Environmental Assessment of the Effects Scientific Research and Enhancement Activities Would Have on Endangered Black Abalone (*Haliotis cracherodii*) Under Proposed Permit 26342

September 30, 2022

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Acronym List

ARM	Abalone recruitment module
CDFW	California Department of Fish and Wildlife
EA	Environmental Assessment
ESA	Endangered Species Act
NMFS	National Marine Fisheries Service
OSPR	Office of Spill Prevention and Response
SWFSC	Southwest Fisheries Science Center
UCSC	University of California, Santa Cruz
WCR	West Coast Region

1.0 Introduction

The National Marine Fisheries Service (NMFS) West Coast Region (WCR) is proposing to issue Scientific Research and Enhancement Permit 26342 (and subsequent permit renewals as appropriate) under section 10(a)(1)(A) of the Endangered Species Act (ESA) to the University of California, Santa Cruz (UCSC) and thereby authorize rescue and relocation of endangered black abalone (*Haliotis cracherodii*) in response to emergency events. Permit 26342 and subsequent permit renewals would authorize UCSC to: collect and remove black abalone from the wild, hold the rescued black abalone in captivity for one day to several months, release them to field sites, and conduct post-release monitoring. If UCSC seeks and receives NMFS's approval, they may also use a subset of the rescued abalone in spawning, culturing, and experimental outplanting studies. All activities would be conducted in rocky intertidal reefs along the California coast within the range of black abalone as well as at approved land-based facilities. This Environmental Assessment (EA) analyzes the proposed activities under Permit 26342 and subsequent ESA Permits that fall within the activities analyzed here.

1.1 Purpose and Need

The purpose of the proposed permit is to enhance black abalone survival and recovery by allowing rescue and relocation of black abalone in response to emergency events. Emergency events include oil spills, landslides, debris flows, vessel groundings, and other events that threaten the loss of black abalone and/or their habitat. For example, the Mud Creek Landslide in 2017 and the Big Sur debris flows in 2021 buried large segments of rocky intertidal coast and an unknown number of black abalone within those areas (Bell and Raimondi 2020; Malsbury 2021; Caltrans 2021). Oil spills, such as the Refugio Beach Oil Spill in 2015, can kill black abalone and other rocky intertidal biota through smothering and toxic effects (Refugio Beach Oil Spill Trustees 2021). Vessel groundings like the Blue Mist vessel grounding in 2014 can result in release of ballast or fuel that can kill black abalone and other rocky intertidal organisms. Rescuing black abalone can save at-risk individuals, and relocating them can enhance populations at other sites.

Issuance of the proposed permit would be needed to authorize direct take of ESA-listed endangered black abalone, which is otherwise prohibited, during rescue and relocation activities. ESA Section 10(a)(1)(A) authorizes NOAA Fisheries to issue permits for the purposeful or direct take of an ESA-listed species only for scientific purposes or to enhance the propagation (such as through hatcheries) or survival of listed species. The permits would be issued consistent with these requirements. A biological opinion on the proposed permit issuance determined that the action is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat.

1.2 Action Area

The action area consists of rocky intertidal reefs along the California coast within the range of black abalone (Figure 1). Rescue, release, and post-release monitoring activities would occur in rocky intertidal reefs in California within the species' range from Point Arena to the U.S.-Mexico border. Black abalone would be held at captive facilities to be assessed, tagged, and

prepared for release back into the wild within the action area. Spawning and culturing activities may also be conducted at the captive facilities. Laboratories throughout the coast would conduct research activities involving black abalone genetic samples, fecal samples, shells, other parts, and specimens.

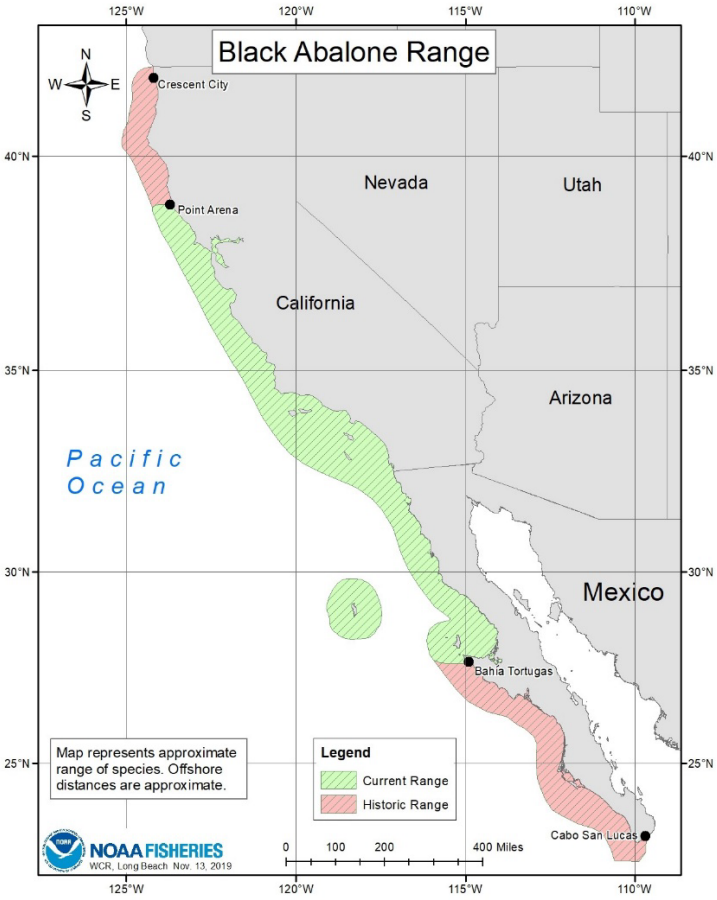

Figure 1. Map of the current and historical range of black abalone.

2.0 Description of Alternatives

This EA considers a "no action" alternative and a preferred alternative: (1) Under the "No Action" alternative, NMFS would not issue the proposed permit; and (2) under the preferred alternative, NMFS would issue the proposed permit for the activities described in the permit application, with additional permit terms and conditions specified by NMFS. This range of alternatives is appropriate with respect to the proposed action, given the limited environmental concerns, discrete focus of the research activities and expertise of the researchers, and scope of the proposed action.

2.1 Alternative 1, No Action

Under the No Action alternative, NMFS would not issue Permit 26342 to UCSC for rescue and relocation of black abalone. This alternative would maintain the status quo, where any

authorization to rescue and relocate black abalone in response to an emergency event is addressed on a case-by-case basis by coordinating with the NMFS WCR. For emergency responses that are carried out, funded, or authorized by a Federal agency (i.e., a "Federal action"), the rescue and relocation of black abalone may be authorized through expedited consultation under Section 7 of the ESA. 50 CFR 402.05.[1] There is currently no mechanism for authorizing non-federal emergency rescue of black abalone. As a result, all such activities currently depend solely on NMFS' discretion, with little opportunity for planning or coordination absent delay in response time. Under both the federal and non-federal scenarios, the entities involved in the response would need to coordinate with NMFS on an ill-defined and ad-hoc basis, in the midst of an emergency situation requiring a timely response, to determine whether activities could be authorized to rescue and relocate at-risk black abalone.

2.2 Alternative 2, Proposed Action – Issuance of Permit 26342 with Terms and Conditions (Preferred Alternative)

Under the Proposed Action, NMFS WCR would issue Permit 26342 to the UCSC for black abalone rescue and relocation in response to future emergency events. The permit would outline the authorized activities and best practices for each activity to minimize any adverse effects on black abalone and their habitat. The permitted activities would include:

Rescue/collection: UCSC would assess observed or expected effects of the emergency event on black abalone and its habitat and the risks posed by these effects to determine whether or not to rescue and relocate black abalone. UCSC would notify NMFS WCR prior to conducting rescue and relocation activities. UCSC would collect black abalone according to established protocols with best practices to minimize stress and injury to the abalone. Only personnel with experience removing abalone would conduct collection activities.

Captive holding: UCSC would transport and hold rescued black abalone in captive facilities for one day to several months. The duration of captive holding would depend on several factors, including the health of the abalone, the timing of low tide cycles, and the condition of the habitat at the rescue site and the potential relocation site(s). During holding, researchers would photograph, measure (shell length), weigh, assess health and gonad condition, genetically sample (e.g., swab and/or epipodial clipping), and tag the abalone. If needed, researchers would apply health treatments (e.g., shell waxing to remove shell-boring organisms, antibiotic treatment to remove bacterial infections) and would preserve dead or obviously unhealthy/dying abalone for necropsy to determine the cause of death.

Relocation/Reintroduction to field sites: Researchers would transport and release rescued black abalone at selected field site(s), placing the abalone in pre-identified cracks and crevices with suitable habitat. To prepare the habitat for abalone, researchers may remove encrusting organisms (e.g., sponges, Phragmatopoma/sand castle worms) that have been observed to fill in cracks and crevices following the decline of black abalone. If conditions allow, rescued abalone

[1] 50 CFR 402.05 Emergencies. a) Where emergency circumstances mandate the need to consult in an expedited manner, consultation may be conducted informally through alternative procedures that the Director determines to be consistent with the requirements of sections 7(a)-(d) of the Act. This provision applies to situations involving acts of God, disasters, casualties, national defense or security emergencies, etc.

may be returned to their original site or a nearby site. Factors for selecting relocation sites include: the availability of sufficient suitable habitat and food to support additional black abalone; proximity to affected area and established long-term monitoring sites; accessibility for monitoring; and protection from poaching.

Post-release monitoring: Researchers would conduct post-release monitoring to track the survival and movements of black abalone. Initial monitoring would occur within a day to a few days after release. Monitoring may occur once per tide cycle (about every two weeks) for the first three months and then be conducted at six months and then annually. For each tagged black abalone found, researchers would record the tag number, location, and habitat. Researchers would collect and record empty, tagged shells to track confirmed mortalities.

Spawning, culturing, and outplanting: Recent attempts to spawn black abalone in captivity have not been successful in producing progeny (SWFSC 2021). If rescued black abalone are healthy and have ripe gonads, researchers may use a subset in spawning studies to determine effective spawning induction methods. These spawning studies would involve standard spawning and culturing methods as described by Kawana and Aquilino (2020) as well as test the following modifications: prolonged desiccation, elevated temperatures (from 17-21˚C), simulated seasonal tidal cycles, and hormone injections. If spawning is successful, then researchers may use the progeny in experimental outplanting trials or transfer them to the black abalone captive program (under ESA Permit 19571-2R issued to the SWFSC) for long-term holding and grow-out. Experimental outplanting would involve releasing larvae directly into the intertidal or settling the larvae onto abalone recruitment modules (ARMs) made of stacked tiles or cobbles/blocks in vexar mesh bags and then installing the ARMs at field sites. Post-outplant monitoring would occur at six months and up to three times per year. UCSC would be required to coordinate with NMFS, CDFW, and the black abalone recovery team to determine whether to conduct spawning studies using the rescued abalone and to develop a spawning, culturing, and outplanting plan. Only trained and experienced researchers would conduct spawning, culturing, and outplanting activities.

3.0 Affected Environment

This section describes the current conditions of the resources that may be affected by the alternatives described in this EA.

3.1 Physical Environment

The physical environment in the action area consists of rocky intertidal reefs where black abalone occur along the California coast from Point Arena to the U.S.-Mexico border. Rescue, release, and monitoring activities would be conducted in suitable habitats for black abalone, i.e., rocky intertidal and subtidal habitats to 6 meters depth. This includes designated critical habitat for black abalone (76 FR 66806; 27 October 2011).

In general, rocky intertidal reefs within the action area contain good to excellent quality habitat for black abalone. In recent years, sedimentation events have buried rocky intertidal habitat along the Big Sur coast. The 2017 Mud Creek landslide buried 1,700 linear feet (518 linear

meters) of rocky intertidal habitat in Monterey County (Caltrans 2021). The 2021 Big Sur debris flow event also buried segments of rocky intertidal habitat; the loss of habitat is still being assessed. In addition, the 2015 Refugio Beach Oil Spill affected approximately 1,500 acres of shoreline habitat including sandy beach and rocky intertidal habitats (Refugio Beach Oil Spill Trustees 2021).

3.2 Biological Environment

The biological environment within the action area consists of diverse fish, invertebrate, and algal communities that occupy rocky intertidal habitats. South of Cayucos, researchers have observed changes to habitat features following the decline of black abalone. Changes include shifts in the invertebrate and algal community with increased growth of encrusting organisms like Phragmatopoma tube worms and sponges that have filled in cracks and crevices and reduced the surface area for crustose coralline algae (Miner et al. 2006; VanBlaricom et al. 2009; NMFS 2011). These changes can reduce habitat quality for adult and juvenile black abalone.

NMFS listed black abalone as endangered under the ESA in 2009 (74 FR 1937, 14 January 2009) and designated critical habitat in 2011 (76 FR 66806; 27 October 2011). The species range extends from Point Arena, California, to Bahía Tortugas, Mexico, from the intertidal to six meters depth (74 FR 1937, 14 January 2009). The disease called withering syndrome is the primary threat to black abalone, resulting in mass mortalities in the 1980s and 1990s. Populations south of Cayucos (San Luis Obispo County) declined in abundance by more than 80% and most remain at low densities (Neuman et al. 2010). Populations north of Cayucos have not yet experienced disease-induced mass mortalities and several are considered healthy in terms of their density, size structure, recruitment, and population growth. Other threats to black abalone include illegal harvest, elevated water temperatures, and ocean acidification. In addition, over the past ten years, several emergency events have impacted black abalone and their habitat, including the 2014 Blue Mist vessel grounding (San Luis Obispo County), the 2015 Refugio Beach Oil Spill (Santa Barbara County), the 2017 Mud Creek Landslide (Monterey County), and the 2021 Big Sur debris flows (Monterey County). The Final ESA Recovery Plan for Black Abalone (NMFS 2020) identifies several priority recovery actions including long-term monitoring, population and habitat restoration, disease research and management plans, emergency response planning, coordination with Mexico, and outreach and education.

4.0 Environmental Consequences

This section evaluates the impacts of the alternatives on the resources described in section 3.0.

4.1 Alternative 1, No Action

Under the No Action alternative, NMFS would not issue the proposed ESA Permit to UCSC and would not authorize the proposed rescue and relocation activities for black abalone in response to emergency events. Authorization for rescue and relocation of black abalone would need to be obtained for each emergency event. For emergency responses that involve a Federal action, such

as oil spill response, the rescue and relocation of black abalone may be authorized through expedited consultation under Section 7 of the ESA. For responses that involve a non-Federal action, the options for obtaining authorization (including issuance of an ESA permit under section 10(a)(1)(A) of the ESA) could take several months and may delay response activities. In both cases, entities would need to coordinate with NMFS on an ill-defined and ad-hoc basis to determine what activities could be authorized to rescue and relocate at-risk black abalone.

4.1.1 Effects of Alternative 1 (No Action) on the Physical Environment

Under the No Action alternative, there would be limited effects on the physical environment. Rescue and relocation of black abalone may still occur in response to emergency events, if authorized by NMFS for a particular event. Effects on the physical environment would be limited to the local areas where rescue and relocation surveys are conducted. Minor trampling of the rocky intertidal habitat may occur during rescue and relocation activities and monitoring surveys. Researchers would minimize trampling effects by wearing soft-soled shoes and avoiding walking on vulnerable species. NMFS expects trampling effects to be minimal, given the low frequency and duration of rescue, relocation, and monitoring activities.

4.1.2 Effects of Alternative 1 (No Action) on the Biological Environment

Under the No Action alternative, rescue and relocation of black abalone may still occur in response to emergency events, but in some cases may be delayed due to the time needed to obtain authorization. For example, for an oil spill, rescue and relocation of black abalone may be authorized in a timely manner under an emergency ESA Section 7 consultation between the lead Federal agency (typically the U.S. Coast Guard or the U.S. Environmental Protection Agency) and NMFS. For other types of emergency events that involve a non-Federal action, options for obtaining authorization would take more time (e.g., about six months to obtain an enhancement permit under Section 10(a)(1)(A) of the ESA). These delays may limit response efforts, resulting in the loss of opportunities to rescue black abalone and further loss of black abalone following the emergency event.

4.2 Alternative 2, Proposed Action – Issuance of Permit 26342 with Terms and Conditions (Preferred Alternative)

Under the Proposed Action, NMFS would issue ESA Permit 26342 to UCSC to authorize the rescue and relocation of black abalone in response to emergency events for ten years. Authorized activities would include collection, transport, captive holding, release/relocation, and post-release monitoring of rescued black abalone. The permit would also allow a subset of the rescued black abalone to be used in spawning, culturing, and experimental outplanting studies, pending development of a plan in coordination with NMFS and CDFW.

4.2.1 Effects of Alternative 2 (Issuance of Permit 26342) on the Physical Environment

Under the Proposed Action (Issuance of Permit 26342), researchers would be allowed to rescue and relocate black abalone in a timely manner in response to an emergency event that poses a risk to black abalone and their habitat. Field activities may result in trampling of rocky intertidal

habitat. As described above in Section 4.1.1, NMFS expects any trampling effects to be minimal and limited to small areas where rescue and relocation activities are conducted.

The installation of ARMs for experimental outplanting would affect rocky substrate. NMFS expects the effects would be minor and affect a small area (approximately 15 centimeters (cm) by 15cm surface area per ARM) of rocky intertidal habitat. Effects would also be temporary because all modules would be removed at the end of the study. Mounting materials (epoxy, screws, anchors) may be left in place but would affect a very small area (a few cm per ARM).

Overall, NMFS does not expect the proposed activities under Permit 26342 to result in significant adverse effects on the physical environment. Rescue, relocation, and monitoring activities may result in minor trampling of rocky intertidal habitat. Installation of ARMs would result in minor, temporary effects on small areas of rocky substrate. Mounting materials may be left in place, but would affect a very small area of rocky substrate.

4.2.2 Effects of Alternative 2 (Issuance of Permit 26342) on the Biological Environment

Under the Proposed Action (Issuance of Permit 26342), rescue and relocation efforts in response to emergency events would likely be more streamlined, efficient, and timely because the permit would clearly state what response activities are authorized and identify the best practices and protocols to use when conducting rescue and relocation activities. As a result, the permit may help to minimize the loss of black abalone due to an emergency event and any stress, injury, and mortality arising from rescue and relocation activities.

Preparation of the habitat prior to relocation of black abalone may involve removing encrusting organisms such as sponges and Phragmatopoma/sand castle worms that have filled in cracks and crevices. The removal of encrusting organisms would be limited to the pre-selected cracks and crevices where rescued black abalone would be placed. The affected area would be small (cracks and crevices are typically 1-5 meters in length and 0.5-1 meter in depth). NMFS does not expect the removal of encrusting organisms from selected cracks and crevices to result in significant adverse effects on these species or the biological community at the field sites. NMFS expects that removing these organisms would improve habitat quality for adult black abalone and enhance juvenile settlement habitat by creating more surface area for crustose coralline algae to grow.

Rescue, transport, captive holding, and release activities may stress, injure, or even kill the rescued black abalone, but NMFS expects that more abalone would die if they were not rescued. Researchers would implement best practices to minimize stress, injury, and mortality (NMFS 2015, 2021; Bell and Raimondi 2020). For example, only experienced personnel would conduct the proposed activities, and only those abalone that can be accessed and likely removed without injury would be rescued. Researchers would minimize transport times and maintain appropriate temperatures throughout transport. Captive holding conditions would mimic natural conditions as much as possible. Researchers would quarantine rescued black abalone in separate systems from other abalone that may be held at the captive facilities, to minimize the spread of disease or parasites between abalone (including any endangered white abalone, *Haliotis sorenseni*, held at

the facilities). Rescued abalone would be released into pre-selected cracks and crevices that provide good quality habitat and protection.

Spawning activities may cause stress to individual black abalone. To minimize that stress, researchers would use well-established methods (Kawana and Aquilino 2020) to conduct spawning studies. Potential modifications (e.g., increased desiccation periods, exposure to elevated temperatures, simulated seasonal tidal cycles) would be within the range of conditions that black abalone experience in the wild. Hormone injections have been tested on black abalone and found to cause minimal stress (SWFSC 2021). Researchers would monitor the abalone for signs of stress during the spawning studies. If spawning is successful, some level of natural mortality is expected from larval development through the early post-settlement life stages. In addition, some or all of the captive-bred progeny may die following outplanting. To improve survival of the outplanted abalone, researchers would (a) select sites with good juvenile habitat features (e.g., crustose coralline algae, complex cracks and crevices), (b) outplant larvae into enclosed areas to promote local recruitment, and (c) outplant post-settlement juveniles in ARMs to provide shelter. Any survival of outplanted black abalone would be considered a benefit to the species' recovery, because it would increase the abundance and reproductive potential of the wild population.

The release of rescued black abalone and of captive-bred juvenile black abalone to the field sites would increase the number of black abalone at the sites and therefore has the potential to affect any resident black abalone already at the site (as well as the fish, invertebrate, and algal communities at the sites). Potential effects on resident black abalone include the spread of diseases and increased competition for food and space. To minimize the spread of disease, researchers would assess the health of the rescued black abalone before releasing them. NMFS expects that all black abalone in the wild are already infected with the pathogen that causes withering syndrome because that pathogen is found throughout the species' range (Moore et al. 2002; Friedman and Finley 2003) (pers. comm. with Jim Moore, CDFW, 20 November 2015; pers. comm. with Jim Moore, CDFW, cited in VanBlaricom et al. 2009). Researchers would also wash all gear and equipment with fresh water between sites to minimize the spread of pathogens and non-native species.

To minimize competition for food and space, researchers would assess the availability of resources within each relocation and outplant site and adjust the number of black abalone to be released to achieve appropriate densities. Regarding effects on the overall biological community, NMFS expects increased abalone populations to promote diversity and resilience in rocky intertidal communities. For example, the grazing activity of black abalone appears to create space for growth of crustose coralline algae and diverse algal communities that are critical for the settlement, growth, and survival of abalone and other invertebrate species while at the same time limiting overgrowth of fouling organisms (Miner et al. 2006; VanBlaricom et al. 2009). Overall, NMFS expects the release of rescued and captive-bred black abalone to contribute to the recovery of black abalone and to promote the diversity and resilience of biological communities within the relocation and outplanting sites. NMFS does not expect significant adverse effects on the biological environment.

Post-release monitoring would include counting and measuring individual abalone and collecting genetic samples. Researchers would use well-established protocols and would not remove the abalone from the substrate (Engle 2008). Measuring shell length involves touching the shell and may result in minor, temporary stress to individual abalone. Researchers would avoid touching the soft tissue and minimize contact with the abalone. Collecting genetic samples involves swabbing the shell or soft tissue or clipping a small piece of epipodium. Abalone may experience minor, temporary stress and minor injuries. Overall, NMFS expects the proposed monitoring activities to result in minor, temporary stress and minor injuries to individual abalone. NMFS does not expect the proposed monitoring activities to have any significant adverse effects on black abalone or their critical habitat.

As part of rescue and post-release monitoring, researchers propose to collect empty black abalone shells and dead/obviously unhealthy black abalone from the rescue, relocation, and outplanting sites. Removal of empty shells would not affect the biological environment because the abalone are already dead. The shells would be used for further analysis, such as to confirm the death of released abalone and to evaluate the growth of individual abalone. Removal of dead or obviously unhealthy black abalone would reduce the number of black abalone in the wild but may also benefit the wild population by removing potentially diseased animals from the sites. Researchers would only collect abalone that are determined to be dead or obviously unhealthy and likely to die within a few days regardless of whether they are collected. The collected abalone would be made available for analysis at labs to determine the cause of death. This analysis would contribute to our understanding of the health of the individuals and their populations. NMFS does not expect the collection of empty shells and dead or obviously unhealthy black abalone to result in significant adverse impacts on the biological environment.

Marine mammals may be present in or adjacent to the rocky intertidal sites where activities will be conducted. Marine mammals observed at the sites include Pacific harbor seals, California sea lions, and Northern elephant seals. Researchers would minimize disturbance to marine mammals by approaching the sites quietly and cautiously and avoiding surveys during pupping seasons. Researchers have obtained or will obtain the appropriate MMPA authorizations.

5.0 Persons and Agencies Consulted

Karah Ammann, Research Specialist, UCSC

Nathaniel Fletcher, Research Specialist, UCSC

Pete Raimondi, Professor, UCSC

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