Refer to NMFS No: WCRO-2023-00532

Memorandum for: The Record

From: Chris Yates
Assistant Regional Administrator, Protected Resources Division

Subject: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, for the issuance of Scientific Research and Enhancement Permit 14344-3R to University of California, Davis, Office of Research, for field collection, captive breeding, and research on white abalone (*Haliotis sorenseni*) in California, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

Enclosed is the NOAA National Marine Fisheries Service's (NMFS) biological opinion pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the proposed issuance of Permit 14344-3R to the University of California, Davis, for scientific research and enhancement activities involving endangered white abalone (*Haliotis sorenseni*) in California.

We conclude that the proposed issuance of Permit 14344-3R is likely to adversely affect, but not likely to jeopardize the continued existence of white abalone. We do not discuss effects on critical habitat, because NMFS has not designated critical habitat for white abalone. We also conclude that the proposed permit may affect but is not likely to adversely affect black abalone and designated critical habitat for black abalone. The proposed permit would not affect any other ESA-listed species or designated critical habitat.

This concludes formal consultation on this action. Consultation on this action must be reinitiated if: (1) the amount or extent of allowable take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

We also completed an Essential Fish Habitat (EFH) consultation on the proposed action, in accordance with section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) [16 U.S.C. 1855(b)]. We concluded that there are no adverse effects on EFH. Therefore, we are hereby concluding EFH consultation.

Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Issuance of Scientific Research and Enhancement Permit 14344-3R to the University of California, Davis, Office of Research, for field collection, captive breeding, and research on white abalone (*Haliotis sorenseni*) in California, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

NMFS Consultation Number: WCRO-2023-00532

Action Agency: NOAA's National Marine Fisheries Service, West Coast Region, Protected Resources Division

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
White abalone (*Haliotis sorenseni*)	Endangered	Yes	No	NA	NA
Black abalone (*Haliotis cracherodii*)	Endangered	No	NA	NA	NA

Fishery Management Plan that Identifies EFH in the Project Area	Does Action have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Groundfish	No	No
Pacific Coast Salmon	No	No

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: [signature]
Chris Yates
Assistant Regional Administrator for Protected Resources

Date: June 13, 2023

Cc: Administrative File 151422WCR202300098

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ACRONYMS

BML	Bodega Marine Laboratory
CDFW	California Department of Fish and Wildlife
CICESE	Centro de Investigación Científica y de Educación Superior de Ensenada
CIMRI	Channel Islands Marine Resource Institute
CMA	Cabrillo Marine Aquarium
CSC	California Science Center
DQA	Data Quality Act
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ITS	Incidental Take Statement
MLML	Moss Landing Marine Laboratory
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
NWFSC	Northwest Fisheries Science Center
OTC	Oxytetracycline
PFMC	Pacific Fishery Management Council
PIT	Passive Integrated Transponder
PRD	Protected Resources Division
RPM	Reasonable and Prudent Measure
SBMNH	Santa Barbara Museum of Natural History
SL	Shell length
SWFSC	Southwest Fisheries Science Center
TBF	The Bay Foundation
UC Davis	University of California, Davis
UCI	University of California, Irvine
UCSB	University of California, Santa Barbara
UV	Ultra-violet
UW	University of Washington
WCR	West Coast Region
WDFW	Washington Department of Fish and Wildlife

1. Introduction

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the NMFS West Coast Region (WCR) Long Beach office.

1.2 Consultation History

On January 5, 2023, the NMFS WCR Protected Resources Division (PRD) Permits Team received an application from the University of California, Davis, Office of Research (UC Davis) to renew their permit to "take" endangered white abalone to continue the captive white abalone propagation and research program.

The Permits Team solicited public comments on the permit application from January 18 through February 17, 2023, via a notice published in the Federal Register (88 FR 2889; January 18, 2023). No comments were received.

On April 27, 2023, the Permits Team developed the draft permit conditions and we initiated consultation on the proposal to issue Scientific Research and Enhancement Permit 14344-3R to the UC Davis, to authorize research and enhancement activities involving endangered white abalone. Issuance of the permit constitutes a Federal action that may affect marine species listed under the ESA, as well as designated EFH.

This opinion analyzes the research and enhancement activities that may be authorized under Permit 14344-3R and evaluates their effects on ESA-listed resources, primarily endangered white abalone, as well as EFH for Pacific Coast Groundfish and Pacific Salmon.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

1.3 Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (see 50 CFR 402.02). Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (see 50 CFR 600.910).

The NMFS WCR PRD Permits Team proposes to issue Permit 14344-3R under the authority of Section 10(a)(1)(A) of the ESA to the UC Davis, to authorize research and enhancement activities for white abalone, as described in the permit application and summarized below. The proposed permit would authorize researchers at UC Davis and their co-investigators to continue the research and enhancement activities authorized under the current permit (Permit 14344-2R) for an additional five years.

The purpose of Permit 14344-3R is to support white abalone recovery by captive breeding and grow-out of healthy white abalone for use in research and field planting. Permit 14344-3R would authorize researchers to maintain captive white abalone populations, continue the white abalone captive propagation program, conduct laboratory experiments on white abalone, collect wild white abalone to serve as broodstock, and reintroduce (field plan) wild-origin white abalone to the wild. Field planting of captive-bred white abalone would be covered under a different permit (Permit 18116 issued to the NMFS WCR). The Final White Abalone Recovery Plan (NMFS 2008) identifies captive breeding and field planting as key recovery actions.

In the following sections, we describe the proposed research and enhancement activities and identify those aspects likely to affect ESA-listed resources.

We considered, under the ESA, whether or not the proposed action would cause any other activities that would have consequences on listed species or their critical habitat, and we determined that it would not. 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.

1.3.1 Collection and Reintroduction of Wild Broodstock

1.3.1.1 Collection of wild broodstock

Researchers would collect up to an additional 16 white abalone from the wild to serve as broodstock in the captive propagation program. Researchers would conduct surveys throughout the species' range (Point Conception, California, to central Baja California). Only "reproductively isolated" individuals (based primarily on distance from other individuals) would be eligible for collection (see Section 1.3.4, Permit Conditions, for specific collection criteria). Researchers may collect white abalone any time of the year, and may specifically target the spawning season (winter/spring months) when abalone are most likely to have mature gonads and are also most likely to be aggregated, if they aggregate to spawn. For any white abalone that are observed but not collected, researchers may measure their shell length and collect genetic samples (epipodial clips and/or swab samples) and fecal samples (swab samples).

Researchers would apply the methods outlined in the White Abalone Recovery Plan (NMFS 2008) to minimize the risk of injuring abalone during collection, transport, and holding. Researchers would remove white abalone from the substrate using their hands or a plastic spatula in conjunction with an abalone iron where necessary. If the abalone clamps down, researchers would wait for it to relax before attempting removal again. Only experienced personnel would be allowed to remove abalone. Abalone would be transported by vessel, vehicle, and/or air over a period of less than 24 hours to a few days, depending on the duration of the collection cruise and the distance to holding facilities (see Section 1.3.2.4 *Transport*).

Researchers would measure the shell length, weigh, and tag each abalone with an external tag attached to the shell. The white abalone would become part of the captive program and subject to the following research and enhancement activities: breeding (spawning) up to five times per year, genetic sampling, health inspections and treatments as needed, and routine holding and husbandry activities (see Section 1.3.2 Captive maintenance, grow-out, and propagation).

Permit 14344-3R would stipulate the number of white abalone that may be collected, the collection criteria, monitoring and reporting requirements, and the long-term disposition of the abalone (e.g., maintain in captivity or re-introduce to the wild) (see Section 1.3.4 Permit Conditions below).

1.3.1.2 Reintroduction of wild broodstock

Wild-origin broodstock must be considered for reintroduction to the wild after three or more years in captivity. NMFS would decide whether to reintroduce or keep the abalone in captivity based on review of their health, spawning success, and the Permit holder's recommendation.

Reintroduction would involve monitoring potential field planting sites and any white abalone already present at those sites, health screening prior to release, land and vessel transport, field planting procedures, and post-release monitoring. The proposed permit would authorize researchers to reintroduce wild-origin abalone and cover all aspects of reintroduction except for post-release monitoring, which is covered under ESA Permit 18116 (issued to the NMFS WCR for white abalone field planting and monitoring).

Before conducting reintroductions, the Permit holder must develop a NMFS-approved reintroduction plan detailing the field planting methods, strategies, and best practices to minimize harm and maximize benefits to both the existing wild population and the wild-origin abalone to be reintroduced. This plan would optimize genetic diversity and aggregation sizes in the wild, to promote natural reproduction.

1.3.2 Captive maintenance, grow-out, and propagation

Researchers would maintain captive white abalone at approved facilities throughout the coast. These facilities include: UC Davis-BML, Aquarium of the Pacific, The Bay Foundation (TBF), Cabrillo Marine Aquarium (CMA), California Science Center (CSC), Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE), The Cultured Abalone Farm, Moss Landing Marine Laboratories (MLML), NMFS Southwest Fisheries Science Center (SWFSC) La Jolla Laboratory, Santa Barbara Museum of Natural History (SBMNH), and the University of California, Santa Barbara (UCSB). Additional facilities may be added to the captive program.

Currently, these facilities hold tens of thousands of captive-bred white abalone juveniles and adults, as well as ten wild-origin adults. Following spawning events, facilities may hold millions of larvae and tens of thousands of newly settled juveniles. Permit 14344-3R would allow researchers to receive additional white abalone from other facilities holding captive white abalone, including facilities in Mexico. Researchers may also receive white abalone from law enforcement cases (most likely poaching cases), emergency response activities (e.g., rescues in response to spills), and activities carried out, funded, or authorized by a Federal agency that involve removing white abalone from the wild (the effects of removal would be covered under a separate consultation for the Federal action).

1.3.2.1 Holding conditions and maintenance

Researchers would maintain abalone under conditions that mimic natural conditions in the ocean, following guidelines provided in the White Abalone Recovery Plan (NMFS 2008). These conditions include optimal temperature and oxygen levels for abalone survival and growth and regular removal of waste products. Some facilities treat the incoming seawater with ultra-violet (UV) light to remove pathogens. To reduce water quality effects on offshore waters, facilities treat their effluent with UV irradiation or with chlorine (under 10 parts per million) and dechlorinate the water before release to the ocean.

On a regular basis (annually), researchers would remove abalone from the substrate to measure their shell length, weight, health, and gonad condition. The standard method for removal is to slide a broad-faced plastic spatula or similar tool between the tank surface and the abalone's foot. Alternate methods may be used for abalone that are difficult to remove (e.g., strongly hunkered down, attached to complex surfaces). These alternate methods include: exposure to 2-3% ethanol in seawater solution for 5-10 minutes; squirting of 25% ethanol in seawater along the shell base to encourage lifting of the shell such that a spatula can be inserted between the foot and tank surface; and exposure of abalone to a live seastar (*Pisaster* sp.) to encourage movement.

1.3.2.2 Captive spawning

Researchers would attempt to spawn the white abalone broodstock about 2-5 times per year, primarily during the natural spawning season (winter/spring months). Additional spawning attempts may be conducted at other times of the year to evaluate the effectiveness of broodstock conditioning methods (see Section 1.3.3 Captive Research Activities). Researchers would use standard spawning and culturing methods (Kawana and Aquilino 2020), which include placing male and female broodstock in separate containers, a desiccation period, and exposing them to increased temperatures and a solution of Tris-buffered seawater and hydrogen peroxide (6% H_2O_2). Once spawning occurs, or after about three hours of exposure to the Tris/H_2O_2 solution, researchers remove the abalone from the solution and place them in filtered seawater. Researchers collect any eggs and sperm and mix them to promote fertilization. During spawning attempts, researchers would closely monitor the abalone for signs of stress.

To maximize genetic diversity, researchers aim to conduct pair-wise mating, where the gametes from one male will be used to fertilize the eggs of one female at a time, so that the progeny from that cross can be traced over time. As much as possible, researchers plan to cultivate larvae, juveniles, and adults from each facility separately, or mark families to protect genetic integrity.

1.3.2.3 Culturing, grow-out, and maintenance

Permit 14344-3R would allow researchers to grow-out and maintain all captive-bred progeny produced during propagation activities at the approved facilities. Researchers would settle the captive-bred white abalone according to established protocols (Kawana and Aquilino 2020). To determine survival rates through all stages of development, researchers may collect a sample at each stage to assess initial numbers (e.g., of released eggs, swimming trochophores, developing veligers) and enumerate settled veligers using a microscope. Researchers may also preserve a small number of each stage to document early life development.

Researchers would monitor abalone health and holding conditions daily. Researchers may collect a genetic sample (epipodial clip, swab sample) using non-lethal methods. When appropriate, abalone may be integrated into the broodstock population and spawning efforts. In the event of mortalities, tissues would be preserved for analysis.

Researchers may intentionally kill captive-bred white abalone when necessary to cull smaller or slow-growing individuals to optimize densities in the holding tanks. Researchers may also destroy captive-bred progeny when the number produced exceeds the capacity of the facilities. For example, a very successful spawning event may produce more larvae than the facilities can handle for settlement and grow-out. The Permit Holder must discuss these options with NMFS and only cull and/or destroy progeny after all other options (e.g., research, experimental field planting, grow-out in a separate area or facility) have been explored.

1.3.2.4 Transport

White abalone (all life stages) may be transported among facilities by vehicle or air, using established transport protocols. Typically, transport includes placing the abalone in coolers with sufficient oxygen, moisture, and temperature levels. Transport times would be less than 24 hours and minimized as much as possible.

1.3.2.5 Tagging

Researchers would apply tags to all wild-origin white abalone and may also apply tags to captive-bred abalone, for identification in the lab as well as for future field planting. Several types of tags may be used, including: shell banding, external tags attached to the shell, and external tags embedded in the shell. Shell banding involves manipulating the diet to produce different color patterns. Shell banding may be useful for identifying captive-bred vs. wild abalone in field planting studies. External visual tags, such as numbered bee tags or numbered vinyl shellfish tags, may be attached to the shell using marine epoxy or superglue, typically on the posterior end near the whorl. The tags are small compared to the size of the shell and smaller than the size of organisms (e.g., barnacles, tubeworms) that typically grow on the shell of wild animals. Passive integrated transponder (PIT) tags may also be attached to the shell, either to the outer surface using marine epoxy or to the interior surface using glue and allowing nacre to form over the tag (Hale et al. 2012). Genetic markers may also serve as a tag to identify captive-bred vs. wild abalone in field planting studies and can be developed using genetic samples.

1.3.2.6 Genetic sampling

Researchers may collect samples from juvenile and adult abalone for genetic analysis, to evaluate the genetic diversity and composition of the captive population and inform genetic management (e.g., to maximize diversity in spawning events and track lineage in captive-bred stocks). Understanding the genetic makeup of the captive-bred population may provide a method to track the survival and reproduction of these individuals once released to the ocean.

Researchers would obtain tissue samples from freshly dead individuals or by taking epipodial clips from live abalone. Epipodial clipping is a well-established, non-lethal method to collect a tissue sample from abalone for genetic analysis (Hamm and Burton 2000). Researchers would use tweezers to grasp the end of an epipodial tentacle on the side or posterior of the abalone and cut the tentacle 1-2 millimeters from its base. Samples would be preserved (e.g., in 95-100% ethanol, RNAlater, or frozen) and sent to approved facilities, including the University of Washington (UW), NMFS Northwest Fisheries Science Center (NWFSC), CDFW Shellfish Health Lab, and University of California, Irvine (UCI).

Researchers may also obtain genetic samples by swabbing the abalone shell or foot. Researchers would use the tip of a buccal swab to swab the surface of the shell or any exposed soft tissue. Duplicate swabs would be collected for each abalone. Samples would be placed in vials filled with preservative solution (e.g., 70% or higher concentration of ethanol), if needed, and sent to approved facilities for analysis.

1.3.2.7 Health monitoring and treatments

Researchers would visually examine the captive abalone to monitor their health. The three main health concerns for captive abalone are: (1) withering syndrome; (2) shell-boring organisms; and (3) parasitic sabellid polychaete worms.

Withering syndrome is a disease that causes the abalone's foot muscle to shrink and eventually results in death. For newly-collected wild-origin abalone, researchers would collect fecal samples to evaluate whether the abalone are infected with the pathogen (Moore and Marshman 2015b). Fecal samples may be collected by inserting a flexible soft-tipped swab between the epipodium and mantle, along the gills. If recommended by the CDFW Shellfish Health Lab, abalone would be treated with oxytetracycline (OTC), an antibiotic capable of eliminating the pathogen from infected abalone. The treatment involves immersing abalone in an OTC bath solution and has been used routinely to treat captive white abalone (Moore et al. 2019).

Shell-boring organisms can infest and weaken the abalone's shell, leading to shell damage and potentially to death. Researchers would apply a wax treatment (Moore and Marshman 2015a) to remove heavy infestations. The treatment involves scrubbing the shell surface with a brush and coating the shell surface with a wax mixture (beeswax and coconut oil), taking care not to cover the respiratory pores. Abalone are out of the water for less than 10 minutes. The wax suffocates the shell-boring organisms and will flake off the shell over time.

Parasitic sabellid polychaete worms can infest the growing edge of shells and cause shell deformity, slow growth, and brittleness. An eradication program has essentially removed the worms from farms and prevented new infestations. All facilities in the captive program must be sabellid-free certified by CDFW and undergo regular (annual) inspections. Inspections involve removing the abalone from holding tanks and visually inspecting their shells for the presence of sabellid worms. Abalone are out of the water for up to 30 minutes. Depending on the number of abalone at the facility, all or a subset may be examined.

1.3.2.8 Processing dead or obviously dying abalone

The proposed permit would allow researchers to process, preserve, and analyze dead white abalone, as well as intentionally kill obviously dying white abalone for necropsy. Obviously dying abalone are those that show the following symptoms: reduction or cessation of feeding, extreme lethargy, withered and discolored foot muscle, and/or inability to adhere to the substrate. Abalone showing these symptoms will die soon. Pathologists recommend that obviously dying abalone be sacrificed and preserved before they die. Once an abalone dies, the tissues deteriorate quickly and are no longer useful for necropsy to determine the cause of sickness/death.

Researchers would follow the procedures described in the White Abalone Moribund and Dead Animal Processing Guide (Moore 2014). Researchers may freeze whole animals, or dissect the relevant tissues (gut and foot muscle) and either freeze the tissues or fix them in formalin before placing in ethanol. Whole specimens, tissues, and parts would be analyzed at the approved facilities listed on the permit, as well as the UW, NMFS NWFSC, CDFW Shellfish Health Lab, and UCI. Additional facilities may be added to the list of approved facilities.

1.3.2.9 Public display and education

Researchers would continue public outreach and education programs to raise awareness of the ecological and economic importance of abalone and their conservation needs. Approved facilities may allow public visitors to view the abalone in their holding tanks or may move some of the abalone to separate display tanks. Researchers would maintain holding conditions consistent with the guidance provided in the White Abalone Recovery Plan (NMFS 2008).

1.3.3 Captive Research Activities

Researchers would conduct research using captive live white abalone and white abalone samples or parts at the approved facilities. Captive research would focus on critical questions for species recovery, including increasing captive production through improved gametogenesis and spawning; optimizing survival, health, and grow-out; and improving survival upon field planting. Research methods would include hormone injections to trigger gametogenesis, use of probiotics to improve abalone health, exposure to varying holding conditions (temperature, photoperiods) to accelerate grow-out, exposure to environmental conditions linked to climate change, and use of epoxies to remove shell epibionts. The numbers of white abalone used for captive research would depend on production and program needs (e.g., ensuring sufficient numbers for field planting studies under Permit 18116). Researchers would use the earliest life stages possible for experiments and aim to keep the abalone alive and eligible for field planting, except where histological or other lethal take is absolutely necessary. Researchers would use captive-bred white abalone for research studies, except when use of wild-origin abalone is absolutely necessary. Research using wild-origin abalone would not involve lethal take.

1.3.4 Permit Conditions

Research and enhancement permits lay out the conditions to be followed before, during, and after the permitted activities are conducted. These conditions are intended to: (a) manage the interaction between researchers and listed abalone by requiring that activities be coordinated between permit holders and NMFS, (b) minimize effects on listed species, and (c) ensure that NMFS receives information about the effects the permitted activities have on the species concerned. NMFS will use the annual reports to monitor the actual number of listed abalone taken every year by scientific research and enhancement activities and will adjust permitted take levels if they are deemed to be excessive or if cumulative take levels rise to the point where they are detrimental to the listed species.

The proposed permit conditions refer to the following personnel under the permit: Permit holder, principal investigator, and co-investigator. “Permit holder” means the person, institution, or agency that is ultimately responsible for all activities of any individual who is operating under the authority of the permit. “Permit holder” refers to the permit holder or any employee, contractor, or agent of the permit holder. “Principal investigator” means the individual primarily responsible for the taking, importation, exportation, and any related activities conducted under the permit. "Co-investigator" means an individual who is qualified and authorized to conduct or directly supervise activities conducted under the permit without the on-site supervision of the Principal Investigator.

The proposed permit conditions include the following:

General Conditions

1. The Permit Holder must ensure that listed species are taken only at the levels, by the means, in the areas, and for the purposes stated in the permit application, and according to the conditions in this permit.
2. The Permit Holder must not intentionally kill, or cause to be killed, any listed species unless and to the extent that the permit specifically allows intentional lethal take.
3. All personnel operating under this permit must exercise the utmost caution and care to avoid unnecessary disturbance or harm to endangered white abalone.
4. All personnel operating under this permit must handle white abalone with care and provide adequate transport and holding conditions for abalone health, including water temperatures within the optimal range for white abalone, proper aeration and oxygen levels, and routine removal of waste products as outlined in the White Abalone Recovery Plan.
5. The person(s) actually carrying out the research and enhancement activities must carry a copy of this permit while conducting the authorized activities.
6. Co-investigators must coordinate permitted activities with the Principal Investigator before conducting the activities.
7. The Permit Holder must allow any NMFS employee or representative to accompany personnel while they conduct the research and enhancement activities.
8. The Permit Holder must allow any NMFS employee or representative to inspect any records or facilities related to the permit activities.
9. The Permit Holder may not transfer or assign this permit to any other person as defined in Section 3(12) of the ESA. This permit ceases to be in effect if transferred or assigned to any other person without NMFS' authorization.
10. NMFS may amend the provisions of this permit after giving the Permit Holder reasonable notice of the amendment.
11. The Permit Holder must obtain all other required Federal, state, and local permits and/or authorizations for the research and enhancement activities.
12. This permit does not authorize take of any protected species other than white abalone, including those species under the jurisdiction of the USFWS. Should other protected

species be encountered during the research and enhancement activities authorized under this permit, researchers should exercise caution and remain a safe distance from the animal(s) to avoid take, including harassment.

13. The Permit Holder is responsible for all costs incurred by research and enhancement activities, including determinations of cause of death of abalone during any of the activities authorized under this permit.
14. If the Permit Holder violates any permit condition, they will be subject to any and all penalties provided by the ESA. NMFS may revoke this permit if the authorized activities are not conducted in compliance with the permit and the requirements of the ESA or if NMFS determines that its ESA section 10(d)[1] findings are no longer valid.

Duration of Permit

1. This permit expires on December 31, 2028. Researchers may conduct activities authorized by this permit only through the expiration date and only until authorized take or mortality levels are reached. Annual review and authorization is required to document annual take and evaluate compliance with the permit conditions. A renewal or amendment for this permit can be applied for through the NOAA Fisheries online system (currently APPS, available at: https://apps.nmfs.noaa.gov/index.cfm). A completed application must be submitted before the expiration date in order to be considered for the renewal or amendment without a break in coverage.
2. If authorized take or mortality is exceeded, researchers must cease permitted activities and notify the NMFS contact listed on the cover letter (page 1) of this permit as soon as possible, but no later than within two business days. The Permit Holder must also submit a written incident report. NMFS may amend the permit, granting authorization to resume some or all permitted activities based on review of the incident report and in consideration of the Terms and Conditions of this permit.
3. In the event that any ESA-listed species is taken (as defined by the ESA) in a manner not authorized by this permit, or not otherwise allowed by another permit or exemption during the course of the activities authorized under this permit, the Permit Holder shall document and notify the NMFS contact of the subject taking. Such notification shall be made to the NMFS contact within a reasonable period of time, but in no case later than two business days after the discovery of an unauthorized take. Pending review of the circumstances surrounding the unauthorized take, NMFS may suspend or terminate the

[1] Section 10(d) of the ESA states that the Secretary of Commerce may issue scientific research and enhancement permits under Section 10(a)(1)(A) of the ESA based on findings that such permits: (1) were applied for in good faith; (2) will not operate to the disadvantage of such endangered species; and (3) will be consistent with the purposes and policy set forth in section 2 of the ESA.

authorized activities or amend this permit prior to allowing the permitted activities to continue.

Conditions Related to Broodstock Collection

1. Broodstock collection is authorized to occur in three phases. Under the previous permit (Permit 14344-2R), researchers have already completed the first phase (Phase I) and have collected 14 white abalone from the wild. Authorization to collect additional white abalone (Phase II and III) is contingent upon approval by NMFS pending review of written reports submitted by the Permit Holder. Written reports must include information related to the health, survival, and spawning success rate of previously collected animals. The composition of each phase is as follows:
    a. Phase I, researchers collected 14 white abalone (under Permit 14344-2R).
    b. Phase II and III: Pending NMFS approval, researchers may collect additional abalone, up to a total of 30 white abalone collected under Phases I, II, and III.
    c. To request collection of additional abalone under Phase II and Phase III of this permit, the Permit Holder must submit a request specifying the number of additional abalone requested and justification for that number, as well as information on the health, status, survival, and spawning success of previously collected individuals, including:
        i. Health of previously collected abalone (e.g., growth, disease, shell condition),
        ii. Survival rate of previously collected abalone,
        iii. Spawning rate of previously collected abalone (i.e., the proportion of spawned successfully).
    d. NMFS approval to collect additional abalone under Phases II and III of this permit will include discussion of which abalone are eligible for reintroduction into the wild.
2. The collection criteria are intended to limit collections to reproductively isolated individuals, to minimize the loss of reproductive potential in the wild.
    a. An individual is eligible for collection if it is more than 10 meters from all other white abalone. The area within 10 meters of each white abalone must be surveyed for the presence of additional white abalone by experienced, qualified divers. The Permit Holder must allow a NOAA diver to participate on each collection cruise.
    b. Researchers may not collect white abalone at two specific research sites along the mainland California coast off Point Loma. These research sites range from about 400 to 500 m^2 in area. To protect the white abalone from poaching, we do not

provide detailed information or maps of these site locations in this permit, but will provide the information directly to the Permit Holder.

c. NMFS may apply the same or less restrictive criteria for collection of additional wild-origin white abalone in Phases II and III of the permit.

d. At-risk abalone: NMFS may apply less restrictive criteria for collection of white abalone that are at high risk of being killed (e.g., by poaching, anchor strike).

3. The Permit Holder must submit a collection cruise plan to NMFS at least four weeks before the collection cruise. The collection cruise plan must include:

    a. The dive plan,

    b. The date(s) or range of dates when diving will occur,

    c. Cruise location,

    d. Vessel description,

    e. Names of participants and their roles, including: divers, NOAA diver(s), and topside support,

    f. A description of survey and collection methods and data collection (see Appendix A of the Final White Abalone Recovery Plan). This description should include a discussion of whether and how a larger search area (i.e., beyond the required 10m radius around each individual white abalone) will be surveyed to document the presence of white abalone and habitat features within the collection area. This information will inform our assessment of wild populations and how collection activities affect wild populations, for future analyses.

    g. A description of how white abalone will be transported (see Appendix A of the Final White Abalone Recovery Plan), and

    h. The short-term and long-term holding facilities, including points of contact.

4. The Permit Holder must submit a collection cruise report to NMFS no more than 90 days following the collection cruise. The collection cruise report must include:

    a. Date(s) and location of the collection cruise, including coordinates, depth range, and the area surveyed,

    b. Names of participants and their roles, including: divers, NOAA diver(s), and topside support.

    c. A description of habitat quality within the surveyed area,

    d. A summary of the number of abalone observed and their general location within the habitat and in proximity to other white abalone or other abalone species. Note any other abalone species observed and their proximity to one another,

e. For any white abalone that were not collected: A summary of the observed abalone, including shell length, samples collected (tissue, fecal, unique identifiers), and a description of why the abalone was not eligible for collection,

f. For any white abalone that were collected: The total number collected and for each individual, the tag type and number, shell length, weight, sex, gonad index, samples collected (tissue, fecal, unique identifiers), date collected, location, habitat type, nearest neighbor distance (i.e., the distance to the nearest white abalone), who collected the abalone, and the facility to which the abalone was transported. Describe how each individual met the collection criteria. Note any injuries and additional comments.

g. A summary of holding conditions on the vessel and during transport,

h. A summary of post-collection handling, including the facility to which the abalone were transported and general holding conditions, the general health and reproductive condition of the abalone, health/disease testing and treatments, and any injuries or mortalities. Note where tissue samples were sent and any results,

i. A summary of any deviations from the approved collection cruise plan.

5. The Permit Holder must allow a NOAA diver (i.e., a NOAA employee or NOAA contractor that is a certified NOAA diver) to participate on collection cruises to provide expertise, assist in collections, transport tissue samples to NMFS SWFSC, and act as a liaison to NMFS management on the status of the collection operation.
6. All collected white abalone must be individually identifiable following collection.
7. Two epipodial tissue samples must be collected from each collected animal. If possible, two epipodial tissue samples should be collected from each white abalone that is observed but not collected. Samples must be collected from epipodial tentacles on the sides or posterior of each animal and must be taken at least 1-2 mm from the base of the tentacle. One sample will be maintained by the Permit Holder and one sample will go to the NMFS SWFSC.
8. If possible, collect fecal samples from each white abalone that is observed but not collected, using an in-situ sampling method that involves inserting a flexible nylon swab between the epipodium and mantle, along the gills, to collect fecal material near the anus. This method does not require removing abalone from the substrate. Samples will be analyzed to determine if abalone are infected with the withering syndrome pathogen.
9. Newly collected abalone must be quarantined for at least four weeks and examined daily for signs of disease, mortality, or behavioral disorders. Newly collected abalone must be screened for the pathogen that causes withering syndrome and treated if recommended by the CDFW Shellfish Health Lab. If methods have been developed, then the newly collected abalone must also be screened for the bacteriophage that infects the pathogen

and potentially reduces its pathogenicity. See protocols in the appendices to the Final White Abalone Recovery Plan.

10. BML must keep a detailed inventory of the number of individuals collected and mortalities and share these data with NMFS and the co-investigators on the permit.
11. NMFS may require reintroduction of wild-origin white abalone to the wild after three or more years in captivity, if the abalone either do not spawn in captivity, or spawn successfully such that their genetic diversity is adequately captured. In the annual permit report, the Permit Holder must summarize the abalone's health and spawning success and recommend whether to reintroduce or keep the abalone in captivity. NMFS will consider the information and BML's recommendation. Any reintroductions must be conducted in compliance with applicable state regulations and permits. The Permit Holder must work with NMFS to develop a reintroduction plan at least four weeks before reintroduction activities. The reintroduction plan must include:
    a. Planned dates and location of reintroduction activities,
    b. Names of participants and their roles, including: divers, NOAA diver(s), and topside support,
    c. A description of the reintroduction site, including a summary of information on white abalone, other abalone species, and habitat quality at the site,
    d. A description of health screening methods and/or results prior to reintroducing the abalone to the wild,
    e. A description of how the white abalone will be transported to the field, and
    f. A description of field planting methods.
12. The Permit Holder must submit a report to NMFS no more than 30 days following reintroduction activities. The reintroduction report must include:
    a. Dates and locations of reintroduction activities, including coordinates, depth range, and the reintroduction site,
    b. Names of participants and their roles, including: divers, NOAA diver(s), and topside support,
    c. A description of the reintroduction site, including the habitat quality and presence of white abalone and other abalone species within the area,
    d. A summary of the reintroduction activities, the effects on the reintroduced white abalone and any abalone already present at the sites, and any deviations from the reintroduction plan, and
    e. A description of planned post-release monitoring activities.

Conditions related to captive holding, breeding, and research activities

1. Research activities are limited to those described in the application. Research topics include increasing captive production; improving survival, health, and grow-out in captivity; and improving survival of field planted abalone. Prior to conducting research, the Permit Holder must coordinate with the NMFS WCR's White Abalone Recovery Coordinator on the following to balance the use of white abalone across recovery activities:
    a. The number of wild-origin and/or captive-bred white abalone to be used for each research activity;
    b. The life stages to be used for each research activity; and
    c. The estimated number of abalone that may be killed, unintentionally and intentionally, as part of the research activity.
2. Broodstock abalone must be individually identifiable (e.g., by tagging).
3. Shell waxing may be conducted when necessary to prevent damage by shell-boring organisms (e.g., evidence of live Polydora covering the shell, or more than 50 percent of the shell surface shows evidence of boring organisms). Researchers should keep the animals moist and minimize the time out of water (typically less than 10 minutes).
4. Anesthetics: Researchers may use anesthetics to sedate abalone prior to removal from substrates. To minimize stress to the abalone, researchers must limit the concentration of the anesthetics and exposure time to the minimum needed to relax the abalone and remove them from the substrate.
    a. For juvenile abalone: Exposure to low concentrations of ethanol (e.g., less than 3%) for a short period of time (e.g., 5-10 minutes) has been effective for sedating mass numbers of small juvenile abalone.
    b. For larger abalone: Researchers may use ethanol (non-denatured) at a maximum concentration of 3% (30 mL/L) and a maximum exposure time of 10 minutes.
5. Researchers may euthanize obviously dying abalone to preserve their tissues for necropsy. Obviously dying abalone are those that show the following symptoms: reduction or cessation of feeding, extreme lethargy, withered and discolored foot muscle, and/or inability to adhere to the substrate. Abalone that fit this description are expected to die within days and may be preserved to determine the cause of death.
6. Prior to transferring abalone to an approved facility, the responsible official of the facility must be designated as a co-investigator (CI) on this permit or possess a separate scientific research and/or enhancement permit.

7. Prior to transfer to a new facility which has not previously held white abalone, husbandry and research protocols including disease screening and prevention of disease transmission at the facility must be submitted to NMFS for approval.
8. Public display of captive white abalone is authorized provided that it is incidental to and does not interfere with attaining the survival or recovery objectives as described in this permit. Such incidental public display may only occur as part of an educational program. A portion of this program must describe the research and/or enhancement activities.
9. Researchers and approved facilities listed on this permit are authorized to transfer, receive, import, and export tissue samples, parts, live white abalone (e.g., embryos, larvae, juveniles, adults), including gametes, as well as dead white abalone for scientific research and enhancement activities. The ability to exchange live animals, dead specimens, and samples will facilitate collaboration among researchers in the U.S. and Mexico and enhance research in both areas. The Permit Holder must:
    a. Maintain a record of all live animals, dead specimens, parts, and tissue samples received from and transported to other facilities, including the purpose of the transfer, what was transferred (live animals, dead specimens, parts, tissue samples), origin (wild, captive, location), individual identifiers (e.g., tag numbers, cohort), transport methods, and final destination and disposition;
    b. Summarize these records in the annual report to NMFS; and
    c. Notify NMFS prior to importing/exporting live animals, dead specimens, parts, or tissue samples to/from approved co-investigators and approved facilities in Mexico.
10. Researchers and facilities listed on this permit may receive wild-origin white abalone from the following sources listed below and conduct permitted activities with these abalone. Newly obtained abalone must be quarantined and undergo health screenings and treatments as needed.
    a. Captive white abalone held at other facilities, including facilities in Baja California, Mexico.
    b. Law enforcement cases (e.g., poaching) that involve confiscation of live white abalone. The white abalone would be under the custody of law enforcement and placed on loan for research purposes at the approved captive facilities. Permit 14344-3R would cover the receipt of and research and enhancement activities involving these white abalone once brought into captivity.
    c. Activities carried out, funded, or authorized by a Federal agency that involve removing white abalone from the wild. The removal of these white abalone from the wild would be analyzed and covered by a consultation under Section 7 of the ESA for the action. Permit 14344-3R would cover the receipt of and research and enhancement activities involving these abalone once brought into captivity.

   d. Emergency response activities that involve removing white abalone from the wild. The removal of these white abalone from the wild would be analyzed and covered under the appropriate ESA process for the action. Permit 14344-3R would cover the receipt of and research and enhancement activities involving these animals once brought into captivity.

11. Disposition: The Permit Holder is responsible for all captive-bred white abalone produced under this permit and all disposition alternatives are subject to the Terms and Conditions of this permit. For each year class of captive-bred abalone, the Permit Holder must confer with NMFS on the proportion of individuals to be raised for each disposition option listed below. The following dispositions have been considered for this permit:
    a. Use in authorized research activities,
    b. Transfer to facilities for settlement and grow-out, research, field planting, and/or outreach and educational purposes, and
    c. Destroying.
12. Mortalities: Although unlikely, we consider the possibility that all of the white abalone held in captivity under this permit could die due to natural or unusual mortality events.

Number and Kind(s) of Protected Species, Location(s), and Manner of Taking

1. The take table in the permit application outlines the number of white abalone that may be taken, and the locations, manner, and period in which they may be taken. These numbers are subject to annual review and authorization by NMFS.
2. Researchers working under this permit may collect visual images (e.g., still photographs, motion pictures) as needed to document the permitted activities, provided the collection of such images does not result in the taking of protected species.
3. The Permit Holder may use visual images collected under this permit in printed materials (including commercial or scientific publications) and presentations, provided the images and recordings are accompanied by a statement indicating that the activity was conducted pursuant to Permit No. 14344-3R. This statement must accompany the images and recordings in all subsequent uses or sales.
4. Upon written request from the Permit Holder, approval for photography, filming, or audio recording activities not essential to achieving the objectives of the permitted activities, including allowing personnel not essential to the research (e.g. a documentary film crew) to be present, may be granted by NMFS.
    a. Where such non-essential photography, filming, or recording activities are authorized, they must not influence the conduct of permitted activities or result in take of protected species.

   b. Personnel authorized to accompany the Researchers during permitted activities for the purpose of non-essential photography, filming, or recording activities are not allowed to participate in the permitted activities.
   c. The Permit Holder and Researchers cannot require or accept compensation in return for allowing non-essential personnel to accompany Researchers to conduct non-essential photography, filming, or recording activities.
5. Biological Samples:
   a. The Permit Holder is responsible for all biological samples collected from listed species, including whole specimens, tissue samples, and shells. Such samples are subject to the Terms and Conditions of this Permit.
   b. All biological samples collected from white abalone obtained under the permit shall be identified by a unique number and maintained according to accepted curatorial standards. After completion of initial research goals, any remaining samples or specimens shall be maintained by the Permit Holder or deposited into a bona fide scientific collection that meets the minimum standards of collection, curation, and data cataloging as established by the scientific community.
   c. The Permit Holder may not transfer biological samples to researchers other than those specifically identified in the application without prior written approval from NMFS.
6. Take is not authorized for activities not specifically authorized by this permit (e.g., commercial culture and sale of white abalone, including shells).

Reporting Requirements

1. The Permit Holder must submit collection cruise, annual, final, and incident reports, and papers or publications resulting from the research authorized herein to NMFS. Reports may be submitted:
   a. through the online system at https://apps.nmfs.noaa.gov, or
   b. by email attachment to the NMFS contact listed on the cover letter (page 1) of this permit.
2. As stated above, the Permit Holder must submit to NMFS a collection cruise plan at least four weeks prior to the collection cruise and a collection cruise report no more than 90 days following the conclusion of the collection cruise.
3. The Permit Holder must submit an annual report to NMFS at the conclusion of each year for which the permit is valid. Annual reports for the previous reporting year are due by January 31st. Falsifying annual reports or permit records is a violation of this permit.

Annual reports must describe research and enhancement activities and include the following:

a. Wild-origin broodstock: health, survival, spawning success, and recommendation(s) on disposition (return to wild or keep in captivity);

b. Captive-origin broodstock: health, survival, spawning success;

c. Progeny: larval survival, juvenile health and survival, and estimated numbers for each year class and for each facility;

d. Wild white abalone observed but not collected: number, date, location, depth, habitat, size, nearest neighbor distance, and samples collected;

e. A summary of results from research studies, including the number of abalone used in the studies and their final disposition (e.g., sacrificed, returned to captive population); and

f. A summary of progress toward developing a central repository for biological samples and toward developing a forum for sharing data and public outreach and education materials with the project partners.

4. The Permit Holder and Co-investigators must develop and maintain a central tracking system (e.g., database, spreadsheet) for the following information collected as part of the permit activities, to inform future analyses and implementation of the proposed field and captive activities. The Permit Holder must provide access to the tracking system to NMFS and the Co-investigators, and provide a summary of the data in the annual reports.

    a. Observations of wild white abalone during collection cruise surveys, including animals that are and are not eligible for collection. The tracking system should include the following information for each white abalone observed: date, location, depth, name of researcher, habitat features, estimated size, nearest neighbor distance, tissue sample collected (Y/N), fecal sample collected (Y/N), eligible or not eligible for collection and why, and collected or not collected and why.

    b. Observation of other abalone species observed during collection cruise surveys. The tracking system should include the information as listed above.

    c. Tracking the survival, growth, and spawning success of wild-origin broodstock. The tracking system should include the following information: collection location and depth, collection date, holding facility, tag number, size, weight, gonad index, sex, tissue sample collected (Y/N), health, growth, spawning success, fecundity, and crosses.

    d. Biological samples collected and analyzed. The tracking system should include the following information for each sample: collection date and location; name of collector; reason for collection; description of specimen (e.g., whole animal, parts, sample, shell); life stage, origin (wild or captive), sex, size, weight, and tag number for the individual; and a summary of analysis results.

e. Tracking captive breeding success of wild- and captive-bred broodstock. The tracking system should include the following information for each spawning event: date, facilities involved, number of broodstock involved, gonad index of broodstock, spawning success, gametes released, crosses produced, fertilization rate, larval survival, and juvenile survival.

f. Tracking observations of disease and parasites and necropsy results. The tracking system should include the following information: results of health monitoring at each facility and necropsy results, including the following information for each specimen: date of death, origin (wild or captive), size, weight, age (if known), symptoms, description of specimen (preservation method, tissues), and cause of death.

5. The Permit Holder must submit a final report to NMFS within 90 days after expiration of the permit (March 31, 2029), or, if the research concludes prior to permit expiration, within 90 days of when the research ends.
6. The Permit Holder must submit written incident reports related to mortality events and serious injury, or to exceeding authorized take, to NMFS as soon as possible, but not more than two business days from when the incident or exceedance occurred. The incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional research-related mortality or exceedance of authorized take.
7. Research results must be published or otherwise made available to the scientific community in a reasonable period of time, taking care to protect sensitive location data for abalone in the wild.

2 ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency’s actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The proposed action is likely to adversely affect endangered white abalone. We analyze these effects on white abalone in this opinion. Critical habitat has not been designated for white abalone.

Although the proposed research and enhancement activities may occur within habitats or at facilities that also hold endangered black abalone (*Haliotis cracherodii*), we determined that the proposed action is not likely to adversely affect black abalone or its critical habitat. We summarize our analysis of the effects of the proposed action on black abalone and black abalone critical habitat in Section 2.12 ("Not Likely to Adversely Affect" Determinations).

2.1 Analytical Approach

This biological opinion includes a jeopardy analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species:

- Evaluate the rangewide status of the species expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species.
- Evaluate the effects of the proposed action on species and their habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species, analyze whether the proposed action is likely to directly or indirectly 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.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2 Rangewide Status of the Species

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" for the jeopardy analysis.

Two factors affecting the rangewide status of white abalone are climate change and ocean acidification. Increasing ocean water temperatures may result from global warming as well as short- and longer-term oceanographic conditions (e.g., El Niño Southern Oscillation or Pacific Decadal Oscillation events) and may have varying effects on abalone. For example, warmer water temperatures may reduce food availability and quality by reducing macroalgal growth (Hobday et al. 2001a; Tegner et al. 2001), and increase susceptibility to withering syndrome (Ben-Horin et al. 2013), but may also benefit larval survival if temperatures move toward the optimum temperatures (Leighton 1972). Ocean acidification could result in water quality conditions that reduce larval survival and shell growth and increase shell abnormalities (Crim et al. 2011). Effects of ocean acidification are highly species-specific due to differences in physiology, adaptability, and exposure to natural variation in ocean pH.

There is a large degree of variability and uncertainty in climate change and ocean acidification predictions, the timeframe over which changes may occur, and how the species and their habitat may respond. For example, abalone may be able to adapt to ocean acidification because they already experience natural variability in ocean pH, including low pH levels (Feely et al. 2004, 2008, 2009; Hauri et al. 2009). Studies are underway to evaluate the effects of increasing water temperatures and ocean acidification on abalone and to assess how other factors (e.g., presence of disease vectors) may affect these interactions.

We consider the ongoing effects of climate change as part of the status of white abalone. Where necessary or appropriate, we consider whether the effects of the proposed action could potentially influence the resiliency or adaptability of the species to deal with the climate change effects that we believe are likely over the foreseeable future.

2.2.1 Rangewide Status of White Abalone

White abalone are marine snails with a univalve shell, typically three to five open respiratory pores, an anterior head, and a large muscular foot fringed by sensory structures called epipodia (Cox 1962). Abalone use their foot muscle to move and to anchor themselves on rocky surfaces. White abalone range from Point Conception, California, to Punta Abreojos, Baja California, Mexico (Bartsch 1940; Cox 1960, 1962; Leighton 1972). Adults occupy open, low relief rocky reefs or boulder habitat surrounded by sand (Hobday and Tegner 2000). They are the deepest living abalone species on the North American West Coast, occupying depths from 5-60m (Cox 1960).

Life History, Reproduction, and Population Structure: White abalone are estimated to live up to about 35 years (Hobday et al. 2001b; Andrews et al. 2013). They are broadcast spawners, meaning that males and females release their gametes into the water column and rely on external fertilization. Thus, they must be in close proximity to one another to successfully reproduce. Spawning is highly synchronous (i.e., gametes are released at the same time) and believed to occur once a year from February to April (Tutschulte and Connell 1981). Chemical cues (bioactive triggers) and/or physical cues (abrupt temperature changes, tidal rhythm, lunar periodicity) may stimulate spawning (Giese and Pearse 1977; Leighton 2000).

White abalone become reproductively mature at approximately four to six years of age (about 88 to 134 mm shell length or SL) (Tutschulte and Connell 1981). Captive-bred white abalone may become reproductively mature at about one year of age (about 25 mm SL) (McCormick and Brogan 2003). Estimated fecundity (eggs released per year) ranges from about 3.7 million to 6.5 million eggs, based on gonad volume and oocyte density of abalone collected off Catalina Island (Tutschulte and Connell 1981). Fecundity may increase with size and age (Tutschulte 1976; Tegner 1989; Leighton 2000). At UC Davis-BML's spawning event in April 2019, one wild-origin female white abalone released an estimated 20.5 million eggs, surpassing previous fecundity estimates (UC Davis-BML 2020).

About 24 hours after fertilization, the free-swimming larvae emerge from the embryo and swim in the plankton (Leighton 1989). This stage does not actively feed, but instead survives on its own yolk sac. The larval stage lasts about 3-10 days before larvae settle and metamorphose (McShane 1992), induced by a chemical cue produced by crustose coralline algae (Morse et al. 1979). Other environmental cues may also influence settlement (Shepherd and Turner 1985; Slattery 1992; Daume et al. 1999).

Small juveniles feed on benthic diatoms, bacterial films, and other benthic microflora (Cox 1962). Juveniles occupy cryptic habitat (e.g., rock crevices, under rocks) and are difficult to see until they reach about 75 to 100 mm SL (Cox 1962). Abalone greater than 100 mm SL are considered "emergent" as they leave sheltered habitat and move to more open habitat to forage on attached and drift macroalgae (Tutschulte 1976). In general, juvenile abalone tend to be more cryptic and move more frequently and over larger distances, whereas adults become less cryptic and exhibit limited movements as they increase in size (Cox 1962; Shepherd 1973; Tutschulte 1976; Tutschulte and Connell 1976).

Little information is available on the population structure of white abalone in the wild. One genetic study indicated that the wild population still contains significant genetic variation; however, the study could not evaluate population structure, because all of the samples (n=19) came from one site (Gruenthal and Burton 2005). Collection and analysis of samples throughout the species' range is needed to assess population structure.

Population Status and Trends: White abalone face a high risk of extinction. NMFS listed white abalone as endangered under the ESA in 2001 (66 FR 29046; May 29, 2001), primarily due to low densities resulting from historical overfishing. White abalone were subject to serial depletion by the commercial fishery in the early 1970s and suffered the most dramatic declines of the five abalone species (Karpov et al. 2000). During the main period of commercial harvest of white abalone (1969-1981), landings peaked in 1972, but declined to nearly zero by the early 1980s and remained low until the fishery was closed in 1996 (Karpov et al. 2000). Fishery independent surveys also show severe declines in abundance and density.

Abundance estimates for the 1960s to 1970s ranged from about 600,000 to 1.7 million white abalone (Tutschulte 1976; Rogers-Bennett et al. 2002), whereas estimates for the 1990s were around 2,000 white abalone, or about 0.1% of estimated pre-exploitation abundance (Hobday et al. 2001b). ROV surveys in 2004 estimated about 1,900 abalone at San Clemente Island and 5,800 abalone at Tanner Bank (Butler et al. 2006). However, surveys results also indicate continued declines in white abalone abundance and density at Tanner Bank from 2002-2010, with fewer animals in close proximity to one another (Stierhoff et al. 2012).

In recent years, increased survey efforts along the mainland southern California coast have led to more observations of white abalone and evidence of recruitment in the wild. From 2010 to 2016, white abalone (n = 67) ranging in size from 130-187 mm SL were observed in areas where they had not been observed for 10 or more years, including off the mainland California coast (e.g., Palos Verdes Peninsula, La Jolla, and Point Loma) (Neuman et al. 2015). These observations indicate that the remaining white abalone in the wild have been able to reproduce and recruit successfully, though likely not at the rate or scale needed to support recovery.

In Mexico, very little data is available on white abalone. White abalone are commercially harvested along with four other abalone species off Baja California. Where data are available, the estimated proportion of white abalone in the catch has varied from less than 1% to 65%, depending on the year and location (Hobday and Tegner 2000). Only two fishery-independent surveys have been conducted. Estimated densities in 1968-1970 ranged from 0.07 to 0.149 abalone per m^2, whereas no white abalone were found in 1977-1978 (Guzman-Del Proo 1992). Based on the limited data available, white abalone in Mexico have likely declined since the 1970s and may have experienced recruitment failure in some areas (Hobday and Tegner 2000).

The fragmented populations that remain in the wild are likely unable to reproduce successfully or at levels needed for recovery (NMFS 2021). Much progress has been made toward recovery since 2001. Expanded field monitoring off southern California and Mexico supports improved assessments of the species' status (NMFS 2021). Recovery efforts focus on increasing densities in the wild, to establish self-sustaining populations. The increased success and expansion of captive production led to the first ever field planting of captive-bred white abalone to the wild in 2019 at two sites off southern California (NMFS 2021). Several field planting efforts have been conducted since 2019, with several more planned over the next five years.

Threats: In California, the species' abundance and density have declined substantially, resulting in low reproductive and recruitment success, such that the remaining animals in the wild do not appear to be replacing themselves. The primary threat to the species is historical overfishing that led to low densities, where individuals may be too far apart to reproduce successfully or at levels needed for recovery. Complete and partial closures of the abalone fishery have been proposed in Mexico, but we do not know whether they have been adopted and implemented. Illegal harvest of undersized white abalone remains a problem in Mexico, but we have limited information on the problem's extent (NMFS 2008).

Recovery will require: (1) protecting the remaining abalone in the wild; (2) promoting natural reproduction at a level that can sustain the population, by increasing the abundance and density of white abalone in the wild through captive breeding and field planting; and (3) monitoring wild populations in California and Baja California to assess the species' status throughout its range.

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area for the proposed action consists of: (1) coastal marine waters within the range of white abalone (Point Conception, California, to central Baja California); and (2) approved facilities throughout the range of white abalone and the U.S. West Coast where captive breeding, grow-out, and research activities would be conducted. The facilities and coastal marine waters within this action area are connected through their transit routes.

Field surveys, broodstock collection, and reintroduction of wild-origin white abalone would occur in coastal marine waters within the species' range, in habitats suitable for white abalone. White abalone occur in rocky subtidal habitats at depths ranging from 5 to 60 m. Areas where white abalone are observed typically consist of soft sediment with patches of rocky outcrops and kelp forests, which supply drift algae for abalone to feed on.

Research and enhancement activities involving wild-origin and captive-bred white abalone would be conducted at facilities throughout the species' range and the U.S. West Coast. Captive propagation, holding, grow-out, research, and public display of animals would be conducted at approved captive facilities, including the UC Davis-BML, Aquarium of the Pacific, TBF, CMA, CSC, CICESE, The Cultured Abalone Farm, MLML, NMFS SWFSC La Jolla Lab, SBMNH, and the UCSB. Research activities, including the receipt and analysis of specimens, samples, and parts, would occur at approved facilities throughout the coast, including the UW, NMFS NWFSC, CDFW Shellfish Health Lab, and UCI. Additional facilities may be added.

2.4 Environmental Baseline

The "environmental baseline" refers to 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 consultations, 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).

Because the action area overlaps with the species' range, the description of the status of the species in Section 2.2 of this opinion applies to the action area. In this environmental baseline, we discuss how specific factors and activities have affected white abalone within the action area, including past broodstock collections, past and ongoing captive propagation and research activities, and past and ongoing field monitoring and field planting activities.

2.4.1 Past Broodstock Collection Activities

In 1999-2000, researchers collected 19 white abalone from Catalina Island (Gruenthal and Burton 2005), prior to the listing of white abalone as endangered under the ESA in 2001. All of these abalone were taken to the Channel Islands Marine Resource Institute (CIMRI) and UCSB for holding. In 2004, NMFS issued Permit 1346-01 to Mr. Tom McCormick, allowing collection of additional white abalone from the wild. Under Permit 1346-01, researchers collected three white abalone from Santa Cruz Island. Overall, these collection activities removed 22 white abalone and their reproductive potential from the wild population. To date, all but one of these abalone have died in captivity due to various causes, including collection-related injuries, disease, accidents (toxic chemical exposure, crawling out of tanks), and unknown causes (unpublished data by Kristin Aquilino, UC Davis-BML, June 2014). A small number (four individuals) spawned in captivity in 2001 and 2003 and produced thousands of progeny. A subset of these progeny have survived and now serve as broodstock for the captive program, producing thousands of progeny since 2012.

In 2016, NMFS issued a permit modification (14344-2R) to UC Davis-BML, to allow collection of additional white abalone from the wild to serve as broodstock in the captive program. In 2016-2019, researchers collected 13 white abalone from sites off southern California; an additional white abalone was collected in 2022. All were determined to be reproductively isolated (i.e., more than 10 m from another white abalone) and eligible for collection. Of the 14 white abalone collected since 2016, four have died and the remaining ten abalone have been integrated into the captive breeding program. Four of these wild-origin broodstock have spawned in captivity to contribute to the captive-bred population (UC Davis-BML 2020, 2021).

2.4.2 Past and Ongoing Captive Propagation and Research Activities

The white abalone captive propagation program began in 2000 at CIMRI, with the 19 wild-origin broodstock collected in 1999-2000 off Catalina Island. After the ESA-listing in 2001, NMFS issued scientific research and enhancement Permit 1346 to Mr. Tom McCormick, authorizing the captive program at CIMRI. NMFS issued a modified permit (Permit 1346-01) in 2004 to allow collection of additional wild broodstock. Successful spawnings in 2001 and 2003 produced thousands of captive-bred white abalone.

Between 2002 and 2005, a large number of the captive-bred abalone at CIMRI died, most likely due to withering syndrome as well as an unknown shell disease. Due to water quality concerns, all of the remaining white abalone at CIMRI (four wild-origin broodstock and 30 captive-bred progeny) were transferred to UC Davis-BML in May 2008. Captive-bred abalone held at UCSB (n ≥18), CMA (n = 20), and the SBMNH Sea Center (n = 4) remained at those facilities.

In 2011, NMFS issued Permit 14344 to UC Davis-BML, authorizing captive propagation and research on white abalone. Due to natural mortality over time, the captive broodstock decreased to only one wild-origin adult (one of three abalone collected in 2004 at Santa Cruz Island, under Permit 1346-01) and 33 captive-bred abalone produced in the 2001 and 2003 spawning events that involved abalone collected from the wild in 1999-2000.

In 2012 and 2013, UC Davis-BML and its partner facilities in southern California successfully spawned white abalone in captivity, but produced only a small number of abalone (9 in 2012 and 123 in 2013) compared to the thousands produced in 2001 and 2003. Researchers attributed the limited spawning success to difficulties in conditioning the captive abalone for spawning, resulting in low gonad ripeness and the abalone releasing fewer gametes than they are capable of (e.g., 300,000 eggs vs. 3-6 million eggs). Since 2014, researchers have improved broodstock conditioning and larval rearing and settlement methods, resulting in increased spawning and settlement success, with successful spawning in each year since 2014 and production of thousands of captive-bred juveniles (UC Davis-BML 2021). As of June 2022, the captive program estimated over 21,000 captive-bred white abalone at the facilities (CDFW 2022).

In September 2015, BML successfully transported 200 juvenile white abalone from the 2014 cohort to the SBMNH Sea Center, CMA, Aquarium of the Pacific, and the SWFSC La Jolla lab (n = 50 juveniles per facility) (pers. comm. with Kristin Aquilino, BML, on 8 September 2015), with relatively low mortality rates (185 remained as of February 2016; unpublished data by Kristin Aquilino, BML, on 5 March 2016). Since then, researchers regularly transfer white abalone larvae and juveniles between facilities, with low mortality rates (CDFW 2022).

At each facility, researchers monitor the abalone daily to maintain optimal holding conditions and check for mortalities. Researchers regularly monitor the health of all captive animals and apply disease treatments or shell waxing when needed. Researchers have observed normal rates of natural mortality at the larval rearing and post-settlement stages, which can be as high as 100% mortality. The maximum survival of captive-bred white abalone from the larval to one-year old stage has been 0.5% (unpublished data by Kristin Aquilino, BML, on 20 January 2016). Researchers have also observed normal rates of natural mortality for juveniles and adults (about 5% per year) (NMFS 2011). Mortality events do occur; for example, in 2020, an unprecedented red tide event led to the loss of all newly settled juveniles in one of two trough systems at the SWFSC La Jolla Lab and high temperatures due to a chiller failure led to high mortality among juveniles held at the UC Davis-BML (UC Davis-BML 2021). These events are investigated to determine the cause and to implement corrective and preventative measures.

Overall, the captive propagation program has been progressing, with increased production and survival of progeny. Collection of wild-origin broodstock under Permit 14344-2R has increased the number of potential spawners as well as the genetic diversity of the captive population. Captive research has continued to address key recovery needs including:

- Development and optimization of sperm cryopreservation methods;
- Ocean acidification, withering syndrome, and water temperature effects: how white abalone respond to ocean acidification, changing water temperature regimes, and a temperature-dependent disease (withering syndrome);
- Disease and health studies, such as the genetic resistance to withering syndrome and the relationship between the pathogen and coccidian infections and abalone health;
- Reproductive conditioning, such as the effects of temperature and disease on reproductive conditioning and development of methods to assess gonad maturation; and
- Optimizing rearing, settlement, and grow-out conditions.

2.4.3 Past and Ongoing Field Monitoring and Field Planting Activities

Survey data from the 1980s to early 2000s show continued declines in abundance and little to no recruitment; however, more recent survey data indicate recruitment is happening in the wild, though likely at low levels. In 2010-2015, white abalone (n = 67) ranging from 130-187 mm SL were observed in areas where they had not been observed for 10 or more years, including off the mainland California coast (e.g., Palos Verdes Peninsula, La Jolla, and Point Loma) (Neuman et al. 2015). Based on their sizes, the estimated age range of the abalone was 7 to 14+ years (Tutschulte 1976). Abalone within the size/estimated age range of 3-16 years were also observed during ROV surveys at Tanner Bank between 2002-2014, indicating recruitment occurred between 1995 to 2005 (Stierhoff et al. 2015). More systematic survey efforts and analyses are needed to monitor abundance and density and to estimate productivity in the wild. These efforts would inform our evaluation of the species' status, recovery, and population dynamics, and our definition of "singleton" animals that are reproductively isolated from other individuals.

Since 2019, NMFS has worked with partners to release more than 4,200 captive-bred juvenile white abalone at two sites off Los Angeles and San Diego counties, as part of experimental field planting studies (NMFS 2021). This work was conducted under ESA Permit 18116, issued to the NMFS WCR for white abalone field planting and monitoring. All of the white abalone came from the captive program under Permit 14344-2R.

Withering syndrome is known to cause mortalities in captive white abalone, but we do not know how the disease affects white abalone in the wild. No wild white abalone have been observed with withering syndrome, although several of the white abalone collected from the wild in 2016-2019 were infected with the pathogen. A few freshly dead animals with undamaged shells were observed near Catalina Island in the early 1990s, but the cause of death is uncertain (Tegner et al.

1996). Hobday and Tegner (2000) suggest that if withering syndrome had significantly affected wild white abalone, then surveys in the late 1980s should have detected large numbers of empty white abalone shells. Overall, the available field observations suggest that withering syndrome was not a major contributor to the species' decline.

2.5 Effects of the Action on White Abalone

Under the ESA, "effects of the action" are 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 (see 50 CFR 402.02). 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 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

We use the "exposure-response-risk" approach to analyze the effects of the proposed action on white abalone. First, we evaluate the exposure of individual white abalone to the effects of the action. Next, we evaluate how individual white abalone are likely to respond to those effects. We then evaluate how those responses are expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success). Finally, we evaluate the risk to white abalone at the individual, population, and species level, to determine whether the proposed action could appreciably reduce the species' likelihood of survival and recovery in the wild.

In our analysis of effects, we consider the proposed permit conditions described under Section 1.3.4 (Permit Conditions) and their effectiveness at reducing adverse effects on white abalone. We expect the Permit holder to comply with the proposed permit conditions, because the Permit holder complied with all of the permit conditions under the current permit (14344-2R).

2.5.1 Estimated Annual Take

Permit 14344-3R would authorize research and enhancement activities that involve direct take of naturally produced (wild-origin) and captive-bred white abalone. Researchers would directly take wild-origin and captive-bred white abalone when collecting wild white abalone to serve as broodstock, conducting captive activities (holding, propagation, research), and reintroducing wild-origin white abalone to the field. Activities involve measuring, swabbing, tagging, handling and transporting white abalone, as well as collection of epipodial clips, swab samples, samples of early life stages, and dead or obviously dying abalone.

Table 1 summarizes the annual take of white abalone that would be allowed under the proposed permit. The approved captive facilities currently hold 11 wild-origin white abalone. The proposed permit would authorize researchers to collect up to an additional 16 wild-origin white abalone to serve as broodstock, for a total of up to 30 white abalone collected from the field for the captive program (the program has already collected 14 white abalone under the previous permit). The proposed permit would authorize researchers to collect genetic and fecal samples from white abalone that are observed in the field but not collected. The proposed permit would also authorize approved facilities to receive up to an additional 30 wild-origin white abalone from other sources (other captive facilities, law enforcement cases, emergency activities, Federal project covered by ESA section 7 consultations). Researchers and approved captive facilities would be authorized to maintain, grow-out, and conduct captive breeding and research on all of the captive-bred white abalone produced under the permit. This could include millions of eggs and larvae and thousands of juveniles per year. Although unlikely, we consider the possibility that all of the white abalone held in captivity under this permit could die in captivity, due to natural mortality or unusual mortality events.

Table 1. Proposed annual take of white abalone under Permit 14344-3R.

Life Stage	Origin	Research Component	Take Activity	Number of abalone	Estimated Mortality
Adult	Wild	Maintain existing wild-origin white abalone in captivity; captive breeding; reintroduction.	Captive, maintain, monitor, breed, lab experiments; Tagging; Tissue sample; Mortality; Transport; Field planting	11	11
Adult, juvenile	Wild	Collect additional white abalone from the wild; maintain in captivity; captive breeding; reintroduction.	Collect; Captive, maintain, monitor, breed, lab experiments; Tagging; Tissue sample; Mortality; Transport; Field planting	16	16
Adult, juvenile	Wild	Receive additional white abalone from other sources; maintain in captivity; captive breeding; reintroduction	Captive, maintain, monitor, breed, lab experiments; Tagging; Tissue sample; Mortality; Transport; Field planting	30	30
Adult, juvenile	Wild	Field monitor white abalone observed but not collected; collect genetic and fecal samples	Count/survey; Measure; Tissue sample	70	0
Egg, larval, juvenile	Captive	Maintain captive-bred white abalone; document early life development; rear, settle, and grow-out; captive breeding and research	Captive, maintain, monitor, breed, lab experiments; Tagging; Tissue sample; Mortality; Transport; Import, export	Unlimited	Unlimited

2.5.2 Effects of Field Activities on White Abalone

2.5.2.1 Collection of wild broodstock

Under the proposed permit, researchers may collect up to 16 wild white abalone and bring them into captivity to serve as broodstock for the captive program. As described in Section 1.3 (Proposed Federal Action), collection would occur over three phases. Under Permit 14344-2R (issued in 2016), researchers collected 14 white abalone, completing Phase I. Under the proposed permit, the Permit holder must submit a request to NMFS to collect additional white abalone under Phase II and III. The request must assess the health, survival, and spawning success of the white abalone collected in the previous phase(s). This phased approach allows NMFS to weigh the effects, risks, and benefits before allowing additional collections. NMFS may also approve collection of white abalone with a high risk of being taken, injured, or killed if left in place.

Collection activities would involve field surveys to identify individuals eligible for collection, removal of these abalone from the wild, and transport to land-based captive facilities by vessel, vehicle, and/or air. Once at the facilities, researchers would measure, weigh, tag, and collect tissue and swab samples from each abalone. The abalone would integrated into the captive program and subject to captive holding, maintenance, breeding, and research activities as described below (e.g., handling, health assessments, spawning).

Researchers may conduct collection activities any time of year, though efforts may focus on the spawning season (winter to early spring months) when gonads are most likely to be ripe and abalone are most likely to aggregate, if they aggregate to spawn.

Researchers would minimize effects on habitat by using non-destructive methods to survey the field sites. That means researchers would not turn over or break apart rocks. Researchers would only remove white abalone from the substrate if they meet the collection criteria and are deemed eligible for collection. Researchers plan to collect both female and male abalone; however, we cannot predict the number of each, because we cannot determine the sex of individuals until we remove them from the substrate and examine their gonads.

Once researchers identify an abalone as eligible and decide to collect it, they would remove the abalone by hand or by using a plastic spatula in conjunction with an abalone iron where necessary. The abalone typically react by clamping down more tightly to the substrate, making them more difficult to remove and also increasing the chance of injury (e.g., cuts to the foot muscle). To minimize stress and injury to the abalone, only experienced researchers would collect abalone. They would try to remove the abalone quickly in one swift motion, before the abalone has a chance to clamp down. Once an abalone clamps down, researchers would wait until the abalone relaxes before attempting to remove it again.

Even with these measures, injuries could occur. Abalone are able to heal and survive from minor cuts (Loeher and Moore 2020); however, the combination of injuries along with the stress of handling and transport could kill some of the abalone. UC Davis-BML stated that of the 22 white abalone collected in 1999-2004, 17% died within the first six months of collection. Of the 14 white abalone collected since 2016, two died within the first six months of collection (14%) and two more died over a year after collection. Based on this, we estimate that up to 17% (three abalone) of the 16 abalone to be collected under the proposed permit may die due to collection activities (defined as mortalities within the first six months after collection).

We expect transport to cause minor, temporary stress to the abalone. Transport would be less than 24 hours to a few days, depending on the duration of the collection cruise and distance to the captive holding facility. To minimize stress to the abalone, researchers would maintain appropriate temperature, oxygen, and moisture levels throughout transport. Abalone farms in California routinely transport adult abalone by vehicle and/or air, and researchers have successfully transported adult abalone by vessel, vehicle, and air, with high survival rates, including the white abalone collected from the wild since 2016.

We expect measuring, weighing, tagging, and swab sampling to cause minor, temporary stress to the abalone due to handling and being out of the water for a period of time. Tagging involves scrubbing the shell with a brush and/or towel to remove epibionts (organisms that live on the shell surface) and attaching a tag to the shell with glue or marine epoxy. Swab sampling involves inserting a flexible nylon swab into a respiratory pore or along the epipodium and mantle, along the gills, to collect fecal material near the anus (Neuman et al. 2012). Researchers would minimize stress and avoid injuring the abalone by minimizing the time out of water (to several minutes), keeping the abalone moist, and avoiding the soft tissues as much as possible.

We expect tissue sampling to cause minor stress and minor injuries to the abalone, with a very low likelihood of long-term injury or harm. Tissue sampling involves cutting off a small piece of the epipodia (up to two epipodia per abalone) for genetic analysis. Researchers would use well-established, non-lethal methods (Hamm and Burton 2000) that have been routinely used with minimal effects on individual abalone (Gruenthal and Burton 2005; Gruenthal et al. 2014; Coates et al. 2014). Researchers would cut the epipodia no closer than 1-2 mm from the base, to avoid injuring the foot muscle.

Overall, we expect collection to remove up to 16 white abalone adults from the wild and to kill up to three of these abalone. We expect most of the collection activities (transport, measuring, weighing, tagging, swab sampling) to cause minor, temporary stress to the abalone. We expect collection of epipodial clips to cause minor injuries with a low likelihood of long-term injury or harm. We expect removal of abalone from the substrate to cause stress and potential injury to the foot muscle. Researchers would minimize injuries by only allowing experienced researchers to collect abalone, using appropriate collection tools, and, if the first attempt is not successful, waiting for the abalone to relax before attempting to remove it again. Some injuries may occur, but we expect most of the abalone to survive and recover.

The proposed permit would also allow researchers and approved facilities to receive, maintain, and conduct permitted activities using wild-origin white abalone obtained from other sources, including other captive facilities, law enforcement cases, emergency response activities, or Federal agency actions involving removal of live white abalone from the wild. In these cases, the effects of removing these abalone from the wild would not be considered an effect of the proposed permit. The proposed permit would cover the holding, maintenance, and research and enhancement activities carried out using these abalone once they are brought into the captive program, as well as the reintroduction of these abalone to the wild. Upon receipt, researchers would quarantine the abalone, conduct health assessments, and apply health treatments as needed. Researchers would transport, measure, weigh, tag, and sample the abalone as described above, with similar effects expected.

2.5.2.2 Monitoring and collection of samples from wild white abalone

During collection surveys, researchers may observe white abalone that cannot be collected because they do not meet the collection criteria or are not accessible. Researchers would record the number observed, their estimated shell length, and other information (e.g., location, habitat, nearest neighbor distance). If possible, researchers would collect two epipodial clips and a fecal (swab) sample from each abalone without removing them from the substrate. Researchers would use the same methods as describe above for tissue and fecal (swab) sampling, with similar expected effects (minor, temporary stress and minor injuries due to epipodial clips). The samples would be analyzed to evaluate genetic diversity and population structure in wild populations as well as to assess whether and to what level wild white abalone are infected with the pathogen that causes withering syndrome.

2.5.2.3 Reintroduction of wild-origin broodstock to the wild

The proposed permit would allow researchers to reintroduce wild-origin white abalone to the wild, including the wild-origin white abalone currently in captivity and any wild-origin white abalone collected under this permit or obtained from other sources. The decision of whether to reintroduce the abalone to the wild would be based on review of their health and spawning success, as well as information on the health and survival of previously reintroduced abalone.

Reintroduction would involve health screening prior to release, transport by vehicle and vessel, field planting, and post-release monitoring. These activities may have direct effects on the reintroduced white abalone, as well as direct and indirect effects on wild white abalone (e.g., through effects on habitat, food availability, predation risk, disease risk). The proposed permit would cover all reintroduction activities except for post-release monitoring, which is covered under ESA Permit 18116 (issued to the NMFS WCR for field planting and monitoring).

Health screening would involve a general health assessment (e.g., condition index based on body size vs shell size, observation of normal feeding), shell/sabellid inspection, shell waxing to remove excessive epibiont growth, and screening for pathogens and parasites. Screening for pathogens and parasites may involve adding “clean” captive-bred juveniles (e.g., about 60 juveniles greater than 20mm SL) to broodstock holding tanks for a period of time (e.g., 90 days) and performing histology on those juveniles (pers comm. with Jim Moore, UC Davis-BML/CDFW, on April 7, 2016). This would avoid the need to sacrifice wild-origin abalone.

We expect reintroduction activities to cause short-term stress to the abalone due to removal and handling during assessments and transport. Researchers would minimize stress by carefully removing the abalone using appropriate tools, taking care not to injure the soft tissues. When conducting health assessments, researchers would minimize the time out of water and use well-established protocols. Researchers would also maintain appropriate temperatures and oxygen levels throughout transport.

We expect a portion of the reintroduced abalone to die, due to increased stress, disease, and predation risk in the wild, after spending several years in captivity in fairly pristine, predator-free conditions. The only information we are aware of on this topic is from pinto abalone restoration activities in Washington State, led by Washington Department of Fish and Wildlife (WDFW), the Puget Sound Restoration Fund, and many other partners. In 2008, researchers moved 60 wild-origin pinto abalone from captivity to two sites in the San Juan Archipelago (30 abalone per site) (Friedman et al. 2011). At six months post-release, researchers confirmed two reintroduced abalone had died at one site (7%) and six had died at the other site (20%). In 2012, researchers reintroduced another 21 wild-origin pinto abalone to one of the sites; after 1.3 years, researchers confirmed that eight had died (38%) (WDFW 2014). Overall, researchers reintroduced 81 wild-origin pinto abalone to the wild with confirmed mortality ranging between 20% to 40% over 1.5 years. More abalone may have died but the shells were not found. Several factors could have contributed to the high mortality rates, including the age of the abalone, domestication in captivity (each had spent a few years in captivity), injury while handling, predation, and/or unfavorable ocean conditions (WDFW 2014). Based on this information, we estimate that up to 40% (25 abalone if we reintroduced all 61 wild-origin abalone) of the reintroduced white abalone would die following reintroduction.

Researchers would survey potential field sites to evaluate habitat quality and the presence of white abalone and other abalone species within the area, using non-destructive survey methods. Researchers would place the abalone in suitable habitat, making sure each abalone adheres to the substrate. NMFS, UC Davis-BML, and the project partners would consider the risks and benefits (disease, genetic diversity, aggregation size) to decide whether to place the abalone in aggregation with one another at sites with or without wild white abalone.

Potential effects of reintroduction activities on wild white abalone include an increased risk of disease, competition for food and space, and predation. To minimize the risk of transmitting pathogens or parasites, researchers would thoroughly screen the abalone prior to field planting, as described above. To minimize effects on competition, researchers would select sites based on the availability of sufficient food and space to support the number and density of abalone. Given the low numbers and density of white abalone in the wild, food and space are currently not limiting factors and we do not expect the reintroduced abalone to have a measurable effect on food resources or habitat availability at the field planting site(s). Predation risk may increase for a short period of time following reintroduction, because the reintroduced abalone may be stressed or have injuries and may release chemicals that attract predators. To minimize predation risk, researchers would select sites with complex habitat to provide refuge from predators and may temporarily move potential predators (e.g., octopus) from the area.

Reintroducing white abalone may cause changes to the habitat, such as reduced food and space; however, as described above, food and space do not appear to be limiting factors for wild white abalone at this time, given the low numbers and density of white abalone in the wild. In addition, researchers would select sites with ample food and space and consider the capacity when determining the number of abalone to reintroduce at each site. We expect other changes resulting from reintroduction activities to make the habitat more suitable for white abalone in the future. For example, reintroducing white abalone to a site where they are currently absent could alter the algal community as the abalone establish their territory and graze on attached algae. These changes may improve larval settlement and recruitment by promoting growth of crustose coralline algae.

Post-release monitoring would be covered under a separate ESA permit (Permit 18116) that includes field planting and monitoring of white abalone. Researchers would use non-destructive survey methods to monitor the reintroduced and resident white abalone at the site(s). Monitoring would occur at regular intervals and may include measuring shell lengths, collecting fecal (swab) samples, cleaning the shells to read tag numbers, and collecting genetic samples to identify reintroduced abalone (e.g., if tag loss is suspected). Researchers would not remove the abalone from the substrate during monitoring surveys. We expect post-release monitoring to cause minor stress to the abalone.

In summary, we expect to potentially reintroduce all of the wild-origin white abalone to the wild. We expect most reintroduction activities (measuring, weighing, health screening, transport) to cause minor, temporary stress to the abalone. Researchers would use appropriate tools and care to minimize stress and injury when moving, transporting, and field planting the abalone. Reintroduced abalone may take a period of time to acclimate to ocean conditions, during which growth and reproductive development may be reduced. We expect up to 40% of the reintroduced abalone to die following release due to stress, injuries, and other factors (e.g., increased susceptibility to predation, disease, unfavorable ocean conditions). To minimize disease risks, researchers would conduct health screenings involving sacrifice of up to 60 juvenile captive-bred white abalone. Researchers would also carefully consider food and space availability to reduce competition and may remove predators to reduce predation risk immediately following reintroduction. We expect reintroduction of white abalone to result in habitat changes that would improve habitat suitability for white abalone.

2.5.3 Effects of Captive Holding, Propagation, and Research on White Abalone

Captive maintenance, grow-out, and propagation activities would involve all captive white abalone, whereas research and public display activities would involve a subset of the captive white abalone. Captive white abalone include the white abalone currently held in captivity (wild-origin and captive-bred), the wild-origin white abalone to be collected under the proposed permit, any additional white abalone obtained from other sources, and all of the captive-bred progeny produced under the proposed permit.

We cannot predict how many progeny may be produced each year; however, we can estimate the maximum number of progeny per year, based on the number of broodstock, fecundity rates, and survival rates at each life stage. Each spawning event may involve 20-30 broodstock. If we assume a 1:1 sex ratio, then each event would involve 15 females and 15 males. If each female can release 3.7 to 20.5 million eggs per spawn and fertilization rate is 97% (based on the captive program's past success rates), then each spawning event could produce almost 300 million eggs. If larval survival ranges from 40 to 100% and survival to one year ranges from 0.002 to 0.5% (unpublished data by Kristin Aquilino, BML, on 20 January 2016), then each spawning event could produce 1.5 million juveniles. If the program conducts 2-5 spawning events per year, then it may produce as many as 3-7.5million juveniles per year. Given a survival rate of 95% per year (NMFS 2011), we would expect most of the juveniles produced to survive. Thus, the program could grow by 3-7.5 million abalone per year, for a maximum of 37.5 million abalone by year 2028, the majority of which would be juveniles less than five years old.

Currently, the white abalone captive breeding program consists of several facilities throughout the California coast that can hold live white abalone (larvae, juveniles, and adults). Additional facilities may be added to the program if they meet the permit conditions, which include: adding the facility's point of contact as a co-investigator on the permit, NMFS-approved husbandry and disease management protocols for each facility, and agreement by the facility to abide by the permit conditions.

2.5.3.1 Captive maintenance, grow-out, and propagation

Captive maintenance, grow-out, and propagation activities would involve both wild-origin and captive-bred white abalone of all life stages. Abalone would be held in land-based facilities; handled on a regular basis to measure, weigh, and assess health; tagged for individual identification; and sampled (epipodial clippings) for genetic analysis. Adults (wild-origin and captive-bred) may be used in spawning events conducted two to five times per year. Health treatments (shell waxing, OTC) would be applied as needed. Abalone may be transported between facilities via vehicle or air, as needed to optimize capacity at each facility. Factors that may affect the fitness of individuals include handling stress, water quality, food quality and quantity, stocking density, disease, and shell infestations. Researchers have developed protocols, treatments, and best practices to address these factors and optimize the survival, health, and growth of the captive abalone.

Captive maintenance, grow-out, and propagation activities have been conducted routinely at the white abalone captive facilities and other abalone facilities since 2011, with minimal harm to the abalone (UC Davis-BML 2021). We expect the abalone to experience minor, temporary stress, primarily due to being removed from the tanks, handled, and kept out of water for a period of time. We do not expect captive maintenance, grow-out, and propagation activities to kill or cause long-term harm to the abalone.

We expect spawning activities to cause stress to individual white abalone. Spawning events would be conducted at each facility up to 2-5 times per year, using well-established spawning protocols and best practices (Kawana and Aquilino 2020). Standard methods include exposing the broodstock to a solution of Tris-buffered seawater and hydrogen peroxide (6%) for a maximum of three hours, as well as thermal treatments (increasing water temperatures by 1-2°C, for about 0.5 hr) to induce spawning. Only trained personnel would conduct spawning activities. Researchers would closely monitor the abalone for signs of stress during spawning activities and return the abalone to their holding tanks following spawning activities. To maximize genetic diversity, researchers would aim to conduct pair-wise mating of males and females, where they mix (or cross) gametes of one male and one female at a time (rather than multiple males and females) and track those crosses throughout grow-out.

Researchers would use standard protocols for fertilization and larval rearing and settlement (Kawana and Aquilino 2020). These early life stages experience the highest natural mortality rates. Survival from the larval stage to one year ranges from 0.002 to 0.5 percent (unpublished data presented by Kristin Aquilino, BML, on January 20, 2016). It is possible that all of the progeny produced during a spawning event could die before reaching the settlement or one-year old stage due to high natural mortality. Researchers would implement best practices to maximize survival, but many other factors can affect survival, such as egg and water quality. A goal of the proposed research activities under the proposed permit is to evaluate these factors and optimize survival during larval rearing to early post-settlement.

During captive maintenance and grow-out, researchers would optimize holding conditions (e.g., water temperature, water quality, food quality and quantity, stocking density) and implement best practices for general health and husbandry (e.g., regular feeding, regular tank cleaning). Researchers would follow established protocols for holding and disease and parasite management (NMFS 2008) and update these protocols based on research results.

Researchers would limit handling to reduce stress to the abalone. Most abalone would only be handled once per year for the annual assessment. Researchers would also implement measures to minimize stress and injury to the abalone during handling. First, researchers would carefully remove abalone from the holding tanks by hand or by using a plastic spatula and abalone iron. Anesthesia may be used to sedate the abalone and reduce the risk of injury. Researchers have successfully used ethanol to sedate juveniles with minimal harm to the abalone (pers. comm. with Kristin Aquilino, UC Davis-BML, on April 1, 2016). Second, researchers would minimize the time out of water to a few minutes and avoid touching the soft tissues as much as possible. Researchers would keep the abalone moist by placing them on seawater dampened towels.

Tagging, tissue sampling, and health assessments and treatments may require additional handling. Tagging involves attaching a small tag to the shell using glue or marine epoxy and would only need to be conducted once, unless the tag falls off. We expect tagging to cause minor, temporary stress to the abalone, given the abalone would be out of the water for a few minutes. Researchers have routinely tagged abalone with minimal effects on the abalone (Hale et al. 2012; UC Davis-BML 2020). Tissue sampling involves cutting off a small piece of the epipodia and would result in a minor injury that we do not expect to cause long-term harm or injury to the abalone (Hamm and Burton 2000; Gruenthal and Burton 2005; Gruenthal et al. 2014; Coates et al. 2014).

Sabellid-worm inspections may require abalone to be out of the water for up to 30 minutes; in most cases, abalone would be out of the water for only a few minutes. Shell waxing involves applying a hot wax (a mixture of beeswax and coconut oil) to the surface of the shell, to suffocate and kill any infesting organisms that could damage the shell. The procedure takes less than 10 minutes. Researchers would avoid covering the respiratory pores and minimize the time out of water. Sabellid-worm inspections and shell waxing would be conducted by trained professionals using well-established protocols that have been used routinely at captive abalone facilities with minimal effects on the abalone (UC Davis-BML 2021).

Disease outbreaks (particularly of withering syndrome) have been a concern for captive white abalone and was the likely cause of past mortality events at CIMRI in 2002 and 2005 (NMFS 2011) and at UCSB in 2015 (NMFS 2016). Researchers implement several measures to minimize the risk of withering syndrome, including UV treatment of incoming seawater (to kill the pathogen), maintaining cool water temperatures, and regular fecal sampling and analysis to test for infections. When recommended by the CDFW Shellfish Health Lab, researchers would use OTC treatment to eliminate the pathogen from infected abalone. The OTC treatment (Moore et al. 2019) is a well-established method that has been routinely used at captive facilities without killing or causing long-term harm to the abalone (Moore et al. 2019). The treatment involves immersing the abalone in an OTC solution for up to 24 hours at a time, for a total of eight times over two seven-day periods. The abalone are not fed during the treatment. We expect abalone to experience stress during the procedure, which may cause abalone to release or re-absorb any gametes; however, we expect the stress to be short-term and temporary.

Researchers would use well-established methods to transport abalone (NMFS 2008). For adults and large juveniles, transport involves removing the abalone from the substrate, placing them in coolers with kelp or seawater soaked towels, and moving them by vehicle or air. The abalone would be out of the water for up to 24 hours. For early life stages, transport involves placing the abalone in seawater in spill-proof containers and placing those containers in coolers for transport by vehicle or air. In all cases, researchers would maintain appropriate temperature, moisture, and oxygen levels throughout transport.

In summary, we expect captive maintenance, grow-out, and propagation activities to cause minor, temporary stress to white abalone, primarily due to being removed from the tanks, handled, and kept out of water for a period of time. Injuries may occur when removing the abalone from the tanks. Researchers would minimize injuries by using the appropriate tools and methods for removing abalone. To further reduce the risk of injury, researchers may use ethanol to sedate the abalone prior to removal. We do not expect captive maintenance, grow-out, and propagation activities to kill or cause long-term harm to the abalone. We do expect loss of white abalone at all life stages due to natural mortality, as well as possible disease outbreaks. We expect natural mortality to be greatest for early life stages and to decrease as individuals grow to larger sizes. Researchers would use well-established protocols for all activities and implement best practices and measures to reduce stress and the risk of injury or mortality, to maximize survival at each stage.

2.5.3.2 Captive research activities

Research involving captive white abalone would focus on increasing captive production through improved gametogenesis and spawning; improving health by preventing, controlling, and eliminating pests and pathogens; improving survival and accelerating growth of captive-bred abalone; and improving survival of field planted individuals. Research activities would involve a subset of the captive white abalone. The number of abalone used for research would vary depending on production success and program needs, including the number of abalone needed for field planting (under Permit 18116). Most research activities would use captive-bred white abalone. Research involving wild-origin white abalone would include research to improve gametogenesis, spawning, and overall animal health, and would not involve any lethal take.

We expect abalone to undergo multiple levels of stress due to removal and handling, time out of water, and exposure to variables such as different temperatures, salinity levels, pH levels, and pathogens. For example, research studies may involve subjecting abalone to environmental conditions linked to climate change. Adult abalone may be injected with hormones to assess their effectiveness at triggering gametogenesis. Researchers may test the use of marine epoxies to remove shell epibionts like the boring sponge (Cliona), because the standard shell waxing protocol is not effective at removing it.

We also expect some of the research studies to kill abalone. For example, abalone may die due to experimental conditions (e.g., studies involving exposure to pathogens). Abalone may be sacrificed for analysis of experimental effects. Researchers would aim to keep the abalone alive and eligible for field planting, except where histological or other lethal take is absolutely necessary. Researchers would conduct experiments using the earliest life stage possible to effectively address the research questions, because the early life stages are the most abundant and have the highest natural mortality rates.

Overall, we expect research activities to cause temporary stress to white abalone, primarily due to removal from the tanks, handling, time out of water, and exposure to varying conditions. Some studies may involve killing captive-bred abalone; none of the research using wild-origin abalone would involve intentional lethal take. In addition, the proposed permit would require researchers to coordinate with the NMFS WCR's White Abalone Recovery Coordinator on research activities, the number of white abalone to be used, and the number that would be intentionally killed, to ensure we minimize lethal take and maximize the number of white abalone that are available for field planting (to be conducted under Permit 18116).

2.5.3.3 Public display and education

A subset or all of the captive-bred white abalone may be used for public display and education at the approved captive facilities. The approved captive facilities may provide opportunities for the public to view the white abalone, through guided tours or by placing a subset of the abalone on display for general viewing. Whether in their regular holding tanks or in separate display tanks, researchers would maintain holding conditions (e.g., water flow, temperature, aeration, feeding, cleaning) consistent with the guidance provided in the White Abalone Recovery Plan (NMFS 2008). The public would not be allowed to touch or handle the white abalone in any way. We expect the abalone to experience no more than minor, short-term stress that might result from being handled and placed in separate display tanks. When moving abalone, researchers would minimize the risk of injury by carefully removing the abalone from the tanks using the appropriate tools and methods. Ethanol may also be used to sedate the abalone prior to removal. We do not expect public display and education activities to kill or cause long-term harm to individual abalone.

2.5.3.4 Intentional lethal take

The proposed permit would allow researchers to intentionally kill white abalone if needed to cull or destroy excess captive-bred abalone, or to kill obviously dying abalone for necropsy, including both wild-origin and captive-bred abalone.

If needed, researchers may cull or destroy excess captive-bred larvae, juveniles, or adults to reduce densities and avoid or minimize overcrowding, or if production exceeds the captive program's capacity. Researchers must discuss the decision with NMFS prior to culling or destroying excess animals. Culling or destroying animals would be the last option after all other options (e.g., research, experimental field planting, grow-out in a separate area or facility) have been explored and found infeasible.

Researchers would monitor the holding tanks daily and may isolate or remove individuals that appear unhealthy. As needed, researchers may intentionally kill and preserve obviously dying abalone for necropsy. This is necessary because once abalone die, their tissues deteriorate quickly and may no longer be useful for analysis. Researchers would identify obviously dying abalone based on the following symptoms: extreme lethargy, a withered and/or discolored foot muscle, and/or an inability to hold onto the substrate (Moore 2014). Researchers may kill the animals by refrigerating or freezing the animals. Researchers would preserve tissues by freezing whole abalone or dissecting the relevant tissues (gut; foot muscle) and either freezing them or fixing them in formalin before placing in ethanol. Researchers would send specimens, samples, and/or parts to labs for necropsy and analysis.

2.5.4 Population and Species Level Effects

We expect the proposed permit and permit activities to affect individual white abalone in the wild and in captivity. The proposed permit would allow researchers to remove up to an additional 16 white abalone from the wild and bring them into captivity to serve as broodstock in the captive program, with the possibility of reintroducing these abalone to the wild after three or more years in captivity. We expect these collection and reintroduction activities to cause stress or to injure or kill some portion of the abalone, as well as to indirectly affect white abalone that remain in the wild. The proposed permit would also allow captive facilities to receive, maintain, and conduct research, enhancement, and reintroduction activities with up to 30 wild-origin white abalone obtained from other captive facilities, law enforcement cases, emergency response activities, and/or Federal projects involving live white abalone. These abalone would be incorporated into the captive program. The proposed permit would also allow researchers to maintain, propagate, conduct research on, and display both wild-origin and captive-bred white abalone in captivity. We expect these activities to cause stress to individual abalone; in some cases, these activities may result in injuries to abalone. The proposed permit would also allow researchers to intentionally kill white abalone as part of captive research studies, when needed to cull or destroy excess abalone produced by the captive breeding program, or when needed to preserve obviously dying abalone for necropsy.

In the sections above, we evaluated the effects of these activities on white abalone at the individual level. In this section, we evaluate the effects on white abalone at the population and species level. We conclude by evaluating whether the proposed permit could appreciably reduce the species' likelihood of surviving and recovering in the wild. We consider these effects within the context of the species' status and recovery needs. White abalone have a high risk of extinction, because wild populations remain at low densities and continue to decline in some areas despite prohibitions on fisheries harvest since 1996 (Butler et al. 2006; Stierhoff et al. 2012). We estimate that the wild population consists of at least 4,000 individuals, based on the most recent estimates for San Clemente Island (approximately 500 individuals) and Tanner Bank (approximately 3,500 individuals; pers. comm. with Kevin Stierhoff, SWFSC, on 16 July 2015). Field observations since 2013 indicate recruitment is occurring in some areas off outhern California (Stierhoff et al. 2015; Neuman et al. 2015). However, the remaining individuals in the wild are likely too far apart to support successful reproduction at the levels and time frames needed to support long-term recovery and viability (Babcock and Keesing 1999; Butler et al. 2006; Stierhoff et al. 2012; Catton et al. 2016; NMFS 2018).

The White Abalone Recovery Plan (NMFS 2008) identifies captive propagation and field planting as priority recovery actions for white abalone. The proposed permit would allow the existing captive program to continue the critical work of producing healthy white abalone for use in field planting efforts and in captive research to inform species recovery. The proposed permit would also enhance the existing captive program by allowing collection of additional wild white abalone, to increase the number of potential spawners and the genetic diversity of the captive population. The proposed permit would limit collection to those individuals that are most likely to be reproductively isolated, to minimize the loss of reproductive potential in wild populations. Below, we describe our analysis of the risks and benefits of the proposed activities on white abalone and why we do not expect the proposed activities to appreciably reduce the likelihood of survival and recovery of white abalone in the wild.

2.5.4.1 Field activities – collection and reintroduction of wild white abalone

The proposed permit would allow researchers to collect and remove up to an additional 16 white abalone from the wild, reducing the wild population by 16 individuals. We expect that up to three of these abalone may die shortly after collection (within six months) due to stress and/or injuries, without contributing to captive production (in the worst case) or only contributing to one cohort (in the best case). Some or all of the wild-origin abalone may be reintroduced to the wild after three or more years in captivity. A Memorandum to the File (Yates 2016) discusses the development of the collection criteria and analyzes the risks and benefits of collection to the wild population and the captive program. This Memorandum formed the basis for our analysis below.

The risks of collection include the loss of individuals and reproductive potential in the wild over the short-term (if animals are reintroduced) or the long-term (if animals are not reintroduced). The benefits of collection include the potential increase in production and genetic diversity for the captive population should one or more of the wild-origin broodstock successfully spawn. The benefits and risks of collection depend on several factors, including the reproductive viability of the abalone that are removed from the wild, the ability of newly collected abalone to spawn and contribute to the captive population, and the successful production of progeny suitable for field planting. If collected abalone are not reproductively viable in the wild, then the costs to the wild population would be minimal whereas the benefits could be significant. However, if the collected abalone are reproductively viable in the wild, then the costs to the wild population could be large and may or may not be outweighed by the benefits, depending on how well the abalone spawn and contribute to the captive population. Therefore, to ensure that the benefits of collection outweigh costs, we must ensure that the collection criteria only allow collection of individuals that are most likely reproductively isolated.

The proposed permit would continue to apply the same collection criteria as established in the previous permit. First, white abalone would be eligible for collection if they are more than 10 m from all other white abalone. We identified this minimum nearest neighbor distance based on field studies conducted by Babcock and Keesing (1999) showing that two individuals separated by distances of 8 to 16 m have very low (less than 20%) fertilization rates. When we consider the probability that the two individuals are of the opposite sex (50%) and that one individual is down current of the other (60° out of 360°), the probability of fertilization success declines to less than 10%. Based on this information, we conclude that white abalone are most likely reproductively isolated if they are separated by a distance of at least 10 m from all other white abalone.

Second, the proposed permit would continue the phased, adaptive approach established under the previous permit and limit the total number that may be collected under all phases to 30 white abalone, representing a small proportion (0.75%) of the estimated wild population of 4,000 white abalone. Researchers have completed Phase I, under which they have collected 14 white abalone. The proposed permit would allow researchers to collect up to an additional 16 white abalone under Phase II and Phase III. Initiation of Phase II and III would require NMFS approval upon review of the health, status, survival, and spawning success of the previously collected abalone.

Finally, the proposed permit would prohibit collection of white abalone from two research sites off Point Loma. The two sites range from about 400 to 500 m^2 in area and are among the few well-studied sites where researchers have found multiple white abalone along contiguous reef habitat, where white abalone were not previously recorded as present 10-15 years ago. These two sites provide a unique opportunity to study the movements and dynamics of small white abalone populations, to inform our understanding of population dynamics and refine the minimum nearest neighbor distances for identifying reproductively isolated individuals.

The proposed permit would include the option of reintroducing wild-origin white abalone to the wild after three or more years in captivity. Reintroduction would affect the reintroduced white abalone (stress, injury, mortality), wild white abalone (increased risk of disease, competition for food and space), and the captive population (reducing the number of spawners and the genetic diversity of the captive broodstock). Researchers plan to address these effects by conducting health screenings prior to reintroduction; implementing best practices to minimize stress, injury, and mortality; and selecting sites with ample food and space. Researchers would only reintroduce abalone that have not spawned or that have spawned enough such that we have sufficiently captured their genetic diversity in the captive population. The benefits of reintroduction include increasing the density and reproductive potential of local populations by aggregating abalone with one another and/or with white abalone already present at the sites. Because the wild-origin abalone were deemed to be reproductively isolated, we would consider any survival and reproduction by reintroduced abalone to be a net benefit to the wild population and to species recovery.

Overall, the proposed collection and reintroduction activities may reduce the fitness of individual wild white abalone. However, we do not expect these activities to result in adverse effects on white abalone populations or the species as a whole. Successful spawning of the wild-origin broodstock would potentially benefit the wild population by increasing the production and genetic diversity of white abalone for field planting and research. The reintroduction of wild-origin broodstock would also potentially benefit the wild population should those animals survive and reproduce in the wild.

2.5.4.2 Captive activities – holding, propagation, research, public display, intentional lethal take

The proposed permit would allow the captive program to continue producing healthy white abalone for field planting (under Permit 18116) and captive research (under the proposed permit), two critical components of white abalone recovery. The captive program includes:

- holding, grow-out, and propagation of white abalone at multiple land-based facilities;
- research to enhance captive production, optimize survival and growth in captivity and in the field, and improve health and disease/pest management;
- public display of abalone for education and outreach; and
- intentional lethal take of individuals to optimize holding densities or for necropsy.

We expect natural mortality to occur at every life stage. We recognize that all of the captive abalone could die over the life of the permit, due to natural mortality or catastrophic events; however, the likelihood of this happening is low for several reasons. First, the abalone would be held at multiple facilities throughout California, to guard against the risk of a catastrophic event killing the whole captive population or a whole cohort. Second, researchers have developed and implemented protocols to optimize holding conditions, abalone health and husbandry, spawning procedures, and disease and parasite management at the facilities. Finally, the researchers have gained much experience and expertise over the past ten years to optimize the production, survival, and health of the captive abalone.

We expect white abalone to experience varying degrees of stress as a result of captive maintenance, handling, spawning, culturing, rearing, transport, and research activities. As described above, researchers would minimize stress and injury to the captive abalone by using well-established protocols and implementing best practices for all activities. Researchers would routinely monitor and assess the health of the abalone and apply appropriate treatments as needed. Researchers would coordinate with NMFS to focus captive research on high priority studies to inform recovery and to limit the number of abalone used as well as lethal take to the minimum numbers necessary. Researchers would only cull or destroy abalone after all other options have been explored and discussed with NMFS. Only obviously dying abalone would be sacrificed for necropsy.

In summary, we expect captive activities to cause stress and to injure or kill individual abalone of all life stages. Though possible, we do not expect all of the captive abalone to die over the duration of the five-year permit; however, we do expect some portion to die due to natural mortality, handling stress/injury, research experiments (e.g., exposure to experimental conditions, sacrifice of abalone for analysis), culling/destroying of "excess" abalone, and sacrifice of obviously dying abalone for necropsy. We expect the proposed permit conditions to sufficiently minimize stress and harm to the captive abalone and support the program's ability to produce and maintain large numbers of healthy white abalone. Producing and maintaining a healthy captive population would benefit the species because captive-bred abalone can be used for research and for field planting to support white abalone recovery in the wild.

2.6 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 area of the Federal action subject to consultation [50 CFR 402.02 and 402.17(a)]. 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.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of the environmental baseline (Section 2.4).

We expect the threats and factors described in Section 2.2.1 (Rangewide Status of White Abalone) and Section 2.4 (Environmental Baseline) to continue to affect white abalone in captivity and in the field. For example, withering syndrome will continue to pose a threat to white abalone. We expect this threat to decline or remain stable into the future, given implementation of health monitoring and treatment protocols by researchers.

Other non-Federal activities that could affect white abalone include changes to State regulations and requirements for captive holding facilities and for the import of invertebrates, which can affect the introduction and spread of abalone diseases. We visited CDFW's webpages for Marine Aquaculture (https://wildlife.ca.gov/Aquaculture) and the Shellfish Health Laboratory (https://wildlife.ca.gov/Conservation/Laboratories/Shellfish-Health). We did not find any information indicating changes in State regulations or requirements that may affect captive facilities or the introduction and spread of abalone diseases.

We did not identify additional state or private activities that are reasonably certain to occur within the action area and that could result in cumulative effects on white abalone. We do not know of or expect major changes in State regulations or requirements for facilities that hold abalone. Oil spills and the introduction of pathogens and parasites could affect both wild and captive abalone, but we do not consider these to be reasonably certain to occur, given the unpredictability and uncertainty in timing, location, scope, and severity of such events.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.7.1 White Abalone

White abalone have declined significantly throughout their range and face a high risk of extinction, primarily due to overfishing and the resulting low local densities. Little information is available to track population abundance and trends over time, except for a few locations off southern California. The best available data indicate white abalone off southern California have declined by several orders of magnitude since the 1960s and remain at low abundance and density. Although harvest has been prohibited since 1996, the effects of historical overharvest continue to affect the wild population. Other factors such as poaching, disease, ocean acidification, and elevated water temperatures pose a potential threat to white abalone. Surveys indicate suitable habitat remains intact and available for the species and the one study on genetics indicates a high degree of genetic variation remains.

The primary threat to the species is their current low densities and spatial distribution, where the remaining white abalone may be too far apart to reproduce successfully or at levels needed for recovery. Field observations since 2013 indicate successful reproduction and recruitment has occurred in the wild over the past 10-15 years. However, natural production may not be happening at the rate or scale needed to reverse declining trends. Recovering white abalone will require protecting the remaining wild populations, increasing the species' abundance and density in the wild to promote natural reproduction, and monitoring to track the species' status in California and Mexico.

The White Abalone Recovery Plan (NMFS 2008) highlights captive breeding and field planting as the main recovery actions needed to increase the abundance and density of white abalone in the wild. Since the early 2000's, researchers have been developing the captive breeding program for white abalone, with increasing success and production since 2012. In 2019, researchers conducted the first white abalone field planting at two sites off southern California and have since released thousands of captive-bred white abalone into the ocean. At the same time, outreach and education efforts have raised public awareness of abalone conservation needs.

The proposed permit would maintain the existing captive program and allow researchers to continue captive maintenance, propagation, grow-out, and research activities, as well as public display of white abalone for education and outreach. The proposed permit would authorize extensive take of white abalone in captivity. Researchers would work with millions of eggs and larvae and tens of thousands of juveniles and adults each year. We expect white abalone to experience natural mortality across all life stages, as well as stress, injury, and mortality due to captive activities. Researchers would minimize stress, injury, and mortality by maintaining optimal holding conditions, implementing best practices for abalone husbandry and health, and minimizing handling frequency. Researchers would coordinate with NMFS on captive research and use the earliest life stages and minimum number of abalone possible for experiments.

We conclude that these measures sufficiently minimize the effects of the proposed activities on white abalone in captivity. We do not expect that continuation of the captive program would cause long-term harm to the captive or wild population. Instead, we expect the captive program to maintain and expand the captive population by producing large numbers of healthy white abalone for field planting and research. Thus, the captive program would benefit species recovery through the knowledge gained through research as well as the production of abalone for field planting to enhance wild populations.

The proposed permit would also maintain the phased approach under which researchers could collect additional white abalone from the wild to serve as broodstock in the captive program. Collection of additional wild-origin broodstock is critical for the success of the captive program, to increase the number of potential spawners and the genetic diversity of the captive population. Although collection would remove individuals and their reproductive potential from the wild population, the proposed permit would sufficiently minimize this loss by only allowing collection of individuals that are most likely to be reproductively isolated. The proposed permit would also limit the total collection to 30 white abalone (0.75% of the estimated 4,000 individuals in the wild population) and require a phased approach. Under the previous permit (Permit 14344-2R), researchers have already completed Phase I and collected 14 white abalone from the wild. NMFS approval would be required to collect additional wild white abalone under Phase II, based on review of Phase I.

The proposed permit would also allow researchers to reintroduce wild-origin white abalone to the wild after three or more years in captivity. Reintroducing abalone in aggregation with one another or with existing wild white abalone would increase the potential for natural reproduction and support species recovery. Researchers would minimize potential risks to the wild population by conducting thorough health screenings prior to reintroduction and selecting sites that have sufficient food and space to support the additional abalone.

Researchers would also collect tissue and fecal samples from white abalone that are observed, but not collected. Sampling would not require removing the abalone from the substrate and would cause minor, short-term stress to individual abalone, while providing valuable information to assess the genetic diversity and health of the wild population. Approved captive facilities would also be able to receive wild-origin white abalone from other sources (other captive facilities, law enforcement cases, emergency response activities, or Federal agency actions that involve live white abalone). In these cases, the white abalone would have already been removed from the wild. Allowing these abalone to be incorporated into the captive program would benefit the program by adding to the captive population and to the wild-origin broodstock.

We conclude that the proposed collection, sampling, and reintroduction activities would not cause long-term harm to wild populations. We recognize the potential risks associated with collection activities, but conclude that the proposed permit's phased approach and collection criteria adequately minimize those risks and support the needs of the captive program. We also conclude that the proposed permit would minimize the risks associated with reintroduction activities and that reintroduction would benefit the wild-origin white abalone as well as wild populations by increasing the abundance and reproductive potential of local populations.

In conclusion, we have considered the status of the species, the environmental baseline, and the cumulative effects along with the effects of the action and have determined that the proposed permit would not reduce fitness at the population or species level. The proposed permit would authorize extensive take of white abalone, including collection of white abalone from the wild and lethal take of both wild and captive-bred abalone. Collection activities would remove individuals and their reproductive potential from the wild population, bringing the individuals into a captive program where they may or may not reproduce. Although the captive program has been operating since the early 2000's, there is the risk that all or a large portion of the captive population may die in captivity. We determined, however, that the proposed permit provides appropriate measures to address these risks and minimize harm to the wild and captive populations. These measures include criteria to ensure collection of individuals that are most likely to be reproductively isolated, minimizing the loss of reproductive potential in the wild. In addition, the proposed permit requires a phased approach to collections, allowing us to respond adaptively as we learn more about the species' status and population dynamics. The proposed permit also includes measures to minimize stress, injury, and mortality of white abalone in captivity and safeguard against catastrophic events. Overall, the proposed permit would support critical recovery actions (produce and raise healthy white abalone for field planting and research) and adequately considers and minimizes the risks such that the potential benefits of the proposed activities would largely offset the potential adverse effects.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of white abalone. No critical habitat has been designated or proposed for this species; therefore, none was analyzed.

2.9 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 actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). “Harass” is further defined by interim guidance as to “create 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.” “Incidental take” is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). 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 this ITS.

For the action considered in this opinion, there is no incidental take at all. The reason for this is that all the take contemplated in this opinion would be carried out under a permit that allows the permit holder to directly take white abalone, consistent with section 10(a) of the ESA, which allows such direct take in limited circumstances present here. The actions are considered to be direct take rather than incidental take because in every case their actual purpose is to take the animals as a lawfully permitted activity. Thus, the take cannot be considered "incidental" under the definition given above. Nonetheless, one of the purposes of an incidental take statement is to specify the amount or extent of take that may not be exceeded without being in possible violation of section 9 of the ESA. That purpose is fulfilled here by the amounts of direct take specified in the effects section above (Table 1 in Section 2.5.1). Those amounts constitute hard limits on both the amount and extent of take that could occur during the permitted activities in a given year. This concept is also reflected in the reinitiation clause below.

2.10 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. Specifically, “conservation recommendations” are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

We provide two conservation recommendations for the proposed permit:

1. The Permit holder and researchers under the permit should consider developing a central repository for biological samples collected and analyzed. The specimens in the repository should be linked to a central database providing metadata on the specimens.
2. The Permit holder and researchers under the permit should consider developing a forum for sharing data (e.g., results of experimental research studies) and public outreach and education materials with one another, to inform all the project partners.

To keep NMFS informed of actions that minimize or avoid adverse effects or that benefit listed species or their habitats, we request that the Permit holder notify us of the implementation of any conservation recommendations. The proposed permit would require the Permit holder to summarize their progress on these conservation measures in the annual reports

2.11 Reinitiation of Consultation

This concludes formal consultation for NMFS' proposal to issue Permit 14344-3R to UC Davis to take white abalone for research and enhancement purposes pursuant to the provisions of Section 10(a)(1)(A) of the ESA.

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

In the context of this opinion, there is no incidental take anticipated and the reinitiation trigger set out in § 402.16(a)(1) is not applicable. If any of the direct take amounts specified in this opinion's effects analysis (Section 2.5) are exceeded, reinitiation of formal consultation will be required because the regulatory reinitiation triggers set out in § 402.16(a)(2) and/or (a)(3) will have been met.

2.12 "Not Likely to Adversely Affect" Determinations

NMFS does not anticipate the proposed action would adversely affect black abalone or designated critical habitat for black abalone. When evaluating whether the proposed action is not likely to adversely affect listed species or critical habitat, we consider whether the effects are expected to be completely beneficial, insignificant, or discountable. Completely beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the effect and should never reach the scale where take occurs. Effects are considered discountable if they are extremely unlikely to occur.

2.12.1 Black Abalone and Black Abalone Critical Habitat

Black abalone range from Point Arena, California, to Baja California and occupy intertidal and shallow subtidal rocky habitats to 6 m depth. NMFS listed black abalone as endangered under the ESA on January 14, 2009 (74 FR 1937) and designated critical habitat on October 27, 2011 (76 FR 66806) along segments of the coast throughout the species range, including the Palos Verdes Peninsula. Proposed activities that may affect black abalone and their critical habitat include field collection and reintroduction of white abalone, as well as captive activities.

Researchers may encounter black abalone at shallow field sites. Researchers would not touch or disturb any black abalone, but would record the number observed and their approximate size, habitat, and distance to the nearest abalone of the same or different species. Researchers would use non-destructive methods to survey and monitor field sites for white abalone, meaning they would not move or turn over rocks or otherwise disturb the habitat. Based on this, we conclude that the potential effects of field activities on black abalone and their habitat would be minimal and insignificant.

Proposed activities within captive facilities may also affect black abalone at facilities that hold both white abalone and black abalone. Currently, the CDFW Shellfish Health Lab and the SWFSC La Jolla Lab hold both white abalone and black abalone. To minimize effects on other abalone at the captive facilities, researchers would quarantine newly-collected or obtained white abalone for at least four weeks and treat the abalone for pathogens and parasites if needed. Researchers would also hold white abalone in separate tanks and systems from other abalone at the facilities. The proposed activities would only involve white abalone and would not involve black abalone at the facilities. These measures sufficiently avoid and minimize potential effects to other abalone held at the facilities, including black abalone. We conclude that the potential for the proposed action to affect captive black abalone is extremely unlikely and therefore discountable.

In summary, we conclude that the proposed action is not likely to adversely affect black abalone and their designated critical habitat.

3 Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

This analysis is based on the effects analysis discussed above and on descriptions of EFH for Pacific Coast groundfish (PFMC 2005) and Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

In this instance, because we do not expect adverse effects on habitat, we also do not anticipate any effects on EFH. As the biological opinion above states, the proposed permit activities are not likely, singly or in combination, to adversely affect the habitat upon which Pacific salmon and groundfish depend. All the actions are of limited duration, minimally intrusive, and are discountable in terms of their effects, short- or long-term, on any habitat parameter important to the fish.

NMFS WCR PRD must reinitiate EFH consultation if plans for these actions are substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for the EFH conservation recommendations (50 CFR Section 600.920(k)).

4 DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the NMFS WCR PRD. Other interested users could include the permit applicant (UC Davis-BML), co-investigators listed on the permit application, and abalone researchers. Individual copies of this opinion were provided to the NMFS WCR PRD. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR part 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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