 5-year cycle.

Species	Captures	Mortalities
Smalltooth sawfish	1	0

Table 13. Anticipated captures and resulting mortalties of rockfish species by the NCCA program during each 5-year sampling cycle.

Species	Captures	Mortalities
Bocaccio Yelloweye Rockfish	1	0

Table 14. Anticipated captures and resulting mortalities of sea turtles by the NCCA program during each 5-year sampling cycle.

Species	Captures	Mortalities
North Atlantic DPS green sea turtle East Pacific DPS green sea turtle Kemp's ridley sea turtle Leatherback sea turtle Hawksbill sea turtle Northwest Atlantic Ocean DPS loggerhead sea turtle North Pacific Ocean DPS loggerhead sea turtle Pacific Coast of Mexico breeding populations of olive ridley sea turtle All other populations of olive ridley sea turtle	1	0

12.2 Reasonable and Prudent Measures

Reasonable and Prudent Measures (RPMs) are non-discretionary measures to minimize take that may or may not already be part of the description of the proposed action. They must be implemented as binding conditions for the exemption in section 7(o)(2) to apply. The NCCA program has a number of minimization and mitigation measures built in, minimizing the risks associated with their sampling protocols (Appendix 1). NMFS has a duty to ensure the monitoring, minimization, and mitigation measures included in the program are carried out appropriately. If the EPA fails to adhere to the terms and conditions of the incidental take statement, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. Activities which do not comply with all relevant RPMs will require further consultation.

NMFS believes it is necessary and appropriate to minimize take of listed species via monitoring and reporting to the NMFS Office of Protected Resources.

12.3 Terms and Conditions

The terms and conditions described below are non-discretionary, and EPA must comply with them in order to implement the RPMs (50 CFR 402.14). If the EPA does not comply with the following terms and conditions, protective coverage for the proposed action will lapse and thereby cause the EPA to be in violation of the ESA.

To be exempt from the prohibitions of section 9 of the ESA, EPA must:

1) Provide endangered species training, maintain records of interactions with NMFS trust resources, and report the record of those interactions at the completion of each NCCA sampling season;
2) Immediately contact NMFS Office of Protected Resources in the event the amount of take identified in Section 12.1 is exceeded to determine whether or how to safely proceed with sampling under the program.

13 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans or develop information (50 C.F.R. §402.02).

NMFS Office of Protected Resources does not have any Conservation Recommendations associated with EPA's Office of Water coastal condition assessment activities.

14 REINITIATION NOTICE

This concludes formal consultation for the Permits Division proposed issuance of Permit No. 17304-03. As 50 CFR 402.16 states, 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 incidental take is exceeded, (2) new information reveals effects of the agency action that may affect ESA-listed species or designated 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 ESA-listed species or designated critical habitat that was not considered in this opinion, or (4) a new species is ESA-listed or designated critical habitat designated that may be affected by the action.

15 References

Acevedo-Whitehouse, K., and A. L. J. Duffus. 2009. Effects of environmental change on wildlife health. Philosophical Transactions of the Royal Society of London B Biological Sciences 364(1534):3429-3438.

Adams, P. B., C. Grimes, J. E. Hightower, S. T. Lindley, and M. L. Moser. 2002. Population status of North American green sturgeon, *Acipenser medirostris*. National Marine Fisheries Service, Southwest Fisheries Science Centerm Santa Cruz, California, North Carolina Cooperative Fish and Wildlife Research Unit, United States Geological Survey, National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA.

Adams, P. B., C. Grimes, J. E. Hightower, S. T. Lindley, M. L. Moser, and M. J. Parsley. 2007. Population status of North American green sturgeon, *Acipenser medirostris*. Environmental Biology of Fishes 79:339-356.

Alexander, G. 1977. Food of vertebrate predators on trout waters in north central Lower Michigan. The Michigan Academician 10:181–195.

Alexander, G. 1979. Predators of fish in coldwater streams. Pages 153–170 in H. Stroud and H. Clepper, editors. Predator–prey systems in fisheries management: proceedings of the international symposium on predator-prey systems in fish communities and their role in fisheries management. Sport Fishing Institute, Washington, D.C.

Al-Humaidhi, A. 2011. Analysis of green sturgeon bycatch by sector and time in the West Coast Groundfish Fishery. 3pp. Included as Attachment 2 to: National Marine Fisheries Service. 2011. Endangered Species Act Section 7.

ASMFC (Atlantic States Marine Fisheries Commission). 2017. Atlantic sturgeon benchmark stock assessment and peer review report. Alexandria, Virginia.

ASSRT. 2007. Status Review of Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus). National Marine Fisheries Service, Northeast Regional Office.

Auer, N. A. 1996. Response of spawning lake sturgeons to change in hydroelectric facility operation. Transactions of the American Fisheries Society 125(1):66-77.

Azanza-Ricardo, J., M. E. I. Martín, G. G. Sansón, E. Harrison, Y. M. Cruz, and F. Bretos. 2017. Possible Effect of Global Climate Change on Caretta caretta (Testudines, Cheloniidae) Nesting Ecology at Guanahacabibes Peninsula, Cuba. Chelonian conservation and Biology.

Bahn, R. A., J. E. Fleming, and D. L. Peterson. 2012. Bycatch of Shortnose Sturgeon in the commercial American shad fishery of the Altamaha River, Georgia. North American Journal of Fisheries Management 32:557-562.

Baker, J. D., C. L. Littnan, and D. W. Johnston. 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. Endangered Species Research 2:21-30.

Balazik, M. T., K. J. Reine, A. J. Spells, C. A. Fredrickson, M. L. Fine, G. C. Garman, and S. P. McIninch. 2012. The potential for vessel interactions with adult Atlantic sturgeon in the James River, Virginia. North American Journal of Fisheries Management 32:1062-1069.

Balazik, M., M. Barber, S. Altman, K. Reine, A. Katzenmeyer, A. Bunch, G. Garman. 2020. Dredging activity associated sound have negligible effects on adult Atlantic sturgeon migration to spawning habitat in a large coastal river. PLoS ONE 15(3):e0230029.

Barko J. W. and R. M. Smart. 1981. Comparative influences of light and temperature on the growth and metabolism of selected submersed freshwater macrophytes. Ecological Monographs 51, 219-236.

Baum, E. T. 1997. Maine Atlantic Salmon: A National Treasure. Atlantic Salmon Unlimited, Hermon, Maine.

Beardsall, J. W., M. F. McLaren, S. J. Cooke, B. C. Wilson, M. J. Dadswell, A. M. Redden, and M. J. W. Stokesbury. 2013. Consequences of incidental otter trawl capture on survival and physiological condition of threatened Atlantic sturgeon. Transactions of the American Fisheries Society 142:1202-1214.

Beland, K. 1984. Strategic plan for management of Atlantic salmon in the state of Maine. Atlantic Sea Run Salmon Commission. Bangor, ME.

Bellman, M. A., E. Heery. And J. Majewski. 2010. Observed and estimated total bycatch of salmon in the 2008 US West Coast groundfish fisheries. West Coast Groundfish Observer Program. NWFSC, 2725 Montlake Blvd E., Seattle, WA 98112.

Bellman, M.A. and J. Hastie. 2008. Observed and estimated total bycatch of salmon in the 2005-2006 west coast limited entry bottom trawl groundfish fishery. West Coast Groundfish Observer Program. NWFSC, 2725 Montlake Blvd E., Seattle, WA 98112.

Bjorkland, R., D. C. Dunn, M. McClure, J. Jannot, M. A. Bellman, M. Gleason, and K. Schiffers. 2015. Spatiotemporal patterns of rockfish bycatch in the US west coast groundfish fisheries: opportunities for reducing incidental catch of depleted species. Canadian Journal of Fisheries and Aquatic Sciences 72:1835-1846.

Bourgeois, S., E. Gilot-Fromont, A. Viallefont, F. Boussamba, and S. L. Deem. 2009. Influence of artificial lights, logs and erosion on leatherback sea turtle hatchling orientation at Pongara National Park, Gabon. Biological Conservation 142(1):85-93.

Brown, J. J. and G. W. Murphy. 2010. Atlantic sturgeon vessel-strike mortalities in the Delaware Estuary. Fisheries 35:72-83.

Brown, J. J., J. Perillo, T. J. Kwak, and R. J. Horwitz. 2005. Implications of Pylodictis olivaris (flathead catfish) introduction into the Delaware and Susquehanna drainages. Northeastern Naturalist 12:473-484.

Brown, L. R., P. B. Moyle, and R. M. Yoshiyama. 1994. Historical decline and current status of coho salmon in California. North American Journal of Fisheries Management 14:237-261.

BRT. 2005. Green Sturgeon (*Acipenser medirostris*) Status Review Update. Biological Review Team. NOAA, National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, CA. NMFS 2015b.

Byrd, B. L., A. A. Hohn, and M. H. Godfrey. 2011. Emerging fisheries, emerging fisheries interactions with sea turtles: a case study of the large mesh gillnet fishery for flounder in Pamlico Sound, North Carolina. Marine Policy 35:271-285.

Campbell, J. G., and L. R. Goodman. 2004. Acute sensitivity of juvenile shortnose sturgeon to low dissolved oxygen concentrations. Transactions of the American Fisheries Society 133(3):772-776.

Carr, A. 1987. Impact of nondegradable marine debris on the ecology and survival outlook of sea turtles. Marine Pollution Bulletin 18(6):352-356.

Carretta, J. V., V. Helker, M. M. Muto, J. Greenman, K. Wilkinson, D. Lawson, J. Viezbicke, and J. Jannot. 2019. Sources of human-related injury and mortality for US Pacific West Coast marine mammal stock assessments, 2013-2017. NOAA Technical Memorandum NMFS-SWFSC-616.

Casale, P., D. Freggi, G. Furii, C. Vallini, P. Salvemini, M. Deflorio, G. Totaro, S. Raimondi, C. Fortuna, and B. J. Godley. 2014. Annual survival probabilities of juvenile loggerhead sea turtles indicate high anthropogenic impact in Mediterranean populations. Aquatic Conservation: Marine and Freshwater Ecosystems 25:690-700.

Caut, S., E. Guirlet, and M. Girondot. 2009. Effect of tidal overwash on the embryonic development of leatherback turtles in French Guiana. Marine Environmental Research 69(4):254-261.

Celi, M. F. Filiciotto, G. Maricchiolo, L. Genovese, E. M. Quinci, V. Maccarrone, S. Mazzola, M. Vazzana, and G. Buscaino. 2016. Vessel noise pollution as a human threat to fish: assessment of the stress response in gilthead sea bream (*Sparus aurata*, Linnaeus 1758). Fish Physiology and Biochemistry 42:631-641.

Cohen A. N. & Carleton J. T. (1995) Nonindigenous aquatic species in a United States estuary: A case study of the biological invasions of the San Francisco Bay and delta. United States Fish and Wildlife Service and The National Sea Gran College Program.

Cohen A. N. & Carlton J. T. (1998) Accelerating invasion rate in a highly invaded estuary. Science 279, 555-558.

Collins, M. R., S. G. Rogers, and T. I. J. Smith. 1996. Bycatch of sturgeons along the southern Atlantic coast of the USA. North American Journal of Fisheries Management 16:24 - 29.

Collins, M. R., S. G. Rogers, T. I. Smith, and M. L. Moser. 2000. Primary factors affecting sturgeon populations in the southeastern United States: fishing mortality and degradation of essential habitats. Bulletin of Marine Science 66(3):917-928.

Conant, T. A., P. H. Dutton, T. Eguchi, S. P. Epperly, C. C. Fahy, M. H. Godfrey, S. L. MacPherson, E. E. Possardt, B. A. Schroeder, J. A. Seminoff, M. L. Snover, C. M. Upite, and

B. E. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the United States Endangered Species Act. National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Cooke, D. W., and S. D. Leach. 2004. Implications of a migration impediment on shortnose sturgeon spawning. North American Journal of Fisheries Management 24(4):1460-1468.

Cumming, H. and N. A. Herbert. 2016. Gill structural change in response to turbidity has no effect on the oxygen uptake of a juvenile sparid fish. Conservation Physiology 4(1):doi:10.1093/conphys/cow033.

Davies, M.S. and J. Hawkins. 1998. Mucus from marine molluscs. Advances in Marine Biology, 34, 1-71.

De Robertis, A. and N.O. Handegard. 2013. Fish avoidance of research vessels and the efficacy of noise-reduced vessels: a review. ICES Journal of Marine Science 70(1):34-45.

Demetras, N. J., B. A. Helwig, and A. S. Mchuron. 2020. Reported vessel strike as a source of mortality of white sturgeon in San Francisco Bay. California Fish and Wildlife 106:59-65.

Denkinger, J., M. Parra, J. P. Munoz, C. Carrasco, J. C. Murillo, E. Espinosa, F. Rubianes, and V. Koch. 2013. Are boat strikes a threat to sea turtles in the Galapagos Marine Reserve? Ocean and Coastal Management 80:29-35.

DeRuiter, S. L. and K. L. Doukara. 2012. Loggerhead turtles dive in response to airgun sound exposure. Endangered Species Research 16:55-63.

Dickerson. 2006. Observed takes of sturgeon and turtles from dredging operations along the Atlantic Coast.

Doney, S. C., M. Ruckelshaus, J. E. Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, and N. Knowlton. 2011. Climate change impacts on marine ecosystems.

Drake, J. S., E. A. Berntson, J. M. Cope, R. G. Gustafson, E. E. Holmes, P. S. Levin, N. Tolimieri, R. S. Waples, S. M. Sogard, and G. D. Williams. 2010. Status review of five rockfish species in Puget Sound, Washington: bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinniger*), yelloweye rockfish (*S. ruberrimus*), greenstriped rockfish (*S. elongatus*), and redstripe rockfish (*S. proriger*). U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-108, 234 p.

EPA (Environmental Protection Agency). 2010. Climate Change Indicators in the United States: Weather and Climate. Page 14. Evironmental Protection Agency.

EPA FOM (Field Operations Manual). 2020. National Coastal Condition Assessment Field Operations Manual 2020. EPA #841-F-19-005. 156 p.

Fahlman, A., J. L. Crespo-Picazo, B. Sterba-Boatwright, B. A. Stacy, and D. Garcia-Párraga. 2017. Defining risk variables causing gas embolism in loggerhead sea turtles (Caretta caretta) caught in trawls and gill nets. Scientific Reports 7:1-7.

Fay, C., M. Bartron, S. Craig, A. Hecht, J. Pruden, R. Saunders, T. Sheehan, and J. Trial. 2006. Status review of anadromous Atlantic salmon (Salmo salar) in the United States. National Marine Fisheries Service and United States Fish and Wildlife Service.

Flowers, H. J. and J. E. Hightower. 2015. Estimating sturgeon abundance in the Carolinas using side scan sonar. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 7:1-9.

Ford, J. K. B. and G. M. Ellis. 2005. Prey selection and food sharing by fish-eating "resident" killer whales (*Orcinus ocra*) in British Columbia. Canadian Science Advisory Secretariat research document 2005/041. Fisheries and Oceans Canada, Pacific Biological Station Nanaimo, BC.

Ford, J. K. B., G. M. Ellis, P. F. Olesiuk, and K. C. Balcomb. 2009. Linking killer whale survival and prey abundance: food limitation in the oceans' apex predator? Biology Letters 29(6):139-142.

Foss S. F., Ode P. R., Sowby M. & Ashe M. (2007) Non-indigenous aquatic organisms in the coastal waters of California. California Fisha dn Game 93, 111-129.

Friesen, T. A., and D. L. Ward. 1999. Management of northern pikeminnow and implications for juvenile salmonid survival in the lower Columbia and Snake rivers. North American Journal of Fisheries Management 19:406-420.

Fuentes, M. M. P. B., C. J. Limpus, and M. Hamann. 2011. Vulnerability of sea turtle nesting grounds to climate change. Global Change Biology 17:140-153.

Fuentes, M. M. P. B., J. A. Maynard, M. Guinea, I. P. Bell, P. J. Werdell, and M. Hamann. 2009b. Proxy indicators of sand temperature help project impacts of global warming on sea turtles in northern Australia. Endangered Species Research 9:33-40.

Fuentes, M. M. P. B., M. Hamann, and C. J. Limpus. 2010. Past, current and future thermal profiles of green turtle nesting grounds: Implications from climate change. Journal of Experimental Marine Biology and Ecology 383:56-64.

Fuentes, M., M. Hamann, and C. J. Limpus. 2009a. Past, current and future thermal profiles of green turtle nesting grounds: Implications from climate change. Journal of Experimental Marine Biology and Ecology 383(1):56-64.

Garcia-Párraga, D., J. L. Crespo-Picazo, Y. Bernaldo de Quirós, V. Cervera, L. Martí-Bonmati, J. Díaz-Delgado, M. Arbelo, M. J. Moorem P. D. Jepson, and A. Fernández. 2014. Decompression sickness ('the bends') in sea turtles. Diseases of Aquatic Organisms 111:191-205.

Goldberg, D. W., D. T. de Almeida, F. Tognin, G. G. Lopez, G. T. Pizetta, N. O. Leite Jr., and R. Sforza. 2015. Hopper dredge impacts on sea turtles on the northern coast of Rio de Janeiro state, Brazil. Marine Turtle Newsletter 147:16-20.

Grace J. B. & Harrison J. S. (1986) The biology of Canadian weeds. 73. Typha latifuliaL., Typha angustifolia L. and Typha xglauca Godr. Canadian Journal of Plant Science 66, 361-379.

Graham, N. A. J., R. D. Evans, G. R. Russ. 2003. The effects of marine reserve protection on the trophic relationships of reef fishes on the Great Barrier Reef. Environmental Conservation 30:200–208.

Graham, A. L. and S.J. Cooke. 2008. The effects of noise disturbance from various recreational boataing activities common to inland waters on the cardiac phyiology of a freshwater fish, the largemouth bass (*Micopterus salmoides*). Aquatic Conservation: Marine and Freshwater Ecosystems 18:1315-1324.

Groombridge, B. 1982. Testudines, Crocodylia, Rhynchocephalia. Page 426 in I. U. f. C. o. Nature, editor. The IUCN Amphibia-Reptilia Red Data Book. IUCN.

Gulko, D., and K.L. Eckert. 2003. Sea Turtles: An Ecological Guide. Mutual Publishing, Honolulu, Hawaii.

Gustafson, R. G., L. Weitkamp, Y-W. Lee, E. Ward, K. Somers, V. Tuttle, and J. Jannot. 2016. Status Review Update of Eulachon (*Thaleichthys pacificus*) Listed under the Endangered Species Act: Southern Distinct Population Segment. Available: www.westcoast.fisheries. noaa.gov/publications/status_reviews/other_species/eulachon/eulachon_2016_status_review_ update. pdf (October 2018).

Gustafson, R. G., M. J. Ford, D. Teel, and J. S. Drake. 2010. Status review of eulachon (*Thaleichthys pacificus*) in Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-105, 360 p.

Hart, J.L., and J. L. McHugh. 1944. The smelts (Osmeridae) of British Columbia. Bulletin of the Fisheries Research Board of Canada 64:1-27.

Hastings, R. W. 1983. A study of the shortnose sturgeon (Acipenser brevirostrum) population in the upper tidal Delaware River: assessment of impacts of maintenance dredging.

Hatin, D., J. Munro, F. Caron, and R. D. Simons. 2007. Movements, home range size, and habitat use and selection of early juvenile Atlantic sturgeon in the St. Lawrence estuarine transition zone. Pages 129 in American Fisheries Society Symposium. American Fisheries Society.

Hawkes, L. A., A. C. Broderick, H. Godfrey, B. Godley, and M. J. Witt. 2014. The impacts of climate change on marine turtle reproductoin success. Pages 287-310 in B. Maslo and L. Lockwood, editors. Coastal Conservation, Cambridge University Press, Cambridge.

Hawkes, L. A., A. C. Broderick, M. H. Godfrey, and B. J. Godley. 2009. Climate change and marine turtles. Endangered Species Research 7(2):137-154.

Hay, D. E., and McCarter, P. B. 2000. Status of the eulachon *Thaleichthys pacificus* in Canada. Department of Fisheries and Oceans Canada, Canadian Stock Assessment Secretariat, Research Document 2000-145. Ottawa, Ontario. Online at: http://www.dfompo.gc.ca/csas/csas/DocREC/2000/PDF/2000_145e.pdf

Hayes, G. C., S. Fossette, K. A. Katselidis, G. Schofield, and M. B. Gravenor. 2010. Breeding Periodicity for male sea turtles, operational sex ratios, and implications in the face of climate change. Society for Conservation Biology DOI 10.1111/j.1523-1739.2010.01531.x. OR In Press.

Hayhoe, K., D. J. Wuebbles, D. R. Easterling, D. W. Fahey, S. Doherty, J. Kossin, W. Sweet, R. Vose, and M. Wehner. 2018. Our Changing Climate. Pages 72-144 in D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart, editor. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II, U.S. Global Change Research Program, Washington, DC.

Hays, G. C. 2008. Sea turtles: a review of some key recent discoveries and remaining questions. Journal of Experimental Marine Biology and Ecology 356:1-7.

Hazel, J., I. R. Lawler, H. Marsh, and S. Robson. 2007. Vessel speed increases collision risk for the green sea turtle *Chelonia mydas*. Endangered Species Research 3:105-113.

Hazen, E. L., S. Jorgensen, R. R. Rykaczewski, S. J. Bograd, D. G. Foley, I. D. Jonsen, S. A. Shaffer, J. P. Dunne, D. P. Costa, and L. B. Crowder. 2013. Predicted habitat shifts of Pacific top predators in a changing climate. Nature Climate Change 3(3):234.

Holt, M. M. and D. P. Noren. 2009. Speaking up: killer whales (Orcinus orca) increase their call amplitude in response to vessel noise. The Journal of the Acoustical Society of America 125: doi: 10.1121/1.3040028.

Hudson Riverkeeper. 2015. Reports of dead sturgeon have spiked since Tappan Zee Bridge project began; Riverkeeper calls for immediate steps, investigation. Online press release: https://www.riverkeeper.org/news-events/news/preserve-river-ecology/reports-of-dead-sturgeon-have-spiked-since-tappan-zee-bridge-project-began-riverkeeper-calls-for-immediate-steps-investigation/.

ICES. 2004. Report of the Working Group on North Atlantic Salmon. International Council for the Exploration of the Sea (ICES) CM 2004/ACFM:20:293.

Ingram E. C. and D. L. Peterson. 2016. Annual spawning migration of adult Atlantic sturgeon in the Altamaha River, Georgia. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 8:595-606.

IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland.

Israel, J. A., K. J. Bando, E. C. Anderson, and B. May. 2009. Polyploid microsatellite data reveal stock complexity among estuarine North American green sturgeon (Acipenser medirostris). Canadian Journal of Fisheries and Aquatic Sciences 66:1491-1504.

Jambeck, J.R., R. Geyer, C. Wilcox, T.R. Siegler, M. Perryman, A. Andrady, R. Narayan, and K.L. Law. 2015. Plastic waste inputs from land into the ocean. Science 347(6223):768-771.

Jenkins, W. E., T. I. J. Smith, L. D. Heyward, and D. M. Knott. 1993. Tolerance of shortnose sturgeon, Acipenser brevirostrum, juveniles to different salinity and dissolved oxygen concentrations. Pages 476-484 in Annual Conference of the Southeastern Association of Fish and Wildlife Agencies.

Jewett E. B., Hines A. H. & Ruiz G. M. (2005) Epifaunal disturbance by periodic low levels of dissolved oxygen: native vs. invasive species response. Marine Ecology-Progress Series 304, 31-44.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry, and P. Clapham. 2005. Fishing gear involved in entanglements of right and humpback whales. Marine Mammal Science 21(4):635-645.

Johnson, E. L., T. S. Clabough, C. A. Peery, D. H. Bennett, T. C. Bjornn, C. C. Caudill, and M. C. Richmond. 2007. Estimating adult Chinook salmon exposure to dissolved gas supersaturation downstream of hydroelectric dams using telemetry and hydrodynamic models. River Research and Applications 23:963-978.

Johnson, L. E., A. Ricciardi, and J. T. Carlton. 2001. Overland dispersal of aquatic invasive species: a risk assessment of transient recreational boating. Ecological Applications 11(6):1789-1799.

Johnson, S. L. and C. C. Vaughn. 1995. A hierarchical study of macroinvertebrate recolonization of disturbed patches along a longitudinal gradient in a prairie river. Freshwater Biology 34(3):531-540.

Kahn, J. E. 2019. Adult Atlantic sturgeon population dynamics in the York River, Virginia. Dissertation, West Virginia University, Morgantown, West Virginia. 210p.

Kahn, J. E., C. Hager, J. C. Watterson, N. Mathies, and K. J. Hartman. 2019. Comparing abundance estimates from closed population mark-recapture models of endangered adult Atlantic sturgeon. Endangered Species Research 39:63-76.

Kahnle, A.W., K.A. Hattala, and K. McKown. 2007. Status of Atlantic sturgeon of the Hudson River estuary, New York, USA. American Fisheries Society Symposium 56:347-363.

Karl, T. R. 2009. Global climate change impacts in the United States. Cambridge University Press.

Kazyak, D. C., A. M. Flowers, N. J. Hostetter, J. A. Madsen, M. Breece, A. Higgs, L. M. Brown, J. A. Royle, and D. A. Fox. 2020. Integrated side-scan sonar and acoustic telemetry to estimate the annual spawning run size of Atlantic sturgeon in the Hudson River. Canadian Journal of Fisheries and Aquatic Sciences efirst online:1-11. https://doi.org/10.1139/cjfas-2019-0398.

Killgore K. J., Morgan R. P. & Rybicki N. B. (1989) Distribution and Abundance of Fishes Associated with Submersed Aquatic Plants in the Potomac River. North American Journal of Fisheries Management 9, 101-111.

Kynard, B. 1997. Life history, latitudinal patterns, and status of the shortnose sturgeon, Acipenser brevirostrum. Environmental Biology of Fishes 48(1-4):319-334.

Laist, D.W., J.M. Coe, and K.J. O'Hara. 1999. Marine debris pollution. Pages 342-366 *in* J.R. Twiss Jr. and R.R. Reeves, editors. Conservation and Management of Marine Mammals, Smithsonian Institution Press, Washington, D.C.

Liles, M. J., A. R. Gaos, A. D. Bolaños, W. A. Lopez, R. Arauz, V. Gadea, J. Urteaga, I. L, Yañez, C. M. Pacheco, J. A. Seminoff, and M. J. Peterson. 2017. Survival on the rocks: high bycatch in lobster gill net fisheries threaten hawksbill sea turtles on rocky reefs along the Eastern Pacific Coast of Central America. Latin American Journal of Aquatic Research 45:521-539.

Lockwood, B. L. and G. N. Somero. 2011. Invasive and native blue mussels (genus Mytilus) on the California coast: The role of physiology in a biological invasion☆. Journal of Experimental Marine Biology and Ecology.

Lomeli, M. J. M. and W. W. Wakefield. 2012. Efforts to reduce Chinook salmon (Onchorhynchus tshawytscha) and rockfish (Sebastes spp.) bycatch in the US West Coast Pacific hake (Merluccius productus) fishery. Fisheries Research 119-120:128-132.

Lowe, M. L., M. A. Morrison, and R. B. Taylor. 2015. Harmful effects of sediment-induced turbidity on juvenile fish in estuaries. Marine Ecology Progress Series 539:241-254.

Lutcavage, M.E., P. Plotkin, B.E. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival. Pages 387-409 *in* P.L. Lutz and J.A. Musick, editors. The Biology of Sea Turtles, CRC Press, Boca Raton, Florida.

Macfadyen, G., T. Huntington, and R. Cappell. 2009. Abandoned, lost or otherwise discarded fishing gear. Food and Agriculture Organization of the United Nations (FAO).

MacLeod, C. D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endangered Species Research 7(2):125-136.

Mantua, N. J., S. R. Hare, Y. Zhang, J. M. Wallace, and R. C. Francis. 1997. A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the american Meteorological Society 78(6):1069-1079.

Marks M., Lapin B. & Randall J. (1994) Phragmites australis (P. communis): Threats, management, monitoring. Natural Areas Journal 14, 285-294.

Martin, D. W. and J. A. Servizi. 1993. Suspended sediment particles inside gills and spleens of juvenile pacific salmonids (*Oncorhinchus* spp.). Canadian Journal of Fisheries and Aquatic Sciences 50(3):586-590.

Mathur, D., P. G. Heisey, E. T. Euston, J. R. Skalski, and S. Hays. 1996. Turbine passage and survival estimation for chinook salmon smolts (Oncorhynchus tshawytscha) at a large dam on the Columbia River. Canadian Journal of Fisheries and Aquatic Sciences 53:542-549.

Mazaris, A. D., A. S. Kallimanis, S. P. Sgardelis, and J. D. Pantis. 2008. Do long-term changes in sea surface temperature at the breeding areas affect the breeding dates and reproduction performance of Mediterranean loggerhead turtles? Implications for climate change. Journal of Experimental Marine Biology and Ecology.

McLean, J. E., and Taylor, E. B. 2001. Resolution of population structure in a species with high gene flow: microsatellite variation in the eulachon (Osmeridae: *Thaleichthys pacificus*). Mar. Biol. 139:411–420.

McLean, J. E., Hay, D. E., and Taylor, E. B. 1999. Marine population structure in an anadromous fish: Life history influences patterns of mitochondrial DNA variation in the eulachon, *Thaleichthys pacificus*. Mol. Ecol. 8:S143–S158.

McMahon, C. R. and G. C. Hays. 2006. Thermal niche, large-scale movements and implications of climate change for a critically endangered marine vertebrate. Global Change Biology 12:1330-1338.

McMenemy, J. R., and B. Kynard. 1988. Use of inclined-plane traps to study movement and survival of Atlantic salmon smolts in the Connecticut River. North American Journal of Fisheries Management 8:481-488.

McQuinn, I. H., and P. Nellis. 2007. An acoustic-trawl survey of middle St. Lawrence Estuary demersal fishes to investigate the effects of dredged sediment disposal on Atlantic sturgeon and lake sturgeon distribution. Pages 257 in American Fisheries Society Symposium. American Fisheries Society.

Merchant, N. D., E. Pirotta, T. R. Barton, P. M. Thompson. 2014. Monitoring ship noise to assess the impact of coastal developments on marine mammals. Marine Pollution Bulletin 78:85-95.

Miller, R. R., J. D. Williams, and J. E. Williams. 1989. Extinctions of North American fishes during the past century. Fisheries 14:22-38.

Miller, T., and G. Shepherd. 2011. Summary of discard estimates for Atlantic sturgeon. Population Dynamics Branch, Northeast Fisheries Science Center 47.

Misund, O. A., J. T. Ovredal, and M.T. Hafsteinsson. 1996. Reactions of herring schools to the sound field of a survey vessel. Aquatic Living Resources 9:5-11.

Mitson, R. B. and H. P. Knudsen. 2003. Causes and effects of underwater noise on fish abundance estimation. Aquatic Living Resources 16(3):255-263.

Moncheva S. P. & Kamburska L. T. (2002) Plankton stowaways in the Black Sea - Impacts on biodiversity and ecosystem health. In: Alien marine organisms introduced by ships in the Mediterranean and Black seas pp. 47-51. CIESM Workshop Monographs [CIESM Workshop Monogr.]. 2002.

Moore, S. K., N. J. Mantua, and E. P. Salathé. 2011. Past trends and future scenarios for environmental conditions favoring the accumulation of paralytic shellfish toxins in Puget Sound shellfish. Harmful Algae 10(5):521-529.

Morrow Jr., J. V., J. P. Kirk, K. J. Kilgore, H. Rogillio, and C. Knight. 1998. Status and recovery potential of Gulf sturgeon in the Pearl River system, Louisiana-Mississippi. North American Journal of Fisheries Management 18:798-808.

Mortimer, J. A. and M. Donnelly. 2007. Marine turtle specialist group review draft 2007 IUCN red list status assement hawksbill turtle (Eretmochelys imbricata). International Union for Conservation of Nature and Natural Resources.

Moser, M. L., and S. W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the lower Cape Fear River, North Carolina. Transactions of the American Fisheries Society 124(2):225.

Moyle, P. B. 1976. Fish introductions in California: history and impact on native fishes. Biological Conservation 9:101-118.

Murray, K. T. 2011. Interactions between sea turtles and dredge gear in the U.S. sea scallop (Placopecten magellanicus) fishery, 2001-2008. Fisheries Research 107:137-146.

Narazaki T., S. Katsufumi, K.J. Abernathy, G.J. Marshall, N. Miyazaki. 2013. Loggerhead turtles (*Caretta caretta*) use vision to forage on gelatinous prey in mid-water. PLOS One 8(6): e66043.

Nellis, P., and coauthors. 2007. Macrobenthos assemblages in the St. Lawrence estuarine transition zone and their potential as food for Atlantic sturgeon and lake sturgeon. Pages 105 in American Fisheries Society Symposium. American Fisheries Society.

Newson, S. E., S. Mendes, H. Q. P. Crick, N. K. Dulvy, J. D. R. Houghton, G. C. Hays, A. M. Hutson, C. D. Macleod, G. J. Pierce, and R. A. Robinson. 2009. Indicators of the impact of climate change on migratory species. Endangered Species Research 7(2):101-113.

NMFS and USFWS. 2013a. Leatherback sea turtle (*Dermochelys coriacea*) 5-year review: Summary and evaluation. Page 93, National Marine Fisheries Service Office of Protected Resources, Silver Spring, Maryland and United States Fish And Wildlife Service, Southeast Region Jacksonville Ecological Services Office, Jacksonville, Florida.

NMFS and USFWS. 2013b. Hawksbill sea turtle (*Eretmochelys imbricata*) 5-Year Review: Summary and Evaluation. Page 92, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland and United States Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Office, Jacksonville, Florida.

NMFS and USFWS. 2014. Olive ridely sea turtle (lepidocchelys olivacea) 5-year review: summary and evaluation. 87p. National Marine Fisheries Service Office of Protected Resources, Silver Spring, Maryland and United States Fish And Wildlife Service, Southeast Region Jacksonville Ecological Services Office, Jacksonville, Florida.

NMFS. 1998. Recovery Plan for the shortnose sturgeon (*Acipenser brevirostrum*). Page 104 in Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, editor., Silver Spring, Maryland.

NMFS. 2010. Other significant oil spills in the Gulf of Mexico. National Marine Fisheries Service, Office of Response and Restoration, Emergency Response Division, Silver Sprirng, Maryland.

NMFS. 2012. Biological Opinion on the Operation of the Pacific Coast Groundfish Fishery. NMFS, Northwest Region.

NMFS. 2015. Southern Distinct Population Segment of the North American Green Sturgeon (Acipenser medirostris) 5-Year Review: Summary and Evaluation. Long Beach, CA.

NMFS. 2015. Southern Distinct Population Segment of the North American Green Sturgeon (*Acipenser medirostris*) 5-Year Review: Summary and Evaluation. Office of Protected Resources, West Coast Region, Long Beach, CA.

Nobriga M. L. & Feyrer F. (2008) Diet composition in San Francisco Estuary striped bass: does trophic adaptability have its limits? Environmental Biology of Fishes 83, 495-503.

NWFSC. 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. National Marine Fisheries Service, Northwest Fisheries Science Center:356.

O'Hara, J. and J. R. Wilcox. 1990. Avoidance responses of loggerhead turtles, *Caretta caretta*, to low frequency sound. Copeia 1990:564-567.

O'Leary, S. J., K. J. Dunton, T. L. King, M. G. Frisk, and D. D. Chapman. 2014. Genetic diversity and effective size of Atlantic sturgeon, Acipenser oxyrinchus oxyrinchus river spawning populations estimated from microsatellite genotypes of marine-captured juveniles. Conservation Genetics 2014:s10592-014-0609-9.

Onitsuka, T., T. Kawamura, S. Ohashi, S. Iwanaga, T. Horii, and Y. Watanabe. 2008. Effects of sediments on larval settlement of abalone *Haliotis diversicolor*. Journal of Experimental Marine Biology and Ecology 365(1):53-58.

Parsons, J. J. 1972. The hawksbill turtle and the tortoise shell trade. Pages 45-60 in Études de géographie tropicale offertes a Pierre Gourou, volume 1. Mouton, Paris.

Patrício, A. R., A. Marques, C. Barbosa, A. C. Broderick, B. J. Godley, L. A. Hawkes, R. Rebelo, A. Regalla, and P. Catry. 2017. Balanced primary sex ratios and resilience to climate change in a major sea turtle population. Marine Ecology Progress Series 577:189-203.

Patrick, W. S. 2005. Evaluation and mapping of Atlantic, Pacific, and Gulf Coast terminal dams: a tool to assist recovery and rebuilding of diadromous fish populations. Final Report to the NOAA Fisheries, Office of Habitat Conservation, Habitat Protection Division, Silver Spring, Maryland.

Pejchar, L., and K. Warner. 2001. A river might run through it again: criteria for consideration of dam removal and interim lessons from California. Environmental Management 28(5):561-575.

Peterson D. L., P. Schueller, R. DeVries, J. Fleming, C. Grunwald, and I. Wirgin. 2008. Annual run size and genetic characteristics of Atlantic sturgeon in the Altamaha River. Transactions of the American Fisheries Society 137:393-401.

Peterson, D. L., M. B. Bain, and N. Haley. 2000. Evidence of declining recruitment of Atlantic sturgeon in the Hudson River. North American Journal of Fisheries Management 20:231-238.

PFMC (Pacific Fishery Managmenet Council). 2020. Review of 2019 ocean salmon fisheries. Stock assessment and fishery evaluation document for the Pacific Coast Salmon Fishery Management Plan. Portlant, Oregon. February 14, 2020. 347p.

Philippart, C. J. M., R. Anadón, R. Danovaro, J. W. Dippner, K. F. Drinkwater, S. J. Hawkins, T. Oguz, G. O'Sullivan, and P. C. Reid. 2011. Impacts of climate change on European marine ecosystems: Observations, expectations and indicators☆. Journal of Experimental Marine Biology and Ecology.

Phillips, N.E. and J.S. Shima. 2006. Differential effects of suspended sediments on larval survival and settlement of New Zealand urchins *Evechinus chloroticus* and abalone *Haliotis iris*. Marine Ecology Progress Series 314:149-158.

Pike, D. A., E. A. Roznik, and I. Bell. 2015. Nest inundation from sea-level rise threatens sea turtle population viability. Royal Society Open Science 2:150127.

Pike, D. A., R. L. Antworth, and J. C. Stiner. 2006. Earlier nesting contributes to shorter nesting seasons for the loggerhead seaturtle, Caretta caretta. Journal of Herpetology 40(1):91-94.

Pine III, W. E., M. S. Allen, V. J. Dreitz. 1999. Population viability of the Gulf of Mexico sturgeon: inferences from capture-recapture and age-structured models. Transactions of the American Fisheries Society 130:1164-1174.

Poeta, G., E. Staffieri, A. Acosta, and C. Battisti. 2017. Ecological effects of anthropogenic litter on marine mammals: A global review with a "black-list" of impacted taxa.

Poloczanska, E. S., C. J. Limpus, and G. C. Hays. 2009. Vulnerability of marine turtles in climate change. Pages 151-211 Advances in Marine Biology, Academic Press, New York.

Pritchard, P. C. H. 1982. Nesting of the leatherback turtle, *Dermochelys coriacea*, in Pacific México, with a new estimate of the world population status. Copeia 1982:741-747. Spotila et al. 1996

Pughiuc D. (2010) Invasive species: Ballast water battles. Seaways.

Putland, R. L., N. D. Merchant, A. Farcas, and C. A. Radford. 2017. Vessel noise cuts down communication space for vocalizing fish and marine mammals. Global Change Biology 2017:1-14.

Raaymakers S. & Hilliard R. 2002. Harmful aquatic organisms in ships' ballast water - Ballast water risk assessment. In: Alien marine organisms introduced by ships in the Mediterranean and Black seas (ed F. Briand) pp. 103-110. CIESM Workshop Monographs [CIESM Workshop Monogr.]. 2002., Istanbul, Turkey.

Raaymakers S. 2003. The GEF/UNDP/IMO global ballast water management programme integrating science, shipping and society to save our seas. Proceedings of the Institute of Marine Engineering, Science and Technology Part B: Journal of Design and Operations, 2-10.

Raea, T. 2013. The effect of suspended sediment loads on growth, oxygen consumption, and mucus production of Pāua (*Haliotis iris*). Thesis, Victoria University of Wellington.

Reina, R. D., J. R. Spotila, F. V. Paladino, and A. E. Dunham. 2008. Changed reproductive schedule of eastern Pacific leatherback turtles Dermochelys coriacea following the 1997–98 El Niño to La Niña transition. Endangered Species Research.

Reine, K. and D. Clarke. 1998. Entrainment by hydraulic dredges – a review of potential impacts. Technical Note DOER-EI. US Army Corps of Engineers, Environmental Laboratory, Vicksburg, Mississippi.

Robinson, R. A., H. Q. P. Crick, J. A. Learmonth, I. M. D. Maclean, C. D. Thomas, F. Bairlein, M. C. Forchhammer, C. M. Francis, J. A. Gill, B. J. Godley, J. Harwood, G. C. Hays, B. Huntley, A. M. Hutson, G. J. Pierce, M. M. Rehfisch, D. W. Sims, M. B. Santos, T. H. Sparks, D. A. Stroud, and M. E. Visser. 2008. Travelling through a warming world: climate change and migratory species. Endangered Species Research.

Root, S. and C. M. O'Reilly. 2012. Didymo control: Increasing the effectiveness of decontamination strategies and reducing spread. Fisheries 37:440-448.

Ruiz, G. M., P. Fofonoff, and A. H. Hines. 1999. Non-indigenous species as stressors in estuarine and marine communities: Assessing invasion impacts and interactions. Limnology and Oceanography 44(3):950–972.

Ryer, C. H. 2002. Trawl stress and escapee vulnerability to predation in juvenile walleye pollock: is there an unobserved bycatch of behaviorally impaired escapees? Marine Ecology Progress Series 232:269-279.

Samuel, Y., S. J. Morreale, C. W. Clark, C. H. Greene, and M. E. Richmond. 2005. Underwater, low-frequency noise in a coastal sea turtle habitat. Journal of the Acoustical Society of America 117, 1465-1472.

Santos, R.G., R. Andrades, M.A. Boldrini, and A.S. Martins. 2015. Debris ingestion by juvenile marine turtles: an underestimated problem. Marine Pollution Bulletin 93(1):37-43.

Sarti Martinez, A. L. 2000. *Dermochelys coriacea*. 2006 IUCN Red List of Threatened Species. International Union for Conservation of Nature and Natural Resources.

Schueller, P. and D. L. Peterson. 2010. Abundance and recruitment of juvenile Atlantic sturgeon in the Altamaha River, Georgia. Transactions of the American Fisheries Society 139:1526-1535.

Schuyler, Q.A. 2014. Ingestion of marine debris by sea turtles. Doctoral dissertation. The University of Queensland.

Schuyler, Q.A., C. Wilcox, K.A. Townsend, K.R. Wedemeyer-Strombel, G. Balazs, E. Sebille, and B.D. Hardesty. 2016. Risk analysis reveals global hotspots for marine debris ingestion by sea turtles. Global Change Biology 22(2):567-576.

Secor, D. H., and E. J. Niklitschek. 2001. Hypoxia and sturgeons. University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Technical Report Series No. TS-314-01-CBL, Solomons, Maryland.

Sigler, J. W., T. C. Bjornn, and F. E. Everest. 1984. Effects of chronic turbidity on density and growth of steelheads and coho salmon. Transactions of the American Fisheries Society 113:142-150.

Simmonds, M. P. and W. J. Eliott. 2009. Climate change and cetaceans: Concerns and recent developments. Journal of the Marine Biological Association of the United Kingdom 89(1):203-210.

Simpfendorfer, C. A. 2002. Smalltooth sawfish: the USA's first endangered elasmobranch? Endangered Species Update 19:53p.

Singel, K., A. Foley, and R. Bailey. 2007. Navigating Florida's waterways: Boat-related strandings of marine turtles in Florida.in Proceedings 27th Annual Symposium on Sea Turtle Biology and Conservation, Myrtle Beach, SC. International Sea Turtle Society.

Smith, T. I. J., and J. P. Clugston. 1997. Status and management of Atlantic sturgeon, Acipenser oxyrinchus, in North America. Environmental Biology of Fishes 48(1-4):335-346.

Southwood A., K. Fritsches, R. Brill, Y. Swimmer. 2008. Sound, chemical, and light detection in sea turtles and pelagic fishes: sensory-based approaches to bycatch reduction in longline fisheries. Endangered Species Research 5: 225-238.

Spicer, A. V., J. R. Moring, and J. G. Trial. 1995. Downstream migratory behavior of hatcheryreared, radio-tagged Atlantic salmon (Salmo salar) smolts in the Penobscot River, Maine, USA. Fisheries Research 23:255-266.

Stein, A. B., K. D. Friedland, and M. Sutherland. 2004. Atlantic sturgeon marine bycatch and mortality on the continental shelf of the northeast United States. North American Journal of Fisheries Management 24:171-183.

Strayer D. L. (2010) Alien species in fresh waters: ecological effects, interactions with other stressors, and prospects for the future. Freshwater Biology 55, 152-174.

Sulak, K. J. and J. P. Clugston. 1999. Recent advances in life history of the Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*, in the Suwannee River, Florida, USA: a synopsis. Journal of Applied Ichthyology 15:116-128.

Sutherland, A. B. and J. L. Meyer. 2007. Effects of increased suspended sediment on growth rate and gill condition of two southern Appalachian minnows. Environmental Biology of Fishes 80:389-403.

Swingle, W. M., S. G. Barco, T. D. Pitchford, W. A. Mclellan, and D. A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Marine Mammal Science 9(3):309-315.

Taylor, J. N., Courtenay W. R. Jr., and McCann. J. A. editor. 1984. Known impacts of exotic fishes in the continental United States. In Distribution, biology, and management of exotic fishes, The Johns Hopkins University Press, Baltimore, MD

Terdalkar S., Kulkarni A. S., Kumbhar S. N. & Matheickal J. (2005) Bio-economic risks of ballast water carried in ships, with special reference to harmful algal blooms. Nature, Environment and Pollution Technology 4, 43-47.

TEWG. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. NMFS-SEFSC-444, Turtle Expert Working Group (TEWG).

TEWG. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NMFSSEFSC-555, Turtle Expert Working Group, Department of Commerce.

USGCRP. 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II. U.S. Global Change Research Program, Washington, DC, USA.

Vander Haegen, G. E., C. E. Ashbrook, K. W. Yi, and J. F. Dixon. 2004. Survival of spring Chinook salmon captured and released in a selective commercial fishery using gill nets and tangle nets. Fisheries Research 68:123-133.

Vannote, R. L., G. W. Minshall, K. W. Cummins, J. R. Sedell, and C. E. Cushing. 1980. The river continuum concept. Canadian Journal of Fisheries and Aquatic Sciences 37:130-137.

Waldman, J., S. E. Alter, D. Peterson, L. Maceda, N. Roy, I. Wirgin. 2018. Contemporary and historical effective population sizes of Atlantic sturgeon Acipenser oxyrinchus oxyrinchus. Conservation Genetics. doi.org/10.1007/s10592-018-1121-4

Wambiji N., Gwada P., Fondo E., Mwangi S. & Osore M. K. (2007) Preliminary results from a baseline survey of the port of Mombasa: with focus on molluscs. In: 5th Western Indian Ocean Marine Science Association Scientific Symposium; Science, Policy and Management pressures and responses in the Western Indian Ocean region, Durban, South Africa.

Ward, E.J., M.J. Ford, R.G. Kope, J.K.B. Ford, L.A. VelezEspino, C.K. Parken, L.W. LaVoy, M.B. Hanson, and K.C. Balcomb. 2013. Estimating the impacts of Chinook salmon abundance and prey removal by ocean fishing on Southern Resident killer whale population dynamics. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-123.

Weiffen, M. B. Moller, B. Mauck, and G. Dehnhardt. 2006. Effect of water turbidity on the visual acuity of harbor seals (Phoca vitulina). Vision Research 46(11):1777-1783.

Weilgart, L. S. 2007. A brief review of known effects of noise on marine mammals. International Journal of Comparative Psychology 20:159-168.

Wells, R. S. 2019. Common bottlenose dolphin foraging: behavioral solutions that incorporate habita features and social associates. Ethology and Behavioral Ecology of Odontocetes 331-344. https://doi.org/10.1007/978-3-030-16663-2_15.

Wheaton, J. M., G. B. Pasternack, and J. E. Merz. 2004. Spawning habitat rehabilitation-I. Conceptual approach and methods. International Journal of River Basin Management 2(1):3-20.

Wilcove, D. S., and L. Y. Chen. 1998. Management costs for endangered species. Conservation Biology 12:1405-1407.

Wiley, D. N., R. A. Asmutis, T. D. Pitchford, and D. P. Gannon. 1995. Stranding and mortality of humpback whales, Megaptera novaeangliae, in the mid-Atlantic and southeast United States, 1985-1992. Fishery Bulletin 93(1):196-205.

Wiley, T. R. and C. A. Simpfendorfer. 2010. Using public encounter data to direct recovery efforts for the endangered smalltooth sawfish Pristis pectinate. Endangered Species Research 12:179-191.

Wilkinson, C. and D. Souter. 2008. Status of Caribbean coral reefs after bleaching and hurricanes in 2005. Global Coral Reef Monitoring Network, and Reef and Rainforest Research Centre, Townsville.

Williams, S. E., L. P. Shoo, J. L. Isaac, A. A. Hoffmann, and G. Langham. 2008. Towards an integrated framework for assessing the vulnerability of species to climate change. PLoS Biol 6(12):e325.

Willis-Norton, E., E. L. Hazen, S. Fossette, G. Shillinger, R. R. Rykaczewski, D. G. Foley, J. P. Dunne, and S. J. Bograd. 2015. Climate change impacts on leatherback turtle pelagic habitat in the Southeast Pacific. Deep Sea Research Part II: Topical Studies in Oceanography 113:260-267.

Winn, J. P., B. L. Woodward, M. J. Moore, M. L. Peterson, and J. G. Riley. 2008. Modeling whale entanglement injuries: an experimental study of tissue compliance, line tension, and draw-length. Marine Mammal Science 24(2):326-340.

Wirgin, I., L. Maceda, C. Grunwald, and T. King. 2015. Population origin of Atlantic sturgeon Acipenser oxyrinchus oxyrinchus bycatch in US Atlantic Coast fisheries. Journal of Fish Biology 86:1251-1270.

Witherington, B. E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica 48(1):31-39.

Wuebbles, D. J., D. W. Fahey, K. A. Hibbard, B. DeAngelo, S. Doherty, K. Hayhoe, R. Horton, J. P. Kossin, P. C. Taylor, A. M. Waple, and C. P. Weaver. 2017. Executive Summary. Pages 12-34 in D. J. Wubbles, D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock, editors. Climate Science Special Report: Fourth National Climate Assessment, U.S. Global Change Research Program, Washington D.C.

Zehfuss, K. P., J. E. Hightower, and K. H. Pollock. 1999. Abundance of Gulf sturgeon in the Apalachicola River, Florida. Transactions of the American Fisheries Society 128:130-143.

Zollett, E. A. 2009. Bycatch of protected species and other species of concern in the US east coast commercial fisheries. Endangered Species Research 9:49-59.

16 Appendix 1. Proposed Mitigation

16.1 Training

The following training is required before participating in field research:

- First aid and cardiopulmonary resuscitation
- Vehicle safety
- Field safety
- Equipment design, operation, and maintenance
- Handling of chemicals and other hazardous materials
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16.2 Listed Species Considerations

Field crews have the potential to encounter federally listed species and critical habitats that are protected under the Endangered Species Act (ESA) while conducting field sampling. The EPA has established a Field Operations Manual (EPA FOM 2020) that identifies the following list of requirements:

- Efforts should be made to minimize risks to listed species and their critical habitats and avoid the takea of listed species while implementing the NCCA field protocols
- Leads must ensure the crew is aware of potential occurrences of listed species at each site
- abide by all boating speed regulations, including “No Wake” and “Minimum Wake” zones
- remain a respectful distance from marine mammals and sea turtles
- designate a marine animal spotter for when the boat is in motion
- understand the circumstances when it would be necessary to shut down a vessel due to the presence of a listed species
- allow a listed species to naturally move away from the sampling area (do not herd or harass)
- immediately release listed taxa if they are unintentionally collected while implementing the sediment, benthic macroinvertebrate, or fish tissue sampling protocols (do not preserve)
- implement additional limitations that may be established in the scientific sampling permits

These best practices are not an exhaustive list of requirements for field crews. Regulations and guidelines that have been developed for marine life viewing provide useful risk minimization practices when boating in area that may support listed manatee, whales, turtles, sea lions, and sharks. Field crews are expected to be aware of the recommendations and guidelines that apply in a given state and for a given species. Additional information on boating best practices is available on the NOAA Fisheries Marine Life Viewing page and provided by the Florida Fish and Wildlife Conservation Commission.