Endangered Species Act
Critical Habitat Information Report: Basis and Impact Considerations of Critical Habitat Designations for Threatened Indo-Pacific Corals

Acropora globiceps

Acropora jacquelineae

Acropora retusa

Acropora speciosa

Euphyllia paradivisa

Isopora crateriformis

Seriatopora aculeata

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1.0 INTRODUCTION

Critical habitat is defined in section 3 of the Endangered Species Act (ESA or Act) (16 U.S.C. 1532(3)) as: (1) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the ESA, on which are found those physical or biological features (a) essential to the conservation of the species and (b) that may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by a species at the time it is listed upon a determination that such areas are essential for the conservation of the species. ''Conservation'' is defined in the ESA as the use of all methods and procedures which are necessary to bring any endangered or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with science-based resource management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

In addition to the determination of physical and biological features essential for the conservation of the listed species, the ESA requires several additional analyses to inform the delineation of critical habitat. Section 4(a)(3)(B) of the ESA prohibits designating as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense or designated for its use that are subject to an integrated natural resources management plan (INRMP), if we determine that such a plan provides a benefit to the species. Section 4(b)(2) of the ESA requires the Secretary to take into consideration the economic impact, impact on national security, and any other relevant impacts of critical habitat designation of any particular area. Additionally, the Secretary has the discretion to exclude any area from designation if he determines the benefits of exclusion outweigh the benefits of designation, based on the best available scientific and commercial data. The sections below in this report will first summarize the biology of the listed corals, then describe the physical and biological features essential to their conservation and where they exist, and finally summarize the information we have gathered to inform our analyses under Sections 4(a)(3) and 4(b)(2) of the ESA to determine if any areas are ineligible or should be excluded from designation.

In the final rule listing 20 coral species as threatened under the ESA (79 FR 53851; September 10, 2014), we did not concurrently propose critical habitat but stated that we would continue to gather information and perform the required analyses of the impacts of critical habitat designation for the listed species. This Information Report is part of that process and provides the basis for determining what areas are proposed for critical habitat for listed Indo-Pacific corals.

2.0 BACKGROUND

2.1 LISTING BACKGROUND

On September 10, 2014, we listed 15 Indo-Pacific coral species (*Acropora globiceps, Acropora jacquelineae, Acropora lokani, Acropora pharaonis, Acropora retusa, Acropora rudis, Acropora speciosa, Acropora tenella, Anacropora spinosa, Euphyllia paradivisa, Isopora crateriformis, Montipora australiensis, Pavona diffluens, Porites napopora, and Seriatopora aculeata*) as threatened under the ESA (79 FR 53851; September 10, 2014). Section 4(a)(3)(A) of the ESA requires that, to the extent prudent and determinable, critical habitat be designated concurrently with the listing of a species as endangered or threatened. Section 4(b)(6)(C)(ii) of the ESA provides for additional time to promulgate a critical habitat designation if such designation is not determinable at the time of final listing of a species. In the final rule listing 20 Caribbean and Indo-Pacific corals (79 FR 53852; September 10, 2014), we found the designation of critical habitat was not determinable "for any of the newly listed corals...due to the extremely complex biological and physical requirements of the species." We acknowledged gathering information during the status review and public comment period, but not having enough information to determine which habitat features were essential to the conservation of the corals and may require special management considerations or protection. At the time of listing, we announced that we would continue to gather and review ongoing studies on the habitat use and requirements of the newly listed corals to attempt to identify features within those habitats that are essential to the conservation of any of the listed corals and may require special management considerations or protection.

Through these efforts, we determined that designating critical habitat for seven of the listed Indo-Pacific corals (*A. globiceps*, *A. jacquelineae*, *A. retusa*, *A. speciosa*, *E. paradivisa*, *I. crateriformis*, and *S. aculeata*) is prudent and determinable. Based on the best available information, these seven listed species are the only ones that have been confirmed in U.S. waters. Three listed corals (*A. pharaonis*, *A. rudis*, and *P. diffluens*) are limited to the Indian Ocean and Red Sea. Colonies resembling *P. diffluens* in the Pacific Ocean are considered to be a different, currently undescribed species. Thus, these three Indian Ocean species are considered foreign species that do not occur within U.S. waters. As such, they will not be included in the rest of this document. Survey work documenting coral species in the U.S. Pacific region is limited and data are often not collected at the species level. While the remaining five listed species (*A. lokani*, *A. tenella*, *A. spinosa*, *M. australiensis*, and *P. napopora*) have not yet been confirmed in U.S. waters, it is possible that some of them may be documented in U.S.

waters in the future with the completion of more surveys that record data at the species level. However, we must use the best available information to make our determinations and the best available information currently indicates that these species have not been documented in U.S. waters. As such, they, too, are excluded from consideration for critical habitat designation at this time, although these species would still benefit from any designated critical habitat if they are confirmed in U.S. waters in the future.

There is a high level of difficulty associated with identifying many of the listed Indo-Pacific corals (Fenner 2015). This challenge coupled with the lack of much species-specific information for the listed species have both influenced our decision to take an ecosystem-based approach to implementing the tools of the ESA where possible, while still meeting species-specific mandates, to achieve conservation value for listed Indo-Pacific corals. Because of the interdependent nature of the biotic and abiotic factors that make up coral reef ecosystems, the conservation of listed coral species depends largely on the successful functioning of their commonly shared ecosystem. In other words, conservation and recovery of the listed coral species is dependent in many ways on the health of the coral ecosystems they occupy. We will be proposing critical habitat for the seven coral species through one rule that is based on the species-specific requirements of the ESA (simultaneously with a separate rule proposing critical habitat for the Caribbean corals that were also listed under the ESA in 2014). Of note is that our approach to critical habitat, while species-specific, will provide ecosystem level benefits for the habitats on which the listed species depend because they all require the same essential biological feature and the successful functioning of their ecosystem to survive. We provide information in this report that is species-specific where possible but also comprehensive for the coral reefs where these species occur when that information is applicable.

2.2 *NATURAL HISTORY/BIOLOGY*

This section summarizes life history and biological characteristics of listed Indo-Pacific corals to provide context for the determination of habitat features that are essential for the conservation of these species. In this section, we cover several topic areas including an introduction to reef-building corals, reproduction, settlement and growth, coral habitat types, and coral reef ecosystems. There is a variable amount of information available on the life history, reproductive biology, and ecology for each of the seven species that occur in U.S. waters, but for most of these species there is very little information. We provide specific information for each species where possible. In addition, we provide information on the biology and ecology of Indo-Pacific corals in general, highlighting traits that these seven listed species share with each other, along with many of the other listed and un-listed species with which they co-occur in Indo-Pacific coral reef habitats. The information below is largely summarized from the final listing rule so more detail can be found there (79 FR 53851; September 10, 2014).

Reef-building corals are marine invertebrates in the phylum Cnidaria that occur as polyps. The Cnidaria include true stony corals (class Anthozoa, order Scleractinia), the blue coral (class Anthozoa, order Helioporacea), and fire corals (class Hydrozoa, order Milleporina). These species secrete massive calcium carbonate skeletons that form the physical structure of coral reefs. Reef-building coral species collectively produce coral reefs over time in high-growth conditions, but these species also occur in non-reef habitats. That is, they are reef-building, but not reef-dependent. About 90 percent of the world's approximately 800 reef-building coral species occur in the Indo-Pacific (79 FR 53852; September 10, 2014, p. 99). These unique animals contain symbiotic algae within their cells, they produce clones of themselves by different means, and most of them occur as colonies of polyps. Polyps are the building blocks of colonies, and colony growth occurs both by increasing the number of polyps, as well as extending the supporting skeleton under each polyp.

Reef-building corals are able to grow and thrive in the characteristically nutrient-poor environments of tropical and subtropical regions due to their ability to form mutually beneficial symbioses with unicellular photosynthetic algae living within the host coral's tissues (zooxanthellae) belonging to the dinoflagellate genus *Symbiodinium*. Zooxanthellae translocate fixed organic carbon and other nutrients to their host in return for inorganic waste metabolites from host respiration and protection from grazing. This exchange of nutrients allows both partners to flourish and helps the coral secrete calcium carbonate that forms the skeletal structure of the coral colony, which in turn contributes to the formation of the reef. Thus, reef-building corals are also known as zooxanthellate corals. Some corals do not contain zooxanthellae, and these species form much smaller skeletons, and therefore are not considered reef-building. The seven ESA-listed Indo-Pacific corals included in this report are zooxanthellate species, and thus reef-building, because they contain symbiotic algae in their cells, enabling them to grow large skeletons that contribute to the physical structure of coral reefs.

Coral polyps can occur as a free-living, solitary polyp (e.g., fungiids) or as a colony of polyps, depending on the species. Most reef-building coral species are colonial, producing colonies made up of dozens to thousands of polyps that are connected seamlessly through tissue and skeleton. In a colonial species, a single larva will develop into a discrete unit (the primary polyp) that then produces modular units of itself (i.e., genetically identical copies of the primary polyp, otherwise known as clones). Each polyp consists of a column with mouth and tentacles on the upper side growing on top of a calcium carbonate skeleton, which the polyps produce through the process of calcification. Colony growth is achieved mainly through the addition of more cloned polyps, and colony growth is indeterminate (i.e., maximum size not finite). The colony can continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged (79 FR 53852; September 10, 2014, p. 100). The seven listed Indo-Pacific corals are all colonial species, although polyp size, colony size, and colony morphology vary considerably by species and also based on environmental variables in different habitats. Colonies themselves can produce clones, most commonly through fragmentation or budding (described in more detail below). Clones can also be produced in some species by asexual larvae or polyp bail-out (a rare case when an individual polyp breaks away from the colony due to poor environmental conditions and re-settles elsewhere). The seven listed Indo-Pacific corals are all clonal species, both as colonies of cloned polyps, and with the ability to produce clones of individual colonies. The way they produce colony-level clones varies by species (e.g., branching species are much more likely to produce clones via fragmentation than encrusting species).

Corals use a number of diverse reproductive strategies that have been researched extensively; however, many individual species' reproductive modes remain poorly described. Most coral species use both sexual and asexual propagation. Sexual reproduction in corals is primarily through gametogenesis (i.e., development of eggs and sperm within the polyps). Some coral species have separate sexes (gonochoric), while others are hermaphroditic. Strategies for fertilization are either by "brooding" or "broadcast spawning" (i.e., internal or external fertilization, respectively). Asexual reproduction in coral species most commonly involves fragmentation, where colony pieces or fragments are dislodged from larger colonies to establish new colonies, although the budding of new polyps within a colony can also be considered asexual reproduction. In many species of branching corals, fragmentation is a common and sometimes dominant means of propagation (79 FR 53852; September 10, 2014).

Of the seven listed Indo-Pacific species, *Acropora retusa*, *A. globiceps*, and *A. jacquelineae* are all hermaphroditic spawners. The reproductive characteristics of *A. speciosa* have not yet been determined, but most other *Acropora* species are also hermaphroditic spawners. *Euphyllia paradivisa*'s reproductive mode is unknown and other *Euphyllia* species exhibit a variety of reproductive characteristics, so it is unclear which is most probable for the species. The reproductive characteristics of *Isopora* *crateriformis* and *Seriatopora aculeata* have also not been determined, but other similar species of both *Isopora* and *Seriatopora* are simultaneous hermaphroditic brooders. As for skeletal growth rates, there is no species-specific information available for the listed corals, but branching *Acropora* species such as the four listed *Acropora* species are typically relatively fast-growing (79 FR 53852; September 10, 2014).

Coral larvae presumably experience considerable mortality (up to 90 percent or more) from predation or other factors prior to settlement and metamorphosis. Such mortality cannot be directly observed, but is inferred from the large amount of eggs and sperm spawned versus the much smaller number of recruits observed later. Little is known concerning the settlement patterns of planula of the listed Indo-Pacific corals. In general, upon proper stimulation, coral larvae, whether released from parental colonies or developed in the water column external to the parental colonies (like *Acropora* spp.), settle and metamorphose on appropriate substrates. Biological and physical factors that have been shown to affect spatial and temporal patterns of coral recruitment include substrate availability and community structure, grazing pressure, fecundity, mode and timing of reproduction, behavior of larvae, hurricane disturbance, physical oceanography, the structure of established coral assemblages, and chemical cues. Like most corals, the listed Indo-Pacific corals require hard, consolidated substrate, including attached, dead coral skeleton, for their larvae to settle. Once larvae are able to settle onto appropriate hard substrate, metabolic energy is diverted to colony growth and maintenance. A low nutrient environment is less conducive to algal growth which would otherwise limit the amount of hard substrate available for coral settlement.

Polyps are the building blocks of colonies, and colony growth occurs both by increasing the number of polyps, as well as extending the supporting skeleton under each polyp. Reef-building corals combine calcium and carbonate ions derived from seawater into crystals that form their skeletons. Skeletal expansion rates vary greatly by taxa, morphology, location, habitat and other factors. For example, in general, branching species (e.g., most *Acropora* species) have much higher skeletal extension rates than massive species (e.g., massive *Porites* species). The energy required to produce new polyps and build calcium carbonate skeleton is provided by the symbiotic relationship corals have with photosynthetic zooxanthellae. As such, corals need light for their zooxanthellae to photosynthesize and provide the coral with food, and thus require low turbidity for energy, growth and survival. Lower water clarity sharply reduces photosynthesis in zooxanthellae with moderate reductions in adult colony survival and calcification. The skeletons of coral colonies are bound together by cementation, resulting in the formation of coral reefs.

Species with high recruitment rates or fast growth rates may have the ability to more quickly recover from disturbances. Additionally, long-lived species with large colony size can sustain partial mortality (fission) and still have potential for persistence and regrowth (79 FR 53852; September 10, 2014). Some additional information on the biological requirements for reproduction, settlement, and growth is provided in the Physical and Biological Feature section below.

Reef-building corals, including the seven listed Indo-Pacific species, have specific habitat requirements including hard substrate, narrow mean temperature range, adequate light, adequate water flow, among others. These habitat requirements most commonly occur on the shallow tropical and subtropical coral reefs described above, but also occur in non-reef and mesophotic areas. Each of these habitat types is described below in more detail.

Shallow coral reefs are fragile ecosystems that exist in a narrow band of environmental conditions that allow the skeletons of reef-building coral species to grow quickly enough for reef accretion to outpace reef erosion. High-growth conditions for reef-building corals include clear, warm waters with abundant light, and low levels of nutrients, sediments, and freshwater. The three broad categories of coral reefs are fringing reefs, barrier reefs, and atolls. Fringing reefs are mostly close to coastlines, and usually have a high component of non-carbonate sediment. Barrier reefs are offshore and are composed of wave-resistant consolidated limestone. Atolls are usually a wall of reefs partially or completely enclosing a central lagoon. There are not sharp differences that clearly mark boundaries between reef types. For example, fringing reefs gradually become barrier reefs with increasing distance from shore. Also, the shape of both barrier reefs and atolls is largely determined by the bathymetry of the substratum, producing many irregularly shaped reefs that are intermediary between the two types. Isolated reefs that do not fit any of these descriptions are referred to as platform reefs. Despite the differences between the reef categories, most fringing reefs, barrier reefs, atolls, and platform reefs consist of a reef slope, a reef crest, and a back-reef, which in turn are typically characterized by distinctive habitats (79 FR 53852; September 10, 2014).

The characteristics of coral reef habitat vary greatly by reef categories, locations, latitudes, frequency of disturbance, *etc.,* and there is also much variability within each habitat type. Temporal variability in coral habitat conditions is also very high, both cyclically (*e.g.,* from tidal, seasonal, annual, and decadal cycles) and episodically (*e.g.,* storms, temperature anomalies, *etc.*). Together all these factors contribute to the habitat heterogeneity of coral reefs across the Indo-Pacific, as described in more detail in the final listing rule (79 FR 53852; September 10, 2014).

As described above, reef-building corals are not dependent on coral reefs, and many of these species can thrive in low-growth conditions where skeletal growth is inadequate to result in accretion of coral reefs. "Non-reef habitat" refers to hard substrates where reef-building corals can grow, including marginal habitats where conditions prevent reef development (e.g., turbid or high-latitude or upwelling-influenced areas) and recently available habitat (e.g., lava flows). All the listed species can occur in both shallow coral reef and non-reef habitats, provided that hard substrate and suitable water quality are present (79 FR 53852; September 10, 2014).

The term "mesophotic habitat" refers to hard substrates deeper than 30 m. Shallow coral reefs, non-reef habitats, and mesophotic habitats are not necessarily sharply delineated from one another, thus one may gradually blend into another. The total area of non-reef and mesophotic habitats is likely greater than the total area of shallow coral reef habitats within the ranges of the listed corals (79 FR 53852; September 10, 2014). Despite the large amount of variability in habitats occupied by corals, they have several characteristics in common that provide the fundamental support necessary for coral settlement and growth, including hard substrate and low-nutrient, clear water with good light penetration.

The seven listed Indo-Pacific species within U.S. waters vary in their recorded depth ranges and habitat types. *Acropora globiceps* occurs on upper reef slopes, reef flats, and adjacent habitats. In the final listing rule, the best available information indicated this species occurs in depths ranging from 0 to 8 meters (m). Since then, we have received new information indicating *A. globiceps* occurs deeper than 8 m, as explained below. *Acropora jacquelineae* is found in numerous subtidal reef slope and back-reef habitats, including but not limited to, lower reef slopes, walls and ledges, mid-slopes, and upper reef slopes protected from wave action, and its depth range is 10 to 35 m. *Acropora retusa* occurs in shallow reef slope and back-reef areas, such as upper reef slopes, reef flats, and shallow lagoons. In the final listing rule, the best available information indicated its depth range to be 0 to 5 m. Since then, we have received new information indicating *A. retusa* occurs deeper than 5 m, as explained below. *Acropora speciosa* occurs on lower reef slopes and walls, especially those characterized by clear water and high *Acropora* diversity, in a depth range of 12 to 40 m. *Euphyllia paradivisa* is found in environments protected from wave action on at least upper reef slopes, mid-slope terraces, and lagoons at a depth range of 2 to 25 m. *Isopora crateriformis*'s predominant habitat is shallow, high-wave energy environments, including reef flats and reef crests, and it also occurs in adjacent habitats such as upper reef slopes. It has a depth distribution of 0 to 12 m, and has been reported as common at 5 to 10 meters. *Seriatopora aculeata* occurs in a broad range of habitats on the reef slope and back reef, including but not limited to upper reef slopes, mid-slope terraces, lower reef slopes, reef flats, and lagoons in a depth range of 3 to 40 m (79 FR 53852, September 10, 2014; Fenner, pers. comm. 2015).

The final listing rule is considered the best available information on each of the seven listed species' depth distributions, unless new, reliable information has become available since the publication of the final rule 2014. In 2015, we learned that *A. globiceps* had been observed in American Samoa at 11 m (Asili, Tutuila), 18 m (National Park of American Samoa, Tutuila), and 25 m (South Bank). Likewise, we learned that *A. retusa* has been observed in American Samoa at 10 m (Asili, Tutuila; Fenner, pers. comm. 2015). In addition, a survey conducted at Tinian and Rota Islands in CNMI in June 2016 found 157 *A. globiceps* colonies at depths ranging from 0 to 12 m, with peak abundance at 5-6 m (Fenner, pers. comm. 2016). Based on the above new information, we consider the rangewide depth distributions of *A. globiceps* and *A. retusa* to be 0 to 20 m and 0 to 10 m, respectively. In addition, several colonies of *Euphyllia paradivisa* have been reported at 40 m from Tutuila (Fenner, pers. comm., 2016). Thus, based on the best currently available information, we consider the rangewide depth distributions of the seven listed species as follows: *A. globiceps*, 0 to 20 m; *A. jacquelineae*, 10 to 35 m; *A. retusa*, 0 to 10 m; *A. speciosa*, 12 to 40 m; *Euphyllia paradivisa*, 2 to 40 m; *Isopora crateriformis*, 0 to 12 m; and *Seriatopora aculeata*, 3 to 40 m.

Species identification of many Indo-Pacific reef-building corals is challenging, even for experts working in the field for decades. There are a multitude of reasons for this, including poor quality type specimens, lack of samples to verify photos, inter-specific and intra-specific morphological plasticity and variability, inherent human subjectivity, and unreliable published information. For the seven listed species considered here, current species identification uncertainty is rated as moderate or high for six species (i.e., all but *Euphyllia paradivisa*). In addition, because traditional coral identification is based on colony morphological characteristics, and recent genetics results often contradict morphological identifications, species identification uncertainty is predicted to increase for most of these species (Fenner 2015).

3.0 *Critical Habitat Identification and Designation*

Critical habitat represents the habitat essential for the species' recovery and provides for the conservation of listed species in several ways (81 FR 7413; February 11, 2016). Specifying the geographic location of critical habitat facilitates implementation of section 7(a)(1) of the ESA (16 U.S.C. § 1536(a)(1)) by identifying areas where Federal agencies may focus their conservation programs and use their authorities to further the purposes of the ESA. Designating critical habitat also provides a significant regulatory protection by ensuring that the Federal government considers the effects of its actions in accordance with section 7(a)(2) of the ESA (§ 1536(a)(2)) and avoids or mitigates those actions that are likely to destroy or adversely modify critical habitat. This requirement is in addition to the section 7 requirement that Federal agencies ensure that their actions are not likely to jeopardize the continued existence of ESA-listed species. Critical habitat requirements do not apply to citizens engaged in activities on private land that do not involve a Federal action or nexus (such as Federal permitting or funding). However, designating critical habitat can help focus the efforts of other conservation partners (*e.g.*, State and local governments, individuals, and nongovernmental organizations).

Section 3(5)(A) of the ESA (16 U.S.C. §1532) defines critical habitat as (i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of the ESA, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protections; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the ESA, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 U.S.C. § 1532(5)(A)). Conservation is defined in section 3 of the ESA as "to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary" (16 U.S.C. 1532(3)). Therefore, critical habitat is the habitat essential for the species' recovery. However, section 3(5)(C) of the ESA clarifies that, except in those circumstances determined by the Secretary, critical habitat shall not include the entire geographical area which can be occupied by the threatened or endangered species.

To identify and designate critical habitat, we considered information on the distribution of the seven threatened Indo-Pacific corals, their major life stages, habitat requirements of those life stages, and conservation objectives that can be supported by identifiable physical or biological features. Our step-wise approach for identifying potential critical habitat areas for the threatened corals was to determine the following: (1) the geographical areas occupied by the listed corals at the time of listing; (2) the physical or biological features essential to the conservation of the corals; (3) whether the physical or biological features within these specific areas may require special management considerations or protection; (4) the specific areas of the occupied geographical area where the essential features occur; and (5) whether any unoccupied areas are essential to the conservation of any of the corals.. Each of these steps are described in the five sub-sections below.

3.1 GEOGRAPHIC AREAS OCCUPIED BY THE SPECIES

"Geographical areas occupied by the species at the time of listing" in the definition of critical habitat is interpreted to mean the entire range of the species at the time it was listed and not every discrete location on which individuals of the species are physically located (50 CFR 424.02). The seven listed species being considered for critical habitat have ranges of variable sizes throughout the Indo-Pacific. The most restricted of the seven species relative to the others is *A. jaquelineae*, which is limited primarily to the Coral Triangle area in the western Pacific. The most broadly ranging of the seven species are *A. retusa*, ranging from the east coast of Africa through most of the coral triangle and as far east as French Polynesia, and *A. globiceps* ranging from parts of the Eastern Indian Ocean to French Polynesia. The remaining species have intermediate ranges that all overlap to some degree, primarily in the Coral Triangle area. More detailed information on the ranges of listed corals is available on our website https://www.fisheries.noaa.gov/corals.

Our regulations at 50 CFR 424.12(h) state: ''Critical habitat shall not be designated within foreign countries or in other areas outside of United States jurisdiction.'' As noted above, seven of the listed species have been confirmed within U.S. waters thus far, and thus these seven are currently being considered for critical habitat designation. We first identified the U.S. jurisdictional areas where observations of listed coral species have been confirmed. In summary, six listed species are confirmed in American Samoa (*Acropora globiceps, Acropora jacquelineae, Acropora speciosa, Acropora retusa, Isopora crateriformis*, and *Euphyllia paradivisa*), three listed species are confirmed in Guam and CNMI (*Acropora globiceps, Acropora retusa*, and *Seriatopora aculeata*), and three listed species are confirmed in the PRIA (*Acropora globiceps*, *Acropora retusa*, and *Acropora speciosa*). We further broke down the areas under consideration for critical habitat designation into 19 units based on the confirmed location information for each species, most containing individual islands or atolls and nearby shoals or banks, in order to better describe the geographic areas occupied by each species. Table 1 summarizes the occupied and unoccupied units for each of the seven species.

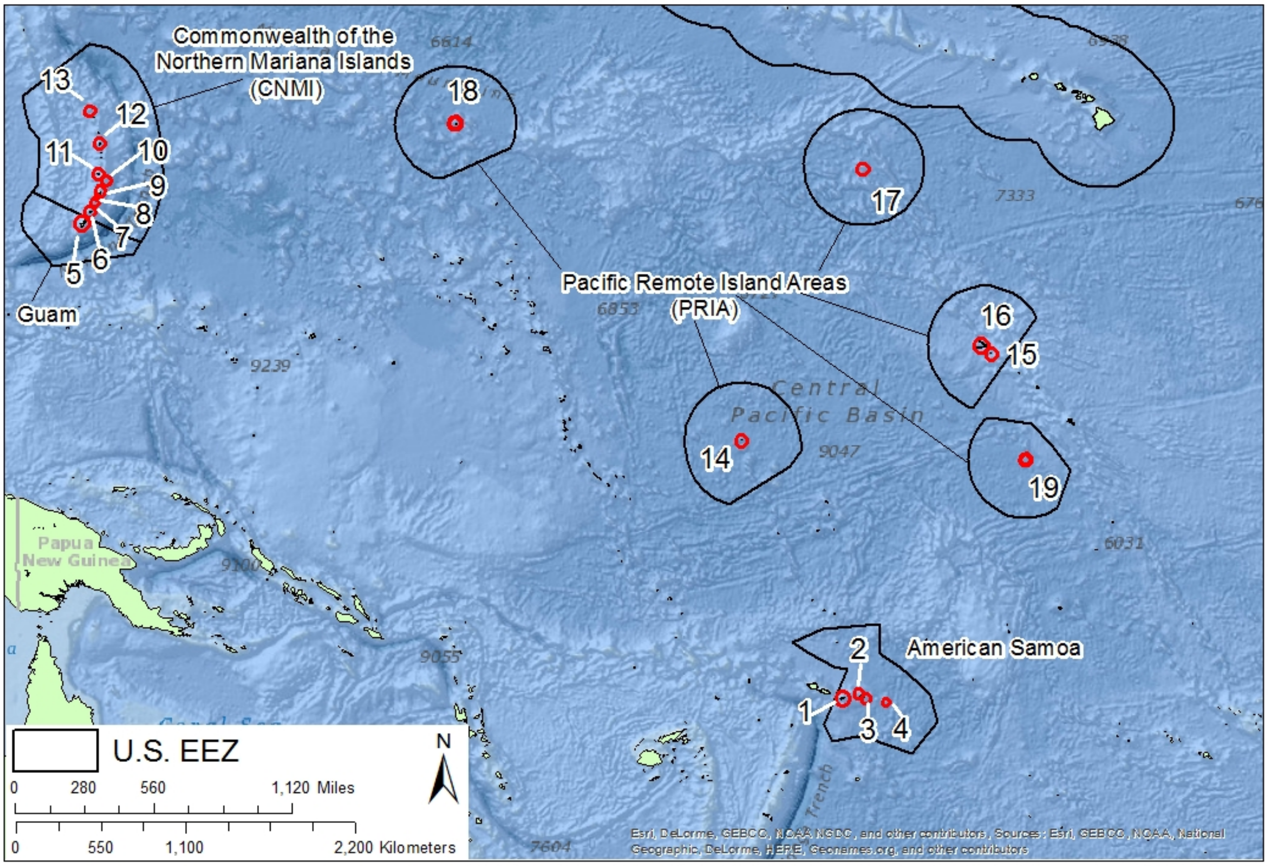
American Samoa, CNMI, and PRIA each include islands where no listed species have been confirmed (e.g., Swains Island in American Samoa, several islands in northern CNMI, Baker Island in PRIA). We did not include these locations in the areas considered for proposed critical habitat because it is unknown if these locations are within the ranges of any listed corals or not.

Table 1. Confirmed geographic and depth distributions of ESA-listed coral species in U.S. Pacific Island jurisdictions and potential critical habitat units.

Jurisdiction	**Am Samoa**				**Mariana Islands (Guam and CNMI)**									**Pacific Remote Island Area**					
Unit[1]	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
A. globiceps (0-20 m)	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	
A. jacquelineae (10-35 m)	X																		
A. retusa (0-10 m)	X	X	X	X	X			X						X		X	X	X	X
A. speciosa (12-40 m)	X															X			
E. paradivisa (2-40 m)	X																		
I. crateriformis (0-12 m)	X	X	X																
S. aculeata (3-40 m)					X				X										
Depths of all listed spp.[2]	a	b	b	b	a	b	b	b	a	b	b	b	b	c	b	a	c	b	c

[1]Unit Key: (1) Tutuila & Offshore Banks; (2) Ofu & Olosega; (3) Ta'u; (4) Rose Atoll; (5) Guam & Offshore Banks; (6) Rota; (7) Aguijian; (8) Tinian and Tatsumi Reef; (9) Saipan and Garapan Bank; (10) Farallon de Medinilla; (11) Anatahan; (12) Pagan; (13) Maug Islands & Supply Reef; (14) Howland Island; (15) Palmyra Atoll; (16) Kingman Reef; (17) Johnston Atoll; (18) Wake Atoll; and (19) Jarvis Island.
[2]Depth Key: (a) 0-40 m; (b) 0-20 m; (c) 0-10 m.

Figure 1. The 19 units considered for coral critical habitat.



Indo-Pacific Threatened Coral Critical Habitat Units: 1. Tutuila & Offshore Banks; 2. Ofu & Olosega; 3. Ta'u; 4. Rose Atoll; 5. Guam & Offshore Banks; 6. Rota; 7. Aguijian; 8. Tinian and Tatsumi Reef; 9. Saipan and Garapan Bank; 10. Farallon de Medinilla; 11. Anatahan; 12. Pagan; 13. Maug Islands & Supply Reef; 14. Howland Island; 15. Palmyra Atoll; 16. Kingman Reef; 17. Johnston Atoll; 18. Wake Atoll; 19. Jarvis Island

Although the geographical area occupied by the listed Indo-Pacific corals includes coastal waters of many Indo-Pacific nations, we are not considering these areas for designation. The geographical area collectively occupied by listed coral species which is within the jurisdiction of the United States is therefore limited to the nearshore waters of the 19 specific areas identified in Guam, CNMI, American Samoa, and the PRIA (Table 1, Figure 1). Species-specific information on the geographical areas within U.S. waters occupied by each of the seven Indo-Pacific listed coral species occurring in the U.S. is provided below.

Acropora globiceps occurs on upper reef slopes, reef flats, and adjacent habitats (79 FR 53852; September 10, 2014). *Acropora globiceps* has been found on Tutuila (Brainard et al. 2011), Aunu'u, and South Bank in multiple habitats between 2005 and 2011, including backreef pools, reef flats, upper reef slopes, and offshore banks: (1) In backreef pools at Fagaitua and Utulei, it was found at 29 percent of surveyed sites; (2) on reef flats at Fagamalo, Fagasa, Alofau, Amaua, and Utulei, it was found at 20 percent of surveyed sites; and (3) on reef slopes at many sites around

Tutuila, and also at Aunu'u, in roving search dives done from the bottom to the top of reef slopes outside of Pago Pago Harbor, it was found at 76 percent of the surveyed sites, and 29 percent of the surveyed sites within the harbor; and (4) on offshore banks at Taema, Nafanua, and South Banks, it was found at 100 percent of surveyed sites (Fenner, pers. comm., 2016). Fenner (pers. comm., 2016) also reports finding *A. globiceps* on reef flats and back-reef pools on both Ofu and Olosega, at Ta`u, and at Rose Atoll. Carden Wallace's 1999 book Staghorn Corals of the World lists a specimen of *A. globiceps* from Guam in the North Queensland Museum collection (Doug Fenner, pers. comm., 2015). David Burdick (pers. comm., 2015) reports that he has found *Acropora globiceps* at 22 reef slope sites in Guam. In the Marianas, Peter Houk (pers. comm., 2015) and Maynard et al. (2015) both report finding *A. globiceps* at Rota, Tinian, and Saipan. Maynard et al. (2015) adds additional findings at Aguijan, while Peter Houk (pers. comm., 2015) also reports *A. globiceps* from Anatahan, Pagan, and Maug's reef slopes. Surveys conducted at Farallon de Medinilla in 2017 reported a single colony of *A. globiceps*, and several others that potentially may have been the species (Carilli et al. 2017). In the PRIA, Williams *et al.* (2008) and Kenyon et al. (2011) report *A. globiceps* on Palmyra Atoll, while Kenyon et al. (2011) and Fenner (pers. comm.) report it from Kingman Reef and Wake Atoll, respectively. The general species identification uncertainty described in the Biology/Life History section above is particularly acute for *A. globiceps*. For example, this species has been identified differently by experts working in the Mariana Islands, demonstrating both the need for species identification standardization and the likelihood that distribution data for this species will change in the future.

Acropora jacquelineae occurs in numerous subtidal reef slope and back-reef habitats, including but not limited to, lower reef slopes, walls and ledges, midslopes, and upper reef slopes protected from wave action (79 FR 53852; September 10, 2014). *Acropora jacquelineae* has been found at Faga'alu, Tutuila, on the lower reef slope (Fenner, pers. comm.). It is only confirmed at this site on Tutuila, and has not been recorded in any monitoring surveys elsewhere around Tutuila, including roving searches.

Acropora retusa's habitat includes shallow reef slopes and back-reef areas, such as upper reef slopes, reef flats, shallow lagoons (79 FR 53852; September 10, 2014, p. 171). *Acropora retusa* has been found on Tutuila (Brainard et al. 2011), including at Fagasa Bay, Fagafue Bay, Gataivai, Aoa and Asili on upper reef slopes. (Fenner, pers. comm., 2015). Doug Fenner (pers. comm., 2015) and Charles Birkeland (pers. comm., 2015) both report finding *A. retusa* on upper reef slopes of Ofu Island. Fenner (pers. comm., 2015) reports finding *A. retusa* on upper reef slopes on Ta'u Island, and Kenyon et al. (2010, 2011) report finding *A. retusa* on Rose Atoll. David

Burdick (pers. comm., 2015) reports finding *A. retusa* at one reef slope site in Guam. The Joint Region Marianas Integrated Natural Resources Management Plan (JRM INRMP) (DoN 2019a) reports *A. retusa* from Guam. In the PRIA, Kenyon et al. (2011) reports *A. retusa* from Kingman Reef, Howland Island, and Johnston Island, while Fenner (pers. comm., 2016) and Vargas-Angel (pers. comm., 2016) report it from Wake Atoll and Jarvis Islands, respectively.

Acropora speciosa occurs on lower reef slopes and walls, especially those characterized by clear water and high *Acropora* diversity on steep slopes. Fenner (2014) reports *A. speciosa* from several sites on the south side of Tutuila, based on photographs and samples. The species has been found during one-hour biodiversity searches on the deep slopes of Tutuila at Amaua, Faga'alu, Coconut Point, Fagatele, and Leone. It was also found at Onososopo in the harbor (Fenner, pers. comm., 2015). NMFS (2012) indicates that *A. speciosa* has also been confirmed from Tutuila by J. Maragos. Kenyon et al. (2011) report *A. speciosa* from Kingman Reef.

Euphyllia paradivisa occurs in environments protected from wave action on at least upper reef slopes, mid-slope terraces, and lagoons (79 FR 53852; September 10, 2014, p. 264). Fenner (2014) reported *E. paradivisa* (supported by photographs), from Vatia Bay, Tutuila, at about 25 m deep protected from wave action, in horizontal fine sediment below the reef. Sediment covers the floor of most of the bay, and only a small proportion of it has been searched for this species; there may or may not be more colonies. In addition, several colonies of *Euphyllia paradivisa* have been reported from approximately 40 m on Tutuila (Fenner, pers. comm., 2016).

Isopora crateriformis's predominant habitat is reef flats and lower reef crests, and it also occurs in adjacent habitats such us upper reef slopes. *Isopora crateriformis* is reported from many locations around Tutuila, including Aunu'u (Birkeland et al, 1987; Mundy 1996; Kenyon et al, 2010, 2011), and is one of the most common species on upper reef slopes of this unit (Fenner 2014). In southwest Tutuila, it is most common on upper reef slopes and less common on the reef flats and lower slopes. It has been confirmed at 12-13 m depth at Asili, Tutuila, and it was common there at 10 m depth. *Isopora crateriformis* is most common on the upper reef slope on the southwest portion of Tutuila, from Fagatele Bay west to the western end of the island, where it can be dominant (Fenner, pers. comm., 2015). Mundy (1996), Fisk and Birkeland (2002), and Fenner (pers. comm., 2015) have all reported *I. crateriformis* from multiple locations around Ofu and Olosega Islands, and multiple locations around Ta`u.

Seriatopora aculeata occurs in a broad range of habitats on the reef slope and back-reef, including but not limited to upper reef slopes, mid-slope terraces, lower reef slopes, reef flats, and lagoons (79 FR 53852; September 10, 2014, p. 130). David Burdick reports (pers. comm., 2015) that he has found *S. aculeata* at two sites in Guam, both north of Facpi Point. Peter Houk (pers. comm., 2015) reports finding *S. aculeata* on Saipan.

3.2 PHYSICAL OR BIOLOGICAL FEATURES ESSENTIAL FOR CONSERVATION

Within the geographical area occupied, critical habitat consists of specific areas on which are found those physical and biological features (PBFs) essential to the conservation of the species and that may require special management considerations or protection. PBFs essential to the conservation of the species are defined as the features that occur in specific areas and that are essential to support the life-history needs of the species, including water characteristics, soil type, geological features, sites, prey, vegetation, symbiotic species, or other features. A feature may be a single habitat characteristic, or a more complex combination of habitat characteristics. Features may include habitat characteristics that support ephemeral or dynamic habitat conditions. Features may also be expressed in terms relating to principles of conservation biology, such as patch size, distribution distances, and connectivity (50 CFR 424.02).

In the final listing rule, we determined that the seven corals were threatened under the ESA. This means that while the species are not in danger of extinction currently, they are likely to become so within the next several decades based on their current abundances and trends in abundance, distributions, and threats they experience now and in the future. The goal of an ESA listing is to first prevent extinction, and then to recover the species so they no longer meet the definition of a threatened species and no longer need the protections of the ESA. One of the first steps in recovery planning we conduct after listing a species is to identify a Recovery Vision, which describes what the state of full recovery "looks like" for the species. We have identified the following Recovery Vision for the 15 Indo-Pacific corals listed in 2014, including the seven species covered by this critical habitat rule: Populations of the 15 listed Indo-Pacific corals should be present throughout as much of their historical ranges as future environmental changes will allow, and may expand their ranges into new locations with more favorable habitat conditions in the future (https://www.fisheries.noaa.gov/resource/document/15-indo-pacific-coral-species-recovery-outline). Recovery of these species will require conservation of the coral reef ecosystem through threats abatement to ensure a high probability of survival into the future (NMFS, 2015). The key conservation objective that facilitates this Recovery Vision, and can be implemented through this critical habitat designation, is supporting successful reproduction and recruitment, and survival and growth of all life stages, by abating threats to the corals' habitats. In the final listing rule, we identified the major threats contributing to the seven corals' extinction risk: ocean warming, disease, ocean acidification, trophic effects of reef fishing, nutrient enrichment, and sedimentation. Five of the six major threats (*i.e.*, all but disease) impact corals in part by changing the corals' habitat, making it unsuitable for them to carry out the essential functions at all life stages. We identified contaminants as a threat in the final listing rule; however, they were rated as low in terms of contribution to the global extinction risk of corals. The field of research on the effects of contaminants on corals is relatively new and growing quickly. Therefore, the impact of contaminants may be significant, but we did not know how to rate them compared to the other major threats. Thus, we identify ocean warming, ocean acidification, trophic effects of reef fishing, nutrient enrichment, sedimentation, and contaminants as the threats to the seven corals' habitat that are impeding their recovery. Protecting essential features of the corals' habitat from these threats will facilitate the Recovery Vision.

We then turned to determining the physical or biological features essential to this conservation objective of supporting successful reproduction and recruitment, and survival and growth of all life stages. Specifically, we evaluated whether particular habitat features will facilitate recovery through enhancing population growth. Although there are many physical and biological features that characterize a coral reef habitat, we focus on a composite habitat feature that supports the conservation objective through its relevance to the major threats and threats impeding recovery: Reproductive, recruitment, growth, and maturation habitat. This essential feature is a complex combination of habitat characteristics that support normal functions of all life stages of the corals. Due to corals being sessile for almost their entire life cycle, they carry out most of their demographic functions in one location. Thus, we have identified sites with a combination of substrate and water column characteristics as the essential feature. Appropriate attachment substrate, in association with warm, aragonite-supersaturated, oligotrophic, clear marine water, is essential to reproduction and recruitment, survival, and growth of all life stages of all seven species of coral. The substrate can be impacted by ocean acidification, trophic effects of reef fishing, nutrient enrichment, and sedimentation, and the associated water column can be impacted by ocean warming, ocean acidification, nutrient enrichment, sedimentation, and contamination. Other features of coral reef habitats are not directly affected by the major threats to the seven corals and do not particularly limit satisfying the conservation objective for these seven corals.

Based on the best scientific information available we identify the following physical feature essential to the conservation of the seven corals. Our proposed definition for the essential feature is:

Reproductive, recruitment, growth, and maturation habitat. Sites that support the normal function of all life stages of threatened corals are natural, consolidated hard substrate or dead coral skeleton, which is free of algae or sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column. Several attributes of these sites determine the quality of the area and are useful in considering the conservation value of the associated feature:

(1) The presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or the presence of crustose coralline algae;

(2) Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae;

(3) Marine water with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support all demographic functions; and

(4) Marine water with levels of anthropogenically-introduced chemical contaminants that do not preclude or inhibit any demographic function.

3.2.1 SUBSTRATE COMPONENT

Reef-building corals require exposed natural consolidated hard substrate for the settlement and recruitment of larvae or asexual fragments. Substrate provides the physical surface and space necessary for settlement of coral larvae, a stable environment for metamorphosis of the larvae into the primary polyp, growth of juvenile and adult colonies, and re-attachment of fragments. Larvae can settle and attach to dead coral skeleton (Brainard et al., 2011). A number of attributes have been shown to influence coral larval settlement. Positive cues include the presence of crustose coralline algae (Heyward and Negri, 1999), biofilms (Webster et al., 2004), and cryptic habitat such as crevices and holes (Nozawa, 2008). Attributes that negatively affect settlement include presence of sediment and algae (Vermeij et al., 2009). Coral recruitment tends to be greater when macroalgal biomass is low (Birrell et al., 2005). In addition to preempting space for coral larvae settlement, many fleshy macroalgae produce substances that may inhibit larval settlement, recruitment, and survival (Jompa and McCook, 2003). Furthermore, algal turfs can trap sediments (Purcell and Bellwood, 2001), which then create the potential for algal turfs and sediments to act in combination to hinder coral settlement (Birrell et al., 2005).

Presence and amount of sediment is a particularly important determinant of the quality of substrate for reef-building coral habitat. Sediments enter the reef environment through many processes that are natural or anthropogenic in origin, including erosion of the coastline, resuspension of bottom sediments, terrestrial run-off, and nearshore dredging for coastal construction projects and navigation purposes. The rate of sedimentation affects reef distribution, community structure, growth rates, and coral recruitment (Dutra et al., 2006). Sediment accumulation on dead coral skeletons and exposed hard substrate reduces the amount of available substrate for coral larvae settlement and fragment reattachment (Rogers, 1990). Sediment impedes settlement of coral larvae (Babcock and Smith, 2002). The deeper the sediment, the longer it may take for natural waves and currents to remove the sediment from the settlement substrate. Sediment texture also affects the severity of impacts to corals and recruitment substrate. Fine grain sediments have greater negative effects to live coral tissue and to recruitment substrate (Erftemeijer et al., 2012). Accumulation of sediments is also a major cause of mortality in coral recruits (Fabricius et al., 2003). In some instances, if mortality of coral recruits does not occur under heavy sediment conditions, then settled coral planulae may undergo reverse metamorphosis and die in the water column (Te, 1992). Accumulation of sediment can smother living corals and cover dead coral skeleton and exposed hard substrate (Erftemeijer et al., 2012; Fabricius, 2005). Sedimentation, therefore, impacts the health and survivorship of all life stages of corals (i.e., adults, fragments, larvae, and recruits).

The literature provides several recommendations on maximum sediment levels for coral reefs (i.e., levels that managers should strive to stay under). De'ath and Fabricius (2008) and GBRMPA (2010) recommend that sediment levels on the GBR be less than a mean annual sedimentation rate of 3 $mg/cm^2/day$, and less than a daily maximum of 15 $mg/cm^2/day$. Rogers (1990) recommends that sediment levels on coral reefs globally be less than a mean maximum of 10 $mg/cm^2/day$ to maintain healthy corals, and also notes that moderate to severe effects on corals are generally expected at mean maximum sedimentation rates of 10 to 50 $mg/cm^2/day$, and severe to catastrophic effects at >50 $mg/cm^2/day$. Similarly, Erftemeijer et al. (2012) suggests that moderate to severe effects to corals are expected at mean maximum sediment levels of >10 $mg/cm^2/day$, and catastrophic effects at >50 $mg/cm^2/day$. Nelson et al. (2016) suggests that sediment depths of >0.5 cm result in substantial stress to most coral species, and that sediment depths of >1.0 cm are lethal to most coral species. The above generalizations are for coral reef communities and ecosystems, rather than individual species.

Sublethal effects of sediment to corals potentially occur at much lower levels than mortality. Sublethal effects include reduced growth, lower calcification rates and reduced productivity, bleaching, increased susceptibility to diseases, physical damage to coral tissue and reef structures (breaking, abrasion), and reduced regeneration from tissue damage (see reviews by Fabricius et al., 2005; Erftemeijer et al., 2012;

Browne et al., 2015; and Rogers, 1990). Erftemeijer et al. (2012) states that sublethal effects for coral species that are sensitive, intermediate, or tolerant to sediment (i.e., most reef-building coral species) occur at mean maximum sedimentation rates of between <10 and 200 $mg/cm^2/day$, depending on species, exposure duration, and other factors.

3.2.2 *WATER QUALITY COMPONENT*

The substrate characterized above must be associated with water that also supports all life functions of corals that are carried out at the site. Water quality conditions fluctuate greatly over various spatial and temporal scales in natural reef environments (Kleypas et al., 1999). However, certain levels of particular parameters must exist on average to provide the conditions conducive to coral growth, reproduction, and recruitment. Corals may tolerate and survive in conditions outside these levels, depending on the local conditions to which they have acclimatized and the intensity and duration of any deviations from conditions conducive to a particular coral's growth, reproduction and recruitment. Deviations from tolerance levels of certain parameters result in direct negative effects on all life stages. As described in this Draft Information Report, corals thrive in warm, clear, nutrient-poor marine waters with calcium carbonate concentrations that allow for symbiont photosynthesis, coral physiological processes and skeleton formation. This water must also have low to no levels of contaminants that would interfere with normal functions of all life stages. Water quality that supports normal functions of corals is adversely affected by ocean warming, ocean acidification, nutrient enrichment, sedimentation, and contamination.

3.2.2.1 *SEAWATER TEMPERATURE*

Seawater temperature is a particularly important limiting factor of coral habitat, and consequently ocean warming is one of the most important threats to reef-building corals. Corals occur in a wide temperature range across geographic locations (15.7°C–35.5°C weekly average and 21.7–29.6°C annual average; Guan et al., 2015), but only thrive in areas with mean temperatures in a narrow range (typically 25°C–29°C) as indicated by the global distribution of coral reefs (Brainard et al., 2011; Kleypas et al., 1999). Short-term exposures (days) to temperature increases of a few degrees (i.e., 3°C–4°C increase above mean maximum summer temperature) or long-term exposures (several weeks) to minor temperature increases (i.e., 1°C–2°C above mean maximum summer temperature) can cause significant thermal stress and mortality to most coral species (Berkelmans and Willis, 1999; Jokiel and Coles, 1990). In addition to coral bleaching, elevated seawater temperatures impair coral fertilization and settlement (Nozawa and Harrison, 2007) and cause increases in coral disease (Miller et al., 2009).

Effects of elevated seawater temperatures are well-studied for reef-building corals, and many approaches have been used to estimate temperature thresholds for coral bleaching and mortality (see reviews by Brown, 1997; Berkelmans, 2002; Coles and Brown, 2003; Jokiel, 2004; Baker et al., 2007; Jones, 2008; Coles and Riegl, 2013). The tolerance of corals to temperature is species-specific (van Woesik et al. 2011, Vega-Rodriguez 2016) and depends on suites of other variables that include acclimation temperature, aragonite saturation state, dissolved inorganic nitrogen (Cunning and Baker 2012, Fabricius 2005, Wooldridge 2013); and physical, physiological, and chemical stressors, including suspended sediments and turbidity (Anthony et al. 2007, Woods et al. 2016); trace metals such as copper (Negri and Hoogenboom 2011, Woods et al. 2016), ultraviolet radiation (Anthony et al. 2007), salinity, nitrates, and phosphates (Negri and Hoogenboom 2011).

Ocean warming is one of the most significant threats to the seven corals. Mean seawater temperatures in reef-building coral habitat in the Indo-Pacific have increased during the past few decades, and are predicted to continue to rise between now and 2100 (IPCC, 2013). The primary observable coral response to ocean warming is bleaching of adult coral colonies, wherein corals expel their symbiotic zooxanthellae in response to stress (Brown, 1997). Even so, evaluating the effects that changes in water temperatures have on the conservation value of coral habitat is very complex and contextually-driven, and simple numeric effect thresholds are not easily assigned to listed corals to establish when stress responses occur. For many corals, an episodic increase of only 1°C–2°C above the normal local seasonal maximum ocean temperature can induce bleaching (Hoegh-Guldberg et al., 2007; Jones, 2008). Corals can withstand mild to moderate bleaching; however, severe, repeated, or prolonged bleaching can lead to colony death (Brown, 1997). In addition to coral bleaching, other effects of ocean warming detrimentally affect virtually every life-history stage in reef-building corals. Impaired fertilization and developmental abnormalities (Negri and Heyward, 2000), mortality, and impaired settlement success (Nozawa and Harrison, 2007) have all been documented. Increased seawater temperature also may act synergistically with coral diseases to reduce coral health and survivorship (Bruno and Selig, 2007). Coral disease outbreaks often have either accompanied or immediately followed bleaching events (Jones et al., 2004; Miller et al., 2009). Outbreaks also follow seasonal patterns of high seawater temperatures (Willis et al., 2004).

Coles and Brown (2003) defined a general bleaching threshold for reef-building corals as increases in seawater temperatures of 1–3°C above maximum annual mean temperatures at a given location. GBRMPA (2010) defined a general "trigger value" for bleaching in reef-building corals as increases in seawater temperatures of no more than 1°C above maximum annual mean temperatures at a given location. Duration of exposure to elevated temperatures determines the extent of bleaching, thus several methods have been developed to integrate duration into bleaching thresholds, including the number of days, weeks, or months of the elevated temperatures (Berkelmans, 2002; Eakin et al., 2009). NOAA's Coral Reef Watch Program utilizes the Degree Heating Week method (Glynn and D'Croz, 1990; Eakin et al. 2009), which defines a general bleaching threshold for reef-building corals as seawater temperatures of 1°C above maximum monthly mean at a given location for four consecutive weeks (https://coralreefwatch.noaa.gov/).

These general thresholds were developed for coral reef communities and ecosystems, rather than individual species. Many of these studies are community or ecosystem-focused and do not account for species-specific responses to changes in seawater temperatures, and instead are focused on long-term climatic changes and large-scale impacts (e.g., coral reef distribution, persistence).

In summary, temperature deviations from local averages prevent or impede successful completion of all life history stages of the listed coral species. Identifying temperatures at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, and other factors.

3.2.2.2 ARAGONITE SATURATION STATE

Carbonate ions (CO_3^{2-}) are used by many marine organisms, including corals, to build calcium carbonate skeletons. For corals, the mineral form of calcium carbonate in their skeletons is called "aragonite." The more carbonate ions there are dissolved in seawater, the easier it is for corals to build their aragonite skeletons. The metric used to express the relative availability of calcium and carbonate ions is the aragonite saturation state (Ω_{arg}). Thus, the lower the Ω_{arg} of seawater, the lower the abundance of carbonate ions, and the more energy corals have to expend for skeletal calcification, and vice versa (Cohen and Holcomb, 2009). At saturation states between 1 and 20, marine organisms can create calcium carbonate shells or skeletons using a physiological calcifying mechanism and the expenditure of energy. The aragonite saturation state varies greatly within and across coral reefs and through daily cycles with temperature, salinity, pressure, and localized biological processes such as photosynthesis, respiration, and calcification by marine organisms (Gray et al., 2012; McMahon et al., 2013; Shaw et al., 2012b).

Coral reefs form in an annually-averaged saturation state of 4.0 or greater for optimal calcification, and an annually-averaged saturation state below

3.3 will result in reduced calcification at rates insufficient to maintain net positive reef accretion, resulting in loss of reef structure (Guinotte et al., 2003; Hoegh-Guldberg et al., 2007). Guinotte et al. (2003) classified the range of aragonite saturation states between 3.5-4.0 as "adequate" and < 3 as "extremely marginal." Thus, aragonite saturation state between 3 and 4 is likely necessary for coral calcification. But, generally, seawater Ω_{arg} should be 3.5 or greater to enable maximum calcification of reef-building corals, and average Ω_{arg} in most coral reef areas is currently in that range (Guinotte et al., 2003). Further, (Kleypas et al., 1999) concluded that a general threshold for Ω_{arg} occurs near 3.4, because only a few reefs occur where saturation is less than this. Guan et al. (2015) found that the minimum aragonite saturation observed where coral reefs currently occur is 2.82; however, it is not known if those locations hosted live accreting corals. These general characterizations and thresholds were identified for coral reef communities and ecosystems, rather than individual species.

Ocean acidification is a term referring to changes in ocean carbonate chemistry, including a drop in the pH of ocean waters, that is occurring in response to the rise in the quantity of atmospheric CO_2 and the partial pressure of CO_2 (pCO_2) absorbed in oceanic waters (Caldeira and Wickett, 2003). As pCO_2 rises, oceanic pH declines through the formation of carbonic acid and subsequent reaction with water resulting in an increase of free hydrogen ions. The free hydrogen ions react with carbonate ions to produce bicarbonate, reducing the amount of carbonate ions available, and thus reducing the aragonite saturation state. Ocean acidification is one of the most important threats to reef-building corals (Brainard et al., 2011; Jokiel, 2015).

A variety of laboratory studies conducted on corals and coral reef organisms (e.g., Langdon and Atkinson, 2005) consistently show declines in the rate of coral calcification and growth with rising pCO_2, declining pH, and declining carbonate saturation state. Laboratory experiments have also shown that skeletal deposition and initiation of calcification in newly settled corals is reduced by declining aragonite saturation state (Albright et al., 2008; Cohen et al., 2009). Field studies from a variety of coral locations in the Caribbean, Indo-Pacific, and Red Sea have shown a decline in linear extension rates (Bak et al., 2009; De'ath et al., 2009; Schneider and Erez, 2006; Tanzil et al., 2009). Reduced calcification and slower growth will mean slower recovery from breakage, whether natural (hurricanes and storms) or human (breakage from vessel groundings, anchors, fishing gear, etc.), or mortality from a variety of disturbances. Slower growth also implies even higher rates of mortality for newly settled corals due to the longer time it will take to reach a colony size that is no longer vulnerable to overgrowth competition, sediment smothering, and incidental predation. Reduced calcification and slower growth means more time to reach reproductive size and reduces sexual and asexual reproductive potential. Increased pCO_2 coupled with increased sea surface temperature can lead to even lower rates of calcification, as found in the meta-analysis by Kornder et al. (2018).

In summary, aragonite saturation reductions prevent or impede successful completion of all life history stages of the listed coral species. Identifying declining aragonite saturation state at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, acclimatization to localized nutrient regimes, and other factors.

3.2.2.3 NUTRIENTS

Nitrogen and phosphorous are two of the main nutrients that affect the suitability of coral habitat (Fabricius et al., 2005; Fabricius, 2005). These two nutrients occur as different compounds in coral reef habitats and are necessary in low levels for normal reef function. Dissolved inorganic nitrogen and dissolved inorganic phosphorus in the forms of nitrate (NO_3) and phosphate ($PO4_3$) are particularly important for photosynthesis, with dissolved organic nitrogen also providing an important source of nitrogen, and are the dominant forms of nitrogen and phosphorous in coral reef waters. Nutrients are a major component of land-based sources of pollution (LBSP), one of the most important threats to reef-building corals (Brainard et al., 2011). Excessive nutrients affect corals through two main mechanisms: direct impacts on coral physiology such as reduced fertilization and growth (Harrison and Ward, 2001; Ferrier-Pages et al., 2000), and indirect effects through nutrient-stimulation of other community components (e.g., macroalgae seaweeds, turfs/filamentous algae, cyanobacteria, and filter feeders) that compete with corals for space on the reef (79 FR 53851, September 10, 2014). The latter also affects the quality of recruitment substrate discussed previously. The physiological response a coral exhibits to an increase in nutrients mainly depends on intensity and duration. A short duration of a large increase in a nutrient may result in a severe adverse response, just as a chronic, lower concentration might.

Most coral reefs occur where annual mean nutrient levels are low. Kleypas et al. (1999) analyzed dissolved nutrient data from nearly 1,000 coral reef sites, finding mean values of 0.25 micromoles per liter (μmol/l) for NO_3, and 0.13 μmol/l for PO_4. Over 90 percent of the sites had mean NO_3 values of <0.6 μmol/l, and mean PO_4 values of <0.2 μmol/l (Kleypas et al., 1999). Several authors, including Bell and Elmetri (1995) and Lapointe (1997) have proposed threshold values of 1.0 μmol/l for NO_3, and 0.1-0.2 μmol/l for PO_4, above which NO_3 and PO_4 are excessive (eutrophic). However, concentrations of dissolved nutrients are poor indicators of coral reef status, and the concept of a simple threshold concentration that indicates eutrophication has little validity (McCook et al., 1999). One reason for that is because corals are exposed to nutrients in a variety of forms, including dissolved nitrogen (e.g., NO_3), dissolved phosphorus (e.g., $PO4_3$), particulate nitrogen (PN), and particulate phosphate (PP). Since the dissolved forms are assimilated rapidly by phytoplankton, and the majority of nitrogen and phosphorus discharged in terrestrial runoff is in the particulate forms, PN and PP are the most common bio-available forms of nutrients for corals on coastal zone reefs (Cooper and Fabricius, 2007). Thus, De'ath and Fabricius (2008) and GBRMPA (2010) provide general recommendations on maximum annual mean values for PN and PP of 1.5 µmol/l PN and 0.09 µmol/l PP for coastal zone reefs. These generalizations are for coral reef communities and ecosystems, rather than individual species.

As noted above, identifying nutrient concentrations at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, and acclimatization to localized nutrient regimes, and other factors.

3.2.2.4 WATER CLARITY/TURBIDITY

Water clarity or transparency is a key factor for marine ecosystems and it is the best explanatory variable for a range of bioindicators of reef health (Fabricius et al., 2012). Water clarity affects the light availability for photosynthetic organisms and food availability for filter feeders. Corals depend upon their symbiotic algae for nutrition and thus depend on light availability for algal photosynthesis. Reduced water clarity is determined by the presence of particles of sediment, organic matter, and/or plankton in the water, and so is often associated with elevated sedimentation and/or nutrients. Water clarity can be measured in multiple ways, including, percent of solar irradiance at depth, Secchi depth (the depth in the water column at which a black and white disk is no longer visible), and Nephelometric Turbidity Unit (NTU – measure of light scatter based on particles in the water column). Reef-building corals naturally occur across a broad range of water clarity levels from very turbid waters on enclosed reefs near river mouths (Browne et al., 2012) to very clear waters on offshore barrier reefs, and many intermediate habitats such as open coastal and mid-shelf reefs (GBRMPA, 2010). Corals reefs appear to thrive in extremely clear areas where Secchi depth is ≥ 15 m or light scatter is < 1 NTU (De'ath and Fabricius, 2010). Typical levels of total suspended solids (TSS) in reef environments are less than 10 mg/L (Rogers, 1990). The minimum light level for reef development is about 6-8 percent of surface irradiance (Fabricius et al., 2014).

For a particular coral colony, water clarity levels tolerated likely depend on several factors, including species, life history stage, spatial variability, and temporal variability. For example, colonies of a species occurring on fringing reefs around high volcanic islands with extensive groundwater inputs are likely to be better acclimatized or adapted to higher turbidity than colonies of the same species occurring on offshore barrier reefs or around atolls with very little or no groundwater inputs. In some cases, corals occupy naturally turbid habitats (Anthony and Larcombe, 2000; McClanahan and Obura, 1997; Te, 2001) where they may benefit from the reduced amount of UV radiation to which they are exposed (Zepp et al., 2008). Reductions in water clarity affect light availability for corals. As turbidity and nutrients increase, thus decreasing water clarity, reef community composition shifts from coral dominated to macroalgae to ultimately heterotrophic animals (Fabricius et al., 2012). Light penetration is diminished by suspended abiotic and biotic particulate matter (esp. clay and silt-sized particles) and some dissolved substances (Fabricius et al., 2014). The availability of light decreases directly as a function of particle concentration and water depth, but also depends on the nature of the suspended particles. Fine clays and organic particles are easily suspended from the sea floor, reducing light for prolonged periods while undergoing cycles of deposition and resuspension. Suspended fine particles also carry nutrients and other contaminants (Fabricius et al., 2013). Increased nutrient runoff into semi-enclosed seas accelerates phytoplankton production to the point that it also increases turbidity and reduces light penetration, and can also settle on colony surfaces (Fabricius, 2005). In areas of nutrient enrichment, light for benthic organisms can be additionally severely reduced by dense stands of large fleshy macroalgae shading adjacent corals (Fabricius, 2005).

The literature provides several recommendations on maximum turbidity levels for coral reefs (i.e., levels that managers should strive to stay under). GBRMPA (2010) recommends minimum mean annual water clarity, or "trigger values", in Secchi distances for the GBR depending on habitat type: For enclosed coastal reefs, 1.0-1.5 m; for open coastal reefs and mid-shelf reefs, 10 m; and for offshore reefs, 17 m. De'ath and Fabricius (2008) recommend a minimum mean annual water clarity trigger value in Secchi distance averaged across all GBR habitats of 10 m. Bell and Elmetri (1995) recommend a maximum value of 3.3 mg/L TSS across all GBR habitats. Thomas et al. (2003) recommend a maximum value of 10 mg/L averaged across all Papua New Guinea coral reef habitats. Larcombe et al. (2001) recommend a maximum value of 40 mg/L TSS for GBR "marginal reefs", i.e., reefs close to shore with high natural turbidity levels. Guan et al. (2015) recommend a minimum light intensity (µmol photons second/m2) of 450 µmol photons second/m2 globally for coral reefs. The above generalizations are for coral reef communities and ecosystems, rather than individual species.

A coral's response to a reduction in water clarity is dependent on intensity and duration. For example, corals exhibited partial mortality when exposed to 476 mg/L TSS (Bengtsson et al., 1996) for 96 hours, but had total mortality when exposed to 1000 mg/L TSS for 65 hours (Thompson and Bright, 1980). Depending on the duration of exposure, most coral species exhibited sublethal effects when exposed to turbidity levels between 7 and 40 NTU (Erftemeijer et al., 2012). The most tolerant coral species exhibited decreased growth rates when exposed to 165 mg/L TSS for 10 days (Rice and Hunter, 1992). Turbidity reduces water clarity and so reduces the maximum depth at which corals can live, making deeper habitat unsuitable (Fabricius, 2005). Existing data suggest that coral reproduction and settlement are more highly sensitive to changes in water clarity than adult survival and these functions are dependent on clear water. Suspended particulate matter reduces fertilization and sperm function (Ricardo et al., 2015) and strongly inhibits larvae survival, settlement, recruitment, and juvenile survival (Fabricius, 2005).

In summary, water clarity deviations from local averages prevent or impede successful completion of all life history stages of the listed coral species. Identifying turbidity levels at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, and acclimatization to localized nutrient regimes, and other factors.

3.2.2.5 CONTAMINANTS

The water column may include levels of anthropogenically-introduced chemical contaminants that do not prevent or impede successful completion of all life history stages of the listed coral species. For the purposes of this rule, "contaminants" is a collective term to describe a suite of anthropogenically-introduced chemical substances in water or sediments that may adversely affect corals. The study of the effects of contaminants on corals is a relatively new field and information on sources and ecotoxicology is incomplete. The major groups of contaminants that have been studied for effects to corals include heavy metals (also called trace metals), pesticides, and hydrocarbons. Other organic contaminants, such as chemicals in personal care products, polychlorinated biphenyl, and surfactants, have also been studied. Contaminants may be delivered to coral reefs via point or non-point sources. Specifically, contaminants enter the marine environment through wastewater discharge, shipping, industrial activities, and agricultural and urban runoff. These contaminants can cause negative effects to coral reproduction, development, growth, photosynthesis, and survival.

Heavy metals (e.g., copper, cadmium, manganese, nickel, cobalt, lead, zinc, and iron) can be toxic at concentrations above naturally-occurring levels. Heavy metals are persistent in the environment and can bioaccumulate. Metals are adsorbed to sediment particles, which can result in their long distance transport away from sources of pollution. Corals incorporate metals in their skeleton and accumulate them in their soft tissue (Al-Rousan et al., 2012; Barakat et al., 2015). Although heavy metals can occur in the marine environment from natural processes, in nearshore waters they are mostly a result of anthropogenic sources (e.g., wastewater, antifouling and anticorrosive paints from marine vessels and structures, land filling and dredging for coastal expansion, maritime activities, inorganic and organic pollutants, crude oil pollution, shipping processes, industrial discharge, agricultural activities) and are found near cities, ports, and industrial developments.

The effects of copper on corals include physiological impairment, impaired photosynthesis, bleaching, reduced growth, and DNA damage (Bielmyer et al., 2010; Schwarz et al., 2013). Effects to fertilization, larval development, larval swimming behavior, metamorphosis, and larval survival have also been documented (Kwok and Ang, 2013; Negri and Hoogenboom, 2011; Puisay et al., 2015; Reichelt-Brushett and Hudspith, 2016; Rumbold and Snedaker, 1997). Toxicity of copper was found to be higher when temperatures are elevated (Negri and Hoogenboom, 2011). Nickel and cobalt can also have negative effects on corals, such as reduced growth and photosynthetic rates (Biscere et al., 2015), and reduced fertilization success (Reichelt-Brushett and Hudspith, 2016). Chronic exposure of corals to higher levels of iron may significantly reduce growth rates Ferrier-Pages et al. (2001). Further, iron chloride has been found to cause oxidative DNA damage to coral larvae (Vijayavel et al., 2012).

Polycyclic aromatic hydrocarbons (PAHs) are found in fossil fuels such as oil and coal and can be produced by the incomplete combustion of organic matter. PAHs disperse through non-point sources such as road run-off, sewage, and deposition of particulate air pollution. PAHs can also disperse from point sources such as oil spills and industrial sites. Studies have found effects of oil pollution on corals include growth impairments, mucus production, and decreased reproduction, especially at increased temperature (Kegler et al., 2015). Hydrocarbons have also been found to affect early life stages of corals. Oil-contaminated seawater reduced settlement of *Orbicella faveolata* and of *Agaricia humilis* and was more severe than any direct or latent effects on survival (Hartmann et al., 2015). Natural gas (water accommodated fraction) exposure resulted in abortion of larvae during early embryogenesis and early release of larvae during late embryogenesis, with higher concentrations of natural gas yielding higher adverse effects (Villanueva et al., 2011). Oil, dispersant, and a combination of oil and dispersant on significantly decreased settlement and survival of *Porites astreoides* and *O. faveolata* larvae (Goodbody-Gringley et al., 2013).

Anthracene (a PAH used in dyes, wood preservatives, insecticides, and coating materials) exposure to apparently healthy and diseased (Caribbean yellow band disease) fragments of *O. faveolata* reduced activity of enzymes important for protection against environmental stressors in the diseased colonies (Montilla et al., 2016). The results indicated that diseased tissues might be more vulnerable to the exposure to PAHs such as anthracene than apparently healthy corals. PAH concentrations similar to those after an oil spill inhibited metamorphosis of *Acropora tenuis* larvae and sensitivity increased when co-exposed to “shallow reef” UV light levels (Negri et al., 2016).

Pesticides include herbicides, insecticides, and antifoulants used on vessels and other marine structures. Pesticides can affect non-target marine organisms like corals and their zooxanthellae. Diuron, an herbicide, decreased photosynthesis isolated zooxanthellae (Shaw et al., 2012b). Irgarol, an additive in copper-based antifouling paints, significantly reduced settlement in *Porites hawaiiensis* (Knutson et al., 2012). *Porites astreoides* larvae exposed to two major mosquito pesticide ingredients, naled and permethrin, for 18-24 hours showed differential responses. Concentrations of 2.96 µg/L or greater of naled significantly reduced larval survivorship. However, reduced larval survivorship was not detected in exposure of up to 6.0 µg/L of permethrin. Larval settlement, post-settlement survival, and zooxanthellae density were not impacted by any treatment (Ross et al., 2015).

Benzophenone-2 (BP-2) is a chemical additive to personal care products (e.g., shampoo, body lotions, soap, detergents), product coatings (oil-based paints, polyurethanes), acrylic adhesives, and plastics that protects against damage from ultraviolet light. It is released into the ocean through municipal and boat/ship wastewater discharges, landfill leachates, residential septic fields, and unmanaged cesspits. BP-2 is a known endocrine disruptor and a DNA mutagen, and its effects are worse in the light. It caused deformation of *Stylophora pistillata* larvae changing them from a motile planktonic state to a deformed sessile condition at low concentrations. It also caused increasing larval bleaching with increasing concentration (Downs et al., 2014). Benzophenone-3 (BP-3; oxybenzone) is an ingredient in sunscreen and personal care products (e.g., hair cleaning and styling products, cosmetics, insect repellent, soaps) that protects against damage from ultraviolet light. It enters the marine environment through swimmers and municipal, residential, and boat/ship wastewater discharges and can cause DNA mutations. Oxybenzone is a skeletal endocrine disruptor, and it caused larvae of *S. pistillata* to encase themselves in their own skeleton. Exposure to oxybenzone transformed *S. pistillata* larvae from a motile state to a deformed, sessile condition. Larvae exhibited an increasing rate of coral bleaching in response to increasing concentrations of oxybenzone (Downs et al., 2016).

Polychlorinated biphenyls (PCBs) are environmentally stable, persistent organic pollutants that have been used as heat exchange fluids in electrical transformers and capacitors, and as additives in paint, carbonless copy paper, and plastics. They can be transported globally through the atmosphere, water, and food web. A study of the effects of the PCB Aroclor 1254 on the scleractinian coral *S. pistillata* found no effects on coral survival, photosynthesis, or growth; however, the exposure concentration and duration may alter the expression of certain genes involved in important cellular functions (Chen et al., 2012).

Surfactants are used as detergents and soaps, wetting agents, emulsifiers, foaming agents, and dispersants. Linear alkylbenzene sulfonate (LAS) is one of the most common surfactants in use. Biodegradation of surfactants can occur within a few hours to several days, but significant proportions of surfactants attach to suspended solids and remain in the environment. This sorption of surfactants onto suspended solids depends on environmental factors such as temperature, salinity, or pH. Exposure of *Pocillopora verrucosa* to LAS resulted in tissue loss on fragments. The combined effects of LAS exposure with increased temperature (+3°C to 31°C) resulted in greater tissue loss than LAS exposure alone (Kegler et al., 2015).

In summary, there are multiple chemical contaminants that prevent or impede successful completion of all life history stages of the listed coral species. Identifying contaminant levels at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, and other factors.

3.2.3 PHYSICAL OR BIOLOGICAL FEATURE ESSENTIAL FOR CONSERVATION – ARTIFICIAL SUBSTRATES AND CERTAIN MANAGED AREAS NOT INCLUDED

Finally, artificial substrates and frequently disturbed "managed areas" are not essential to coral conservation. Only natural substrates provide the quality and quantity of recruitment habitat necessary for the conservation of threatened corals. Artificial substrates are generally less functional than natural substrates in terms of supporting healthy and diverse coral reef ecosystems (Edwards and Gomez, 2007; USFWS, 2004). Artificial substrates are typically man-made or introduced substrates that are not naturally occurring to the area. Examples include, but are not necessarily limited to, fixed and floating structures, such as aids-to-navigation (AToNs), seawalls, wharves, boat ramps, fishpond walls, pipes, wrecks, mooring balls, docks, and aquaculture cages. Our definition of recruitment substrate does not include any artificial substrate. In addition, there are some natural substrates that, because of their consistently disturbed nature, also do not provide the quality of substrate necessary for the conservation of threatened corals. While these areas may provide hard substrate for coral settlement and growth over short periods, the periodic nature of direct human disturbance renders them poor environments for coral growth and survival over time (e.g., they can become covered with sediment). Therefore, they are not essential to the conservation of the species. Specific managed areas not included in critical habitat are listed in Appendix A of this report.

3.2.4 CONCLUSION

As described above, the best-available information shows coral reefs form on solid substrate but only within a narrow range of water column conditions that on average allow the deposition rates of corals to exceed the rates of physical, chemical, and biological erosion (i.e., conducive conditions, Brainard et al., 2005). However, as with all ecosystems, water column conditions are dynamic and vary over space and time. Therefore, we also describe environmental conditions in which coral reefs currently exist globally, thus indicating the conditions that may be tolerated by corals and allow at least for survival. To the extent tolerance conditions deviate in duration and intensity from conducive conditions, they may not support coral reproduction and recruitment, and reef growth, and thus would impair recovery of the species. Further, annually and spatially averaged-tolerance ranges provide the limits of the environmental conditions in which coral reefs exist globally (Guan et al., 2015), but these conditions do not necessarily represent the conditions that may be tolerated by individual coral species. Individual species may or may not be able to withstand conditions within or that exceed the globally-averaged tolerance ranges for coral reefs, depending on the individual species' biology, local average conditions to which the species are acclimatized, and intensity and duration of exposure to adverse conditions. In other words, changes in the water column parameters discussed above that exceed the tolerance ranges may induce adverse effects in a particular species. Thus, the concept of individual species' tolerance limits is a different aspect of water quality conditions compared to conditions that are conducive for formation and growth of reef structures.

These values presented in the summaries above constitute the best available information at the time of this rulemaking. It is possible that future scientific research will identify species-specific values for some of these parameters that become more applicable to the seven listed coral species, though it is also possible that future species-specific research will document that conducive or tolerance ranges for the seven corals fall within these ranges. Because the ESA requires us to use the best scientific information available in conducting consultations under section 7, we will incorporate new scientific information on conducive and tolerance conditions of the above parameters into consultations. This will not alter the designation to an extent that it constitutes a revision requiring a new rulemaking. The specific areas covered by this designation will not change, nor will the locations or extent of the essential feature, or the attributes included in the essential feature or the approach to consultations. The federal actions that require consultation also will not change.

3.3 NEED FOR SPECIAL MANAGEMENT CONSIDERATIONS OR PROTECTION

When designating critical habitat, we assess whether the specific areas within the geographical area occupied by the species at the time of listing contain the physical or biological feature essential to the conservation of the species and may require special management considerations or protection. We recognize that activities in and adjacent to areas being considered for critical habitat may affect the essential feature found in these areas. The following is a discussion of the types of activities that occur within the units under consideration that may require special management to reduce or mitigate impacts to the essential feature. That is, these are the types of federal actions that may need to be regulated by critical habitat to help protect the essential feature.

IN-WATER AND COASTAL CONSTRUCTION

In-water and coastal construction encompasses a number of activities, all of which can potentially impact several of the areas under consideration for critical habitat designation that overlap with a project footprint. Examples include mooring and buoy installation or repair, road and bridge construction or repair, shoreline protection measures, harbor and marina construction or repair, and others. In addition to direct removal of substrate that can result from many of these activities, sedimentation and turbidity can be caused by the activities and have adverse effects on water quality parameters. Structures can create shaded areas over coral habitat, reducing the light necessary for coral growth. Additionally, structures could be constructed directly over hardbottom substrate, potentially damaging or eliminating it. Both beach nourishment and shoreline protection projects can involve the placement of sand onto eroding beaches. Replacement sand is either dredged from offshore deposits (i.e., a sand borrow area) or retrieved from another source on land. Both the dredging and placement of sand are likely to create turbidity which reduces water clarity. Additionally, sand that becomes suspended in the water column has the potential to settle on hardbottom substrate, reducing the habitat's suitability for coral colonization. Moreover, if the listed Indo-Pacific corals are present within the area impacted by a beach nourishment or shoreline protection project, they could be adversely affected. In-water and coastal construction activities are the most frequently occurring activities that require consultation under Section 7 and may affect the areas under consideration for critical habitat designation. Between 2005 and 2014, NMFS completed 14 formal and 129 informal consultations related to in-water and coastal construction activities within the areas under consideration, most of which were concentrated most heavily in Guam. In total, in-water and coastal construction consultations represented more than 75 percent of all consultations from 2005 to 2014 within potential critical habitat areas. The units most impacted by in-water and coastal construction are the largest and most populated islands of Guam, Saipan, and Tutuila. Other inhabited units may also experience in-water and coastal construction but to a lesser degree.

DREDGING AND DISPOSAL

Dredging is the removal of material from the bottoms of water bodies, and it is most often performed to deepen, widen, or maintain navigation corridors, anchorages, or berthing areas. Dredging for navigation purposes may also involve disposal of dredge spoil material within the marine environment. Impacts to the areas under consideration for critical habitat from dredging and disposal can include direct loss from burial or excavation. In addition, dredging and disposal produces turbidity and sedimentation that can reduce hard surface area available for recruitment (Baird and Associates, 2004) and adversely impact water clarity. These impacts can be particularly adverse with the dredging of coral rock, as limestone and coral materials tend to break into extremely fine particles when dredged. This creates milky white “clouds” of suspended fine sediments and these clouds can stay in suspension for a long time, spreading over a large area and often causing increased sedimentation. Because they result in significantly reduced light penetration, even in low concentrations, they can impact corals over a wide area, reducing growth and calcification rates on coral reefs, thereby indirectly impacting the quality of the critical habitat (Aller and Dodge, 1974; Dodge and Vaisnys, 1977). Moreover, the resuspension of contaminated sediments during dredging activities may amplify the adverse impacts on water clarity caused by dredging (Guam Environmental Protection Agency, 2000). Altogether, channel dredging activities resulted in 13 informal consultations between 2005 and 2014 within potential critical habitat areas, including 10 in Guam, two in CNMI, and one in American Samoa. The largest and most active harbors that have dredged channels and shipping basins that are periodically dredged for maintenance are in the Guam (Apra Harbor) and Tutuila (Pago Pago Harbor) units. There is a dredged channel off of Saipan among the offshore anchorages, and also some dredged areas in marinas in Tinian and Rota. These areas are described in more detail in the Specific Areas section.

WATER QUALITY AND DISCHARGES

Sewage, industrial effluent, storm water runoff, river discharge, and groundwater are sources of nutrients, sediments, turbidity, and contaminants that may adversely affect the essential feature defined above. Nutrification (excess nutrients) from ocean outfall discharges contribute to algal and bacteria blooms that can smother or shade corals and reduce the quantity or quality of areas suitable for coral settlement and growth. A review of the section 7 consultation history from 2005 to 2014 identified only two informal consultations related to water quality management activities, including one each in Guam and CNMI. EPA acts as the NPDES permitting authority for point sources in American Samoa, Guam, and CNMI, as the territorial and commonwealth governments do not have approved NPDES permitting programs. There are seven identified permitted discharges in American Samoa, 19 in Guam, and six in CNMI. Water quality impacts are most prevalent in inhabited units with the largest population centers like Guam, Saipan, and Tutuila. Other inhabited units also have the potential for impacts to water quality parameters from anthropogenic activities.

Anatahan and Aguijan are examples of uninhabited units that still may be subject to water quality parameters impacts from runoff as they both have large populations of feral ungulates that graze large amounts of vegetation, which leads to loose sediment. The goat population on Aguijan in 1998 remained at an estimated 1500 animals (Atkinson and Atkinson, 2000). Goats affect this island's native forest by causing severe erosion and removing the understory, which is becoming dominated by the aggressively invasive weed *Lantana camara* (Esselstyn et al., 2003). The most significant land-based environmental issue on Anatahan is the high number of feral animals, such as goats and pigs (goats are thought to number ~ 6000; Cruz et al., 2000). Anatahan also has the additional constant danger of volcanic eruption. Ash from previous eruptions has been documented to cover portions of the reef habitat, mainly on the west side of the island. Additional surveys are required to determine the extent to which reefs have been affected and whether signs of recovery on the worst affected areas are apparent. Volcanic eruption is a potential natural source of negative impacts to the surrounding coral reef area and the essential feature.

FISHING/FISHERY MANAGEMENT

Fisheries in the EEZ around American Samoa, Guam, CNMI, and the PRIA are under the jurisdiction of the Western Pacific Regional Fishery Management Council (WPRFMC). Beginning in the 1980's, WPRFMC managed fisheries through separate species-based fishery management plans (FMPs): the Bottomfish and Seamount Groundfish FMP, the Crustaceans FMP, the Precious Corals FMP, the Coral Reef Ecosystems FMP, and the Pelagic FMP. In 2010, however, WPRFMC began moving towards an ecosystem-based approach to fisheries management and restructured its management framework from species-based FMPs to place-based fishery ecosystem plans (FEPs). WPRFMC currently has five place-based FEPs, one each for Hawaii, American Samoa, the Mariana Archipelago (Guam and CNMI), the PRIA, and Pacific pelagic fisheries. The federally managed fisheries in American Samoa, Guam, CNMI, and the PRIA can be broadly categorized in terms of habitat and target species as pelagic fisheries, bottomfish fisheries on mesophotic reefs, coral reef fisheries, and crustacean fisheries. According to WPRFMC, the predominant fishing gear types—hook and line, longline, troll, traps—used in these fisheries cause few fishing-related impacts to the habitat utilized by the listed Indo-Pacific corals and other coral reef species. However, WPRFMC has identified potential sources of fishery-related impacts to benthic habitat that may occur during normal fishing operations, including 1) anchor damage from vessels attempting to maintain position over productive fishing habitat, and 2) heavy weights and line entanglement occurring during normal hook-and-line fishing operations(WPRFMC 2009a,b,c,d).

MILITARY ACTIVITIES (GUAM AND CNMI)

The primary military installation located within or adjacent to the areas under consideration for critical habitat is the Navy's Joint Region Marianas (JRM) facility. JRM is a combination of Naval Base Guam and the Air Force's Andersen Air Force Base. Submerged Lands under the jurisdiction of DOD in CNMI overlap with the areas under consideration for critical habitat of the listed Indo-Pacific coral species, including Submerged Lands immediately adjacent to U.S. Navy-leased lands on Tinian and Farallon De Medinilla. The development, operation, and maintenance of the above military installations involves many of the activities already discussed. In particular, DOD may need to build and maintain navigation channels, marinas, and ports, and it may regulate discharges to surface waters from its installations. The potential effects of these activities on the essential feature are discussed above in the in-water and coastal construction, dredging and disposal section, and discharges to navigable waters sub-sections. Additional activities undertaken by the military also have the potential to adversely affect the essential habitat feature for listed corals. Training activities conducted by the Navy include amphibious landings, explosive device training, precision anchorage drills, and firing ranges, all of which have the potential to physically damage hard substrate and or increase turbidity in the water column at least temporarily.

SCIENTIFIC RESEARCH AND MONITORING

NOAA and the Department of the Interior conduct scientific research and issue permits for various research and monitoring activities in the coastal waters of American Samoa, Guam, CNMI, and the PRIA. Scientific research and monitoring that occurs in any of the areas under consideration for critical habitat designation are subject to one or more rigorous permitting processes. Research and monitoring activities that may affect essential feature include installation of scientific instrumentation and a wide variety of others. However, these activities usually have a minor footprint. Additionally, strict protocols are typically observed during field work permitted by NOAA and the Department of the Interior to ensure minimal disturbance to the environment. A review of the section 7 consultation history from 2005 to 2014 indicated that more than two-thirds (11 out of 15) of consultations related to scientific research and monitoring took place in Guam, while two consultations each occurred in American Samoa and CNMI.

Of the 15 total consultations related to this activity, only one, in American Samoa, was formal. Research and monitoring occurs in some form within each of the areas under consideration for critical habitat, both inhabited and uninhabited. Palmyra is a good example of an uninhabited unit with a lot of research activity. While it is technically uninhabited and there are no permanent residents, there is generally a year-round human presence due to the active research station and that houses seasonal researchers, refuge staff, and facility maintenance staff.

AQUACULTURE

Aquaculture projects may affect the listed Indo-Pacific coral species and the essential feature of their proposed critical habitat in the following ways: 1) aquaculture activities that include the placement of fixed structures or cages or net pens that are anchored in the marine environment have the potential to damage corals and substrate; and 2) discharges of effluents from aquaculture activities may impact water quality by increasing turbidity and nutrient concentrations. While NMFS has not yet consulted on aquaculture projects within the areas under consideration for critical habitat, there have been numerous attempts to establish aquaculture in the two territories and commonwealth, and the governments of American Samoa, Guam, and CNMI are actively promoting aquaculture as an emerging industry in their coastal waters.

In addition, NMFS, in coordination with the WPRFMC, is preparing a programmatic environmental impact statement that is intended to support offshore aquaculture development in the U.S. Pacific Islands Region, including appropriate management of unit species for aquaculture, reasonably foreseeable types of offshore aquaculture operations, and permitting and reporting requirements for persons conducting aquaculture activities in federal waters. These initiatives could lead to increased offshore aquaculture activity in the Pacific Islands Region, although most aquaculture activity in federal waters surrounding American Samoa, Guam, CNMI, or the PRIA would occur in waters greater than 50 meters in depth, and impacts to critical habitat are considered unlikely.

The history of aquaculture development in American Samoa includes attempts to culture topminnows as bait for pole-and-line tuna vessels, giant clams and corals for sale in the aquarium trade, and tilapia and mangrove crabs for local consumption (SPC Aquaculture Portal, 2011a; Temple undated). The diversification of candidate species for culture indicates the potential American Samoa has to offer aquaculture production facilities (SPC Aquaculture Portal, 2011a). Aquaculture development in American Samoa has been supported by the University of Hawaii Sea Grant College Program at the American Samoa Community College and the Center for Tropical and Subtropical Aquaculture at Oceanic Institute and University of Hawaii at Manoa. Over the years a large array of aquatic organisms have been considered for culturing on Guam, including seaweed, milkfish, freshwater eel, freshwater and marine shrimp, oysters, tilapia, and freshwater turtles (SPC Aquaculture Portal, 2011b). The development of the Guam Aquaculture Development Plan in 2010 increased the capacity of the University of Guam to provide potential investors with information on the status, opportunities, and impediments for aquaculture investment in Guam. In particular, Asian investors have exhibited greater interest in shrimp broodstock production in Guam (Center for Tropical and Subtropical Aquaculture, 2010; U.S. Department of Agriculture, 2015). Aquaculture activities in CNMI have been mainly limited to tilapia and marine shrimp culture, although the culture of giant clams has also been attempted (SPC Aquaculture Portal, 2011c). Lack of investor capacity has impeded attempts to further develop viable aquaculture operations in CNMI. However, the Northern Marianas College, Cooperative Research Extension and Education Service has begun researching marine fish and invertebrate culture in recent years, and a plan has been prepared to strengthen the development aquaculture in CNMI (The Northern Marianas College, 2011). With respect to aquaculture in federal waters, a recent policy issued by NMFS indicated its intention to promote expanded aquaculture activity nationally (NOAA 2011). This policy could lead to increased offshore aquaculture activity within the areas being considered for critical habitat, although it is likely that most aquaculture activity in the EEZ surrounding American Samoa, Guam, CNMI, or the PRIA would occur in waters greater than 50 meters in depth.

SPECIFIC AREAS WITH NO LOCALIZED ACTIVITIES THAT REQUIRE SPECIAL MANAGEMENT

The activities described above may require special management to reduce or mitigate impacts to the essential feature, and may occur within most of the units under consideration. However, in five of the 19 units, such localized activities do not occur, because of current management. These include Howland Island, Jarvis Island, and Kingman Reef in PRIA, Rose Atoll in American Samoa, and the Maug Islands and Supply Reef in CNMI.

Howland and Jarvis Islands were designated as a National Wildlife Refuge in 1974 and expanded to include Submerged Lands out to 12 nautical miles in 2009. Also in 2009, the islands were included in the designation of the Pacific Remote Islands Marine National Monument. The islands are remote and uninhabited, and access is restricted by the U.S. Fish and Wildlife Service. There are no structures on Howland or Jarvis, and no docks, piers, or channels that require maintenance or repair. USFWS and NMFS conduct occasional ship-based research and monitoring every three years. None of the other activities that would require special management occur at Howland or Jarvis.

Kingman Reef is 932 miles southwest of Hawaii and has no permanent emergent land. It is also part of the Pacific Remote Islands Marine National Monument designated in 2009. None of the activities described above occur at Kingman and any occasional human activity that does take place here is for the express purpose of restoring healthy coral reef ecosystems as part of the conservation of this portion of the Pacific Remote Islands Marine National Monument, established in 2009. A research vessel visits Kingman every three years to do surveys of the reef area. On other very rare occasions, additional research cruises may visit the area to study the marine environment and they go through a rigorous permitting process to gain access to this remote area.

In addition to being a National Wildlife Refuge, Rose Atoll in American Samoa was designated as its own Marine National Monument in 2009.

Rose is visited about three times a year by joint administrators of the refuge and monument for inventory and monitoring, turtle research and other research projects. None of the activities described above occur at Rose.

Because of the isolation of the Maug Islands in the northern CNMI, local anthropogenic impacts around these islands are thought to be few. Maug is included in the islands unit of the Marianas Trench Marine National Monument established in 2009. While fishing at Maug is considered uncommon, fishing and diving by individuals or small groups have been observed at Maug during monitoring cruises by PIFSC CRED. None of the other activities described above occur at Maug.

These five areas are remote marine protected areas with no permanent human presence, and thus are not currently exposed to localized activities affecting the essential feature discussed for the other areas above. However, the water quality parameters of seawater temperature and aragonite saturation state are likely to be affected by anthropogenic greenhouse gas emissions over the foreseeable future in all 19 units, as described in the final listing rule (79 FR 53852, September 10, 2014).

3.4 SPECIFIC AREAS WITHIN THE GEOGRAPHICAL AREA OCCUPIED BY THE SPECIES

The definition of critical habitat further instructs us to identify specific areas on which are found the physical or biological feature essential to the species' conservation. Our regulations state that critical habitat will be defined by specific limits using reference points and lines on standard topographic maps of the area, and referencing each area by the State, county, or other local governmental unit in which it is located (50 CFR 424.12(c)). Our regulations also state that when several habitats, each satisfying requirements for designation as critical habitat, are located in proximity to one another, an inclusive area may be designated as critical habitat (50 CFR 424.12(d)).

We identified 19 units within the geographical area occupied by the seven listed Indo-Pacific species confirmed in U.S. waters, at the time of listing, that contain the essential feature (Table 1, Figure 1 above), thus these 19 units were considered for proposed coral critical habitat. Within each of these 19 units: (1) We reviewed available information on substrate and water quality to determine where the essential feature is most likely to occur; (2) we established upper and lower depth limits for these areas; and (3) within the depth limits, we identified areas that may have the essential feature, but are not necessary for the conservation of the listed species, because they are artificial substrates or natural substrates that are consistently disturbed, and therefore do not qualify as critical habitat.

For step 1, determining specific areas that contain the essential feature, we reviewed available substrate and water quality data for each unit. For substrate, we used data and maps from two benthic habitat mapping programs that collect benthic data for coral reef ecosystems throughout the U.S. (these programs are also available to the public on their websites): (1) For habitat <20 m depth, the National Centers for Coastal Ocean Science's (NCCOS; https://coastalscience.noaa.gov/) provides data and maps (except for some of the PRIA); and (2) for habitat >20 m depth, the Pacific Islands Benthic Habitat Mapping Center (PIBHMC; https://www.soest.hawaii.edu/pibhmc/cms/) provides data and maps. These two complementary programs provide nearly complete, large-scale coverage of reef-building coral substrate in the U.S. Pacific Islands, except for some of the PRIA areas which are not included in the NCCOS database. For substrate and water quality information, we also used coral reef monitoring and status reports from the Pacific Islands Fisheries Science Center (PIFSC, https://www.fisheries.noaa.gov/region/pacific-islands#science) for the Mariana Islands (Brainard et al., 2012; except for Farallon de Medinilla (FDM)) and American Samoa (Brainard et al., 2008). For the PRIA, we used Miller et al. (2008). In contrast to substrate, data for water quality parameters are limited to a few of the parameters over a small overall portion of reef-building coral habitat within the area under consideration for critical habitat.

We applied step 2 in our process by using depth distribution information for the listed coral species that occur in each unit respectively to delineate upper and lower depth limits for each unit. Since some or all listed corals in each unit occur in shallow habitats (e.g., reef flats), the upper depth limit for all units is mean low water, referred to here as zero meters (0 m) depth. The lower depth limit for each unit is based on the deepest observed record of any listed species in that unit. As described in more detail the Life History and Biology section above, based on the best currently available information, we consider the rangewide depth distributions of the seven listed species as follows: *A. globiceps*, 0 to 20 m; *A. jacquelineae*, 10 to 35 m; *A. retusa*, 0 to 10 m; *A. speciosa*, 12 to 40 m; *Euphyllia paradivisa*, 2 to 40 m; *Isopora crateriformis*, 0 to 12 m; and *Seriatopora aculeata*, 3 to 40 m. We used depth distributions for all listed Indo-Pacific species in U.S. waters combined as a comprehensive approach to establish a lower limit because most listed species have overlapping depth distributions, and depth distributions of these species are still not well known for many of the critical habitat units.

We next applied step 3 in our process for each unit by identifying areas that may contain the essential feature, but are not necessary for the conservation of the listed species. There are two types of areas that may contain hard consolidated substrate and suitable water quality parameters, but are not considered necessary for the conservation of the species, and none, one, or both may occur in each unit: (1) artificial substrates; (2) and "managed areas", defined as areas where the substrate has been disturbed by management, and will continue to be periodically disturbed by such management. Artificial substrates include any man-made structure, regardless of age or level of active management. Examples include, but are not necessarily limited to fixed and floating structures, such as fixed or floating Aids to Navigation (AToNs), seawalls, wharves, boat ramps, fishpond walls, pipes, wrecks, mooring balls, docks, and aquaculture cages. Managed areas include, but are not necessarily limited to, dredged navigation channels, shipping basins, and vessel berths, and AToN chain scour areas around anchor blocks. As noted above, protecting artificial substrates and managed areas would not facilitate meeting our conservation goal of maintaining functional natural reef ecosystems on which the listed species depend. They do not provide stable natural environments for coral growth and settlement and therefore are not necessary for the conservation of the species.

The following paragraphs describe the application of our three-step process to determine the specific areas containing the essential feature for each of the 19 units. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The unit names and numbers are based on Table 1 above.

AMERICAN SAMOA

3.4.1 TUTUILA AND OFFSHORE BANKS

This unit includes the nearshore waters of Tutuila Island, the adjacent small island of Aunu\`u Island, and South Bank. Tutuila is the largest island in American Samoa, with a land area of 137 $km^2$ (52 $mi^2$). Tutuila and Aunu\`u Islands are highly eroded, volcanic remnants bounded by broad banks extending three or more kilometers from the shore in most locations. Of the seven primary islands that make up American Samoa, Tutuila contains more land and coral reef area than the other six islands combined. On the north shore of Tutuila, fringing reefs are mainly restricted to bays, but on the south, they extend along much of the shore. The fringing reefs have a narrow reef flat, a reef crest, and a reef slope. Spur-and-groove formation is fairly common on the reef slope. The substrate, water quality (including some data on water quality parameters), coral, and other benthic resources of this unit (except South

Bank) are described in Chapter 3 of PIFSC's coral reef monitoring report for American Samoa (Brainard et al., 2008). Six of the seven listed species within U.S. waters have been confirmed in the nearshore waters of Tutuila (Table 1), as explained in more detail in the species sections in Geographical Areas Occupied by the Species above.

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth (except for Pala Lagoon and inner Pago Pago Harbor, Appendix A) and is commonly found to 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature, with the above exception. This extensive area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, and most data are at least several years old, thus it is not practical to map the essential feature on smaller spatial scales within the unit. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m, except Pala Lagoon and inner Pago Pago Harbor, are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the six listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the suite of listed species that have been confirmed in this unit (Table 1) and the best available information on their depth ranges, as noted for each species in the Life History and Biology section above. Of the six listed species confirmed in this unit, *A. speciosa* is the deepest ranging and occurs down to 40 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 40 m, except Pala Lagoon and inner Pago Pago Harbor, are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may contain the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates in this unit include: (1) 11 fixed and floating AToNs (USCG 2015, 2016); (2) nine shoreline protection and beach erosion control projects built and managed by USACE; and (3) all other currently existing AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures for which we do not have specific information at this time. Managed areas in this unit include: (1) two USACE-managed small boat harbors, including their channels, basins, and seawall breakwaters; (2) any other channels, turning basins, and berthing areas that are periodically dredged or maintained (if any); and (3) a 25 m radius of substrate around all AToN bases. These artificial substrates and managed areas are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 40 m, except Pala Lagoon and inner Pago Pago Harbor, and the artificial substrates and managed areas for this unit summarized above and listed in Appendix A, are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Tutuila Unit of coral critical habitat is approximately 97 km^2 (37 mi^2), and is shown in Figure 2 below.

3.4.2 OFU AND OLOSEGA

Ofu and Olosega Islands are small, twin volcanic islands in the Manu`a Island group, with a collective land area of 13 km^2 (5 mi^2). Ofu and Olosega are separated by a gap of only about 75 m and surrounded by fringing coral reefs. This unit has less than ten percent of the land and coral reef area of the Tutuila unit. The two islands are located in the westernmost part of the Manu`a Islands group, approximately 100 km northeast of Tutuila Island. Ta`u Island, the third island of the Manu`a group, is located approximately 10 km to the southeast. As on Tutuila, the fringing reefs of Ofu and Olosega have a narrow reef flat, a reef crest, and a reef slope, and spur-and-groove formation is fairly common on the reef slope. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 4 of PIFSC's coral reef monitoring report for American Samoa (Brainard et al., 2008). Only three of the six species that occur in American Samoa have been confirmed in the Ofu-Olosega unit (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth and is commonly found to 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, thus it is not practical to map the essential feature on smaller spatial scales. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the three listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the suite of listed species that have been confirmed in this unit (Table 1), and the best available information on their depth ranges, as noted for each species in the Life History and Biology section above. Of the three listed species confirmed in this unit, *A. globiceps* is the deepest ranging and occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may contain the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates in this unit include: (1) Two fixed and floating AToNs; (2) the Ofu Airstrip shoreline protection project built and managed by USACE; and (3) all other currently existing AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures for which we don't have specific information at this time. Managed areas in this unit include: (1) The USACE-managed Ofu Small Boat Harbor; and (2) a 25 m radius of substrate around all AToN bases. These artificial substrates and managed areas are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m, with the exception of the artificial substrates and managed areas summarized above and listed in Appendix A, are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Ofu and Olosega Unit of coral critical habitat is approximately 9.7 km^2 (3.7 mi^2), and is shown in Figure 3 below.

3.4.3 TA`U

Ta`u Island is the easternmost member of the Manu`a Island group, with a land area of 45 km^2 (17 mi^2). Intermediate in size between Tutuila and Ofu-Olosega, Ta`u is also volcanic, but younger and less eroded. Fringing reefs are most developed along the northwest and southeast coasts, but limited or absent elsewhere. Some areas lacking fringing reef structure (i.e., reef flat, crest, and slope) have high coral cover, including some of the world's largest coral colonies. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 5 of PIFSC's coral reef monitoring report for American Samoa (Brainard et al., 2008). The same three species that occur in the Ofu-Olosega unit have also been confirmed in the Ta`u unit (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth and is commonly found to 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, thus it is not practical to map the essential feature on smaller spatial scales. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the three listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the suite of listed species that have been confirmed in this unit (Table 1), and the best available information on their depth ranges, as noted for each species in the Life History and Biology section above. Of the three listed species confirmed in this unit, *A. globiceps* is the deepest ranging and occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates in this unit include: (1) Four fixed and floating AToNs; and (2) all other currently existing AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures for which we don't have specific information at this time. Managed areas in this unit include: (1) The USACE-managed Ta'u Small Boat Harbor; (2) the Territory-managed Faleasao Small Boat Harbor; and (3) a 25 m radius of substrate around all AToN bases. These artificial substrates and managed areas are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m, with the exception of the artificial substrates and managed areas summarized above and listed in Appendix A, are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Ta`u Unit of coral critical habitat is approximately 8.8 km^2 (3.4 mi^2), and is shown in Figure 4 below.

3.4.4 ROSE ATOLL

The uninhabited Rose Atoll is located at the far eastern end of the American Samoa Archipelago, approximately 300 km east of Tutuila Island. In contrast to the high, volcanic islands of Tutuila and the Manu`a group surrounded by fringing reefs, Rose is a typical atoll consisting of a barrier reef enclosing a lagoon, and thus has a very small land area (<1 km^2). The forereef around the outside of the atoll slopes drops steeply into deep water (to at least 3000 m), while the nearly enclosed lagoon consists of a shallow shelf composed of patch reefs interspersed with a rubble flat, and a sandy lagoon floor to <20 m deep with scattered pinnacles rising up to near the surface. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 6 of PIFSC's coral reef monitoring report for American Samoa (Brainard et al., 2008). *Acropora globiceps* and *A. retusa* are the only two listed species to have been confirmed at Rose Atoll (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed outside the barrier reef on the forereef from zero to 40 or 50 m of depth, but substrate inside the lagoon is mostly rubble and sand. In addition, suitable water quality parameters are widely distributed outside the barrier reef on the forereef, but nutrients and turbidity are elevated inside the lagoon. Thus, the marine habitat from 0 to 50 m outside the barrier reef, and across the reef flat inside the barrier reef, has the potential to contain the essential feature, but not inside the lagoon. This extensive forereef area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, thus it is not practical to map the essential feature on smaller spatial scales. Therefore, the results of Step 1 for this unit are that all marine habitat from 0 to 50 m, excluding the lagoon, are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the two listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the suite of listed species that have been confirmed in this unit (Table 1), and the best available information on their depth ranges, as noted for each species in the Life History and Biology section above. *Acropora globiceps* is the deepest ranging species in this unit and it occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m, excluding the lagoon, are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Rose Atoll has no artificial substrates or managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 10 m, excluding the lagoon, are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Rose Atoll Unit of coral critical habitat is approximately 5.8 km^2 (2.2 mi^2) and is shown in Figure 5 below.

MARIANA ISLANDS

3.4.5 GUAM AND OFFSHORE BANKS

This unit includes the nearshore waters of Guam as well as three offshore banks south of the island. Guam is the largest island in Micronesia, has a land area of 544 km^2 (210 mi^2) and a shoreline 244 km long, and is located at the southern end of the Mariana archipelago. Apra Harbor on the central west coast of Guam is one of the largest harbors in the western Pacific. The geology of Guam is unique in the Mariana archipelago because the northern half is uplifted limestone but the southern half is of volcanic origin and highly susceptible to erosion. The three offshore banks in this unit are Santa Rosa Reef (46 km southwest of Guam with a minimum depth of 8 m), Galvez Bank (22 km southwest of Guam with a minimum depth of 25 m), and 11-mile Reef (17 km west of Guam with a minimum depth of 20 m). Guam has fringing reefs, patch reefs, submerged reefs, offshore banks, and a barrier reef surrounding the southern shores. Coral habitat surrounds much of the island. One half of the shoreline is bordered by various types of fringing reefs and reef-like platform. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 4 of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al., 2012). Three of the seven listed species within U.S. waters have been confirmed in the nearshore waters of Guam (Table 1), as explained in more detail in the species sections in Geographical Areas Occupied by the Species above.

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information as well as the Guam Coastal Atlas (Burdick, 2005), suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth (except for most of Apra Harbor, as described in Appendix A), and is commonly found to 50 m or more. Additionally, suitable water quality parameters are also widely distributed throughout this unit, except for most of Apra Harbor. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature, except for most of Apra Harbor (as described in Appendix A). This extensive area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, and most data are at least several years old, thus it is not practical to map the essential feature on smaller spatial scales within the unit. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m, except for most of Apra Harbor, are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the three listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the suite of listed species that have been confirmed in this unit (Table 1), and the best available information on their depth ranges, as noted for each species in the Life History and Biology section above. Of the three listed species confirmed in this unit, *S. aculeata* is the deepest ranging and occurs down to 40 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 40 m, except for most of Apra Harbor, are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may contain the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates in this unit include: (1) 32 fixed and floating AToNs; (2) Glass Breakwater along northwestern edge of Apra Harbor (largest artificial substrate in the Mariana Islands); (3) two shoreline protection and beach erosion control projects built and managed by USACE; (4) five Territory-managed boat ramps; and (5) all other currently existing AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures for which we do not have specific information at this time. Managed areas in this unit include: (1) harbors, basins, and channels managed by the Guam Port Authority and the U.S. Navy within Apra Harbor; (2) two USACE-managed small boat harbors (Agat and Agana); (3) any other channels, turning basins, and berthing areas that are periodically dredged or maintained (if any); and (4) a 25 m radius of substrate around all AToN bases. These artificial substrates and managed areas are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 40 m, except most of Apra Harbor, and the artificial substrates and managed areas for this unit summarized above and listed in Appendix A, are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Guam Unit of coral critical habitat is approximately 159 km^2 (61 mi^2), and is shown in Figure 6 below.

3.4.6 *ROTA*

Rota is the southernmost of CNMI's 14 islands, with a land area of 85 km^2 (33 mi^2). Rota's coastline consists of narrow, fringing coral reefs and reef platforms with numerous patches of raised limestone benches and limestone cliffs that drop abruptly to sea. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 5 of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al., 2012). Only one of the seven listed species within U.S. waters, *Acropora globiceps*, has been confirmed on Rota (Table 1), as explained in more detail in the species sections in Geographical Areas Occupied by the Species above.

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information: (1) Suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth, and is commonly found to 50 m or more; and (2) suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature, i.e., all shallow marine habitats surrounding Rota Island. This extensive area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, thus it is not practical to map the essential feature on smaller spatial scales. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. globiceps*, occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may contain the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates in this unit include: (1) Two fixed

AToNs; (2) one Territory-managed boat ramp; and (3) all other currently existing AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures for which we don't have specific information at this time. Managed areas in this unit include: (1) The USACE-managed Rota Harbor; and (2) a 25 m radius of substrate around all AToN bases. These artificial substrates and managed areas are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m, with the exception of the artificial substrates and managed areas summarized above and listed in Appendix A, are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Rota Unit of coral critical habitat is approximately 14.1 km^2 (5.4 mi^2), and is shown in Figure 7 below.

3.4.7 AGUIJAN

The uninhabited Aguijan Island is located just south of Tinian, and has a land area of 7 km^2 (2.7 mi^2). Aguijan, like the neighboring islands of Guam, Rota, Tinian, and Saipan, is composed of a series of coralline limestone terraces that lie on top of a volcanic core. No beaches are found around Aguijan, which is instead surrounded by sea cliffs. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 6 of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al., 2012). *Acropora globiceps* is the only listed species to have been confirmed at Aguijan (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth and is commonly found to 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, thus it is not practical to map the essential feature on smaller spatial scales. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. globiceps*, occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. The Aguijan unit has no artificial substrates or managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Aguijan Unit of coral critical habitat is approximately 4.0 km^2 (1.6 mi^2), and is shown in Figure 8 below.

3.4.8 TINIAN AND TATSUMI REEF

Tinian is the third largest of CNMI's 14 islands, with a land area of 101 km^2 (39 mi^2). Tinian's coastline consists of narrow, fringing coral reefs and reef platforms with numerous patches of raised limestone benches and limestone cliffs that drop abruptly to sea. Tatsumi Reef lies to the southeast of Tinian with a minimum depth of 7 m. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 7 of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al., 2012). Two of the seven listed species within U.S. waters, *Acropora globiceps* and *A. retusa*, have been confirmed on Tinian (Table 1), including Tatsumi Reef, as explained in more detail in the species sections in Geographical Areas Occupied by the Species above.

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth and is commonly found to 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, thus it is not practical to map the essential feature on smaller spatial scales. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. *A. globiceps* occurs down to 20 m depth, and *A. retusa* down to 10 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying sub-areas in this unit that may contain the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates in this unit include: (1) Six fixed AToNs; (2) Territory-managed boat ramps; and (3) all other currently existing AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures for which we don't have specific information at this time. Managed areas in this unit include: (1) The USACE-managed Tinian Harbor; and (2) a 25 m radius of substrate around all AToN bases. These artificial substrates and managed areas are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m, with the exception of the artificial substrates and managed areas summarized above and listed in Appendix A, are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Tinian Unit of coral critical habitat is approximately 12.0 km^2 (4.6 mi^2), and is shown in Figure 9 below.

3.4.9 SAIPAN AND GARAPAN BANK

This unit includes the nearshore waters of Saipan as well as Garapan Bank west of the island. Saipan is the second-largest island in the Mariana archipelago (after Guam), has a land area of 119 km^2 (46 mi^2), and a shoreline 75 km long. Saipan has fringing reefs, patch reefs, submerged reefs, a barrier reef and shallow bank off the western shore, and the large offshore Garapan Bank. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 8 of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al., 2012). Two of the seven listed species within U.S. waters have been confirmed in the nearshore waters of Saipan (Table 1), as explained in more detail in the species sections in Geographical Areas Occupied by the Species above.

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth and is commonly found to 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, and most data are at least several years old, thus it is not practical to map the essential feature on smaller spatial scales within the unit. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the two listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the suite of listed species that have been confirmed in this unit (Table 1), and the best available information on their depth ranges, as noted for each species in the Life History and Biology section above. Of the two listed species confirmed in this unit, *S. aculeata* is the deepest ranging and occurs down to 40 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 40 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may contain the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates in this unit include: (1) 15 fixed and floating AToNs; (2) five Territory-managed boat ramps; and (3) all other currently existing AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures for which we do not have specific information at this time. Managed areas in this unit include: (1) Commonwealth Ports Authority (CPA) harbors, basins, and navigation channels, and their seawall breakwaters; (2) all other channels, turning basins, and berthing areas that are periodically dredged or maintained; and (3) 25 m radius of substrate around each of the AToN bases. These artificial substrates and managed areas are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 40 m, except the artificial substrates and managed areas for this unit summarized above and listed in Appendix A, are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the

Saipan Unit of coral critical habitat is approximately 109 km^2 (42 mi^2), and is shown in Figure 10 below.

3.4.10 FARALLON DE MEDINILLA (FDM)

Farallon de Medinilla (FDM) is an uninhabited island approximately 80 km north of Saipan controlled by the Department of Defense (DoD). The island is approximately 2 km long and 0.5 km wide, but only 20 m wide where the northern and southern parts join. The shores are rimmed with cliffs. FDM has been used by DoD as a live and inert range since 1971. Due to limited access, FDM is not included in PIFSC's Mariana Islands coral reef monitoring report (Brainard et al., 2012). However, since the NCCOS and PIBHMC mapping programs use aerial photography, FDM is included in the map databases cited above. In addition, the Navy has conducted several marine ecological surveys of nearshore marine resources at FDM since 1999, providing biological data for the island, the most recent of which is for surveys conducted on FDM in 2012 (DoN, 2019a). Thus, the NCCOS and PIBHMC map databases and DoN (2019a) provide information for this section. *Acropora globiceps* is the only listed species to have been confirmed at FDM (DoN, 2019a).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information suitable substrate is widely distributed throughout this unit from zero to at least 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists mostly of aggregate reef, which is potentially suitable substrate. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. globiceps*, occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. FDM has no artificial substrates or managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the FDM Unit of coral critical habitat is approximately 0.8 km^2 (0.3 mi^2) and is shown in Figure 11 below.

3.4.11 ANATAHAN

Uninhabited Anatahan Island is located approximately 120 km north of Saipan, has a land area of 34 km^2 (13 mi^2), and is dominated by an active volcano. A compound summit caldera, formed by at least 3 craters, dominates the island. The calderas of Anatahan are surrounded by steeply sloping banks which continue for some distance underwater. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 9 of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al., 2012). *Acropora globiceps* is the only listed species to have been confirmed at Anatahan (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 20 or 30 m depth and is commonly found to 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists mostly of rock and boulder, potentially suitable substrates. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. globiceps*, occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Anatahan Island has no artificial substrates and managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Anatahan Unit of coral critical habitat is approximately 3.8 km^2 (1.5 mi^2), and is shown in Figure 12 below.

3.4.12 PAGAN

Pagan Island is located approximately 280 km north of Saipan, has a land area of 48 km^2 (19 mi^2), and the north part of the island is dominated by an active volcano. Two volcanoes formed this island, and a low-lying, narrow isthmus connects them. Pagan is approximately 17 km long, and seven km across at its widest point. The substrate, water quality, coral, and other benthic resources of this unit are described in Chapter 13 of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al., 2012). *Acropora globiceps* is the only listed species to have been confirmed at Pagan (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists mostly of rock and boulder, potentially suitable substrates. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. globiceps*, occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Pagan Island has no artificial substrates or managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Pagan Unit of coral critical habitat is approximately 12.4 km^2 (4.8 mi^2), and is shown in Figure 13 below.

3.4.13 MAUG ISLANDS AND SUPPLY REEF

This unit consists of three small islands and a reef; the Maug Islands are remnants of the eroded outer rim of a caldera approximately 2 km in diameter, and Supply Reef is a nearby seamount rising to <10 m depth. The Maug Islands are located about 500 km north of Saipan, and have a land area of 2 km^2 (0.8 mi^2). Supply Reef is about 25 km to the north of the Maug Islands, with a minimum depth of 8 m. The substrate, water quality, coral, and other benthic resources of the Maug Islands portion of this unit are described in Chapter 16 of PIFSC's coral reef monitoring report for the Mariana archipelago, while Supply Reef is described in Chapter 18 (Brainard et al., 2012). *Acropora globiceps* is the only listed species to have been confirmed at the Maug Islands.

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. This extensive area consists mostly of rock and boulder, potentially suitable substrates. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. globiceps*, occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. The Maug Islands and Supply Reef have no artificial substrates or managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Maug Unit of coral critical habitat is approximately 3.0 km^2 (1.1 mi^2), and is shown in Figure 14 below.

PRIA

3.4.14 HOWLAND ISLAND

Howland Island is an uninhabited low coral island located just north of the equator in the central Pacific Ocean, and is about 2 km long and 1 km wide. It lies about 3,000 km southwest of Honolulu, and is one of the northernmost members (along with Baker Island) of the Phoenix Islands. The substrate, water quality, coral, and other benthic resources of this unit are briefly described in Chapter 11 (Miller et al., 2008) of the National Centers for Coastal Ocean Science's (NCCOS)NCCOS's 2008 report (Miller et al. 2008), The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States, and citations within. *Acropora retusa* is the only listed species to have been confirmed at Howland (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. retusa*, occurs down to 10 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 10 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Howland Island has no artificial substrates or managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 10 m are considered to qualify biologically for coral critical habitat. Subsequently, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Howland Unit of coral critical habitat is approximately 2.1 km^2 (0.8 mi^2), and is shown in Figure 15 below.

3.4.15 PALMYRA ATOLL

Palmyra Atoll is a coral atoll located 5 degrees north of the equator in the central Pacific Ocean, and lies about 1,800 km southwest of Honolulu. It is made up of several islands, and has about 14 km of coastline. During DoD control of the atoll during the World War II era, a variety of modifications were made, including extensive dredging and construction. The substrate, water quality, coral, and other benthic resources of this unit are briefly described in Chapter 11 (Miller et al., 2008) of NCCOS's 2008 report, The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States, and citations within. *Acropora globiceps* is the only listed species to have been confirmed at Palmyra (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, as well as NCCOS's Palmyra Atoll mapping project data (available at http://products.coastalscience.noaa.gov/collections/benthic/e58palmyra/#horizontalTab1), suitable substrate is widely distributed throughout this unit from zero to at least 50 m or more outside the atoll, and suitable water quality parameters are also widely distributed throughout this unit outside the atoll. The lagoon inside the atoll is primarily a combination of natural and dredged areas of soft substrate. Thus, all marine habitat from 0 to 50 m outside the atoll in this unit has the potential to contain the essential feature. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m outside the atoll are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. globiceps*, occurs down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Managed areas in this unit include the main channel into the lagoon, and the dredged area in the central lagoon. Thus, the entire lagoon and the navigation channel are a mosaic of natural areas lacking essential feature and managed areas, and do not qualify for critical habitat. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m, except the lagoon and navigation channel (Appendix A), are considered to qualify biologically for coral critical habitat. Accordingly, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Palmyra Unit of coral critical habitat is approximately 41.5 km^2 (16.0 mi^2), and is shown in Figure 16 below.

3.4.16 KINGMAN REEF

Kingman Reef is a mostly submerged, triangular reef surrounding a lagoon about 15 km across, and lies about 1,700 km southwest of Honolulu. It lies about 70 km northwest of Palmyra Atoll, and is also part of the Northern Line Islands. The substrate, water quality, coral, and other benthic resources of this unit are briefly described in Chapter 11 (Miller et al., 2008) of NCCOS's 2008 report. The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States, and citations within. In contrast to the other PRIA, three listed species have been found on Kingman: *Acropora retusa*, *A. globiceps*, and *A. speciosa* (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. *Acropora speciosa* is the deepest ranging species in this unit and it occurs down to 40 m. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 40 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Kingman Reef has no artificial substrates or managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 40 m are considered to qualify biologically for coral critical habitat. Accordingly, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Kingman Unit of coral critical habitat is approximately 75 km^2 (29 mi^2), and is shown in Figure 17 below.

3.4.17 JOHNSTON ATOLL

Johnston Atoll is a coral atoll consisting of several small islands, and is located about 1,400 km southwest of Honolulu. During 70 years of DoD control of the atoll, a variety of modifications were made, including extensive dredging and construction, resulting in the land portion of the atoll increasing by approximately ten-fold. The substrate, water quality, coral, and other benthic resources of this unit are briefly described in Chapter 11 (Miller et al., 2008) of NCCOS's 2008 report. The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States, and citations within. *Acropora retusa* is the only listed species to have been confirmed at Johnston Atoll (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. retusa*, occurs down to 10 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 10 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates and managed areas in this unit are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 10 m, except the artificial substrates and managed areas for this unit listed in Appendix A, are considered to qualify biologically for coral critical habitat. Accordingly, these qualifying areas will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Johnston Unit of coral critical habitat is approximately 53.3 km^2 (20.6 mi^2), and is shown in Figure 18 below.

3.4.18 WAKE ATOLL

Wake Atoll is a small coral atoll in the central Pacific Ocean approximately 2,200 miles west of the Hawaiian Islands and 1,600 miles east of Guam. The Atoll has a total land area of approximately 2.73 mi^2 and a total circumference of approximately 10 miles. The atoll consists of three islands (Peale, Wake, and Wilkes islands) arranged in a "V" pattern with a shallow lagoon that is open to the ocean on the northwest side (USAF, 2017). During 80 years of military (U.S. and Japanese) control of the atoll, a variety of modifications were made, including air strip installation, harbor dredging, and facility construction. The atoll is an active Air Force base, which at one time had a population of over 2,000 people, but now is approximately 100 people (USAF, 2017). The substrate, water quality, coral, and other benthic resources of this unit are briefly described in both the Air Force's INRMP (USAF, 2017), and mentioned in Chapter 11 (Miller et al., 2008) of NCCOS's 2008 report. The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States, and citations within. *Acropora globiceps* and *A. retusa* have been confirmed at Wake Atoll (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed outside the barrier reef on the forereef from zero to 40 or 50 m of depth, but substrate inside the lagoon is mostly rubble and sand. In addition, suitable water quality parameters are widely distributed outside the barrier reef on the forereef, but nutrients and turbidity are elevated inside the lagoon. Thus, the marine habitat from 0 to 50 m outside the barrier reef, and across the reef flat inside the barrier reef, has the potential to contain the essential feature, but not inside the lagoon. This extensive forereef area consists of a patchwork of different substrates and water quality parameters that are highly variable both spatially and temporally, thus it is not practical to map the essential feature on smaller spatial scales. Therefore, the results of Step 1 for this unit are that all marine habitat from 0 to 50 m, excluding the lagoon, are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The listed species confirmed in this unit, *A. globiceps* and *A. retusa*, occur down to 20 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 20 m outside the lagoon are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Artificial substrates and managed areas in this unit are listed in Appendix A. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 20 m, except the artificial substrates and managed areas for this unit listed in Appendix A, are considered to qualify biologically for coral critical habitat. Accordingly, these qualifying areas will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Wake Unit of coral critical habitat is approximately 8.3 km^2 (3.2 mi^2), and is shown in Figure 19 below.

3.4.19 JARVIS ISLAND

Jarvis Island is an uninhabited 1.75 mi^2 coral island located in the South Pacific Ocean about halfway between Hawaii and the Cook Islands. The substrate, water quality, coral, and other benthic resources of this unit are briefly described in Chapter 11 (Miller et al., 2008) of NCCOS's 2008 report, The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States, and citations within. *Acropora retusa* is the only listed species to have been confirmed at Jarvis Island (Table 1).

For step 1 of delineating the specific area in this unit that contains the essential feature, we reviewed the information sources indicated above for substrate and water quality parameters. Based on this information, suitable substrate is widely distributed throughout this unit from zero to at least 50 m or more, and suitable water quality parameters are also widely distributed throughout this unit. Thus, all marine habitat from 0 to 50 m in this unit has the potential to contain the essential feature. Therefore, the results of Step 1 for this unit are that all marine areas from 0 to 50 m are considered for Step 2.

To the area identified in Step 1, we applied step 2 by using depth distribution information for the one listed coral species in this unit to delineate upper and lower depth limits. As explained above, the upper depth limit is 0 m. The lower depth limit is based on the depth distribution of the listed species that has been confirmed in this unit (Table 1), and the best available information on its depth range, as noted for each species in the Life History and Biology section above. The only listed species confirmed in this unit, *A. retusa*, occurs down to 10 m depth. Therefore, the results of Steps 1 and 2 for this unit are that all marine areas from 0 to 10 m are considered for Step 3.

To the area identified by Steps 1 and 2, we applied step 3 by identifying areas in this unit that may have the essential feature but are not necessary for the conservation of the listed species, i.e., artificial substrates and managed areas. Jarvis Island has no artificial substrates or managed areas. Therefore, the results of Steps 1, 2, and 3 for this unit are that all marine areas from 0 to 10 m are considered to qualify biologically for coral critical habitat. Accordingly, this specific area will be subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The specific area included in the Jarvis Island of coral critical habitat is approximately 4.0 km^2 (1.5 mi^2), and is shown in Figure 20 below.

Figure 2. Unit 1, Tutuila and offshore banks, showing specific areas considered for proposed critical habitat.

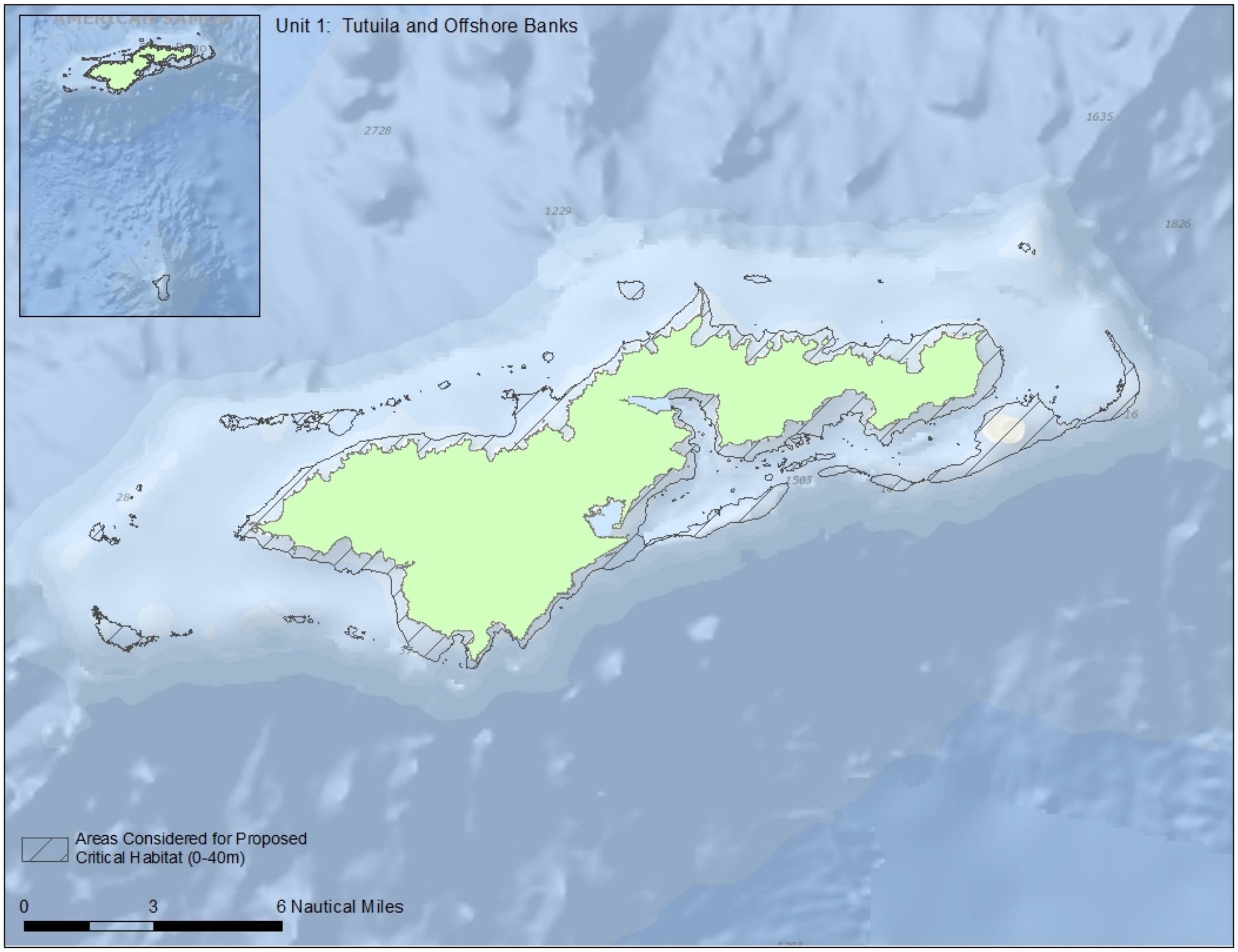


Figure 3. Unit 2, Ofu and Olosega, showing specific areas considered for proposed critical habitat.

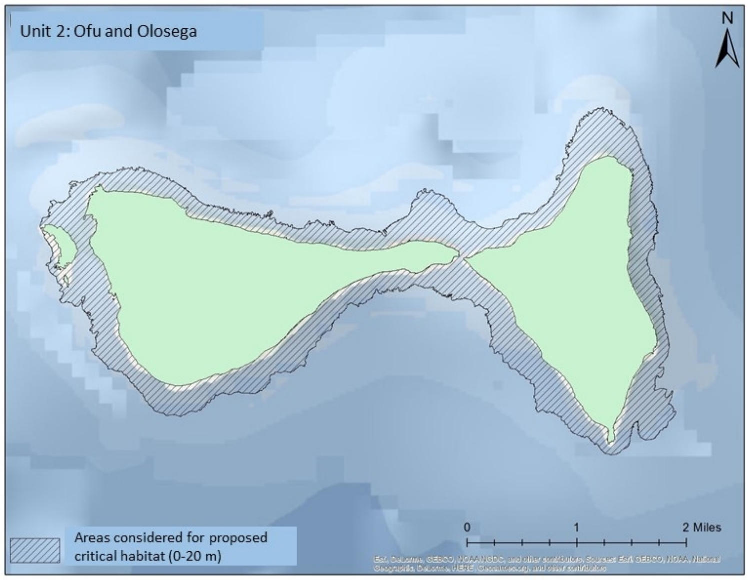


Figure 4. Unit 3, Ta'u, showing areas considered for proposed critical habitat.

Figure 5. Unit 4, Rose Atoll, showing specific areas considered for proposed critical habitat.

Figure 6. Unit 5, Guam and offshore banks, showing specific areas considered for proposed critical habitat.

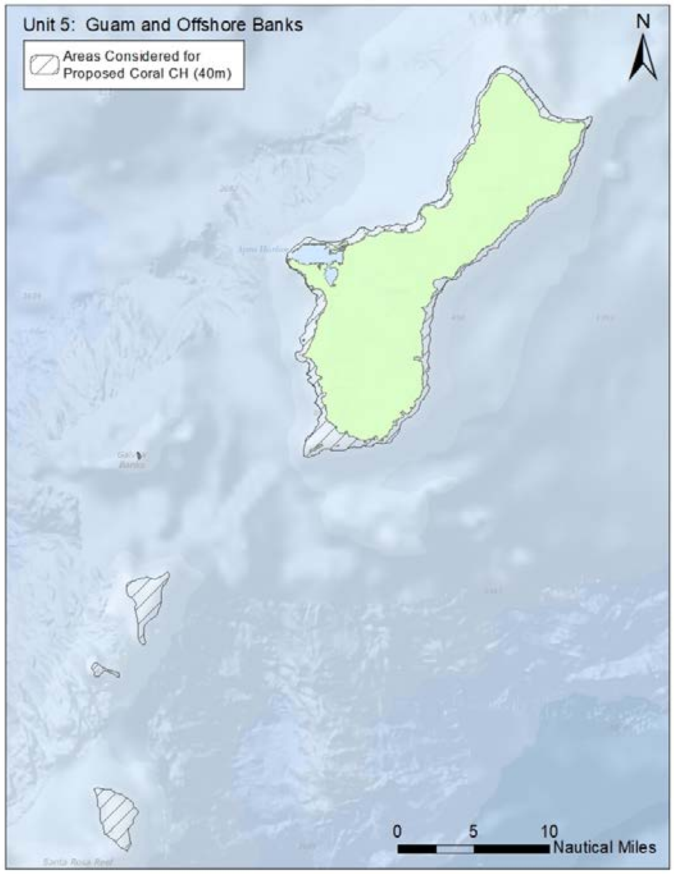


Figure 7. Unit 6, Rota, showing areas considered for proposed critical habitat.

Figure 8. Unit 7, Aguijan, outlining specific areas considered for proposed critical habitat.

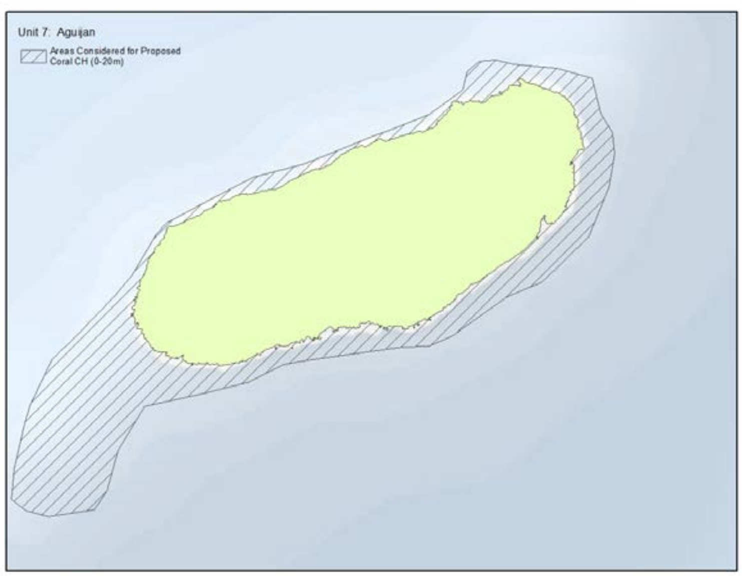


Figure 9. Unit 8, Tinian and Tatsumi Reef, showing specific areas considered for proposed critical habitat.

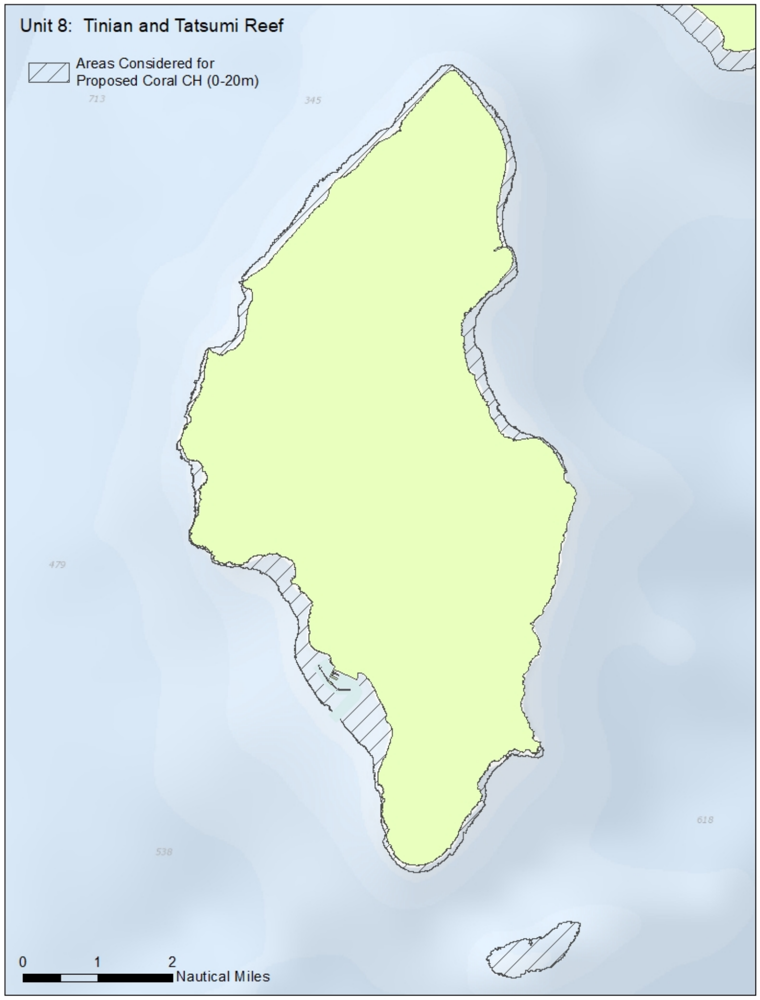


Figure 10. Unit 9, Saipan and Garapan Bank, showing specific areas considered for proposed critical habitat.

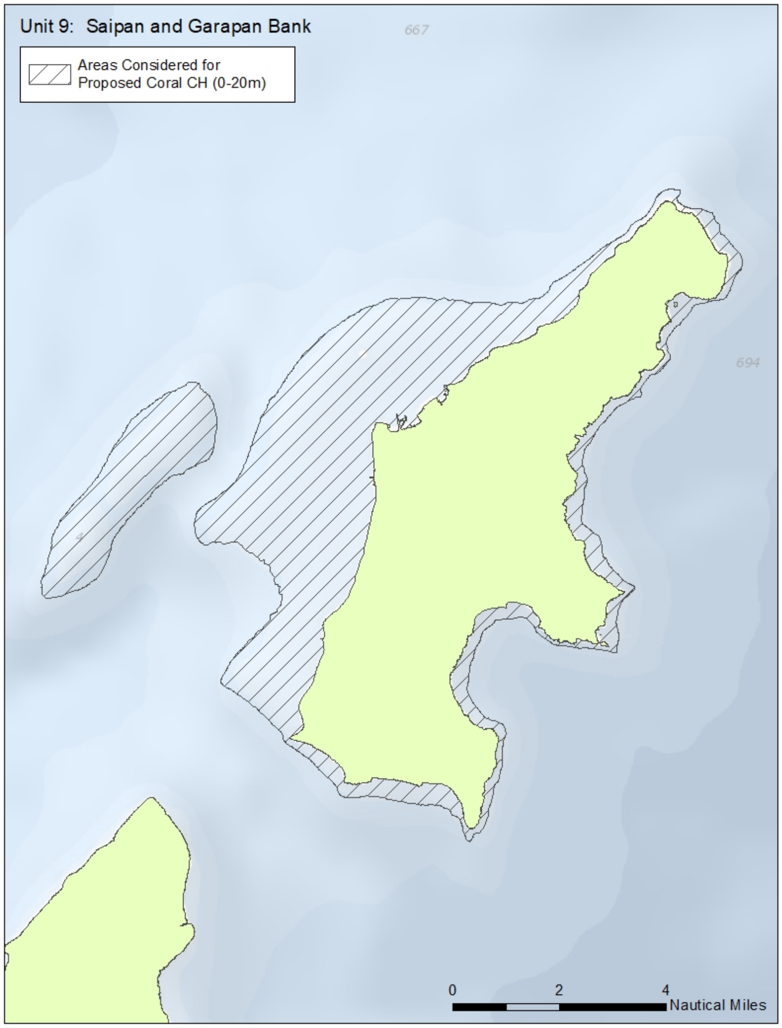


Figure 11. Unit 10, Farallon de Medinilla, showing specific areas considered for proposed critical habitat.

Figure 12. Unit 11, Anatahan, outlining specific areas considered for proposed critical habitat.

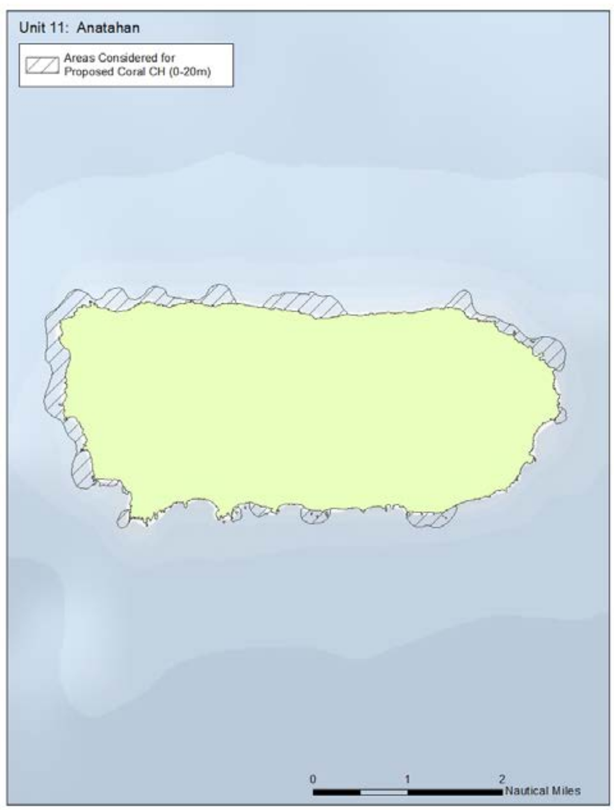


Figure 13. Unit 12, Pagan, showing specific areas considered for proposed critical habitat.

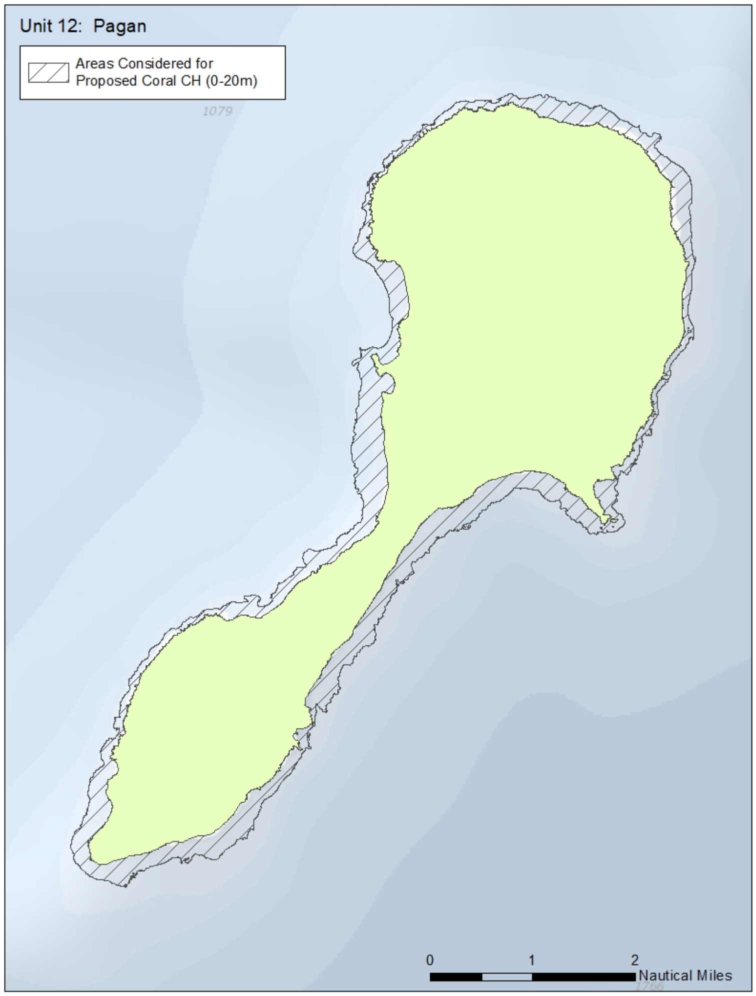


Figure 14. Unit 13, Maug Islands and Supply Reef, showing specific areas considered for proposed critical habitat.

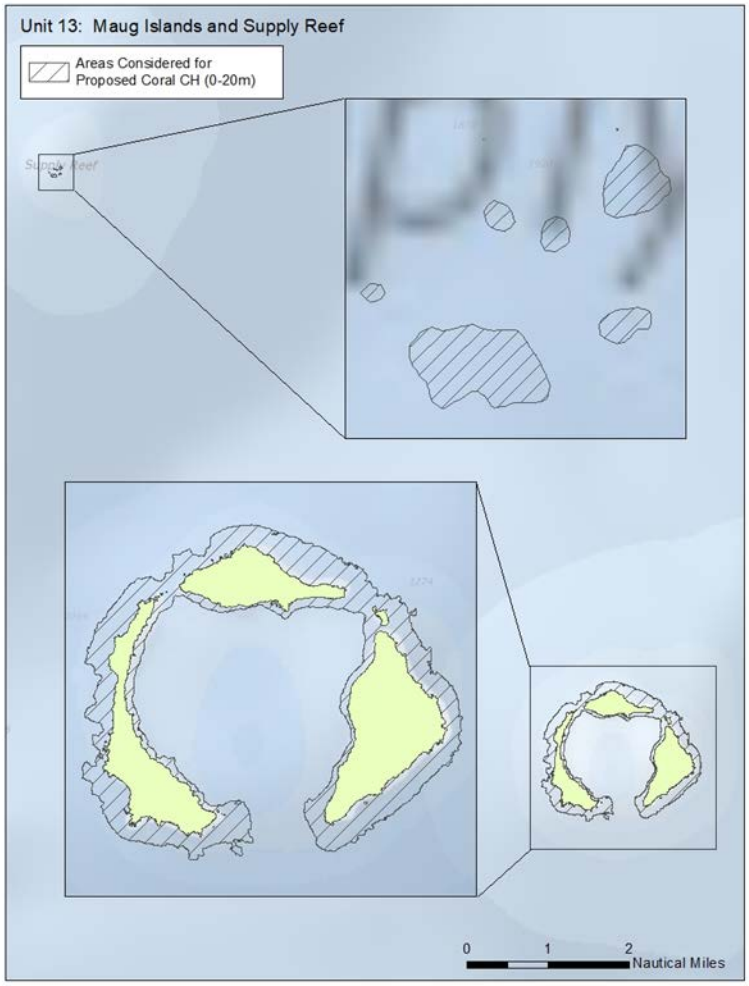


Figure 15. Unit 14, Howland Island, outlining specific areas considered for proposed critical habitat.

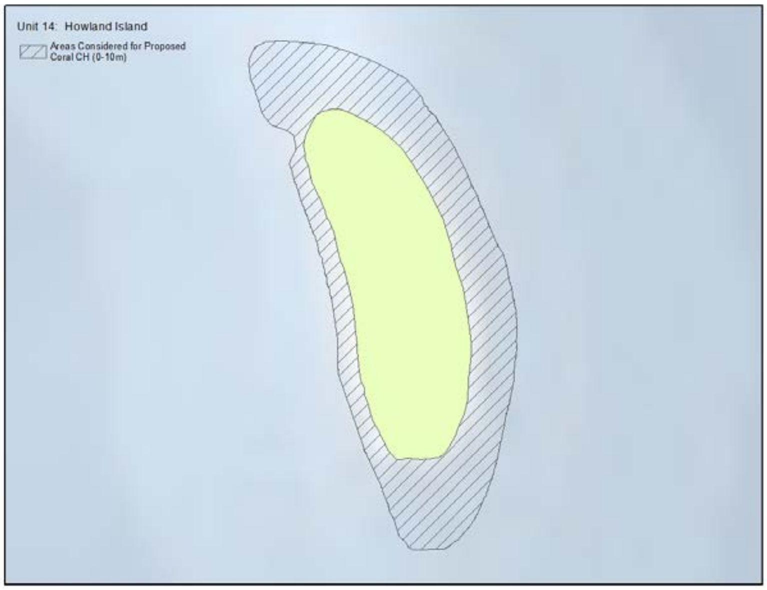


Figure 16. Unit 15, Palmyra Atoll, showing specific areas considered for proposed critical habitat.

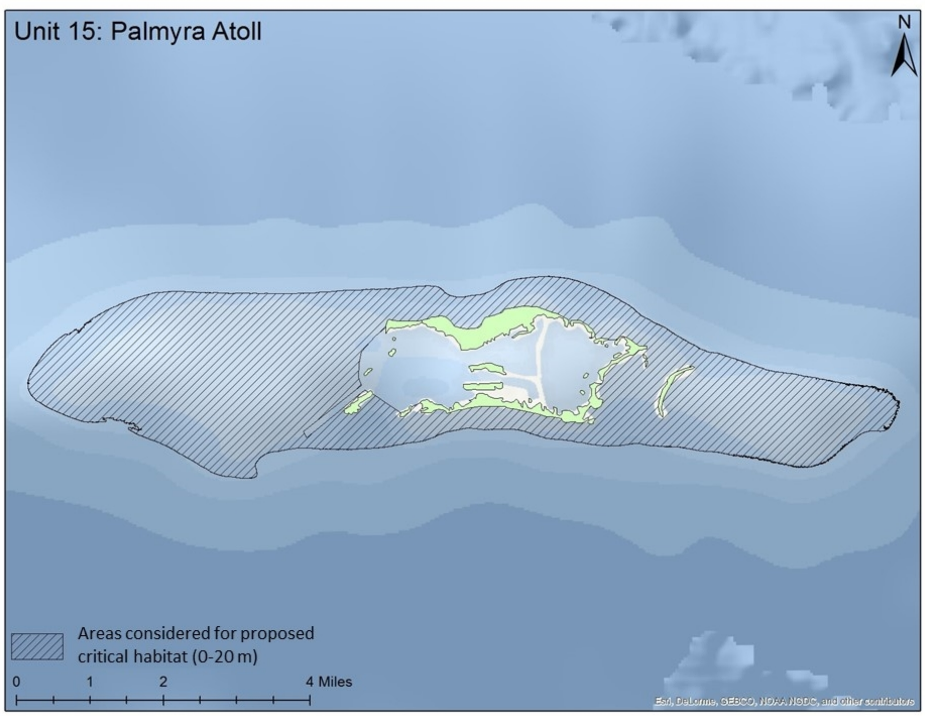
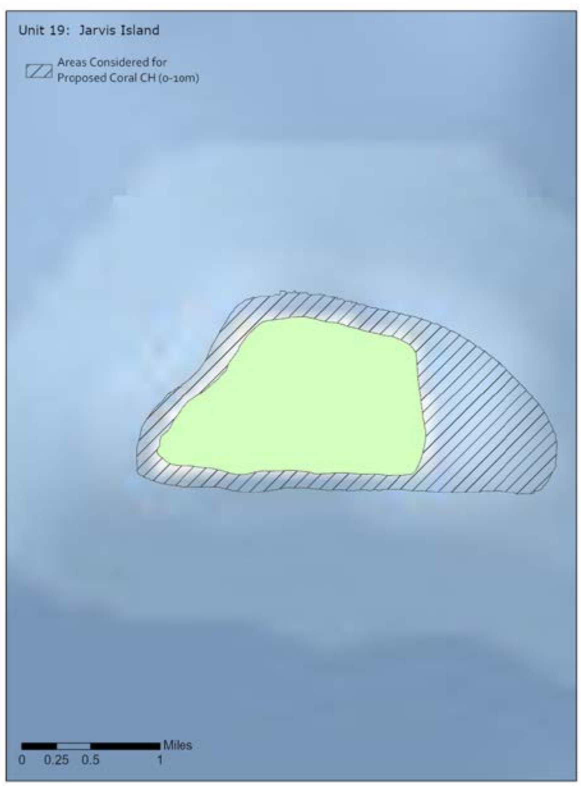


Figure 17. Unit 16, Kingman Reef, showing specific areas considered for proposed critical habitat.

Figure 18. Unit 17, Johnston Atoll, outlining specific areas considered for proposed critical habitat.

Figure 19. Unit 18, Wake Atoll, outlining specific areas considered for proposed critical habitat.

Figure 20. Unit 19, Jarvis Island, outlining specific areas considered for proposed critical habitat.



3.5 UNOCCUPIED AREAS

We have not identified any unoccupied areas for designation of critical habitat. ESA section 3(5)(A)(ii) defines critical habitat to include specific areas outside the geographical area occupied by the species at the time of listing if the areas are determined by the Secretary to be essential for the conservation of the species. Regulations at 50 CFR 424.12(b)(2) specify that we will identify, at a scale determined to be appropriate, specific areas outside the geographical area occupied by the species that are essential for its conservation, considering the life history, status, and conservation needs of the species based on the best available scientific data. Our regulations at 50 CFR 424.12(g) also state: "The Secretary will not designate critical habitat within foreign countries or in other areas outside of the jurisdiction of the United States."

The threats to these seven corals include ocean warming, ocean acidification, and other threats that are primarily caused by global climate change (Brainard et al., 2011). We issued guidance in June 2016 on the treatment of climate change uncertainty in ESA decisions, which addresses critical habitat specifically (NMFS, 2016a). The guidance states that "when designating critical habitat, NMFS will consider proactive designation of unoccupied habitat as critical habitat when there is adequate data to support a reasonable inference that the habitat is essential for the conservation of the species because of the function(s) it is likely to serve as climate changes."

All seven of these species occur in the Coral Triangle, an area predicted to have rapid and severe impacts from climate change. As a response to changing conditions, these species may shift into previously unoccupied habitats as they become more suitable and as other parts of their range become less suitable in the future. However, the best information available currently does not support a reasonable inference that listed Indo-Pacific corals may expand into unoccupied areas within U.S. waters in the future due to changing climate conditions. In addition, coral reef areas within U.S. jurisdiction provide no more than about two percent of each listed species' total range. Without further information, we cannot support the notion that such a small area of unoccupied habitat at the range margin is essential to the conservation of the species. Of note, however, is that all seven species share the same essential feature, and therefore designated critical habitat in areas not currently occupied by any individual species (but designated because of occupation by others) would still provide conservation value should that species occupy that area in the future.

4.0 *Application of ESA Section 4(a)(3)(B)(i)*

Section 4(a)(3)(B)(i) of the ESA was amended by the National Defense Authorization Act (NDAA) of 2004 to preclude the Secretary from designating as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense (DoD), or designated for its use, that are subject to a DoD Integrated Natural Resource Management Plan (INRMP) under the Sikes Act Improvement Act of 1997 (16 U.S.C. §670a), provided that the Secretary certifies in writing that the plan benefits the listed species. That is, DoD-controlled areas that would otherwise qualify for critical habitat are ineligible if an existing INRMP benefits the listed species within those areas.

Neither the ESA nor the 2004 NDAA defines the term "benefit." However, the conference report on the 2004 NDAA (Report 108–354) instructed the Secretary to "assess an INRMP's potential contribution to species conservation, giving due regard to those habitat protection, maintenance, and improvement projects . . . that address the particular conservation and protection needs of the species for which critical habitat would otherwise be proposed." Because a finding of benefit would result in an exemption from critical habitat designation and, given the specific mention of "habitat protection, maintenance, and improvement" in the conference report, we infer that Congress intended that an INRMP provide a conservation benefit to the habitat (e.g., essential feature) of the species, in addition to the species.

Some factors that would help us determine whether an INRMP provides a conservation benefit are provided in 2016 guidance (81 FR 7413; February 11, 2016) and our regulations at 50 C.FR 424.12(h): (1) The extent of the area and features present; (2) The type and frequency of use of the area by the species; (3) The relevant elements of the INRMP in terms of management objectives, activities covered, and best management practices, and the certainty that the relevant elements will be implemented; and (4) The degree to which the relevant elements of the INRMP will protect the habitat from the types of effects that would be addressed through a destruction-or-adverse-modification analysis.

Two signed INRMPs are applicable to our proposed coral critical habitat designation: (1) The Navy's Joint Region Marianas INRMP (JRM INRMP), finalized and signed in 2019 (DoN, 2019a); and (2) the Air Force's INRMP for Wake Island Air Field, Wake Atoll, Kokee Air Force Station, Kauai, Hawaii, and Mt. Kaala Air Force Station, Oahu, Hawaii (Wake INRMP), finalized and signed in 2017 (USAF, 2017). Analyses of whether these two INRMPs are likely to benefit the ESA-listed corals or their habitat are provided below.

4.1 *JRM INRMP*

DoD-controlled marine areas in the Mariana Islands include DoD Submerged Lands. These marine areas are subject to the JRM INRMP (DoN, 2019a), meaning that conservation actions described in the INRMP are carried out within them (hereafter "INRMP marine areas") (DoN, 2019b).

4.1.1 *GUAM*

Guam includes three INRMP marine areas that overlap with areas considered for coral critical habitat: The Submerged Lands on Naval Base Guam – Main Base (NBG Main Base), Naval Base Guam – Telecommunications Site (NBG TS), and Andersen Air Force Base (AAFB) (DoN, 2019a). An analysis of whether the INRMP is likely to benefit the habitat of ESA-listed corals in each of these three INRMP marine areas is provided below, following the 4-step process described the regulation (50 CFR 424.12(h)), as described above.

<u>(1) Extent of The Area and Essential Feature Present</u>: The extent of each INRMP marine area on Guam, and the coral critical habitat essential features within them, are summarized here:

a) *NBG Main Base Submerged Lands*: This INRMP marine area consists entirely of Navy Submerged Lands, designated by Presidential Proclamation 4347 in 1975, making up 30,867 acres, including approximately 3,000 acres within Apra Harbor, and approximately 30,000 acres outside the harbor along the coastline from Orote Peninsula to Asan (Fig. 21). These Submerged Lands and their resources are described in the 2019 JRM INRMP, Section 5.3 (DoN, 2019a), and include extensive areas of potential proposed critical habitat, as shown in Fig. 21.
b) *NBG TS Submerged Lands*. This INRMP marine area also consists entirely of Navy Submerged Lands, making up 19,550 acres of Submerged Lands on the northwestern side of Guam (Fig. 21). These Submerged Lands and their resources are described in the 2019 JRM INRMP, Section 8.3 (DoN, 2019a), and include extensive areas of potential proposed critical habitat, as shown in Fig. 21.
c) *AAFB Submerged Lands*. This INRMP marine area also consists entirely of Navy Submerged Lands, making up 26,529 acres of Submerged Lands on the northern side of Guam (Fig. 21). These Submerged Lands and their resources are described in the 2019 JRM INRMP, Section 9.3 (DoN, 2019a), and include extensive areas of potential proposed critical habitat, as shown in Fig. 21.

Each of the three INRMP marine areas includes extensive potential proposed critical habitat (i.e., hundreds to thousands of acres). Most or all of the potential proposed critical habitat within the three INRMP marine areas includes both the substrate and water quality components of the essential feature of coral critical habitat (i.e., characteristics of substrate and water quality support coral life history, including reproduction, recruitment, growth, and maturation), based on information provided above in the Guam section, the Guam chapter of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al. 2012), and the INRMP (DoN, 2019a).

(2) Use of the Area by the Listed Species. Each of the three INRMP marine areas on Guam includes extensive coral reefs. One listed coral species, *Acropora globiceps*, has been found at many sites around Guam (as described above in also the Geographic Areas Occupied by the Species section), and occurs within all three INRMP marine areas (NMFS 2015a, DoN, 2019a). Two other listed coral species, *Acropora retusa* and *Seriatopora aculeata*, have been recorded on Guam at one or two sites (as also described above in the Geographic Areas Occupied by the Species section), and thus may occur in the three INRMP marine areas (DoN, 2019a).

(3) Relevant Elements of the INRMP (3a), and Certainty That the Relevant Elements will be Implemented (3b). The two parts of this step are addressed below:

(3a) Relevant Elements: The relevant elements in the INRMP for each INRMP marine area on Guam are summarized here:

a) *NBG Main Base Submerged Lands*: The INRMP includes a Coral Habitat Enhancement plan for NBG Main Base Submerged Lands (Section 5.4.2.1), consisting of a Strategy and eight specific actions in three categories: (1) Monitoring and adaptive management (3 actions); (2) collaboration with local partners (3 actions); and (3) reduction of vessel impacts (2 actions; DoN, 2019a).
b) *NBG TS Submerged Lands*. The INRMP includes a Coral Habitat Enhancement plan for NBG TS Submerged Lands (Section 8.4.2.1), consisting of a Strategy and eight specific actions in three categories that are the same as for NBG Main Base, except that Action #7 includes installing and maintaining a mooring buoy at 1 location within NBG TS (Double Reef)(DoN, 2019a).
c) *AAFB Submerged Lands*. The INRMP includes a Coral Habitat Enhancement plan for AAFB Submerged Lands (Section 9.4.2.1), consisting of a Strategy and seven specific actions in three categories that are the same as for NBG Main Base, except that there is no mooring buoy action (DoN, 2019a), because the AAFB

submerged waters are infrequently used by boats that would use such moorings.

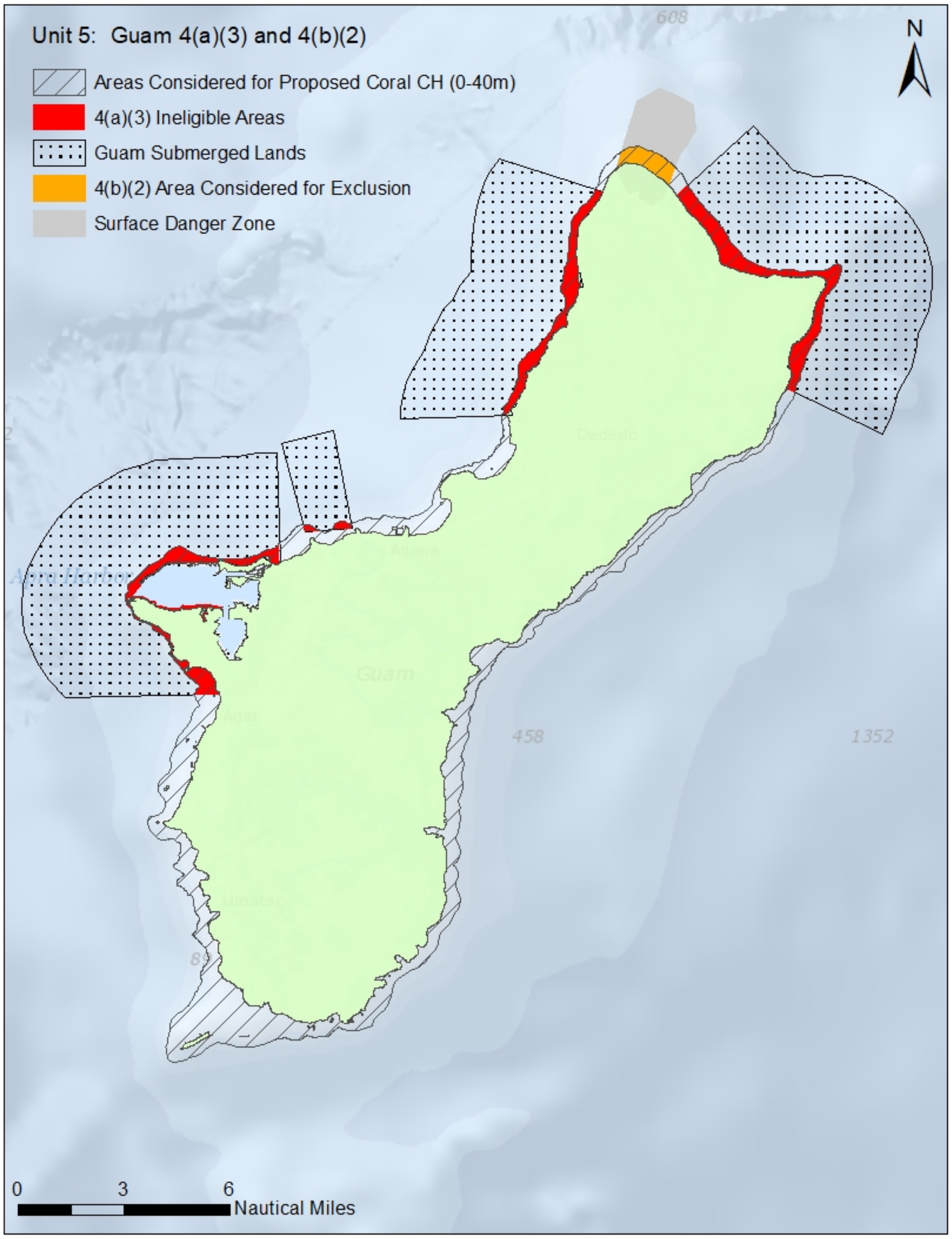
(3b) Certainty that Relevant Elements Will be Implemented: Part of this factor is the certainty that the relevant elements will be implemented. NMFS has certainty that the Navy will implement the elements of the JRM INRMP related to coral habitat within all INRMP marine areas in Guam for three reasons: (1) clear and recent documentation of marine conservation work in Guam; (2) good faith efforts by the Navy to conserve corals and their habitat in Guam; and (3) a Navy history of marine conservation work in Guam, as explained in more detail below:

a) *Clear and Recent Documentation*: As described above, the 2019 JRM INRMP includes Coral Habitat Enhancement plans for INRMP marine areas in Guam, with clear strategies and actions that address the habitat conservation needs of ESA-listed corals within these areas. The JRM INRMP's Appendix D also includes annual reports describing how coral conservation efforts have been implemented in recent years. These new coral habitat conservation plans, as well as reports from recent years, clearly articulate how Navy is conserving coral habitat within the INRMP marine areas in Guam, and how it will do so in the future.
b) *Demonstration of Good Faith Efforts for Listed Corals*: Navy has already implemented coral habitat conservation projects that are beneficial to ESA-listed corals within some INRMP marine areas in Guam, as described in the INRMP annual reports in the JRM INRMP's Appendix D (DoN, 2019a). For example, in Fiscal Year 2018 (Oct-18 to Sep-19, FY18), the following coral habitat conservation projects were carried out by the Navy within these waters: (1) 20 mooring buoys were installed within NBG Main Base submerged waters to prevent anchoring on its coral reefs; (2) monitoring of the impacts of coral bleaching and crown of thorns starfish (COTS) on reef-building corals including listed species; (3) coral surveys of Apra Harbor including listed species; (4) translocation of corals from a dredging area within Apra Harbor (no listed corals); (5) water quality monitoring; and (6) environmental education and outreach (DoN, 2019a, Appendix D, FY18 Annual Report). Many of these projects have been ongoing for several years and are proactive, in that they were not required of the Navy by the ESA.
c) *History of Strong Conservation Work*: The Navy has a long history of carrying out successful marine habitat conservation work on Guam, and often takes the initiative on conservation efforts whether requested by NMFS or FWS or not. For example, many of the coral habitat conservation projects in the 2019 JRM INRMP had already been started by the Navy before corals were listed in 2014, and were being done to improve conservation of marine resources

on the island, regardless of whether they were required by federal statute or not.

(4) Degree to Which INRMP Will Protect Coral Habitat. Finally, we must consider the degree to which the relevant elements of the JRM INRMP will protect the essential feature of coral critical habitat (reproductive, recruitment, growth, and maturation habitat) from the types of effects that would be addressed through critical habitat consultation, i.e., the destruction-or-adverse-modification analysis. That is, how does the protection of the essential feature within the INRMP marine areas in Guam provided by the INRMP compare to that provided by critical habitat via Section 7 consultations between NMFS and the Navy (and other DoD branches)? If fully implemented, the coral habitat enhancement elements of the JRM INRMP described above will substantially reduce the types of effects within the INRMP marine areas in Guam that would be addressed through the destruction-or-adverse-modification analysis. Navy would accomplish this primarily by using the results of its own monitoring program to develop and implement management measures to minimize the impacts of Navy's (and other DoD branches') actions in Guam and CNMI on coral habitat within the INRMP marine areas.

Figure 21. Guam's 4(a)(3) INRMP marine areas, showing overlap with areas considered for proposed coral critical habitat.



4.1.2 *CNMI*

CNMI includes two INRMP marine areas – the Submerged Lands of the Tinian Marine Lease Area (Tinian MLA) and around Farallon de Medinilla (FDM) (DoN, 2019a). The Tinian MLA's Submerged Lands include over half of the potential proposed coral critical habitat on Tinian (Fig. 22). FDM's Submerged Lands encompass all potential proposed coral critical habitat on FDM, described and shown in the FDM section above

(6.10) and in Figure 11. An analysis of whether the JRM INRMP is likely to benefit the habitat of ESA-listed corals in these two INRMP marine areas in CNMI is provided below, following the 4-step process described in our regulations (50 CFRN 600.424(h).).

<u>(1) Extent of Area and Essential Feature Present</u>: The extent of the two INRMP marine areas in CNMI, and the coral critical habitat essential features within them, are summarized here:

a) *Tinian MLA*: The Tinian MLA consists of 47,418 acres of Navy Submerged Lands surrounding the northern portion of Tinian (Fig. 22). These Submerged Lands and their resources are described in the 2019 JRM INRMP, Section 11.3 (DoN, 2019a), and include extensive areas of potential proposed critical, as shown in Fig. 22.
b) *FDM Submerged Lands*. The FDM Submerged Lands consists of 25,094 acres of Navy Submerged Lands surrounding the island (see Fig. 11 in section 6.10 above). These Submerged Lands and their resources are described in the 2019 JRM INRMP, Section 12.3 (DoN, 2019a), and include extensive areas of potential proposed critical habitat.

Both of these INRMP marine areas include extensive potential proposed critical habitat (i.e., hundreds to thousands of acres). Most or all of the potential proposed critical habitat within the two INRMP marine areas includes both the substrate and water quality components of the essential feature of coral critical habitat (i.e., characteristics of substrate and water quality support coral life history, including reproduction, recruitment, growth, and maturation), based on information provided above in the Tinian and FDM sections, the Tinian and FDM chapters of PIFSC's coral reef monitoring report for the Mariana archipelago (Brainard et al. 2012), and the INRMP (DoN, 2019a).

<u>(2) Use of the Area by the Listed Species</u>. The Tinian MLA includes extensive coral reefs. The listed coral species, *Acropora globiceps*, has been found at many sites throughout the Tinian MLA and elsewhere on Tinian, as described above in the Geographic Areas Occupied by the Species section above. Another listed coral species, *Acropora retusa*, has also been recorded at one site within the Tinian MLA, as shown in Table 11-9 of the JRM INRMP (DoN, 2019a). The FDM Submerged Lands include extensive coral reefs. The listed coral species, *Acropora globiceps*, has been recorded at FDM, as described above in the Geographic Areas Occupied by the Species section above and in the INRMP (DoN, 2019a).

<u>(3) Relevant Elements of the INRMP (3a), and Certainty That the Relevant Elements will be Implemented (3b)</u>. The two parts of this step are addressed below:

(3a) Relevant Elements: The relevant elements in the INRMP for the INRMP marine areas in CNMI are summarized here:

a) *Tinian MLA*: The relevant elements in the INRMP for the Tinian MLA are summarized here. The INRMP includes a Coral Habitat Enhancement plan for the Tinian MLA (Section 11.4.2.1), consisting of a Strategy and three specific actions: (1) Establish long-term monitoring programs to track changes in the health of corals and water quality that are compatible with existing monitoring programs in Guam and the CNMI; (2) establish a monitoring program for the detection of coral bleaching and disease within JRM Submerged Lands. Monitoring methodology will be coordinated with resource partners; and (3) establish a COTS monitoring and control program based on best available methods that are effective in JRM Submerged Lands to reduce COTS predation on corals and fish in Essential Fish Habitat (EFH). When COTS control is enacted, it will include monitoring pre, during, and post-intervention. (DoN, 2019a).
b) *FDM Submerged Lands*: The relevant elements in the INRMP for the FDM Submerged Lands are summarized here. The INRMP includes a Marine Habitat Management plan for the FDM marine area (Section 12.4.2.1), consisting of surveys and mapping of coral reef and other marine habitats within the area. The INRMP also includes assessment of ESA-listed corals, as required by the 2015 biological opinion on the Navy's Mariana Islands Testing and Training program (Section 12.4.2.2)(DoN, 2019a).

(3b) Certainty that Relevant Elements Will be Implemented: Part of this factor is the certainty that the relevant elements will be implemented. NMFS has high certainty that the Navy will implement the elements of the JRM INRMP for the INRMP marine areas in CNMI (Tinian MLA, FDM Submerged Lands) for three reasons: (1) clear and recent documentation of marine conservation work in the Mariana Islands; (2) good faith efforts by the Navy to conserve corals and their habitat in the Mariana Islands; and (3) a Navy history of marine conservation work in the Mariana Islands, as explained in more detail below:

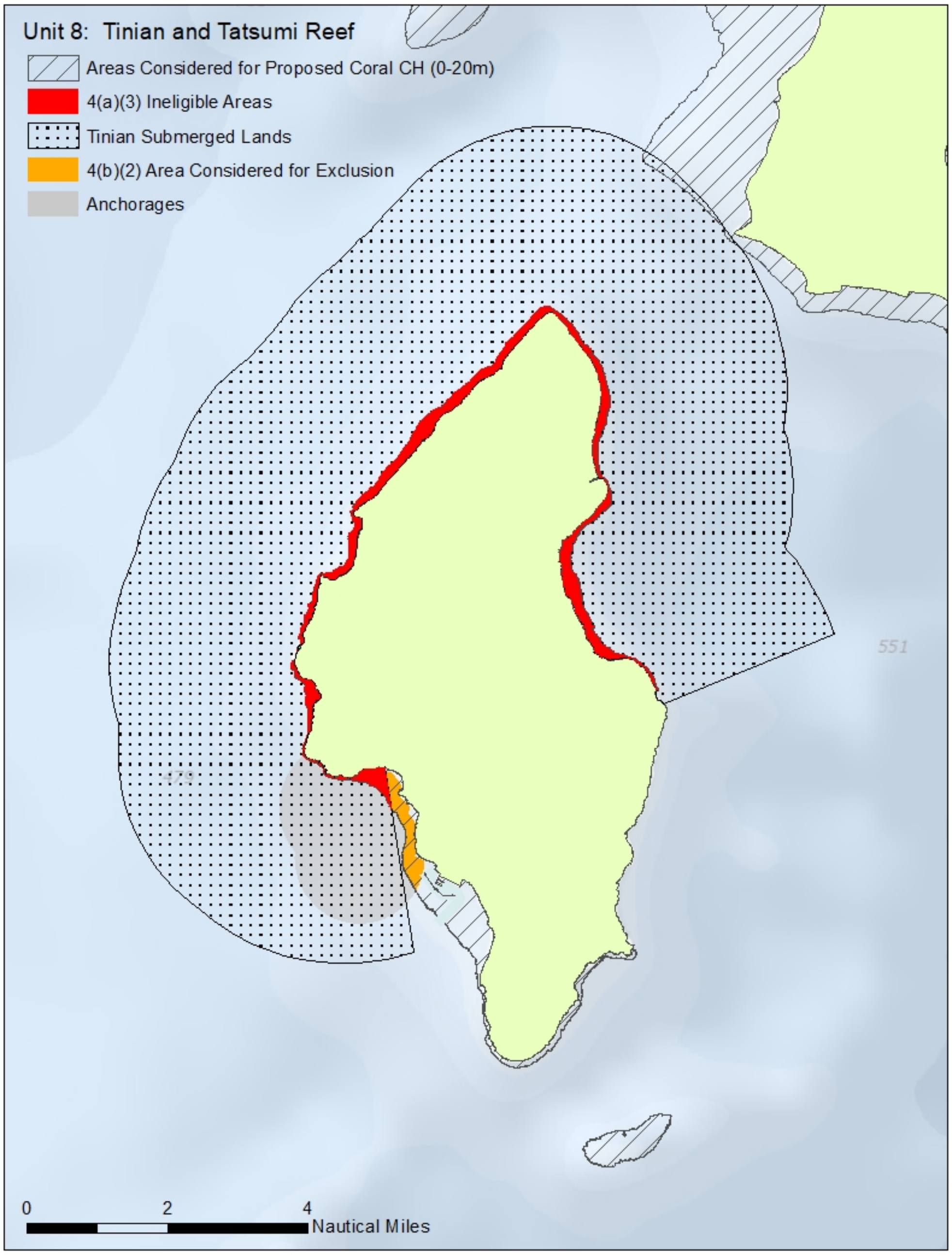
a) *Clear and Recent Documentation*: As described above, the 2019 JRM INRMP includes Coral Habitat Enhancement plans for INRMP marine areas in CNMI (Tinian MLA, FDM Submerged Lands), with clear strategies and actions that address the habitat conservation needs of ESA-listed corals within these areas. The JRM INRMP's Appendix D also includes annual reports describing how coral conservation efforts have been implemented in recent years in INRMP marine areas in CNMI. These new coral habitat conservation plans, as well as reports from recent years, clearly articulate how Navy is conserving coral habitat within the INRMP marine areas in CNMI, and how it will do so in the future.

b) *Demonstration of Good Faith Efforts for Listed Corals*: Navy has already implemented coral projects that have the potential to benefit the habitat of ESA-listed corals within INRMP marina areas in CNMI (Tinian MLA, FDM Submerged Lands). For example, coral species presence and abundance surveys were conducted within the Tinian MLA in 2013 (DoN, 2014) and 2017 (DoN, 2017), and around FDM in 2012 (Smith and Marx, 2016) and 2017 (Carilli et al., 2018). These surveys were not required by the ESA, and have the potential to benefit the habitat of ESA-listed corals by providing information needed to better protect these areas in the future.

c) *History of Strong Conservation Work*: The Navy has a long history of carrying out successful marine habitat conservation work in the Mariana Islands, and often takes the initiative on conservation efforts whether requested by NMFS or FWS or not. For example, many of the coral habitat conservation projects in the 2019 JRM INRMP had already been started by the Navy before corals were listed in 2014, and were being done to improve conservation of marine resources on the island, regardless of whether they were required by federal statute or not. While the great majority of these projects have been implemented in Guam rather than CNMI, the JRM INRMP includes many plans for CNMI (as noted above), and the same Navy office (Navy Facilities Marianas) is responsible for carrying out such work in both Guam and CNMI.

<u>(4) Degree to Which INRMP Will Protect Coral Habitat</u>. Finally, we must consider the degree to which the relevant elements of the JRM INRMP will protect the essential feature of coral critical habitat (reproductive, recruitment, growth, and maturation habitat) from the types of effects that would be addressed through critical habitat consultation, i.e., the destruction-or-adverse-modification analysis. That is, how does the protection of the essential feature within the INRMP marine areas in CNMI (Tinian MLA and FDM Submerged Lands) provided by the INRMP compare to that provided by critical habitat via Section 7 consultations between NMFS and the Navy (and other DoD branches)? If fully implemented, the coral habitat enhancement elements of the JRM INRMP described above will substantially reduce the types of effects within the INRMP marine areas in CNMI that would be addressed through the destruction-or-adverse-modification analysis. Navy would accomplish this primarily by using the results of its own monitoring program to develop and implement management measures to minimize the impacts of Navy's (and other DoD branches') actions in CNMI on coral habitat within the INRMP marine areas. Thus, implementation of the JRM INRMP is likely to provide substantial protection to the essential feature of coral critical habitat (reproductive, recruitment, growth, and maturation habitat) within the CNMI INRMP marine areas from the types of effects that would be addressed through critical habitat consultation.

Figure 22. Tinian's 4(a)(3) INRMP marine area (the Tinian Marine Lease Area's Submerged Lands), and two 4(b)(2) requested exclusion areas (the USCG Anchorages), showing overlap with areas considered for proposed coral critical habitat.



4.1.3 *CONCLUSION FOR JRM INRMP*

In conclusion, based on our determination of the regulatory factors, the JRM INRMP (DoN, 2019a) will benefit the habitat of listed corals in all INRMP marine areas, because: (1) extensive habitat area and essential feature occurs within the INRMP marine areas; (2) these areas are used extensively by at least one listed coral species, *A. globiceps*; (3) the INRMP provides a conservation benefit to the species and its habitat;; and (4) the INRMP's relevant elements will protect the habitat of listed corals from the types of effects that would be addressed through a destruction-or-adverse-modification analysis (i.e., section 7 analyses).

4.2 *WAKE ATOLL INRMP*

The waters surrounding Wake Atoll out to 12 nautical miles are part of the U.S. National Wildlife Refuge System managed by the U.S. Fish and Wildlife Service. However, in 1972, the Departments of the Interior and Defense signed an agreement granting the U.S. Air Force (USAF) full authority for civil administration of the atoll, thereby giving DoD control of access and use of these waters (USAF, 2015, Appendix D). This DoD-controlled marine area is subject to the Wake INRMP (USAF, 2017), meaning that conservation actions described in the Wake INRMP affect the waters within and surrounding the atoll (hereafter "INRMP marine area"). This INRMP marine area (shown in Fig. 5-10, USAF, 2017) encompasses all potential proposed coral critical habitat around the atoll described and shown in the Wake section above and Figure 19. An analysis of whether the INRMP is likely to benefit the habitat of ESA-listed corals in the INRMP marine area is provided below, following the 4-step process described in our regulations at 50 CFR 424.12(h).

<u>(1) Extent of Area and Essential Feature Present</u>: The Wake INRMP marine area includes 495,515 acres of Submerged Lands and waters within the lagoon and surrounding the atoll out to 12 nautical miles from the mean low water line (USAF, 2017), and thus includes all reef-building corals and coral reefs associated with the atoll. A coral survey conducted in 2005 around the entire circumference of Wake Atoll at approximately 9 – 29 m (30 – 95 ft) depth documented 101 reef-building coral species and 36 percent live coral cover. USFWS conducted a coral reef survey on Wake in August 2016, recording reef type and condition as well as coral species (USFWS, 2017). Based on this information, we conclude that the essential feature is widespread around this INRMP marine area.

<u>(2) Use of the Area by the Listed Species</u>. Although no listed coral species were recorded around Wake Atoll by Kenyon (2013), the USFWS coral survey at Wake in August 2016 recorded colonies of both *A. globiceps* and *A. retusa* on the south side of Wake in the vicinity of the three sites (USFWS 2017, USAF, 2017). Thus, we assume that at least these two listed species occur throughout much of the INRMP marine area.

(3) Relevant Elements of the INRMP (3a), and Certainty That the Relevant Elements will be Implemented (3b). The two parts of this step are addressed below:

(3a) Relevant Elements: The relevant elements in the Wake INRMP for the INRMP marine area are summarized here. The Wake INRMP (USAF, 2017) includes a new coral conservation component (Appendix S, Coral Conservation Actions at Wake Atoll), made up of 4 groups of actions: water quality improvements, education and outreach, fisheries management, and physical DoD presence on Wake Atoll. Each group of actions consists of several projects, listed below. The INRMP provides a project or contract number for each project, as well as a description of how each project is expected to benefit ESA-listed corals.

1. Water Quality Improvement Actions:
    a. Wake Stormwater Pollution Prevention.
    b. Spill Prevention Control and Countermeasure Plan.
    c. National Pollution Discharge Elimination System – Reverse Osmosis Permit.
    d. Invasive Species – Ironwood and Rat Removal.
    e. Native Ecosystems Management.
    f. Wetland and Floodplain Management.
2. Education and Outreach:
    a. Outdoor Recreation and Public Access to Natural Resources, Outreach
    b. Wake Island Dive Club Memorandum (on actions to reduce likelihood of contact with corals).
3. Fisheries Management:
    a. Wake Island Operating Guidance – Environmental Compliance and Protection of Natural Resources.
    b. Management of ESA-listed Corals (species surveys of all coral and coral reef habitats of Wake Atoll, including lagoon, reef flats, and slopes).
    c. Management of Fish Populations.
    d. Management of Bumphead Parrotfish and Humphead Wrasse.
4. Physical DoD Presence on Wake Atoll:
    a. Public Access Restrictions (32 CFR Part 935 Wake Island Code).
    b. INRMP 5 Year Review and Update.
    c. INRMP Annual Review and Update.

(3b) Certainty that Relevant Elements Will be Implemented: Part of this factor is the certainty that the relevant elements will be implemented. NMFS has high certainty that USAF will implement the ESA-listed coral elements of the Wake INRMP because of clear and recent documentation, good faith efforts by USAF to conserve ESA-listed corals on Wake Atoll, and a USAF history of strong conservation work on Wake Atoll:

1. *Clear and Recent Documentation*: As described above, the Wake INRMP includes a coral conservation plan (Appendix S) with a 4-pronged strategy (water quality improvement, outreach and education for Wake-based staff, fisheries management, and physical DoD presence on Wake Atoll i.e., restriction of access and overall natural resource management) that comprehensively addresses the conservation needs of ESA-listed corals on Wake Atoll. This new official coral conservation plan clearly articulates how USAF is conserving corals on Wake, and how it will do so in the future.
2. *Demonstration of Good Faith Efforts for Listed Corals*: USAF has already implemented projects on Wake for each of its 4-pronged coral conservation strategy, as explained in Appendix S of the Wake INRMP. For water quality improvement, in 2016 USAF began implementation of both the stormwater pollution prevention and invasive plant control projects. For outreach and education, in 2016 USAF revised the Wake Island Dive Club Charter to further reduce the potential impacts of recreational activities on corals. For fisheries management, in 2017 USAF updated its fishing rules, which are part of the Wake Island Operating Guidance (PSRC 2017) to prohibit the use of (1) cast nets on the exterior of the atoll, (2) anchoring on coral reef habitat, and (3) and trolling over coral reef habitat. For physical DoD presence on Wake Atoll, in 2016 USAF funded and provided logistical support for a FWS coral survey that documented two ESA-listed corals on the atoll for the first time.
3. *History of Strong Conservation Work*: USAF has a long history of carrying out successful conservation work on Wake, and often takes the initiative on conservation efforts whether requested by NMFS or FWS or not. For example, many of the projects in the new INRMP's coral conservation strategy had already been started by USAF before corals were listed in 2014, and were being done to improve conservation of marine and terrestrial resources on the atoll, regardless of whether they were required by federal statute or not. Likewise, in 2016, USAF funded and supported the FWS coral survey of the atoll, leading to the discovery of two ESA-listed corals. In addition, USAF has historically been an excellent conservation partner with NMFS and FWS, supporting a wide variety of marine and terrestrial conservation projects, and actively engaging both agencies in the INRMP planning and implementation process.

<u>(4) Degree to Which INRMP Will Protect Coral Habitat</u>. Finally, we must consider the degree to which the relevant elements of the Wake INRMP will protect the essential feature of coral critical habitat (reproductive,

recruitment, growth, and maturation habitat) from the types of effects that would be addressed through critical habitat consultation, i.e., the destruction-or-adverse-modification analysis. Because all federal actions at Wake are controlled by USAF, the question is how does the protection of the essential feature within INRMP marine area provided by the INRMP compare to that provided by critical habitat via Section 7 consultations between NMFS and USAF? If fully implemented, the coral conservation component of the Wake INRMP (Appendix S, Coral Conservation Actions at Wake Atoll) is expected to reduce both direct and indirect impacts to listed corals via minimization or avoidance of recreational impacts (fishing, diving, anchoring), and terrestrial impacts (i.e., run-off from land-based activities; USAF, 2017), thereby addressing two of the primary threats to listed corals (fishing and land-based sources of pollution).. Thus, after consideration of the above factors, we determined that the Wake INRMP provides a benefit to listed corals; and their critical habitat (reproductive, recruitment, growth, and maturation habitat).

In conclusion, based on the above factors, we determined that the Wake INRMP (USAF, 2017) will benefit the habitat of listed corals, because: (1) extensive habitat area and essential feature occurs within the INRMP marine areas; (2) these areas are used by at least two listed coral species, *Acropora globiceps* and *A. retusa;* (3) the INRMP includes extensive elements for the conservation of the habitat of listed corals that are likely to be implemented; and (4) the INRMP's relevant elements will protect the habitat of listed corals from the types of effects that would be addressed through a destruction-or-adverse-modification analysis (i.e., section 7 determination).

4.3 4(A)(3) CONCLUSION

Based on the above analyses, we determined that the implementation of the JRM INRMP (DoN, 2019a) and the Wake INRMP (USAF, 2017) both provided a benefit to the habitats of ESA-listed coral species within INRMP marine areas on Guam, Tinian, FDM, and Wake. The overlap of these INRMP marine areas with potential proposed coral critical habitat are shown in Figure 21 above for Guam, and Figure 22 above for Tinian. On FDM and Wake, the INRMP marine areas completely encompass all the potential proposed coral critical habitat shown, which is shown earlier in this report in Figures 11 (FDM) and 19 (Wake). Thus, the potential proposed coral critical habitat within the INRMP marine areas on Guam, Tinian, FDM, and Wake are ineligible for coral critical habitat, as described in the Introduction to Section 9.0 above.

5.0 *Application of ESA Section 4(b)(2)*

Section 4(b)(2) of the ESA requires that we consider the economic impact, impact on national security, and any other relevant impact, of designating any particular area as critical habitat. Additionally, the Secretary has the discretion to consider excluding any area from critical habitat if he or she determines that the benefits of exclusion (that is, avoiding some or all of the impacts that would result from designation) outweigh the benefits of designation based upon the best scientific and commercial data available. The Secretary may not exclude an area from designation if exclusion will result in the extinction of the species. Because the authority to exclude is discretionary, exclusion is not required for any particular area under any circumstances.

The ESA provides the USFWS and NMFS (the Services) with broad discretion in how to consider impacts. (See, H.R. Rep. No. 95-1625, at 17, reprinted in 1978 U.S.C.C.A.N. 9453, 9467 (1978). "Economics and any other relevant impact shall be considered by the Secretary in setting the limits of critical habitat for such a species. The Secretary is not required to give economics or any other "relevant impact" predominant consideration in his specification of critical habitat...The consideration and weight given to any particular impact is completely within the Secretary's discretion."). Courts have noted the ESA does not contain requirements for any particular methods or approaches (See, *e.g.*, Bldg. Indus. Ass'n of the Bay Area et al. v. U.S. Dept. of Commerce et al., 792 F.3d 1027 (9th Cir. 2015) (upholding district court's ruling that the ESA does not require the agency to follow a specific methodology when designating critical habitat under Section 4(b)(2)).

The following sub-sections describe the economic, national security, and other relevant impacts that we projected would result from including the specific areas described above in the proposed critical habitat designation. We considered these impacts when deciding whether to exercise our discretion to propose excluding particular areas from the designation. Both positive and negative impacts were identified and considered (these terms are used interchangeably with benefits and costs, respectively). Impacts were evaluated in quantitative terms where feasible, but qualitative appraisals were used where that is more appropriate.

The primary impacts of a critical habitat designation result from the ESA section 7(a)(2) requirement that Federal agencies ensure that their actions are not likely to result in the destruction or adverse modification of critical habitat, and that they consult with NMFS in fulfilling this requirement. Determining these impacts is complicated by the fact that section 7(a)(2) also requires that Federal agencies ensure their actions are not likely to jeopardize the species' continued existence. One incremental impact of designation is the extent to which Federal agencies modify their proposed actions to ensure that they are not likely to destroy or adversely modify the critical habitat beyond any modifications they would make because of listing and the jeopardy requirement. When the same modification would be required due to impacts to both the species and critical habitat, the impact of the designation is co-extensive with the ESA listing of the species (i.e., attributable to both the listing of the species and the designation critical habitat). To the extent possible, our analysis identified impacts that were incremental to the proposed designation of critical habitat, meaning those impacts that are over and above impacts attributable to the species' listing or any other existing regulatory protections. Relevant, existing regulatory protections (including the species' listing) are referred to as the "baseline" and are also discussed in the following sections.

The following economic and national security impact analyses describe projected future federal activities that would trigger section 7 consultation requirements because they may affect the essential feature, and consequently may result in economic or national security impacts. Additionally, these analyses describe broad categories of project modifications that may reduce impacts to the essential feature, and state whether the modifications are likely to be solely a result of the critical habitat designation or co-extensive with another regulation, including the ESA listing of the species. These analyses incorporate recent guidance provided in our final rule on 4(b)(2) analyses (81 FR 7226 February 11, 2016).

5.1 4(B)(2) ECONOMIC IMPACTS

The economic impacts of proposed coral critical habitat were analyzed in the full 4(b)(2) Economic Impact Analysis, completed in 2016 and updated in 2019 can be found in Appendix B of this report. The economic analysis projected economic impacts of coral critical habitat for the 10-year period 2016-2025. Since these impacts were based partially on ESA Section 7 consultation projections, a comparison of the annual consultation projections for 2016-2025 vs. the actual consultations carried out from January 2016 to August 2019 is also provided in the economic report. The results of the 2016 and 2019 updated economic report are summarized below in Section 5.1.4, including a summary of the comparison between the 2016-2025 projected consultations vs. 2016-2019 actual consultations.

5.1.1 INTRODUCTION

The purpose of the 4(b)(2) economic analysis is to identify and analyze the potential economic impacts associated with the designation of marine critical habitat areas for listed coral species found in the waters surrounding American Samoa, Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and the Pacific Remote Islands Area (PRIA). Identification of these impacts addresses the requirements of Executive Orders 12866 (as affirmed and supplemented by Executive Order 13563), which directs federal agencies to assess the costs and benefits of regulatory actions. These economic impacts represent some of the potential "benefits of exclusion."

To estimate the economic impacts of critical habitat designation, this analysis compared the extent of protections afforded the corals' habitat in the "without critical habitat" and "with critical habitat" scenarios and then estimated the incremental costs of achieving compliance under the latter. The "without critical habitat" scenario represents the baseline for the analysis, considering protections already afforded the proposed critical habitat as a result of the listing of the corals as threatened species, or as a result of other federal, territorial, or commonwealth regulations or protections. The "with critical habitat" scenario describes the incremental impacts associated specifically with the designation of critical habitat for the coral species. That is, the impacts described in this analysis are those expected to occur with the designations of critical habitat for the coral species.

5.1.2 FRAMEWORK FOR THE ANALYSIS

The overall analytical framework used for this economic impact analysis is consistent with that used in the recent economic analysis of critical habitat designation for the newly listed Caribbean coral species (NMFS 2020). Both economic analyses focus on the incremental impacts of critical habitat designation, including direct and indirect costs, as well as any incremental benefits that may stem from the rulemaking. These analyses present impacts in present value and annualized terms, with a discount rate of seven percent applied throughout the body of the report, the basis for which is provided on p. 21 of the Economic Impact Analysis report (Appendix B of this report). Present value and annualized impacts are calculated as shown in Equation 1 below. The analyses consider economic impacts to activities over a ten-year period from 2016 through 2025 based on the past consultation history.

While the analytical framework used for the two economic impact analyses for the Southeast and Indo-Pacific are generally the same, the two analyses differ somewhat because critical habitat was previously designated for two previously listed coral species in the Southeast Region and the already designated critical habitat overlaps the proposed critical habitat for the newly listed Caribbean coral species. Consequently, there is approximately a ten-year consultation history for coral listing and critical habitat designation in the Southeast Region jurisdictions where coral critical habitat is being proposed. In addition, the previous listing and critical habitat designation for the two corals provides additional baseline protections for the newly listed Caribbean species. In contrast, there is no previous listing and critical habitat designation of corals in the U.S. Pacific Islands Region.

In addition, because there is no consultation history on which to rely, the economic impact analysis for the Indo-Pacific coral species includes low-end and high-end estimates of costs, with the high-end assuming that all projected future actions will require formal consultations (an unlikely scenario). In both economic impact analyses, the low-end estimates of incremental project modification costs assume these costs would be zero, and the high-end estimates in both analyses assume incremental project modification costs for certain categories of activities. However, the high-end estimate for the Indo-Pacific corals analysis uses maximum per project cost estimates to calculate incremental costs in order to be consistent with the conservative approach of the analysis, while the analysis for the Caribbean corals uses average per project cost estimates.

Equation 1. *Calculating Present Value*

This analysis compares economic impacts incurred in different time periods in present value terms. The present value represents the value of a payment or stream of payments in common dollar terms. That is, it is the sum of a series of past or future cash flows expressed in today's dollars. Translation of economic impacts of past or future costs to present value terms requires the following: a) past or projected future costs of critical habitat designation; and b) the specific years in which these impacts have been or are expected to be incurred. With these data, the present value of the past or future stream of impacts (PV_c) from year t to T is measured in 2015 dollars according to the following standard formula:[a]

$$PV_c = \sum_{t}^{T} \frac{C_t}{(1+r)^{t-2015}}$$

C_t = cost of incremental impacts in year t
r = discount rate[b]

Impacts for each activity are also expressed as annualized values. Annualized values are calculated to provide comparison of impacts across activities with varying forecast periods (T). For this analysis, activities employ a forecast period of ten years, 2016 through 2025. Annualized future impacts (APV_c) are calculated by the following standard formula:

$$APV_c = PV_c \left[\frac{r}{1-(1+r)^{-(N)}} \right]$$

N = number of years in the forecast period (in this analysis, 10 years)

[a] To derive the present value of future impacts to development activities, t is 2016 and T is 2025.
[b] To discount and annualize costs, guidance provided by the OMB specifies the use of a real rate of seven percent. In addition, OMB recommends sensitivity analysis using other discount rates such as three percent, which some economists believe better reflects the social rate of time preference (U.S. Office of Management and Budget 2003a; U.S. Office of Management and Budget 2003b).

5.1.3 *ACTIVITIES THAT MAY BE AFFECTED*

Identification of activities that action agencies believe may affect listed coral species drew upon historical consultation records, most notably for sea turtles, in areas of overlap with the listed corals, from 2005 through 2015. The records showed that there were 20 formal and 185 informal consultations within the geographic boundaries of the proposed critical habitat for the following types of federal activities (information provided by NMFS PIRO's section 7 consultation database. Provided via email to ERM and NEI from NMFS on April 27, 2015 and February 18, 2016):

- In-water & Coastal Construction: Construction and maintenance of roads, bridges, or culverts; installation and maintenance of wharfs, docks, and pilings; placement of buoys, moorings, anchorages, and navigation aids; boat ramp construction or maintenance; shoreline protection (revetments, seawalls, breakwaters, jetties, excavation, fill, etc.); and construction or repair of submarine pipelines and cables.
- Dredging and Disposal: Dredging harbors and navigable waterways, as well as the disposal of dredged material.
- Water Quality and Discharges: Issuance of National Pollutant Discharge Elimination System (NPDES) permits and review of water quality standards. Pesticide regulation. Activities that release heavy metals, hydrocarbons, pesticides, organic compounds, and other contaminants into the marine environment.
- Fishery Management: Development of management measures in federally-managed commercial and recreational fisheries.
- Military Activities: In-water military training exercises.
- Shipwreck Removal: Shipwreck response and removal.
- Scientific Research & Monitoring: Issuance of permits for marine-related research and monitoring projects.
- Aquaculture: Coastal and offshore facilities used for the culture of organisms for commercial, subsistence, or research purposes.

- Protected Area Management: Management of national parks, national marine sanctuaries, and federal wildlife refuges.
- Beach Nourishment/ Shoreline Protection: Placement of sand onto eroding beaches from onshore or offshore borrow sites.

Table 2 summarizes historical section 7 consultation activity for each of the activity categories from 2005 to 2015, broken down by formal vs. informal consultations.

Table 2. NMFS Pacific Islands Region Section 7 Consultations in Proposed Critical Habitat Areas by Activity and Consultation Type (2005 – 2015).

Activity Category	Number of Formal Consultations	Number of Informal Consultations	Total Number of Consultations
In-water & Coastal Construction	13	138	151
Dredging and Disposal	2	13	15
Water Quality and Discharges	0	2	2
Fishery Management	1	3	4
Military Activities	2	0	2
Shipwreck Removal	0	11	11
Scientific Research & Monitoring	2	18	20
Aquaculture	0	0	0
Protected Area Management	0	0	0
Beach Nourishment/ Shoreline Protection	0	0	0
Total	20	185	205
Source: NMFS PIRO's section 7 consultation database. Provided via email to ERM and NEI from NMFS on April 27, 2015 and February 18, 2016.			

5.1.4 *PROJECTED CONSULTATIONS (2016-2015) VS. ACTUAL CONSULTATIONS (2016-2019)*

In total, we forecast that approximately 19 section 7 consultations are likely to consider critical habitat each year over the next ten years. To forecast the location of future consultations, we identified the proposed critical habitat area associated with each historical consultation. We then projected the future number of consultations expected to occur in each proposed critical habitat area based on the consultation history. The projected number of consultations in the Indo-Pacific is lower than projections in the economic impact analysis of critical habitat designation for the newly listed Caribbean coral species. The primary reason for this is that the human population of the Southeast Region jurisdictions where coral critical habitat is being proposed is approximately 100 times that of the U.S. Pacific Island Region jurisdictions where coral critical habitat is being proposed, thus the Southeast Region is expected to have more federal actions that potentially affect coral critical habitat than the U.S. Pacific Islands Region. Table 3 displays the expected number of future consultations over the next ten years by area and consultation type. The majority of consultations are expected to occur in Guam and most of those will be informal.

Table 3. Projected Annual Number of Section 7 Consultations in Proposed Critical Habitat Areas by Area and Consultation Type (2016 – 2025).

Area	**Number of Formal Consultations**	**Number of Informal Consultations**	**Total Number of consultations**
American Samoa	0.9*	2.8	3.7
Guam	0.9	10.4	11.3
CNMI	0.0	3.2	3.2
PRIA	0.0	0.5	0.5
Total	1.8	16.8	18.6

Source: NMFS PIRO's section 7 consultation database. Provided via email to ERM and NEI from NMFS on April 27, 2015 and February 18, 2016.

* Values in table are an annual average for a 10 year period (2016-2025). In the event that <10 consultations are projected for the 10 years, the projected annual average will be <1.

Table 4 disaggregates projected annual consultations over the years 2016-2025 by area and activity category. Reflecting historical occurrence of consultations, this analysis anticipates that consultations related to in-water and coastal construction will constitute around three-quarters of consultations over the next ten years.

Table 4. Projected Annual Number of Section 7 Consultations in Proposed Critical Habitat Areas by Area and Activity Category (2016 – 2025).

Area	Activity Category							
	In-Water and Coastal Construction	Dredging and Disposal	Water Quality and Discharges	Fishery Management	Military Activities	Shipwreck Removal	Scientific Research & Monitoring	Total[a]
American Samoa	3.0	0.2	0.0	0.2	0.0	0.0	0.3	3.7
Guam	8.4	1.0	0.1	0.0	0.2	0.4	1.3	11.3
CNMI	2.1	0.2	0.1	0.2	0.0	0.5	0.2	3.2
PRIA	0.2	0.0	0.0	0.0	0.0	0.2	0.1	0.5
Total[a]	13.7	1.4	0.2	0.4	0.2	1.0	1.8	18.6
Percent of Total	74%	7%	1%	2%	1%	5%	10%	100%

Source: NMFS PIRO's section 7 consultation database. Provided via email to ERM and NEI from NMFS on April 27, 2015 and February 18, 2016.

[a] Because of rounding, numbers by area and activity may not add up to total.

The forecast of future section 7 consultations is the basis for calculation of incremental administrative and project modification costs; however, it is important to recognize the limitations in these forecasts. Data are not available to determine whether the frequency or locations of activities will change over time, and we have not seen an overall trend in the frequency of consultations for any one particular activity. To the extent that the rate of consultations changes over the next ten years, this analysis may under- or overestimate the potential economic burden of critical habitat designation for the listed coral species.

The economic report (Appendix B) was based on PIRO's consultation history between 2005 and 2015. The report provided a forecast of quantity and distribution of future section 7 consultations on coral critical habitat, based on the NMFS PIRO section 7 consultation database for 2005 to 2015, and interviews with key federal action and local agencies. To supplement the 2016 economic report, a comparison was conducted of the 2016-2025 projected Section 7 consultations vs. the 2016-2019 actual Section 7 consultations (see Appendix 3 of economic report), which is summarized below.

During the 3.6-year period from January 2016 to August 2019, 70 consultations were completed within potential proposed coral critical habitat on actions that were likely to affect listed corals, including 2 formal consultations and 68 informal consultations. The annual number of such consultations projected by the 2016 economic report (18.6/yr) was very similar to the annual number of consultations that were actually carried out (19.4/yr). However, the annual number of formal consultations projected by the 2016 economic report (1.8/yr) was three times higher than the annual number of formal consultations that were actually carried out (0.6/yr) (see Appendix 3 of the economic report).

5.1.5 INCREMENTAL COSTS

Given the listing of the corals, and the fact that the proposed critical habitat overlaps the range of other listed species (e.g., green sea turtle), section 7 consultations are already likely to occur for activities with a federal nexus throughout the proposed critical habitat. This analysis anticipates that all activity categories will continue to be subject to section 7 consultation considering the listed coral species and other listed species.

The low-end cost estimate assumes that the relative proportions of informal and formal consultations over the next ten years will be similar to the relative proportions of informal and formal consultations collected from PIRO's section 7 consultation database. In addition, it is assumed that inclusion of an analysis of adverse effects to the listed corals' critical habitat in future consultations will always result in at least some additional administrative cost and effort. Average incremental administrative costs are expected to be $5,100 per formal consultation and $2,400 per informal consultation (Table 5).

Table 5. Estimated Incremental Administrative Costs per Consultation for Activities in Proposed Critical Habitat Areas (2015$).

Consultation Type	NMFS	Federal Action Agency	Third Party	Biological Assessment Cost	Total Cost
Informal	$630	$800	$510	$500	$2,400
Formal	$1,400	$1,600	$880	$1,200	$5,100
Source: Industrial Economics, Inc. (2015)					

This analysis assumes at the high-end that all projected future actions within these categories will require formal consultations, and each formal consultation will incur additional administrative cost and effort.

As shown in Table 6, under the low-end scenario, incremental administrative costs of critical habitat designation are expected to total approximately $349,000 over the next ten years, with an annualized cost of roughly $50,000 (discounted at seven percent). Under the high-end scenario, incremental administrative costs are expected to total about $1.15 million over the next ten years, with an annualized cost of around $164,000.

Table 6. Low-End and High-End Estimated Incremental Administrative Costs for Activities in Proposed Critical Habitat Areas by Area (2016 – 2025).

Area	Present Value Impacts (Seven Percent Discount Rate)	Annualized Impacts
	Low-End	
American Samoa	$80,069	$11,400
Guam	$207,260	$29,509
CNMI	$53,635	$7,636
PRIA	$7,662	$1,091
Total	$348,625	$49,636
	High-End	
American Samoa	$230,373	$32,800
Guam	$696,739	$99,200
CNMI	$196,660	$28,000
PRIA	$28,094	$4,000
Total	$1,151,867	$164,000

Table 7 presents the net present value of forecasted low-end incremental administrative costs by activity category and area. The activity with the highest incremental administrative costs is in-water and coastal construction, with a present value totaling approximately $254,000 over ten years (discounted at seven percent). These costs account for about three-quarters of the total estimated incremental administrative costs. About 60 percent of the incremental administrative costs related to in-water and coastal construction are expected to occur in Guam.

Table 7. Low-End Estimated Incremental Administrative Costs for Activities in Proposed Critical Habitat Areas by Activity (2016 – 2025).

Activity Category	Present Value Impacts (Seven Percent Discount Rate)				
	American Samoa	Guam	CNMI	PRIA	Total
In-Water and Coastal Construction	$60,818	$154,678	$35,246	$3,065	$253,807
Dredging and Disposal	$6,417	$16,952	$3,065	$0	$26,434
Water Quality and Discharges	$0	$1,532	$1,532	$0	$3,065
Fishery Management	$4,789	$0	$3,065	$0	$7,854
Military Activities	$0	$6,513	$0	$0	$6,513
Shipwreck Removal	$0	$6,130	$7,662	$3,065	$16,857
Scientific Research & Monitoring	$8,045	$21,454	$3,065	$1,532	$34,096
Total	$80,069	$207,260	$53,635	$7,662	$348,625

Table 8 presents the present value of forecasted high-end incremental administrative costs by activity category. The present value of incremental costs for consultations associated with in-water and coastal construction activities is expected to total approximately $848,000 over ten years.

Table 8. High-End Estimated Incremental Administrative Costs for Activities in Proposed Critical Habitat Areas by Activity (2016 – 2025).

Activity Category	Present Value Impacts (Seven Percent Discount Rate)				
	American Samoa	Guam	CNMI	PRIA	Total
In-Water and Coastal Construction	$188,232	$519,745	$129,234	$11,238	$848,449
Dredging and Disposal	$14,047	$58,998	$11,238	$0	$84,283
Water Quality and Discharges	$0	$5,619	$5,619	$0	$11,238
Fishery Management	$11,238	$0	$11,238	$0	$22,475
Military Activities	$0	$11,238	$0	$0	$11,238
Shipwreck Removal	$0	$22,475	$28,094	$11,238	$61,808
Scientific Research & Monitoring	$16,857	$78,664	$11,238	$5,619	$112,377
Total	$230,373	$696,739	$196,660	$28,094	$1,151,867

Through communications with the U.S. Army Corps of Engineers (USACE) Honolulu District, and review of project modifications required for projects evaluated from 2005 through 2015 in the U.S. Pacific Islands Region, this analysis identified the types of project modifications that likely would be undertaken to avoid adverse modification or destruction of the seven coral species' critical habitat. Table 9 outlines the three project modifications that could be considered incremental.

Table 9. Estimated Per Project Cost of Potential Incremental Project Modifications in Proposed Critical Habitat Areas (2015$).

Potential Project Modification	**Cost Description**	**Range of Per Project Costs**
Biological and physico-chemical conditions monitoring	Per-day costs of monitoring range from an average of $1,250 per day for small projects, such as inshore/nearshore projects that require only one person and no diving to monitor turbidity, water quality, and protected species, to an average of $7,000 per day for a larger (five person minimum) dive team to conduct more extensive monitoring.[a,b] Remote or offshore sites, common in the U.S. Pacific Islands Region, may require $21,000 per day for a 12-person offshore scientific dive team plus live-aboard diving support vessel.[c] For purposes of cost estimation, projects are assumed to last 5 days.[d]	$6,250 - $35,000 for small or local projects; $105,000 for large or remote project sites
Restricted or assisted anchoring/mooring installation	Although this project modification is not strictly limited to installation of buoys and moorings, determining cost estimates is difficult because assisted anchoring during coastal construction projects is often included in the overall day rates of contractors. The cost of mooring installations was used, as it is more feasible to estimate on a per-installation basis. Cost estimates ranged from $1,700 to $10,000 per installation, depending on the type of mooring and the substrate in which it is installed.[e] Because these cost estimates do not consider portions of contractor day rates, they are likely an overestimation of the cost associated with this project modification.	$1,700 - $10,000
Submarine cable anchoring	An estimate of $1,200 per anchor was used.[f] 6-10 installations per day were assumed, and a total of eight days to cross a reef area.[g] Total costs will vary based on size of reef area and number of anchors required.	$57,600 - $96,000

Sources:

[a] Cost estimate based on an average of quotes provided by environmental consulting firms.

[b] A 1-person boat crew can be safely deployed only in inshore waters or protected nearshore waters.

[c] Rates based on 2015 Tetra Tech contract for Port of Miami Expansion, modified for per-day diving vessel support in Oahu. Assumes field-based conditions monitoring with lab-based follow-up for select parameters.

[d] Staffing in the U.S. Pacific Islands Region cannot always be completed with local personnel, and travel is often required for certain skillsets. Rates do not include travel, but this can be approximated as a one-time cost per person, per project.

[e] NMFS personnel and Broward County Beach and Marine Resources Section staff.

[f] Unit cost obtained from NMFS (2008). This cost estimate was verified as reasonable through email communication with Tetra Tech. Actual cost may vary depending on design and installation requirements of the unit.

[g] According to information available to ERM, simple anchors drilled 2 ft. into rock and set in concrete can be completed at a rate of approximately 6-10 per day in depths of 0-30 meters using a 5-person diving team.

Activities subject to incremental project modification costs include certain USACE-permitted activities such as in-water and coastal construction, dredging and disposal, and beach nourishment/shoreline protection. Based on a review of the consultation history, the percentage of future USACE-permitted activities likely to be subject to incremental project modifications was estimated. While per project modification costs would vary significantly depending on the location and nature of the project, this analysis used the maximum cost estimates in Table 10 to calculate total incremental costs in order to be consistent with the conservative approach of the analysis. In addition, this analysis assumed that these incremental costs would be incurred by their respective categories of activities regardless of the area of proposed critical habitat in which the activities occurred.

The low-end estimate assumes no incremental project modifications occur because baseline permit conditions/regulations would provide sufficient protection to avoid adverse modification of critical habitat. The high-end estimate assumes incremental project modification costs for future projects related to in-water and coastal construction and dredging and disposal. Table 10 presents the high-end incremental project modification costs by area that could occur as a result of the proposed critical habitat designation.

Table 10. High-End Estimated Incremental Project Modification Costs for Activities in Proposed Critical Habitat Areas by Area (2016 – 2025).

Area	**Present Value Impacts (Seven Percent Discount Rate)**	**Annualized Impacts**
American Samoa	$2,605,557	$370,973
Guam	$7,444,103	$1,059,873
CNMI	$1,808,572	$257,500
PRIA	$145,197	$20,673
Total	$12,003,429	$1,709,018

Table 11 presents the incremental project modification results by area and activity category.

Table 11. High-End Estimated Incremental Project Modification Costs for Activities in Proposed Critical Habitat Areas by Area and Activity Category (2016 – 2025).

	Present Value Impacts (Seven Percent Discount Rate)				
Activity Category	**American Samoa**	**Guam**	**CNMI**	**PRIA**	**Total**
In-Water and Coastal Construction	$2,432,043	$6,715,342	$1,669,761	$145,197	$10,962,342
Dredging and Disposal	$173,514	$728,760	$138,812	$0	$1,041,086
Total	$2,605,557	$7,444,103	$1,808,572	$145,197	$12,003,429

The low-end estimation of total incremental costs (administrative and project management) that could occur as a result of critical habitat designation assumes no incremental project modifications and, further, that trends in the frequency of informal consultations over the next ten years will resemble those of the past eleven years. The high-end scenario assumes that there will be incremental project modification costs for future projects related to in-water and coastal construction and dredging and disposal and that all projected future actions will require formal consultations.

Low-end and high-end total incremental costs by area are presented in Table 12, while low-end and high-end total incremental cost estimates by activity category are presented in Tables 13 and Table 14, respectively.

Table 12. Low-End and High-End Estimated Total Incremental Costs (Administrative and Project Modification) for Activities in Proposed Critical Habitat Areas by Area (2016 – 2025).

Area	Present Value Impacts (Seven Percent Discount Rate)	Annualized Impacts
	Low-End	
American Samoa	$80,069	$11,400
Guam	$207,260	$29,509
CNMI	$53,635	$7,636
PRIA	$7,662	$1,091
Total	$348,625	$49,636
	High-End	
American Samoa	$2,835,931	$403,773
Guam	$8,140,842	$1,159,073
CNMI	$2,005,233	$285,500
PRIA	$173,291	$24,673
Total	$13,155,296	$1,873,018

Table 13. Low-End Estimated Total Incremental Costs (Administrative and Project Modification) for Activities in Proposed Critical Habitat Areas by Area and Activity Category (2016 – 2025).

Activity Category	**Present Value Impacts (Seven Percent Discount Rate)**				
	American Samoa	**Guam**	**CNMI**	**PRIA**	**Total**
In-Water and Coastal Construction	$60,818	$154,678	$35,246	$3,065	$253,807
Dredging and Disposal	$6,417	$16,952	$3,065	$0	$26,434
Water Quality and Discharges	$0	$1,532	$1,532	$0	$3,065
Fishery Management	$4,789	$0	$3,065	$0	$7,854
Military Activities	$0	$6,513	$0	$0	$6,513
Shipwreck Removal	$0	$6,130	$7,662	$3,065	$16,857
Scientific Research & Monitoring	$8,045	$21,454	$3,065	$1,532	$34,096
Total	$80,069	$207,260	$53,635	$7,662	$348,625

Table 14. High-End Estimated Total Incremental Costs (Administrative and Project Modification) for Activities in Proposed Critical Habitat Areas by Area and Activity Category (2016 – 2025).

Activity Category	**Present Value Impacts (Seven Percent Discount Rate)**				
	American Samoa	**Guam**	**CNMI**	**PRIA**	**Total**
In-Water and Coastal Construction	$2,620,275	$7,235,087	$1,798,995	$156,434	$11,810,791
Dredging and Disposal	$187,562	$787,759	$150,049	$0	$1,125,369
Water Quality and Discharges	$0	$5,619	$5,619	$0	$11,238
Fishery Management	$11,238	$0	$11,238	$0	$22,475
Military Activities	$0	$11,238	$0	$0	$11,238
Shipwreck Removal	$0	$22,475	$28,094	$11,238	$61,808
Scientific Research & Monitoring	$16,857	$78,664	$11,238	$5,619	$112,377
Total	$2,835,931	$8,140,842	$2,005,233	$173,291	$13,155,296

5.1.6 ECONOMIC BENEFITS

As summarized in Section 5.1.6 of the full economic impact report (Appendix B), many studies describe the economic benefits of corals and coral reefs. By furthering the conservation of the habitat of the listed coral species and associated coral reef species, the critical habitat designation has the potential to contribute to such economic benefits. The extent of the potential economic benefits of coral critical habitat depends on the level of additional protection provided. For example, as described above, certain USACE-permitted activities may be subject to project modifications to avoid adverse modification of critical habitat. These modifications would provide better protection of corals and coral reefs that may contribute to economic benefits. However, the proportion of USACE-permitted activities that would be subject to modifications ranges from zero (low-end scenario) to approximately 85 percent (high-end scenario), thus there is a very high degree of uncertainty with predicting economic benefits.

5.1.7 SUMMARY

Several uncertainties underlie the calculation of incremental costs that could result from the designation of critical habitat for the listed Indo-Pacific coral species. These uncertainties, and their particular significance with respect to the results of this analysis, are summarized in Table 27 of Appendix B. A key uncertainty is the lack of a historic record of Section 7 consultations in these areas and therefore the lack of a good predictor of either the future number of total consultations, or the proportion of formal vs. informal consultations, resulting from coral critical habitat. Mainly because of this uncertainty, there is a very large difference between the low-end and high-end economic impact estimates.

Low-end total incremental costs resulting from the listed corals' critical habitat are estimated at just under $350,000 over ten years (Table 13), with an annualized cost of approximately $50,000. High-end total incremental costs are estimated at more than $13 million over ten years, with an annualized cost of approximately $1.9 million (Table 14). Nearly 92 percent of total high-end incremental costs results from anticipated project modifications. The area with the greatest costs is Guam, due to the high number of expected section 7 consultations in this area. Total incremental costs in Guam resulting from the listed corals' critical habitat are estimated to range from $207,260 (low-end) to $8.5 million (high-end) over ten years, with an annualized cost of $48,960 to over $1.1 million. The activity with the highest costs is in-water and coastal construction, ranging from under $268,000 to $12.3 million over ten years (Tables 13 and 14). At the high-end, in-water and coastal construction accounts for approximately 90 percent of total incremental costs.

The comparison of the 2016-2025 projected Section 7 consultations in the economic report vs. the 2016-2019 actual Section 7 consultations showed that three times more formal consultations were projected than actually occurred (see Appendix 3 of economic report). Since formal consultations result in a higher economic impact than informal consultations, the high-end projections in the 2016 economic report likely substantially overestimate the actual economic impact of coral proposed critical habitat. Since only 3.6 years of consultation data are available, it is still too early to determine the accuracy of the projections in the 2016 economic report. However, this comparison suggests that actual economic impacts are more likely to be near the low-end projections than the high-end projections. Based on the very low economic impacts of the low-end projections, and the benefits to the conservation of listed corals of critical habitat, no economic exclusions should be made.

5.2 4(B)(2) NATIONAL SECURITY IMPACTS

The national security impacts of proposed coral critical habitat are analyzed below. These impacts were analyzed based on responses from DoD/Navy (DoN 2015) and DHS/Coast Guard (USCG 2015) to a June 23, 2015, letter from NMFS describing areas being considered for coral critical habitat, and requesting identification of any national security impacts. These areas were subsequently described more precisely as 19 potential critical habitat units excluding certain sub-areas (i.e., the 19 "specific areas" considered for proposed critical habitat, as defined and described in the Specific Areas section above) for Navy and Coast Guard in late 2015. USCG provided an additional letter in 2016, but it was limited to the potential impacts of coral critical habitat of their Aids to Navigation program (USCG 2016). Navy updated its response in 2019 (DoN, 2019b), and NMFS held several calls in 2019 with Navy and USCG to ensure that updated information was being used for the national security impact analyses below. Within these 19 proposed units, the sites requested by Navy and Coast Guard for national security exclusions were then analyzed by NMFS, as described below.

Outside of the JRM and Wake INRMP marine areas described in the 4(a)(3) section above, four sites were requested for exclusion by DoD and USCG based on national security impacts, one in Guam and three in CNMI: The marine component of the Navy's overlapping surface danger zones off of Ritidian Point (hereafter referred to as Ritidian Point Surface Danger Zone complex) on Guam, two USCG anchorages on Tinian, and a system of six Navy anchorage berths on Saipan. For each of these four sites, information is provided below on the impacts to national security of designating the site as critical habitat, and the benefits to the conservation of listed corals of designating the site as critical habitat.

Impacts to national security may arise when DoD actions at a site are required for national security and are likely to result in adverse modification or destruction of the essential feature, therefore section 7 consultation requirements may cause significant delays in or modifications to the activity, potentially impacting national security. In most cases, consultation under section 7 will already be required because of the listing itself, so consultation for critical habitat would add an additional layer of consultation rather than an entirely new consultation effort on its own. If additional consultation requirements are likely due to critical habitat at a site, then consideration of other factors is needed to characterize subsequent impacts to national security, such as the type and frequency of additional consultation, potential delays and requirements resulting from the additional consultation, and how unique the DoD activities are at the site.

Benefits to the conservation of listed corals depends on whether designation of critical habitat at a site leads to additional conservation of the species above what is already provided by being listed under the ESA in the first place. The potential for additional conservation is a function of many factors, including at least the quantity and quality of essential feature at the site, the level of protection of the essential feature already provided by existing management of the site, the likelihood of other Federal (non-DoD) actions being proposed within the site that would be subject to critical habitat; and whether critical habitat helps address the unique conservation challenges associated with listed corals.

Based on the information below, for each site the proposed rule qualitatively compares the national security impacts to the conservation benefits in order to determine which is greater. If national security impacts outweigh conservation benefits, the site is excluded from proposed critical habitat. If conservation benefits outweigh national security impacts, the site is not excluded from proposed critical habitat. The decision to exclude any sites from a designation of critical habitat is always at the discretion of NMFS. In no circumstances is an exclusion of any site required by our final policy on 4(b)(2) of the ESA (81 FR 7226, February 11, 2016) and regulations.

5.2.1 GUAM: ONE REQUESTED SITE

The Guam Unit of coral critical habitat includes one Navy 4(b)(2) national security site that was requested for exclusion: The portion of the Ritidian Point Surface Danger Zone complex that is outside of DoD Submerged

Lands (i.e. within USFWS Submerged Lands), as shown in Figure 9-1 of the INRMP (DoN 2019a) and in Figure 21 above. The site is described below in terms of the national security impact vs. coral conservation benefits factors.

The site covers 723 acres of proposed critical habitat of 0-40 m depth. The listed species *Acropora globiceps* has been recorded at this site (NMFS 2015a). Although no more than a few colonies of *A. globiceps* have been recorded at this site, the species is easily confused with the unlisted *A. humilis* and *A. gemmifera*, and we believe that many existing records of one or both of these species in Guam may be *A. globiceps*. Thus, A. *globiceps* may be widespread at this site in certain habitats. In addition, the listed species *Seriatopora aculeata* is known to occur in different habitats and across a broad range depth in the Mariana Islands, so this species may also occur at the site. Section 7 consultation on the effects of DoD's training activities at this site was completed on June 12, 2015, via the biological opinion on the Mariana Islands Training and Testing (MITT Opinion) activities by DoD (NMFS 2015b).

National Security Impacts: National security impacts depend on the effects of DOD activities on the site's essential features, and subsequent additional section 7 consultation requirements resulting from critical habitat (i.e., above and beyond what would already be required by the fact that some corals on Guam are listed as threatened under the ESA). The Navy noted that the Ritidian Point Surface Danger Zone complex supports training at the Marine Corps Life Fire Training Range Complex (LFTRC) at AAFB, and construction of new facilities (e.g., range administration building, range maintenance building, observation towers) at AAFB, to meet the individual weapons training/qualification requirements of the Marine Corps. This surface danger zone extends over significant portions of the nearshore marine environment of northern Guam, and is expected to be operational for 32 weeks per year. The site's surface danger zone extends approximately two miles over open water in the event stray bullets go over the berm and into the ocean. If this occurs, the bullets will settle on the seafloor (DoN 2015, 2019a,b).

<u>The Type and Frequency of Additional Consultation</u>: The Navy noted that should the marine component of this site be designated as coral critical habitat, it would result in limitations on live fire training at LFTRC. The Navy explained that this is because limited staff time and resources would be diverted to preparing additional documents required to implement activities in critical habitat areas from work required on other vital environmental items (DoN 2015). Because the marine component of the site includes high quality and quantity of the essential feature for coral critical habitat, combined with the fact that many training and construction activities are planned at LFTRC adjacent to this marine area,

it is possible that informal ESA Section 7 consultations would be required in the future either annually or once every few years, depending on how the Navy organizes its consultation request. If so, completion of informal consultation could delay the planned activities by approximately 30 days.

Uniqueness of DOD Activities at the Site: The Navy noted that the LFTRC on Guam provides critical individual live fire training requirements for Marine Corps personnel, which is a prerequisite for conducting unit level and combined level training. Without the qualification of these live fire training events, individuals and small teams are not capable of conducting larger unit collective events. The LFTRC provides the necessary foundation for which training progression is built upon. Plans are in place to considerably expand LFTRC in anticipation of growing Marine Corps training needs. No other facility on Guam or elsewhere in the Mariana Islands provides this type of training (DoN 2015, 2019a,b).

Conservation Benefits: Benefits to the conservation of ESA-listed corals depend on whether designation of critical habitat at a site leads to additional conservation of the species above what is already provided by the species' listing. The potential for additional conservation at the site is a function of listed corals' use of the area, the level of protection already provided by management, and the likelihood of non-DOD actions subject to critical habitat.

Listed Corals' Use of the Area: One listed coral species, *Acropora globiceps*, is widespread around Guam (as described above in the Geographic Areas Occupied by the Species section), and occurs at this site (DoN, 2019a). Two other listed coral species, *Acropora retusa* and *Seriatopora aculeata*, have been recorded on Guam at one or two sites (as also described above in the Geographic Areas Occupied by the Species section), and may also occur at this site (DoN, 2019a). The coral reef habitat at this site consists of reef flat, spur-and-groove, and aggregate reef pavement, and encompasses some areas of high coral cover (DoN 2015, 2019a). Thus, the site has high quality and quantity of the essential feature.

Level of Protection Already Provided by Management: This site is entirely within U.S. Fish and Wildlife Service (USFWS) Submerged Lands, which forms the marine component of the Guam National Wildlife Refuge (NWR), and is managed according to the Guam NWR Comprehensive Conservation Plan (USFWS, 2009). The plan includes Strategies to Restore, Protect, and Native Marine Communities, such as marine debris removal and area closures (USFWS, 2009). The site is entirely within Essential Fish Habitat (EFH) for coral reef ecosystems, but EFH protections are not mandatory.

Likelihood of Non-DoD Actions Subject to Critical Habitat: It is possible that non-DoD federal actions will be proposed within this site that could affect the essential feature, but that would no longer be subject to the critical habitat provision if the particular area were excluded from the designation. However, the site is off-limits for 32 weeks a year, quite remote, and not currently used for other federal activities; thus, the likelihood of non-DoD actions in the future is low. The site is used for recreational activities, but these may not result in federal actions at the site.

Recommendation: We conclude that the impacts to national security of including this area within critical habitat outweigh the conservation benefits of designation, and recommend that the Ritidian Point Surface Danger Zone complex be excluded from coral critical habitat designation. The most important factors supporting this exclusion are that this area is a unique and important place for DoD activities, and the consultation requirements for critical habitat would place new demands on DoD both in terms of the consultation process as well as potential modifications to the DoD activities. That is, coral critical habitat would create a new consultation requirement for DoD at this site in addition what is already required by the fact that some corals on Guam are listed as threatened under the ESA. The benefits of designating this low-use and remote habitat is reduced in part by the protections already afforded to some of the characteristics of the essential feature, and because DoD use of this area is likely to discourage other federal activities that may otherwise require consultation. While DoD must still ensure that activities in this area are not likely to jeopardize the continued existence of listed corals, the exclusion of this area means DoD will not be required to consult to insure that its activities are not likely to adversely modify habitat or essential features within this area. Based on our best scientific judgment and acknowledging the small size of this area, and other safeguards that are in place (e.g., protections already afforded listed corals under its listing and other regulatory mechanism), we conclude that exclusion of this area will not result in the extinction of the species.

5.2.2 *TINIAN: TWO REQUESTED SITES*

The Tinian Unit of coral critical habitat includes a pair of adjacent USCG 4(b)(2) national security sites, the Tinian Explosive Anchorages A and B, that were requested for exclusion, shown in Figure 22 above. Unlike Guam, proposed critical habitat on Tinian is 0-20 m depth, because only *Acropora globiceps* and *A. retusa* have been recorded there. The two requested sites within coral critical habitat are described below in terms of the national security impact vs. coral conservation benefits factors.

The Tinian Explosives Anchorages A (239 acres) and B (180 acres) are USCG-managed areas within proposed critical habitat of 0-20 m depth. The majority of these two sites are ineligible for critical habitat because they fall within the Tinian Marine Lease Area (Fig. 22)), as explained in Section 4.1.2 above. Thus, the following descriptions of national security impacts versus conservation benefits apply only to the portions of the two anchorages that are eligible for coral critical habitat.

The listed species *Acropora globiceps* has been recorded at these sites (NMFS, 2015c). Because the national security impacts and conservation benefits are the same for both sites, the following analysis is for both sites combined.

National Security Impacts: National security impacts depend on the effects of USCG's activities on the sites' essential features, and subsequent additional section 7 consultation requirements resulting from critical habitat (i.e., above and beyond what would already be required by the fact that some corals on Tinian are listed as threatened under the ESA). USCG oversees the use of these two anchorages (USCG 2015). In 2015, NMFS sent USCG a letter describing areas being considered for coral critical habitat, which included the Tinian anchorages, and requesting identification of any national security impacts. In response, USCG provided a general description of how it manages all of its anchorages within areas being considered for coral critical habitat nationally, and how that could affect coral habitat. However, no specific information was provided in the USCG's letter about how the designation of the Tinian anchorages as coral critical habitat might impact national security (USCG 2015). A follow-up letter was provided by USCG in 2016; however, it had no information about the Tinian Anchorages (USCG 2016).

In a call with USCG on November 28, 2016, NMFS requested that USCG provide a national security-based justification for excluding the Tinian anchorages from coral critical habitat. USCG stated that the anchorages are very lightly used, and that USCG's role is entirely passive, meaning that while USCG is responsible for overseeing the anchorages, it does not carry out activities within them At that meeting, USCG asked NMFS to check with Navy on their use of the Tinian anchorages. NMFS did so at a meeting with Navy on December 1, 2016, and the Navy stated they do not use the Tinian anchorages (NMFS 2016b). USCG confirmed in 2019 that they still would still like to request that the Tinian anchorages be excluded from coral critical habitat, but they did not provide any information on how the critical habitat designation would affect national security.

<u>The Type and Frequency of Additional Consultation</u>: No information was provided by USCG indicating that any additional ESA section 7

consultations would be required if the Tinian anchorages were designated as coral critical habitat. Based on the information provided in the USCG initial response letters (USCG 2015, 2016), in meetings and discussions with USCG in 2016 (NMFS 2016b), and in discussions with USCG in 2019, it does not appear that coral critical habitat designation within the Tinian anchorages would require any additional ESA section 7 consultations.

Uniqueness of USCG Activities at the Site: Based on the information provided in the USCG's response letters (USCG 2015, 2016), in meetings and discussions with USCG in 2016 (NMFS 2016b), and in discussions with USCG in 2019, USCG's activities at the Tinian anchorages are routine. In other words, USCG does not conduct any activities at the Tinian anchorages that it does not conduct at its other anchorages.

Conservation Benefits: Benefits to the conservation of ESA-listed corals depend on whether designation of critical habitat at a site leads to additional conservation of the species above what is already provided by the species' listing. The potential for additional conservation at the site is a function of listed corals' use of the area, the level of protection already provided by management, and the likelihood of non-DOD actions subject to critical habitat.

Listed Corals' Use of the Area: One listed coral species, *Acropora globiceps*, is widespread around Tinian (as described above in the Geographic Areas Occupied by the Species section), and occurs within the two anchorages (DoN, 2019a). According to the information in the Specific Areas section above, both anchorages have extensive hard substrate, a diversity of coral reef habitats, and high coral cover in the nearshore areas along their eastern edges (Figures 7.3.3c and 7.5.2a, Brainard et al., 2012), which also has high quantity and high quality of the essential feature.

Level of Protection Already Provided by Management: As noted above, most of the two anchorages are ineligible for coral critical habitat, because those portions are within the Tinian MLA Submerged Lands, which is covered by the JRM INRMP (DoN, 2019a), as described above and shown in Fig. 22. Of the remaining areas, the only level of protection already provided by management is inclusion within Essential Fish Habitat (EFH) for coral reef ecosystems, but EFH protections are not mandatory.

Likelihood of Non-USCG/DoD Actions Subject to Critical Habitat: It is possible that non-USCG/DoD federal actions will be proposed within this site that could affect the essential feature, but that would no longer be subject to the critical habitat provision if the particular area were excluded from the designation. However, we are not aware that any such federal activities are planned for these areas, plus the areas are very lightly used and managed by USCG, and thus the likelihood of non-USCG/DoD actions in the future is low. The site is used for recreational activities, but these may not result in federal actions at the site.

Recommendation: We conclude that the conservation benefits of designation outweigh the impacts to national security of including this area within critical habitat, and recommend that the two Tinian anchorages not be excluded from coral critical habitat designation. The factors supporting denial of this exclusion request are that: (1) coral critical habitat would not create a new consultation requirement for USCG at this site in addition what is already required by the fact that some corals on Tinian are listed as threatened under the ESA; (2) even if coral critical habitat would create a new consultation requirement for USCG at this site, no justification was provided for how that might impact national security; (3) the majority of the areas within the Tinian anchorages are already ineligible for critical habitat due to overlap with the Tinian Marine Lease Area, and most of the remaining areas of the two anchorages are shallow nearshore areas that provide no anchorage; (4) the portions of the anchorages that lie outside of the Tinian Marine Lease Area (i.e., those areas that are still eligible for coral critical habitat) have no protection other than EFH; and (5) the portions of the anchorages that lie outside of the Tinian Marine Lease contain high quality coral habitat.

5.2.3 SAIPAN: ONE REQUESTED SITE

The Saipan Military Prepositioned Squadron Anchorages site is made of six Navy anchorage berths (L-19, L-32, L-44, L-47, L-62, and M-16), which are shown on Figure 23 below. The initial Navy response letter (DoN 2015) and two follow-up memos (DoN, 2016a, b) explain that the anchorage berths are used by the Military Sealift Command (MSC) to provide a substantial portion of the logistics support needed by distant Navy, USMC, Army, and Air Force military forces for a wide range of national security related activities. These forces need the arms and materials carried by these ships to engage in combat and self-defense in the event of a range of circumstances and threats. The circumstances range from a rise in military tensions with other nations all the way to the US Government's early response to attacks on US forces, the territory and people of the United States, and US allies. The response that the prepositioning fleet provides requires quick transport and delivery to US military forces of weapons, fuel, and supplies.

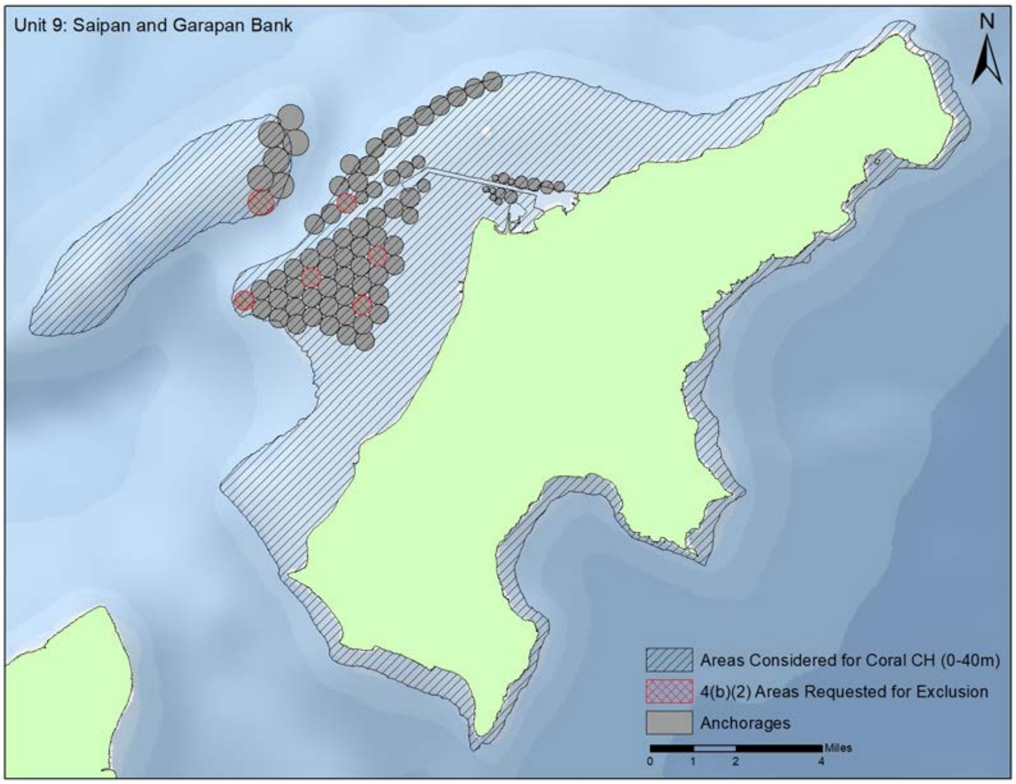
The ships have to be positioned closely enough to potential areas of combat and conflict to quickly support the early, critical defense efforts by the US. But these ships also have to be far enough away from the war zone that they are not easily destroyed in the opening moves of an attack on the US or its allies. These ships carry large quantities of explosive munitions and ammunition, and it is very difficult to get permission for an anchorage for such ships, even from allies. The ships need an anchorage area, such as Saipan, where an accidental explosion or one resulting from an attack on the ships will not endanger large numbers of people, other ships, or port areas. Saipan provides the only location in the western Pacific within U.S. waters where the MSC's mission can be carried out (DoN 2016a, b).

The six berths total 394 acres of proposed critical habitat of 20-35 m depth. Of the 11 4(b)(2) national security sites that overlap with proposed critical habitat, this is the only site that does not include shoreline or shallow habitat. Because DoD uses the berths for the same activity, and they are grouped together on the banks west of Saipan, DoD requested the exclusion as a single site (DoN 2015). However, each berth has different physical (e.g., depth ranges) and biological (e.g., coral cover) characteristics. The seven berths are part of a large group of circular DoN anchorage berths spread across two large, shallow banks on the west side of Saipan. The inner bank extends offshore for 3–6 km, and a natural channel separates it from the outer bank. The five L berths are all on the inner bank, while the two M berths are on the outer bank. These shallow banks are the largest of their kind in the entire Mariana Archipelago, making them both unique coral reef habitat and important anchorage areas for large commercial and military vessels (Brainard et al., 2012).

Each L berth is 1,800 ft (549 m) in diameter, or approximately 58 acres. The M berth is 2,400 ft (732 m) in diameter, or approximately 104 acres. The depth ranges of the six berths are the following: L-19 = 77-94 ft (23-29 m), L-32 = 66-94 ft (20-29 m), L-44 = 84-91 ft (26-28 m), L-47 = 77-88 ft (23-27 m), L-62 = 65-105 ft (20-32 m), and M-16 = 96-116 ft (29-35 m; NOAA 2015). Berth M-2 was also requested for exclusion, but since it is >40 m depth, it does not overlap with proposed critical habitat. As far as we know, none of the six anchorage berths have been surveyed at the species level for corals, so there are no records of listed species at these berths. However, live coral cover surveys have been done in parts of all six berths, each of which are characterized by a complex mosaic of mounds and channels.

Many of the mounds provide large areas of coral-rich habitat, with each berth containing some mounds comprised of coral cover of up to 30 to 50 percent (more details below). Given that both *Acropora globiceps* and *Seriatopora aculeata* are known to occur in different habitats and across a broad range depth in the Mariana Islands, and given the species identification uncertainty described above for *A. globiceps*, there is a high likelihood that at least one listed species occurs in each of the six berths. However, no listed corals have been recorded at the site to date.

Figure 23. Saipan, showing specific areas considered for proposed critical habitat, and requested 4(b)(2) national security exclusions.



National Security Impacts: National security impacts depend on the effects of DoD activities on the site's essential features, and subsequent additional section 7 consultation requirements resulting from critical habitat (i.e., above and beyond what would already be required by the fact that some corals on Saipan are listed as threatened under the ESA). The Navy noted that the nature of its planned activities at this site would adversely affect the essential feature, thereby requiring formal consultation on the effects of its proposed actions on coral critical habitat, were this site to be designated. The Navy's planned activities at this site include the continuation of precision anchoring by MSC of military vessels at the six berths: Vessels are "pre-positioned" over the anchorage point within the berth before the anchor is dropped. The same GPS point is always used so the anchor falls in the same place, limiting the substrate impact zone to a relatively small area (i.e., much smaller than the entire berth) that is used over and over. DoD has used the anchorage for decades, although it is unclear if the six berths have all been used for that period of time (DoN 2016 a,b).

<u>The Type and Frequency of Additional Consultation</u>: The Navy noted that should the six berths be designated as coral critical habitat, it would result in limitations in how MSC uses the site. The Navy explained that this is because formal consultation would be required upon designation of critical habitat, because the DoD activity at this site is likely to adversely affect the essential feature. Based on the best available information about the likely effects of the Navy's planned activities at this site, we concur that formal consultation would likely be required if the site is included in coral critical habitat: Observations within some of the Saipan anchorage berths by PIFSC's Coral Reef Ecosystem Program (CREP) staff confirm that historic Navy use of the berths has adversely affected coral substrate, which is part of the essential feature proposed for coral critical habitat. CREP fieldwork was done in 2003-2007 for the Saipan chapter of the Mariana Archipelago coral reef monitoring report, and included coral cover surveys along tracks over most of the berths in the anchorage, as shown in Figure 8.3.3c of the report (Brainard et al., 2012).

Furthermore, the Navy's MITT program does not include the MSC's use of this site, so it was not included in the 2015 MITT Opinion. And as described above, listed corals have not been recorded at the site to date. Thus, formal consultation would be needed on MSC's activities at the site if it was designated as critical habitat, whereas consultation would not be required in the absence of critical habitat based on current information about listed corals at the site.

Formal consultation is a required process that is typically completed in less than 135 days. The biological opinion resulting from a formal consultation may contain requirements to modify the activity in order to minimize effects on listed corals and on essential feature of critical habitat. Because of the impacts of the MSC's activities to the essential feature at the site, there could be substantial delays and modifications required by a biological opinion. Such delays and modifications would have a major impact on MSC's mission, and could reduce their response time substantially. Because MSC's mission is to provide the weapons, fuel, and supplies required for rapid responses to national security threats, such delays and modifications represent a substantial impact to national security (DoN, 2016b).

<u>Uniqueness of DOD Activities at the Site</u>: Saipan is the westernmost U.S. territory where MSC's ships can be in a secure anchorage within U.S. waters. Additionally, the ships are required to be within a defined geographic region to enable them to respond in a timely manner in the event of a crisis. Saipan falls within this geographic region for these ships.

As coastal environments and the world have increased in population, the locations at which these ships can be positioned offshore for quick response near to potential future conflict areas has become more limited. Presently, in the Western Pacific there are only locations for up to 4 ships in Guam, Korea and Japan that could be similarly used without the need to grant ESQD waivers. The Saipan anchorage offers capability for up to 7 ships to be anchored. On any given day there will be at least four ships utilizing the anchorages with the exception of crisis response or typhoon sortie. Therefore, the Saipan anchorage provides a unique and irreplaceable location for DoD’s activities (DoN, 2016b).

Conservation Benefits: Benefits to the conservation of ESA-listed corals depend on whether designation of critical habitat at a site leads to additional conservation of the species above what is already provided by the species’ listing. The potential for additional conservation at the site is a function of listed corals’ use of the area, the level of protection already provided by management, and the likelihood of non-DOD actions subject to critical habitat.

<u>Listed Corals’ Use of the Area</u>: One listed coral species, *Acropora globiceps*, is widespread around Saipan (as described above in the Geographic Areas Occupied by the Species section), but no listed corals have been confirmed within any of the Saipan anchorage berths. Each of the six berths have high quantity and quality of essential feature. As noted above for each of the six berths, they collectively are 65-116 ft depth (20-35 m), and characterized by a complex mosaic of mounds and channels. The mounds are typically hard substrate, while the channels contain sand and rubble. As described above, historic anchoring has affected the berths, but because of their large size, precision anchoring, and prevailing winds and currents, it appears that substantial portions of the hard substrate of each berth have been unaffected by anchoring. This is borne out by live coral cover results from data CREP collected in 2003-2007 (Figure 8.3.3c, Brainard et al., 2012). An overlay of the six berths with this figure provides the following estimates of live coral cover: Berths L-32 and L-47 had extensive patches of live coral cover of up to 50 percent, L-19 and M-16 had extensive patches of live coral cover of up to 30 percent, and L-44 and L-62 had small patches of live coral cover of up to 30 percent.

<u>Level of Protection Already Provided by Management</u>: No marine areas of CNMI are subject to the JRM INRMP (DoN, 2019a). The site is entirely within EFH for coral reef ecosystems, but EFH protections are not mandatory. CNMI’s Lighthouse Reef Trochus Sanctuary is adjacent to the site but only extends to 40 ft depth, and so does not overlap with any of the six berths.

Likelihood of Non-DoD Actions Subject to Critical Habitat: The six berths are in close proximity to Saipan Harbor and much of Saipan's population. This area is heavily used for various commercial and recreational activities. However, DoD controls access to the berths, and thus non-DoD actions are not expected within them.

Recommendation: We conclude that the impacts to national security of including this area within critical habitat outweigh the conservation benefit of designation, and recommend that the six Saipan anchorage berths be excluded from coral critical habitat designation. The most important factor supporting this exclusion is that formal consultation would cause project delays and modifications that would impact the MSC mission, which is to provide logistics support to distant Navy, USMC, Army, and Air Force military forces for a wide range of national security related activities. The circumstances range from a rise in military tensions with other nations to the ability of the U.S. Government to respond to attacks on U.S. forces, the territory and people of the United States, and U.S. allies. The ability of the prepositioning fleet to provide a response to a threat to the U.S. requires quick transport and delivery of weapons, fuel, and supplies to U.S. military forces; thus delays and modifications at this site would result in substantial national security impacts. Conservation benefits of including the site in critical habitat could be substantial because the site has high quality and quantity of the essential feature with high potential to aid in the conservation of listed corals, for which critical habitat consultation could provide significant protection. However, no listed corals have been recorded within any of the six anchorage berths.

While DoD must still insure that activities in this area are not likely to jeopardize the continued existence of listed corals, the exclusion of this area means DoD will not be required to consult to insure that its activities are not likely to adversely modify habitat or essential features within this area. Based on our best scientific judgment and acknowledging the small size of this area, and other safeguards that are in place (e.g., protections already afforded listed corals under its listing and other regulatory mechanism), we conclude that exclusion of this area will not result in the extinction of the species.

5.3 4(B)(2) OTHER RELEVANT IMPACTS

Our past critical habitat designations have identified other relevant impacts, including conservation benefits, and impacts on governmental or private entities that are implementing existing management plans that provide benefits to the listed species. These other relevant impacts are described below for coral critical habitat.

5.3.1 CONSERVATION BENEFITS

The primary benefit of critical habitat designation is the contribution to the conservation and recovery of the seven corals. That is, in protecting the features essential to the conservation of the species, critical habitat directly contributes to the conservation and recovery of the species. This analysis contemplates three broad categories of benefits of critical habitat designation:

(1) Increased probability of conservation and recovery of the seven corals: The most direct benefits of the critical habitat designation stem from the enhanced probability of conservation and recovery of the seven corals. From an economics perspective, the appropriate measure of the value of this benefit is people's "willingness-to-pay" for the incremental change. While the existing economics literature is insufficient to provide a quantitative estimate of the extent to which people value incremental changes in recovery potential, the literature does provide evidence that people have a positive preference for listed species conservation, even beyond any direct (*e.g.*, recreation, such as viewing the species while snorkeling or diving) or indirect (*e.g.,* reef fishing that is supported by the presence of healthy reef ecosystems) use for the species.

(2) Ecosystem service benefits of coral reef conservation, in general: Overall, coral reef ecosystems, including those comprising populations of the seven corals, provide important ecosystem services of value to individuals, communities, and economies. These include recreational opportunities (and associated tourism spending in the regional economy), habitat and nursery functions for recreationally and commercially valuable fish species, shoreline protection in the form of wave attenuation and reduced beach erosion, and climate stabilization via carbon sequestration. The total economic value of coral reefs in U.S. Pacific Islands jurisdictions where coral critical habitat is being considered in 2012$ million/year is: (1) American Samoa - $12 million, (2) Guam - $155 million, and (3) CNMI - $72 million (Appendix B, Section 7.0). Efforts to conserve the seven corals also benefit the broader reef ecosystems, thereby preserving or improving these ecosystem services and values (NOAA Coral Reef Conservation Program 2013).

Conservation benefits to each coral in all their specific areas are expected to result from the designations. Critical habitat most directly influences the recovery potential of the species and protects coral reef ecosystem services through its implementation under section 7 of the ESA. That is, these benefits stem from the implementation of project modifications undertaken to avoid destruction and adverse modification of critical habitat. Accordingly, critical habitat designation is most likely to generate the benefits discussed in those areas expected to be subject to additional recommendations for project modifications (above and beyond any conservation measures that may be implemented in the baseline due to the listing status of the species or for other reasons). In addition, critical habitat designation may generate ancillary environmental improvements and associated ecosystem service benefits (*i.e.*, to commercial fishing and recreational activities) in areas subject to incremental project modifications. While neither benefit can be directly monetized, existing information on the value of coral reefs provides an indication of the value placed on those ecosystems.

(3) Education and Awareness Benefits that May Result from the Designation: There is the potential for education and awareness benefits arising from the critical habitat designation. This potential stems from two sources: (1) entities that engage in section 7 consultation and (2) members of the general public interested in coral conservation. The former potential exists from parties who alter their activities to benefit the species or essential feature because they were made aware of the critical habitat designation through the section 7 consultation process. The latter may engage in similar efforts because they learned of the critical habitat designation through outreach materials. For example, NMFS has been contacted by diver groups in the Florida Keys who are specifically seeking the two ESA-listed Caribbean *Acropora* corals on dives and report those locations to NMFS, thus assisting us in planning and implementing coral conservation and management activities for those listed species. In our experience, designation raises the public's awareness that there are special considerations to be taken within the area.

Similarly, state and local governments may be prompted to enact laws or rules to complement the critical habitat designation and benefit the listed corals. Those laws would likely result in additional impacts of the designation. However, we are unable to quantify the beneficial effects of the awareness gained through or the secondary impacts from state and local regulations resulting from the critical habitat designation.

5.3.2 IMPACTS TO GOVERNMENTAL AND PRIVATE ENTITIES WITH EXISTING MANAGEMENT PLANS BENEFITTING THE ESSENTIAL FEATURES

Many previous critical habitat impact analyses evaluated the impacts of the designation on relationships with, or the efforts of, private and public entities involved in management or conservation efforts benefiting listed species. These analyses found that the additional regulatory layer of a designation could negatively impact the conservation benefits provided to the listed species by existing or proposed management or conservation plans. For example, Section 7 consultation with NMFS by a marine protected area agency on the effects of their management plan on critical habitat could cause delays to projects that benefit the listed species.

There are a large number of federal marine protected areas in American Samoa, Guam, CNMI, and the PRIA where coral critical habitat is being considered (Appendix B, Table 12). Impacts of critical habitat designation on the agencies responsible for natural resource management planning of these areas depend on the type and number of Section 7 consultations that may result from the designation in the areas covered by those plans, as well as any potential project modifications recommended by these consultations. Negative impacts to these entities could result if the critical habitat designation interferes with these agencies' ability to provide for the conservation of the species, or otherwise hampers management of these areas. Existing or proposed management plans in the marine protected areas and their associated regulations protect existing coral reef resources, but they may not specifically protect the substrate and water quality feature for purposes of increasing listed coral abundance and eventual recovery.

However, most of these federal marine protected areas are still developing management plans, especially the larger ones that include the most potential coral critical habitat (e.g., the National Marine Monuments), thus it is not possible to determine at this time if and how they would be subject to Section 7 consultation due to potential effects on coral critical habitat. Therefore, it is not possible to determine at this time if and how the management of federal marine protected areas in the Pacific Islands would be impacted by coral critical habitat.

6.0 *Conclusion – 19 Units Considered for Proposed Coral Critical Habitat*

We identified 19 specific areas occupied by ESA-listed corals with the essential feature in Guam, CNMI, American Samoa, and PRIA. Of these 19 potential critical habitat units, the areas considered in Farallon de Medinilla (FDM) and Wake Atoll are ineligible for critical habitat per 4(a)(3) of the ESA, because final INRMPs (DoN, 2019a; USAF, 2017) will benefit ESA-listed corals. The remaining 17 units qualify for proposed coral critical habitat: In American Samoa, four units (Tutuila and Offshore Banks, Ofu and Olosega, Ta`u, and Rose Atoll; in Guam, one unit (Guam and Offshore Banks); in CNMI, seven units (Rota, Aguijan, Tinian and Tatsumi Reef, Saipan and Garapan Bank, Anatahan, Pagan, and Maug Islands and Supply Reef); and in PRIA, five units (Howland Island, Palmyra Atoll, Kingman Reef, Johnston Atoll, and Jarvis Island). Based on the 4(b)(2) impact analyses, no exclusions should be made based on economic impacts. However, the marine component of Navy's Ritidian Point Surface Danger Zone complex on Guam, as well as a group of six Navy anchorage berths on Saipan's Garapan Bank (Berths L-62, L-32, L-44, L-47, L-19, and M-16), should be excluded because of impacts on national security.

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8.0 *Appendix A: Descriptions of 19 Specific Areas Considered for Proposed Critical Habitat*

This appendix provides descriptions of the specific areas considered for proposed critical habitat in each of the 19 units, some of which were then subject to the 4(a)(3) and 4(b)(2) analyses described in this report. The 4(a)(3) analyses resulted in the Wake and FDM units being removed from consideration, leaving 17 units for proposed coral critical habitat. Within those 17 units, the 4(b)(2) national security analyses resulted in two sites being excluded (the Ritidian Point Surface Danger Zone complex on Guam, and a group of six anchorage berths on Saipan). The following descriptions are of the areas in all 19 units that were considered for coral proposed critical habitat before the 4(a)(3) and 4(b)(2) analyses were applied.

- Tutuila and Offshore Banks (0 – 40 m depth; see map in Figure 2).
  - Not Included Areas:
    - Inner Pago Pago Harbor: West of line between Nuutatai Point and Trading Point on Map 10 of NOAA Chart 83484.
    - Pala Lagoon: West of line between Coconut Point at point 14°19'20.2"S 170°42'09.9"W, and the airport tarmac at point 14°19'32.6"S 170°42'03.5"W.
  - Artificial Substrates:
    - 11 fixed and floating AToNs (USCG 2015).
    - USACE-managed seawalls (Afono, Aoa, Lepua, Masefau, Matafao, Paloa, Vatia, Pago Pago to Nuuuli, and Pago Pago Airport Shore Protection and Beach Erosion Control Projects, as described on USACE Honolulu District Civil Works' website).
    - All other AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
  - Managed Areas:
    - USACE-managed small boat harbors, basins, and navigation channels (areas within "Federal Project Limits" indicated in Hydrographic Surveys for Aunu'u and Auasi Small Boat Harbors on USACE Honolulu District Civil Works' website), their seawall breakwaters, and areas lying between the Federal Project Limits and seawall breakwaters.
    - All other harbors, navigation channels, turning basins, and berthing areas that are periodically dredged or maintained, all seawall

breakwaters, and areas lying between the managed areas and seawall breakwaters.

    - A 25 m radius of substrate around each of the AToN bases.

- Ofu and Olosega (0 – 20 m depth; see map in Figure 3).
  - Not Included Areas: None
  - Artificial Substrates:
    - Two fixed and floating AToNs (USCG 2015).
    - USACE-managed Ofu Airstrip Shore Protection Project, as described on USACE Honolulu District Civil Works' website.
    - All other AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
  - Managed Areas:
    - USACE-managed Ofu Small Boat Harbor and navigation channel (areas within "Federal Project Limits" indicated in Hydrographic Surveys for the Ofu Small Boat Harbor on USACE Honolulu District Civil Works' website), their seawall breakwaters, and areas lying between the Federal Project Limits and seawall breakwaters.
    - A 25 m radius of substrate around each of the AToN bases.
- Ta`u (0 – 20 m depth; see map in Figure 4).
  - Not Included Areas: None
  - Artificial Substrates:
    - Four fixed and floating AToNs (USCG 2015).
    - All other AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
  - Managed Areas:
    - USACE-managed Ta'u Small Boat Harbor and navigation channel (areas within "Federal Project Limits" indicated in Hydrographic Surveys for Ta'u Small Boat Harbor on USACE Honolulu District Civil Works' website), their seawall breakwaters, and areas lying between the Federal Project Limits and seawall breakwaters.
    - A 25 m radius of substrate around each of the AToN bases.
- Rose (0 – 20 m depth; see map in Figure 5).
  - Not included Areas: Lagoon

- Artificial Substrates: None
- Managed Areas: None

- Guam and Offshore Banks (0 – 40 m depth; see maps in Figures 6).
  - Not included Areas:
    - Inner Apra Harbor: South of a line across the outer entrance of Inner Apra Harbor.
    - Eastern portion of Outer Apra Harbor: East of a line along the west side of the navigation channel into Inner Apra Harbor and continuing straight to Glass Breakwater. The navigation channel is shown on NOAA Chart 81054.
    - Sumay Cove in Outer Apra Harbor, and the two adjacent small coves on either side of Sumay Cove.
  - Artificial Substrates:
    - 32 fixed and floating AToNs (USCG 2015).
    - USACE-managed seawalls (Asquiroga Bay Shoreline Protection Project and marine components of the Namo River Flood Control project, as described on USACE Honolulu District Civil Works' website).
    - Territory-managed boat ramps, including at Agana, Merizo, Seaplane Ramp in Apra Harbor, Umatac, and Agat.
    - All other AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
  - Managed Areas:
    - Guam Port Authority harbors, basins, and navigation channels, if not in unincluded areas of Inner Apra Harbor and eastern portion of Outer Apra Harbor indicated in 5a above.
    - Navy-managed Apra Harbor harbors, basins, and navigation channels, and their seawall breakwaters.
    - USACE-managed small boat harbors, basins, and navigation channels (areas within "Federal Project Limits" indicated in Hydrographic Surveys for Agat and Agana Small Boat Harbors on USACE Honolulu District Civil Works' website), their seawall breakwaters, and areas lying between the Federal Project Limits and seawall breakwaters.
    - All other channels, turning basins, and berthing areas that are periodically dredged or maintained (if any).
    - A 25 m radius of substrate around each of the AToN bases.

- Rota (0 – 20 m depth; see map in Figure 7).
    a. Not Included Areas: None
    b. Artificial Substrates:
        i. Two fixed AToNs (USCG 2015).
        ii. Territory-managed boat ramp at Rota Harbor.
        iii. All other AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
    c. Managed Areas:
        i. USACE-managed Rota Harbor and navigation channel (areas within "Federal Project Limits" indicated in Hydrographic Surveys for the Rota Harbor on USACE Honolulu District Civil Works' website), their seawall breakwaters, and areas lying between the Federal Project Limits and seawall breakwaters.
        ii. A 25 m radius of substrate around each of the AToN bases.
- Aguijan (0 – 20 m depth; see map in Figure 8).
    - Not Included Areas: None
    - Artificial Substrates: None
    - Managed Areas: None
- Tinian and Tatsumi Reef (0 – 20 m depth; see map in Figure 9).
    - Not Included Areas: None
    - Artificial Substrates:
        - Six fixed AToNs (USCG 2015).
        - Territory-managed boat ramp at Tinian Harbor.
        - All other AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
    - Managed Areas:
        - Tinian Harbor and navigation channel as shown on NOAA Navigation Chart 81067, and its seawall breakwater.
        - A 25 m radius of substrate around each of the AToN bases.
- Saipan and Garapan Bank (0 – 40 m depth; see map in Figure 10).
    - Not Included Areas: None

- Artificial Substrates:
  - 15 fixed AToNs (USCG 2015).
  - Territory-managed boat ramps at Smiling Cove (Garapan), Sugar Dock (Chalan Kanoa), Tanapag, Fishing Base (Garapan), and Lower Base (Tanapag).
  - All other AToNs, seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
- Managed Areas:
  - Commonwealth Ports Authority harbors, basins, and navigation channels, and their seawall breakwaters.
  - All other channels, turning basins, and berthing areas that are periodically dredged or maintained (if any)
  - A 25 m radius of substrate around each of the AToN bases.

- Farallon de Medinilla (0 – 20 m depth; see map in Figure 11).
  - Not Included Areas: None
  - Artificial Substrates: None
  - Managed Areas: None
- Anatahan (0 – 20 m depth; see map in Figure 12).
  - Not Included Areas: None
  - Artificial Substrates: None
  - Managed Areas: None
- Pagan (0 – 20 m depth; see map in Figure 13).
  - Not Included Areas: None
  - Artificial Substrates: None
  - Managed Areas: None
- Maug Islands & Supply Reef (0 – 20 m depth; see map in Figure 14).
  - Not Included Areas: None
  - Artificial Substrates: None
  - Managed Areas: None
- Howland Island (0 – 10 m depth; see map in Figure 15).
  - Not Included Areas: None

    - Artificial Substrates: None
    - Managed Areas: None
- Palmyra Atoll (0 – 20 m depth; see map in Figure 16).
    - Not Included Areas: Lagoon.
    - Artificial Substrates: Seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
    - Managed Areas:
        - Main entrance channel into lagoon;
        - Dredged area in central lagoon;
        - Other channels and other areas that are periodically dredged or maintained.
- Kingman Reef (0 – 40 m depth; see map in Figure 17).
    - Not Included Areas: None
    - Artificial Substrates: None
    - Managed Areas: None
- Johnston Atoll (0 – 10 m depth; see map in Figure 18).
    - Not Included Areas: None
    - Artificial Substrates: Seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
    - Managed Areas:
        - Main channel around Johnston Island;
        - Other dredged channels and areas.
- Wake Atoll (0 – 20 m depth; see map in Figure 19).
    - Not Included Areas: Lagoon.
    - Artificial Substrates: Seawalls, wharves, docks, boat ramps, moorings, pipes, wrecks, and other artificial structures.
    - Managed Areas:
        - Main entrance channel into harbor;
        - Harbor;
        - Other channels and other areas that are periodically dredged or maintained.

- Jarvis Island (0 – 10 m depth; see map in Figure 20).
    - Not Included Areas: None
    - Artificial Substrates: None
    - Managed Areas: None