3.10 MARINE BIOLOGY

Section 3.10 describes the existing conditions of the marine biological resources in the waters surrounding Tinian and Pagan. The analysis of marine biology focuses on marine plants, animals, and habitats that are crucial to the functions of biological systems, of special public importance, or are protected under federal or local law or statute. When species are mentioned for the first time in this section they are introduced by common name, followed by the scientific name in parentheses; thereafter, only the common name is used. If there is no accepted English common name, then only the scientific name is used. Appendix L, *Biological Resources Supporting Documentation,* identifies the scientific and Chamorro and Carolinian names where applicable and provides more detailed information on special-status species found in the waters surrounding Tinian and Pagan. Appendix M, *Marine Biology Technical Memo and Survey Reports,* has additional information and details for information presented throughout this section.

The region of influence for marine biological resources generally includes the waters surrounding Tinian and Pagan from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore. A larger region of influence of 7.3 nautical miles (13.6 kilometers) applies to the potential for behavioral effects to marine mammals from pile driving and extraction activities during construction.

3.10.1 Definition

The marine biology section is divided into five categories: marine habitat and essential fish habitat, marine flora, marine invertebrates, fish, and special-status species. Five species of sea turtles are potentially found within the CNMI waters, all of which are listed under the federal Endangered Species Act. Several marine mammals are listed under the Endangered Species Act and all are protected under the Marine Mammal Protection Act. Therefore, sea turtles and marine mammals are considered special-status species for the purposes of this EIS/OEIS.

3.10.1.1 Marine Habitat and Essential Fish Habitat

The U.S. military is preparing an Essential Fish Habitat Assessment for the proposed action in accordance with the Magnuson-Stevens Act. Appropriate consultations with regulatory entities will be completed as part of the EIS/OEIS process, and relevant information will be included in the EIS/OEIS as applicable. Various agency consultations are underway as part of this EIS/OEIS process and as applicable will be summarized in the Final EIS/OEIS. A summary of the in progress assessment is presented in this section.

Due to the overlap of content, the marine habitats and Essential Fish Habitat discussions are both presented in this subsection. For the purposes of this EIS/OEIS, the term “marine habitat” refers to nonliving marine substrate supporting marine organisms within the nearshore waters surrounding Tinian and Pagan. “Essential Fish Habitat” includes marine habitat as well as certain ecological functions. The Magnuson-Stevens Fishery Conservation and Management Act (hereafter referred to as the Magnuson-Stevens Act) defines “Essential Fish Habitat” as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. “Waters,” when used for the purpose of defining Essential Fish Habitat, include aquatic areas and associated physical, chemical, and biological properties used by fish; and may include historical areas of use, where appropriate. "Substrates" include sediment, hard bottom, underlying structures, and associated biological communities.

As a subset of Essential Fish Habitat, "Habitat Areas of Particular Concern" are specific areas that are essential to the life cycle of management unit species that meet one or more of the following criteria:

- The importance of the ecological function provided by the habitat
- The extent to which the habitat is sensitive to human-induced environmental degradation
- Whether, and to what extent, development activities are, or will be, stressing the habitat type
- The rarity of the habitat type

The marine habitat types within the region of influence were determined based on the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) which groups and defines the habitat types by shared substrate characteristics and ecological functions. They are as follows:

- Hard shores/Rocky Shores (rocky intertidal)
- Soft Shores/Unconsolidated Shore (beaches/tidal delta/mudflats/tidal riverine/estuarine streambeds)
- Hard bottoms/Rocky Bottom (reef/seamount/hydrothermal vents)
- Soft bottoms/Unconsolidated Bottom (lagoons/abyssal plain)
- Aquatic beds (seagrass/Sargassum)

Hard shores are the most prevalent marine habitat in the CNMI, and the dominant marine habitat surrounding Tinian and Pagan due to their volcanic origins. Hard shores include aquatic environments that have at least 75% cover of stones, boulders, or bedrock and less than 30% vegetative cover. A diverse array of organisms is supported by the relatively stable rocky substrate provided by hard shores. Environmental gradients between hard shorelines and subtidal habitats are determined by wave action, depth, frequency of tidal inundation, and stability of substrate. Only rock outcrops may persist in areas of extreme wave energy. A mixture of rock sizes will form the intertidal zone in areas of lower energy. Boulders scattered in the intertidal and subtidal areas provide substrate for attached macroalgae and sessile (immobile) invertebrates. Plants and animals usually attach themselves to the rocky surfaces, while some animals hide in rocky crevices, under rocks, or burrow into finer substrate between boulders.

Soft shores include beaches, tidal flats, deltas, tidal rivers and estuarine systems. Soft shore habitats consist of unconsolidated substrates with less than 75% cover of stones, boulders, or bedrock and less than 30% vegetative cover other than pioneering plants. Pioneering plants are species that are the first to colonize previously disrupted or damaged ecosystems that become established during brief periods when growing conditions are favorable. The particle size of the substrate and the water regime are important factors determining the types of plant and animal present in the area. Soft shores can be irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded. The distribution and composition of organisms within this habitat, particularly invertebrates, is determined by substrate particle size, the space between the substrate particles, wave action, currents, and salinity (Cowardin et al. 1979).

Hard bottom habitats in nearshore waters can include reefs and rocky bottoms colonized by dead and living sedentary invertebrates, such as coral reefs. Rocky bottoms in this habitat form as extensions of intertidal shores or isolated offshore outcrops (rock formations visible from the surface) (Cowardin et al.

1979). Colonization of this substrate can be determined by the size and shape of the rocks, but also by the depth, less than 650 feet (200 meters), where there may be enough exposure to sunlight for photosynthesis to occur. This determines whether it is encrusted by algae or marine fauna, such as sponges, sea cucumbers, corals, and sea whips (DoN 2013a). Refer to Section 3.10.1.3, *Marine Invertebrates*, for more information on coral reefs.

Soft bottoms include all wetland and deepwater habitats with at least 25% cover of small unconsolidated substrate particles, such as stones and sands and less than 30% vegetative cover. The distribution and composition of organisms within this habitat is determined by exposure to wave action, sunlight, and duration of being underwater, which results in variations in temperature, salinity, and pH (Cowardin et al. 1979). Soft bottom habitats include lagoons, which are semi-enclosed bays between the shoreline and a fringing or barrier reef, generally with sandy bottoms and scattered coral mounds, rubble, seagrass, and algae (DoN 2013a). Soft bottoms are inhabited by soft-sediment communities of mobile invertebrates fed by benthic algae production, chemosynthetic microorganisms, and decaying organic matter sinking through the water column.

Aquatic beds include mangroves, seagrass beds and mats of floating seaweed that are generally found in the intertidal or shallow subtidal zone of nearshore waters, where the vegetation grows mainly on or below the water surface (Cowardin et al. 1979). Aquatic bed habitats can be subtidal, irregularly exposed, regularly flooded, permanently flooded, intermittently exposed, semi-permanently flooded intermittently exposed, semi-permanently flooded, or seasonally flooded. Seagrasses are living marine resources and biotic habitats where they dominate the intertidal or shallow subtidal zone, and are therefore not covered in this chapter. Section 3.10.1.2, *Marine Flora*, has more information on aquatic beds.

3.10.1.2 Marine Flora

Aquatic beds represent plant communities that require surface water for growth and reproduction. They are best developed in relatively permanent water or under conditions of repeated flooding. Plants are either attached to the substrate or float freely in the water above the bottom or on the surface. Aquatic beds include algae, aquatic moss, rooted vascular, and floating vascular species (Cowardin et al. 1979).

This *Marine Flora* section will focus on macroalgae and seagrasses as these communities are found within the region of influence. Algae are photosynthetic, nonvascular plants, commonly referred to as "seaweeds." Algae live on substrates characterized by a wide range of sediment depths and textures and occur in both the subtidal and intertidal zones up to depths of 98 feet (30 meters) (Cowardin et al. 1979). In tropical regions, such as the CNMI, green algae, brown algae, and red algae are common. Algae are a main food source for sea turtles in the CNMI and within the region of influence.

Seagrasses are flowering marine plants that grow entirely underwater. Seagrasses normally occur in water less than 85 feet (26 meters). The distribution of seagrass is influenced by the availability of suitable soft substrates, such as sand or mud, in low wave energy areas at depths that allow sufficient light exposure (Spalding et al. 2003). Distribution and abundance of marine flora depends on several factors including light availability, water quality/clarity, salinity, type of seafloor substrate, currents, tides/water movement, and temperature (Spalding et al. 2003).

Seagrasses also provide a food source for sea turtles and habitat for fishes within the region of influence (Spalding et al. 2003). In addition, seagrasses play a major role in fisheries production and have been shown to provide protection from coastal erosion (Spalding et al. 2003).

3.10.1.3 Marine Invertebrates

Invertebrates are animals without backbones. Marine invertebrates are a large and diverse group that includes sponges, corals, snails, octopus, clams, lobsters, crabs, starfish, sea urchins, sea cucumbers, and marine worms (Eldredge 1983; DoN 2005).

True corals are categorized in the phylum Cnidaria which also includes fire corals, anemones, Portuguese man-o-war, jellyfish, box jellyfish and a variety of other related animals. Cnidarians have two basic body forms: free-swimming or floating medusa and sessile polyps. However, because many Cnidaria are colonial, both body forms can be found on some floating colonies such as the Portuguese man-o-war. Additionally, a single coral colony can be comprised of thousands of individual polyps, making it difficult to determine between a coral individual and a coral colony.

Corals are marine invertebrates in the class Anthozoa of the phylum Cnidaria that live individually or in colonies. Fire corals are not technically corals since they are part of the class Hydrozoa; however, fire corals are colonial marine organisms that look like true corals and are included in this discussion (DoN 2013a). Major groups of corals in the region of influence include:

- Stony corals (*Scleractinia*)
- Black and wire corals (*Antipatharia*)
- Soft corals (*Alcyonacea*, synonymous with horny corals and sea fans [*Gorgonacea*] and blue corals [*Helioporacea*])

The term "coral reef" refers to any reef, bank, or shoal comprised mostly of corals. "Reef ecosystem" includes coral and other species of reef plants and animals associated with coral reefs, and the physical environmental factors that directly affect coral reefs (Riegl and Dodge 2008; Brainard et al. 2011). Reefs are usually divided into four broad categories: barrier, bank, fringing, and patch reefs. The Mariana Islands are dominated by fringing reefs, with limited examples of barrier, bank, and patch reefs (Riegl and Dodge 2008; Brainard et al. 2011). Among the four reef types, fringing reefs are along a shoreline. Barrier, bank, and patch reefs do not require a shoreline (Riegl and Dodge 2008). Common reef morphology terms are tied to distinctive zones, which are created by differences in depth, wave action, current movement, light, temperature, and sediments along different parts of the reef. Zones are principally composed of the fore reef (adjacent to the reef crest and closer to the shore than the deep reef), reef crest (peak of the reef slope closest to the water surface and closer to the shore than the deep reef) and back reef (reef shoreward of the reef crest) (Riegl and Dodge 2008; DoN 2014a) (Figure 3.10-1). Reef flats (shallow zone located closest to shore), lagoons, and benches may be found shoreward of the reef crest. The fore reef, is often subdivided by depth (e.g., shallow and deep fore reef) or by geomorphology (e.g., spur-and-groove, apron, and sand channel). The fringing reefs of the Mariana Islands are predominately shore-attached with poorly-developed reef crests (Riegl and Dodge 2008; Brainard 2012), meaning the fore reef runs up to mean low water with little or no development of a reef crest between the fore reef and the shoreline. Typical reef crests and reef flats are less than 2 feet (0.6 meter) deep, with some grooves that are as much as 20 feet (6 meters) deep, but less than 3 feet (1 meter) wide (Smith 2012). In order of relative areal extent, fore reef is the most abundant habitat type in the Mariana Islands, followed by reef crest, and very small extents of reef flats (Analytical Laboratories of Hawaii 2004; National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science 2005; Bearden et al. 2008; Riegl and Dodge 2008; Brainard et al. 2011).

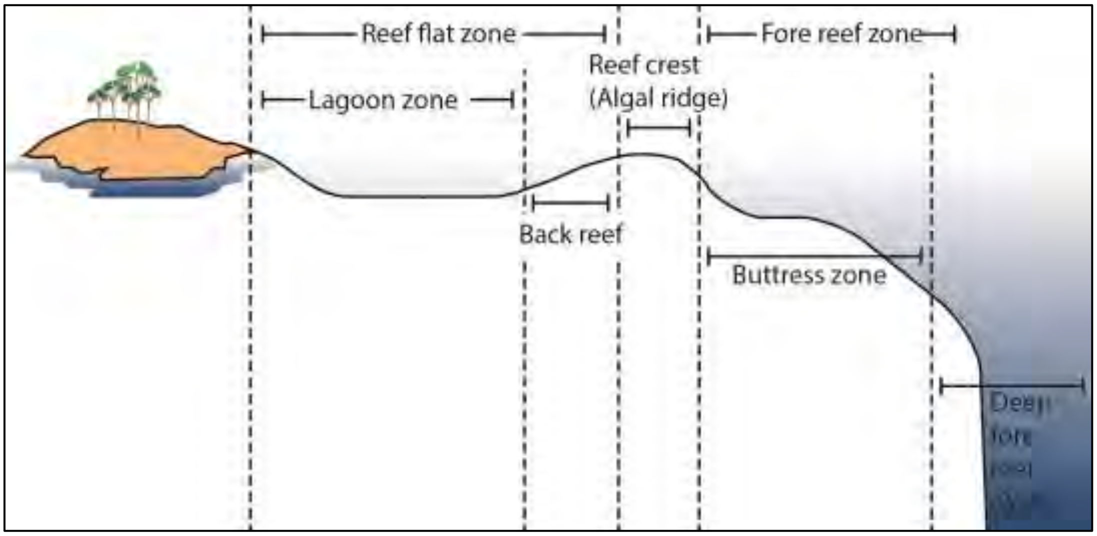


Figure 3.10-1 Typical Reef Zonation

Note: This figure is intended as a simple representation of reef zonation. Actual zonation will vary reef to reef.

3.10.1.4 Fish

Fish include aquatic animals with a hard bone or cartilage skull and gills, and that lack limbs or digits. Fish are not distributed uniformly throughout the region of influence; fish are closely associated with specific habitats. Fish species, such as large sharks, tuna, and billfishes, range across thousands of square miles; others, such as reef fishes, have small home ranges and restricted distributions (Helfman et al. 2009). The distribution and specific habitats of individual fish are influenced by a number of factors including its developmental stage, size, sex, and reproductive condition. This EIS/OEIS will focus mainly on reef fish.

Fisheries, in terms of habitat requirements, are discussed under *Essential Fish Habitat*. Recreation and commercial fishing are addressed in Section 3.8, *Recreation* and Section 3.15, *Socioeconomics and Environmental Justice*.

3.10.1.5 Special-status Species

Special-status species include: (1) those species that currently occur in the wild within the CNMI and are listed as threatened or endangered under the federal Endangered Species Act, (2) candidates or species proposed for listing under the federal Endangered Species Act, (3) those designated by legislative authority in the CNMI as threatened or endangered, (4) Species of Special Conservation Need as identified in the CNMI's Comprehensive Wildlife Conservation Strategy, and (5) those species protected under the Marine Mammal Protection Act. Brief descriptions and life history information for special-status species, are detailed in Appendix L, *Biological Resources Supporting Documentation*. Special-status species within the region of influence of the proposed action include marine invertebrates, fish, sea turtles, and marine mammals. Marine invertebrates and fish are defined above.

Sea turtles, also referred to as marine turtles, are air-breathing reptiles that are found throughout the world's tropical and subtropical ocean waters. Habitat use varies among species and within the life stages of individual species, correlating primarily with the distribution of preferred food sources, as well as the locations of nesting beaches. Sea turtle behaviors such as foraging, migrating, and resting take place in the marine environment, where they spend most of their lives. Generally, after hatching, young sea turtles spend time in the open ocean habitat before returning to nearshore foraging grounds. Green turtles have a mainly herbivore diet and feed on seagrasses and algae. Other sea turtle species are omnivores and eat a variety of plants and animals including jellyfish and sponges (Bjorndal 1997). This section addresses sea turtles in the marine environment, which fall under the jurisdiction of the National Marine Fisheries Service. Nesting sea turtles are addressed in detail in Section 3.9, *Terrestrial Biology* since they are terrestrial at the nesting stage and fall under the jurisdiction of the U.S. Fish and Wildlife Service.

Marine mammals are cited in the Marine Mammal Protection Act as mammals "morphologically adapted to the marine environment," which include members of the orders Sirenia (i.e., manatees and dugongs), Pinnipedia (i.e., seals and sea lions), and Cetacea (i.e., whales, dolphins, and porpoises), as well as mammals that primarily inhabit the marine environment, such as sea otters (*Enhydra lutris*) and polar bears (*Ursus maritimus*). This EIS/OEIS discusses Cetacea as these are the only marine mammals species located within the region of influence. Sirenia and Pinnipedia will not be discussed in this document. In general, cetaceans are large animals with streamlined bodies that glide through the marine environment (National Oceanic and Atmospheric Administration 2014).

Critical habitat is defined in the federal Endangered Species Act as specific geographic areas essential to the conservation of a threatened or endangered species and may require special management and protection. Critical habitat has not been designated for any marine species within the CNMI.

3.10.2 Regulatory Framework

Several laws, regulations, plans, and policies are applicable to the proposed action for marine biological resources. A complete listing of applicable regulations for this EIS/OEIS is provided in Appendix E, *Applicable Federal and Local Regulations*.

3.10.2.1 Federal Regulations

- Federal Endangered Species Act (16 U.S. Code §§ 1531–1544, as amended)
- Magnuson-Stevens Fishery Conservation and Management Act (16 U.S. Code §§ 703–712, as amended)
- Marine Mammal Protection Act (16 U.S. Code §§1361–1421h, as amended)
- Clean Water Act
    - Sections 401 & 404
- Executive Order 13089, Coral Reef Protection
- Executive Order 13112, Invasive Species
- Executive Order 13158, Marine Protected Areas
- Executive Order 13547, Stewardship of the Ocean, Our Coasts, and the Great Lakes
- Executive Order 12962, Recreational Fisheries, as amended by Executive Order 13474, Methodology

3.10.3 Methodology

Project-specific surveys were performed for coral, sea turtles, and marine mammals in support of this EIS/OEIS. Associated survey reports are in Appendix M, *Marine Biology Technical Memo and Survey Reports*. The *Marine Biology Technical Memo,* also included in Appendix M, provides detailed discussion of the coral communities at the beaches in order to support analysis of which coral resources may be affected by the proposed action, as well as details on the acoustic analysis pertaining to marine mammals. In addition, biological surveys that have been conducted in areas that encompass the region of influence were used as key sources of information for this section. A review of data and scientific literature provides an overview of marine resources in the region of influence for this EIS/OEIS.

The Mariana Archipelago Reef Assessment and Monitoring Program surveys, conducted by the National Oceanic and Atmospheric Administration Pacific Islands Fisheries Science Center's Coral Reef Ecosystem Division, provide the basis of information presented in the Marine Flora and Fish sections. Marianas Archipelago Reef Assessment and Monitoring Program conducted surveys in 2003, 2005, and 2007 around the island and reefs of Guam and the CNMI to provide comprehensive information on the coral reef ecosystem including fish biomass and diversity and benthic habitats including occurrence and cover of macroalgae (both calcified and fleshy), crustose coralline red algae, and turf algae.

3.10.4 Tinian

3.10.4.1 Marine Habitat and Essential Fish Habitat

Due to the overlap of content, the marine habitats and Essential Fish Habitat discussions are both presented in this subsection. The Tinian coastline is generally lined with rocky intertidal areas, steep cliffs, and the occasional sandy beach or mudflat. Table 3.10-1 summarizes the amount of various physical characteristics (e.g., coastline, seafloor area, total reef habitat, and reef flat) for the Mariana Islands, southern CNMI, northern CNMI, and Tinian.

Table 3.10-1. Estimates of Select Total Physical Features Compared to Tinian

Physical Characteristic	***Mariana Islands***	***Tinian***
Coastline	313 miles	38 miles
Seafloor area from 0-98 feet (0-30 meters) depth	49,984 acres	4,000 acres
Total Reef Habitat	65,920 acres	5,696 acres
Reef flat‡	1,728 acres mostly on Guam	64--96 acres

Notes: † Estimations. Estimates based of the sources below.
Sources: Analytical Laboratories of Hawaii 2004; Bearden et al. 2008; Brainard et al. 2012; National Oceanic and Atmospheric Administration and National Centers for Coastal Ocean Science 2005; Riegl et al. 2008.

3.10.4.1.1 Hard Shores

Coastline within the region of influence for Tinian is dominated by hard shores and interspersed with soft shores. The hard shores primarily consist of rocky intertidal areas with steep cliffs and headlands, reinforced by large boulders at the base. Erosion and waves carve out these cliffs and create sea-level benches (DoN 2013a). From the base of these cliffs, the depth of nearshore waters increases rapidly to approximately 23 feet (7 meters) into spur-and-groove formations (hard bottom habitat) that support high biological diversity. In order of relative areal extent, fore reef is the most abundant coral reef habitat type in the Mariana Islands by a large margin, followed by reef crest, and very small extents of reef flats (Riegl and Dodge 2008; Brainard 2012). Reef flats occur offshore from many of the beaches within the Military Lease Area, but more generally, reef flats are absent from areas offshore from steep cliffs, which border much of Tinian (Minton et al. 2009).

3.10.4.1.2 Soft Shores

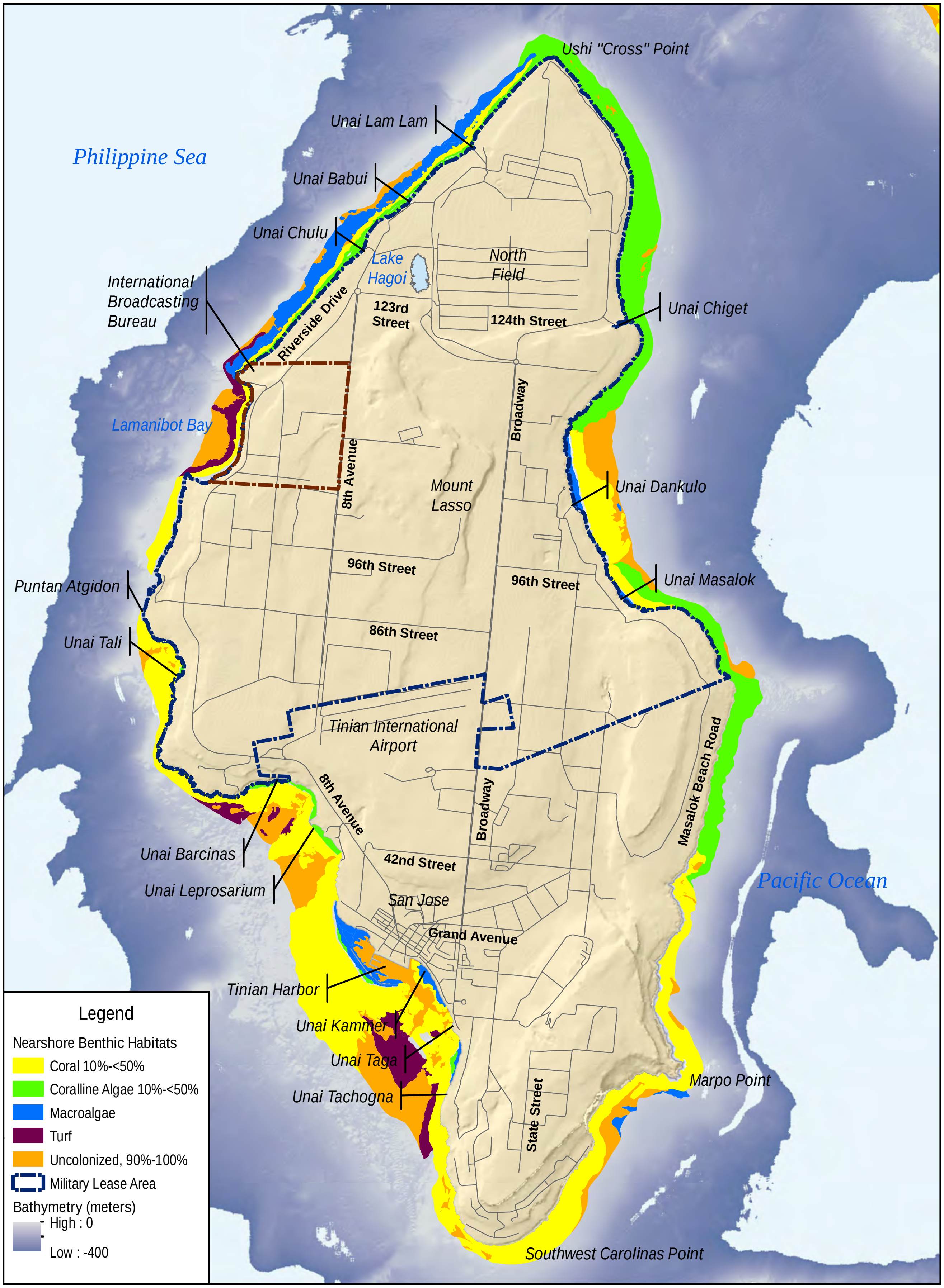
Tinian's shoreline has 13 beaches (10 on the west coast [leeward side] and 3 on the east coast [windward side]) and is mostly undeveloped, except for Tinian Harbor (Figure 3.10-2). These beaches are primarily comprised of medium to coarse sands, gravel, and coral rubble (DoN 2013a). Unai Chulu, Unai Babui, and Unai Lam are small beaches (soft shore habitat) along the northwest coast of Tinian, which is otherwise categorized as hard shore habitat consisting primarily of limestone cliffs. Unai Chulu and Unai Babui transition to narrow reef flats (Tinian has seven well-developed and two poorly-developed reef flats), before moving offshore to spur-and-groove formations (hard bottom habitat). The reef flats at both Unai Babui and Unai Chulu are shallow; ranging from 0.0 to 6.5 feet (0.0 to 2 meters) in depth. The reef crest and outer reef flat at Unai Lam are broad and well developed relative to Unai Babui and Unai Chulu. To the south of the beach, the reef flat zone transitions to a shallow bench. At Unai Babui, the reef slope supports higher diversity for algae, fish, and invertebrates than the reef flat. Conversely, the reef flat at Unai Chulu has higher diversity for algae, but lower diversity for fish and invertebrates (Minton et al. 2009). Unai Masalok is a small beach on the east side of Tinian. The reef area at Unai Masalok is physically complex with moderately deep (12-26 feet [4-6 meters]) regularly spaced grooves in the fore reef, transitioning rapidly to deep fore reef. The fore reef is more topographically complex than the deep fore reef at the beaches on the leeward side of Tinian (DoN 2013a).Coral reef habitat (hard bottom) covers approximately 8.9 square miles (23 square kilometers) of the area around Tinian (Brainard 2012) (see Table 3.10-1; Figure 3.10-2). The transition to hard bottom habitat from the shore at all the Tinian beaches is rapid. The hard bottom substrate moves from narrow reef flat to more well-developed spur-and-groove coral reef substrate (Minton et al. 2009). There are approximately 0.10-0.15 square miles (0.28-0.38 square kilometers) of reef flat around Tinian (Brainard 2012).

3.10.4.1.3 Hard Bottoms

Coral reef habitat (hard bottom) covers approximately 5,696 acres (2,305 hectares) of the area around Tinian (Brainard 2012) (see Table 3.10-1). The transition to hard bottom habitat from the shore at all the Tinian beaches is rapid. The hard bottom substrate moves from narrow reef flat to more well-developed spur-and-groove coral reef substrate (Minton et al. 2009). There are approximately 64-96 acres (179-249 hectares) of reef flat around Tinian (Brainard 2012).

3.10.4.1.4 Soft Bottoms

Limestone pavement (consolidated substrate, typically composed of calcareous elements, which have become cemented together), coral, and submerged boulders limit the development of soft bottom substrates in intertidal and subtidal areas of the CNMI. Tinian has one lagoon (soft bottom habitat) to the northwest of Tinian Harbor, on the southwest coast, where there are small boat piers and the substrate is dominated by sand and patches of coral (Minton et al. 2009).



0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

NORTH

Figure 3.10-2
Tinian Marine Habitat Overview

Sources: National Centers for Coastal Ocean Science 2005, Pacific Islands Fisheries Science Center 2007, DoN 2010a

Table 3.10-2. Essential Fish Habitat and Habitat Areas of Particular Concern for Management Unit Species of the Western Pacific Region

Fishery Management Plan	*Essential Fish Habitat (Juveniles and Adults)*	*Essential Fish Habitat (Eggs and Larvae)*	*Habitat Area of Particular Concern*
Pelagics	Water column down to 3,280 feet (1,000 meters)	Water column down to 656 feet (200 meters)	Water column down to 3,280 feet (1,000 meters) that lies above seamounts and banks
Bottomfish and Seamount Groundfish	Bottomfish: Water column and bottom habitat down to 1,312 feet (400 meters) Seamount Groundfish: (adults only) water column and bottom from 80 to 600 meters, bounded by 29°-35°N and 171°E-179°W, which is outside of the Action Area	Bottomfish: Water column down to 1,312 feet (400 meters) Seamount Groundfish: (including juveniles) epipelagic zone 0 to 200 meters bounded by 29°-35°N and 171°E-179°W, which is outside of the Action Area	Bottomfish: All escarpments and slopes between 131 feet (40 meters) and 918 feet (280 meters), and three known areas of juvenile pink/crimson snapper habitat located in Hawaii No Habitat Areas of Particular Concern designated for Seamount Groundfish
Crustaceans	Lobsters: Bottom habitat from shoreline to a depth of 328 feet (100 meters) Deep-water shrimp: The outer reef slopes at depths from 984-2,296 feet (300-700 meters)	Water column down to 492 feet (150 meters) Water column and associated outer reef slopes from 1,804-2,296 feet (550-700 meters)	All banks with summits less than 98 feet (30 meters) from the surface No Habitat Areas of Particular Concern designated for deep-water shrimp
Coral Reef Ecosystems	Water column and benthic substrata to a depth of 328 feet (100 meters)	Water column and benthic substrata to a depth of 328 feet (100 meters)	All Marine Conservation Areas identified in Fishery Ecosystem Plan, all Pacific Remote Island Areas, many specific areas of coral reef habitat

Notes: All areas are bounded by the shoreline and the outer boundary of the Exclusive Economic Zone (200 nautical miles [370 kilometers] from the coast), unless otherwise indicated.
Source: Western Pacific Regional Fishery Management Council 2009.

3.10.4.1.5 Aquatic Beds

Emergent vegetation is not found around Tinian (International Business Publications, USA 2011), but seagrass is found along the coast (see Section 3.10.4.2, *Marine Flora* for more detailed information on seagrass in the region of influence).

3.10.4.1.6 Essential Fish Habitat

Designated Essential Fish Habitat categories for Tinian are those defined for Pacific pelagics, bottomfish and seamount groundfish, crustaceans, and coral reef ecosystems (Western Pacific Regional Fishery Management Council 2009). Precious corals have not been recorded within the Exclusive Economic Zone in the CNMI, save for pre-World War II reports of harvesting of the precious coral *Corallium* sp., north of Pagan (DoN 2005). There are no Habitat Areas of Particular Concern for precious corals in the CNMI. These categories are summarized in Table 3.10-2. The description of Essential Fish Habitat around Tinian includes information from the CNMI as a whole. The entire water column and seafloor, from the shoreline to the boundary of the Exclusive Economic Zone, is considered Essential Fish Habitat for at least one species.

Specific Essential Fish Habitat management units are summarized below:

Pelagics. Trolling is the most popular fishing method for the pelagic fishing industry. Skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and dolphinfish (*Coryphaena hippurus*) are the most commonly targeted species. The Essential Fish Habitat for pelagic species at Tinian is the water column down to 3,280 feet (1,000 meters); the waters at those depths that lie above seamounts and banks—including Esmeralda Bank, Tatsumi Reef, and innumerable unnamed seamounts—are defined as Habitat Areas of Particular Concern for pelagic species.

Bottomfish and Seamount Groundfish. All 17 of the managed bottomfish species have sustainable recreational, subsistence, and commercial fisheries. Essential Fish Habitat around Tinian includes the water column and bottom habitat down to depths of 3,281 feet (1,000 meters). Habitat Areas of Particular Concern for bottomfish at Tinian include escarpments (underwater steep slopes or long cliffs) and slopes between depths of 131 and 919 feet (40 and 280 meters).

Crustaceans. The spiny lobster is the managed crustacean most likely to comprise a fishery in Tinian, although there is likely only recreational or subsistence fishing. The most common species of spiny lobster, *Panulirus* spp., in the CNMI is generally restricted to windward surf zones of oceanic reefs with clear water where there is minimal terrestrial influence (Berger et al. 2005; DoN 2005). There are no Habitat Areas of Particular Concern for crustaceans in the CNMI.

Coral Reef Ecosystems. The Essential Fish Habitat for coral reef ecosystems in Tinian encompasses the entire water column and benthic substrate to a depth of 328 feet (100 meters).

3.10.4.2 Marine Flora

Of the major species groups of true algae indigenous to the Mariana Islands, there are 109 species of red algae, 31 species of brown algae, and 71 species of green algae (Lobban and Tsuda 2003). According to the Mariana Archipelago Reef Assessment and Monitoring Program algae surveys, Tinian had one of the highest mean macroalgal covers of all the islands in the Mariana Archipelago. The Mariana Archipelago Reef Assessment and Monitoring Program did not note a difference in crustose coralline red algae cover across the archipelago (Brainard 2012).

In 2003, mean macroalgae cover on Tinian fore reefs was 47% (Brainard 2012). The 2003 surveys did not separate macroalgae and algae. The highest mean macroalgal cover was on Tatsumi Reef (offshore of the southeast coast of Tinian). Tinian Harbor (southwest Tinian), and the areas between Puntans Chiget and Asia (northeast Tinian) had moderately dense areas of macroalgal cover. Dominant habitats included pavement or boulder habitats (Brainard 2012). Mean cover of crustose coralline red algae on Tinian fore reef habitats was 6% in 2003. The highest cover was found around Puntan Chiget (northeast region of the island) on spur-and-groove habitats (see Figure 3.10-2).

In 2005, mean macroalgae cover on Tinian fore reefs habitats was 56% and were abundant across the island. The highest areas of cover were in the northeast region of the island between Puntan Asiga and Unai Masalok, and around Tinian Harbor (southwest Tinian). *Halimeda*, a green alga, were found covering large areas in the northeast region near Puntan Tahgong (Brainard 2012). The 2005 survey reported 5% mean cover of crustose coralline red algae. Boulder and pavement habitats had the highest amount of the red algae cover. As in 2003, the northeast region of Tinian had the highest amount of macroalgae cover.

In 2007, mean macroalgae accounted for 40% of the algae cover on the fore reef around Tinian, while turf algae accounted for 52% (note: the macroalgae and turf algae surveys were conducted using different survey methods so the total cover does not equal 100%). Macroalgae species recorded included: *Halimeda* (green algae), *Padina* (brown algae), *Liagora* (red algae), *Asparagopsis* (red algae) and *Microdictyon* (a green algae). Mean crustose coralline red algae cover was 16% in 2007. Unlike other years, the area with the highest cover of macroalgae was along the northwest corner of the island (Brainard 2012).

The Mariana Islands have three species of seagrass; tape seagrass (*Enhalus acoroides*), narrowleaf seagrass (*Halodule uninervis*), and hartog seagrass (*Halophila minor*). Seagrass, a food source for some sea turtle species, is found along most of the coast of Tinian except for the southeastern region and the lower half of the southwestern region (DoN 2005). Tape seagrass was reported at Unai Chiget reef, Unai Masalok, and Lamonibot Bay (Commander, U.S. Naval Forces Marianas 2004).

3.10.4.3 Marine Invertebrates

The oldest and most developed coral reefs of the CNMI are located in the nearshore waters of the southern islands, including Tinian (Starmer et al. 2008). Coral, starfish, sea urchins, sea cucumbers, mollusks, and tube worms are the most common types of invertebrates found on Tinian reefs (DoN 2010). During the *Coral Marine Resource Survey* conducted in support of this EIS/OEIS, giant clams (*Tridacna* spp.) were observed at all beaches surveyed on Tinian, and spider conchs (*Lambis* spp.) were observed at Unai Chulu, Unai Babui, and Unai Masalok (DoN 2014a).

The island of Tinian is virtually surrounded by shore-attached fringing reef (Riegl and Dodge 2008; Brainard 2012). Most of the reef habitat on Tinian has 1-10% coral cover, but patches exceeding 50% cover do occur, particularly in shallow waters (Minton et al. 2009; Brainard 2012; DoN 2014a). Shore-attached fringing reefs are the dominant reef habitat type on Tinian. Well-developed reef crests are less common and reef flats are uncommon. There are seven well-developed reef flats on Tinian. These include Unai Chulu, Unai Babui, Unai Dankulo, Unai Masalok, Unai Barcinas and Unai Leprosarium, and Taga Beach (south of the Tinian Dynasty). There are two additional small or poorly-developed reef flats on the leeward side, one at the south end of the International Broadcasting Bureau property and one approximately 1 mile (1.6 kilometers) south of Puntan Atgidon. There are two additional areas on Tinian that may provide habitat similar to reef flats based on their relatively broad extents of shallow nearshore bathymetry. One is the broad 'shallow bench' south of Unai Lam Lam and one is the shallow habitat at the northwestern tip of Tinian Harbor. All of the reef flats on Tinian are extremely small compared with well-developed reef flat habitats in the Mariana Islands such as Tumon Bay and Piti Bay on Guam. Table 3.10-1 in Section 3.10.4.1, *Marine Habitat* and *Essential Fish Habitat*, summarizes the amount of coastline, seafloor area, total reef habitat, and reef flat for the Mariana Islands and Tinian.

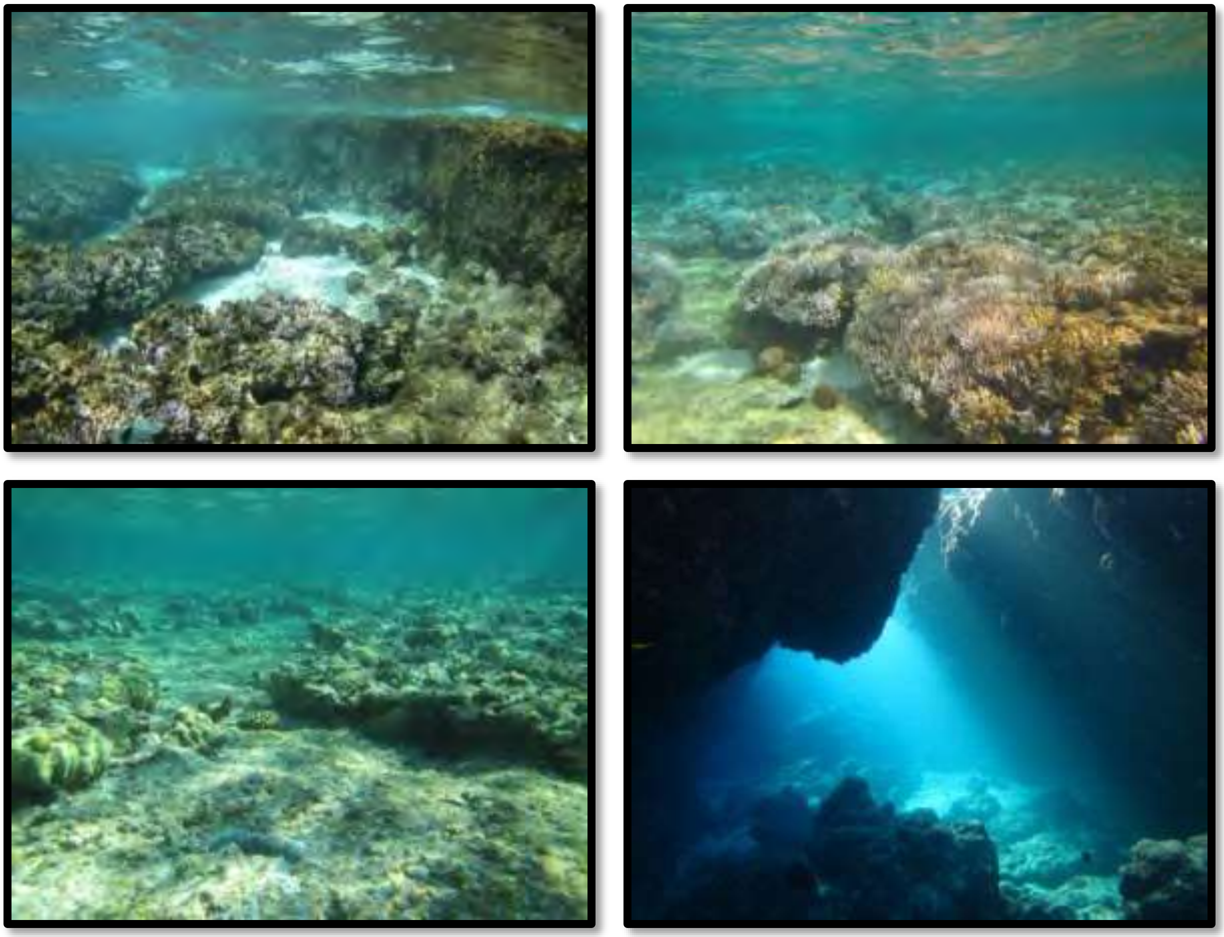
Brief summaries from the *Coral Marine Resources Survey Report* (see Appendix M, *Marine Biology Technical Memo and Survey Reports,* DoN 2014a) are presented in the following sections. The *Coral Marine Resources Survey Report* was conducted in support of this EIS/OEIS and discusses Unai Chulu, Unai Babui, Unai Masalok, Unai Lam Lam, and Unai Dankulo; however, Unai Dankulo is not part of the proposed action for beach landings and is not discussed in the following sections. Refer to Chapter 2, Section 2.3.2.2, *Refinement of Tinian Unit Level Range and Training Area Alternatives* for additional information.

3.10.4.3.1 Unai Chulu

The reef area at Unai Chulu is physically complex, with very deep, irregularly spaced spurs and grooves in the fore reef that transition rapidly to deep fore reef, with broken rock fragments in the grooves. The bases of the grooves have polished surfaces and polished cobble-sized fragments; indicating regular, active water motion and erosion. Many spurs are undercut by grooves that interconnect with other grooves, resulting in a network of tunnels, grottoes, fissures, and chimneys penetrating from the fore reef under the reef crest, and occasionally from under the reef flat (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*).

Reef zonation at Unai Chulu includes distinct deep fore reef, shallow fore reef, reef crest, outer reef flat, inner reef flat, and beach zones. To the south of the beach, the reef flat zone transitions to a shallow bench that is richer with coral cover than the reef flat itself. The habitat is heterogeneous (diverse) across different depths, particularly the shallow bench to the south of the beach, but homogeneous (similar) within the same depths.

The *Coral Marine Resources Survey Report* conducted in support of this EIS/OEIS revealed a total of 121 coral species with the most abundant species identified as *Goniastrea retiformis* (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*). *Goniastrea retiformis*, which is not listed under the federal Endangered Species Act, was also the most abundant species at the other surveyed beaches. Most of the area surveyed revealed low to moderate topographic complexity, low to moderate coral cover, and low sand cover (see Section 3.3 of the *Coral Marine Resources Survey Report* found in Appendix M for category description). There were scattered patches, however, that did have very high coral cover (50-70%). Representative images of Unai Chulu are presented below (Photos 3.10-1). Unai Chulu coral cover is shown in Figure 3.10-3.



Photos 3.10-1. Representative Images of Unai Chulu
(Clockwise from top left: rocky fore shore; shallow bench; grotto underneath reef crest; reef flat)

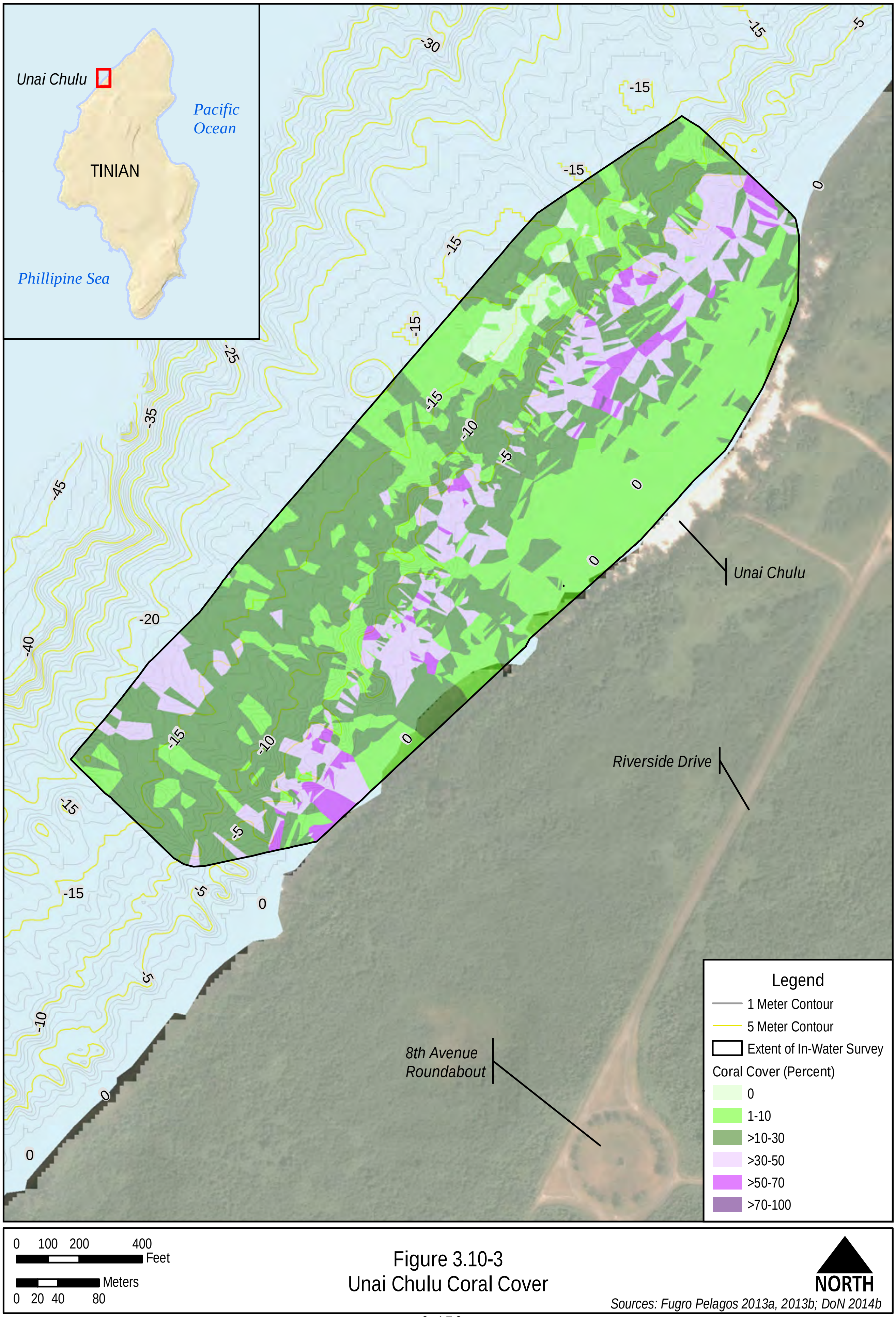


Figure 3.10-3
Unai Chulu Coral Cover

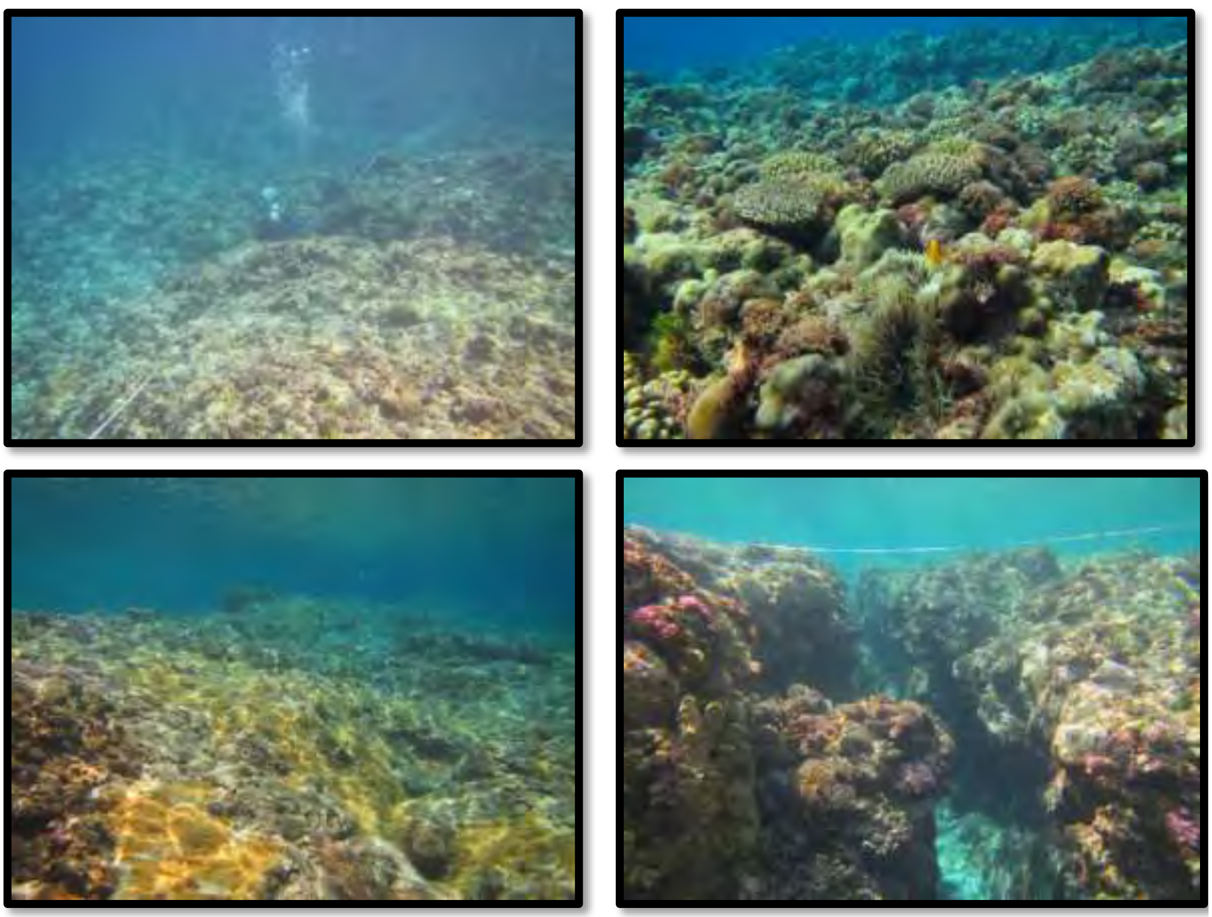
Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.4.3.2 Unai Babui

The reef area at Unai Babui is physically complex, and includes irregularly spaced grooves that are very deep in the fore reef, with broken rock fragments in the grooves. The bases of the grooves have polished surfaces and polished cobble-sized clasts, indicating high-energy sediment transport and erosion. Many spurs are undercut by grooves that interconnect with other grooves, resulting in a network of tunnels, grottoes, fissures, and chimneys penetrating from the fore reef under the reef crest, and occasionally from under the reef flat (DoN 2014a).

Reef zonation at Unai Babui includes distinct deep fore reef, shallow fore reef, reef crest, outer reef flat, inner reef flat, and beach zones. To the south of the beach, the reef flat zone transitions to a shallow bench that has denser coral cover than the reef flat itself. The habitat is heterogeneous across different depths, particularly the shallow bench to the south of the beach, but is relatively homogeneous within the same depths.

Similar to Unai Chulu, Unai Babui has moderate to high topographic complexity, low to moderate coral cover, low sand cover and patches of very high coral cover (70%-100%). Among the 107 coral species that were recorded during the *Coral Marine Resources Survey* conducted in support of this EIS/OEIS, the most abundant species was *Goniastrea retiformis*, (DoN 2014a). Representative images of Unai Babui are presented below (Photos 3.10-2). Unai Babui coral cover is shown in Figure 3.10-4.



Photos 3.10-2. Representative Images of Unai Babui
(Clockwise from top left: deep fore reef; shallow fore reef; fissure through reef crest; reef crest)

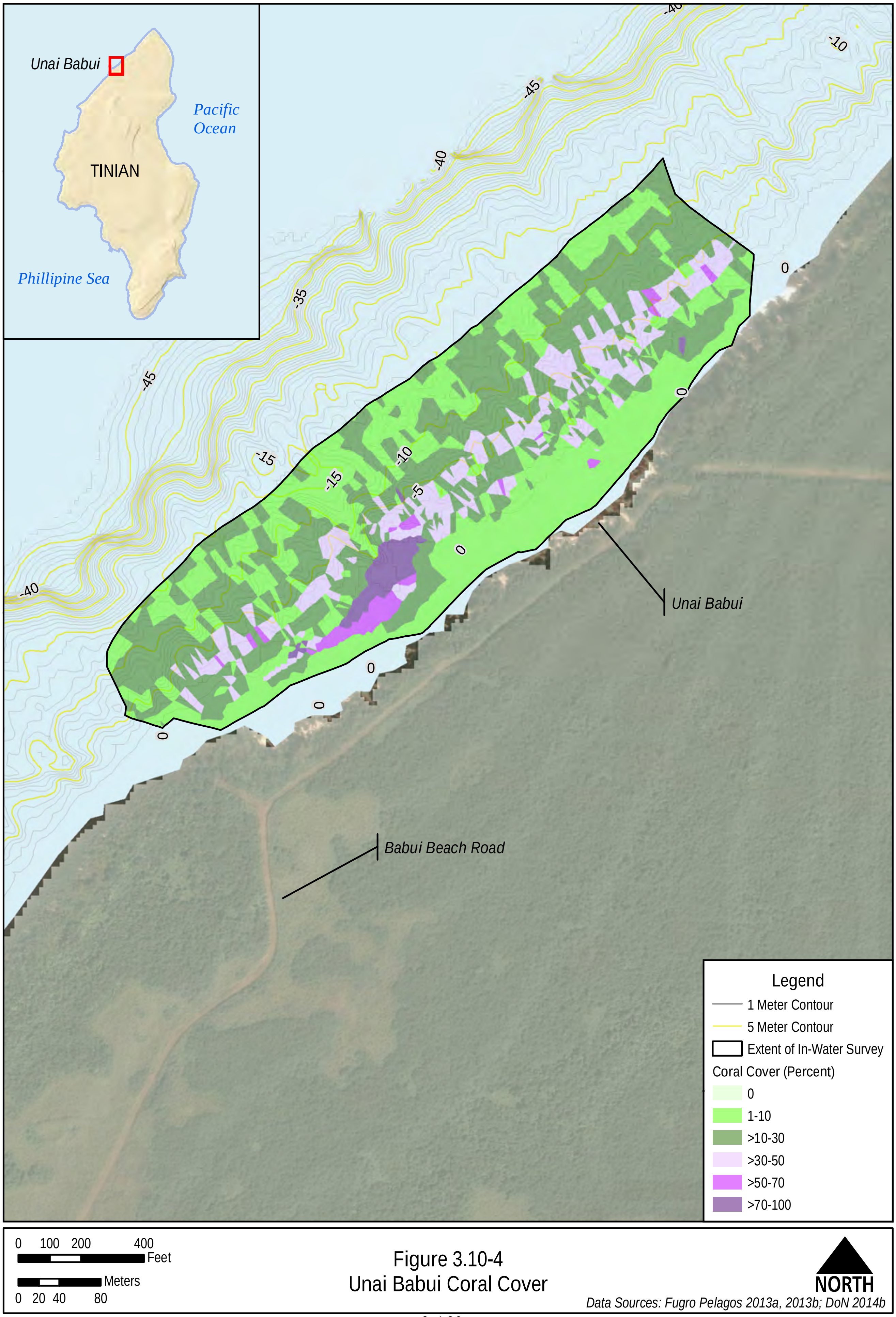


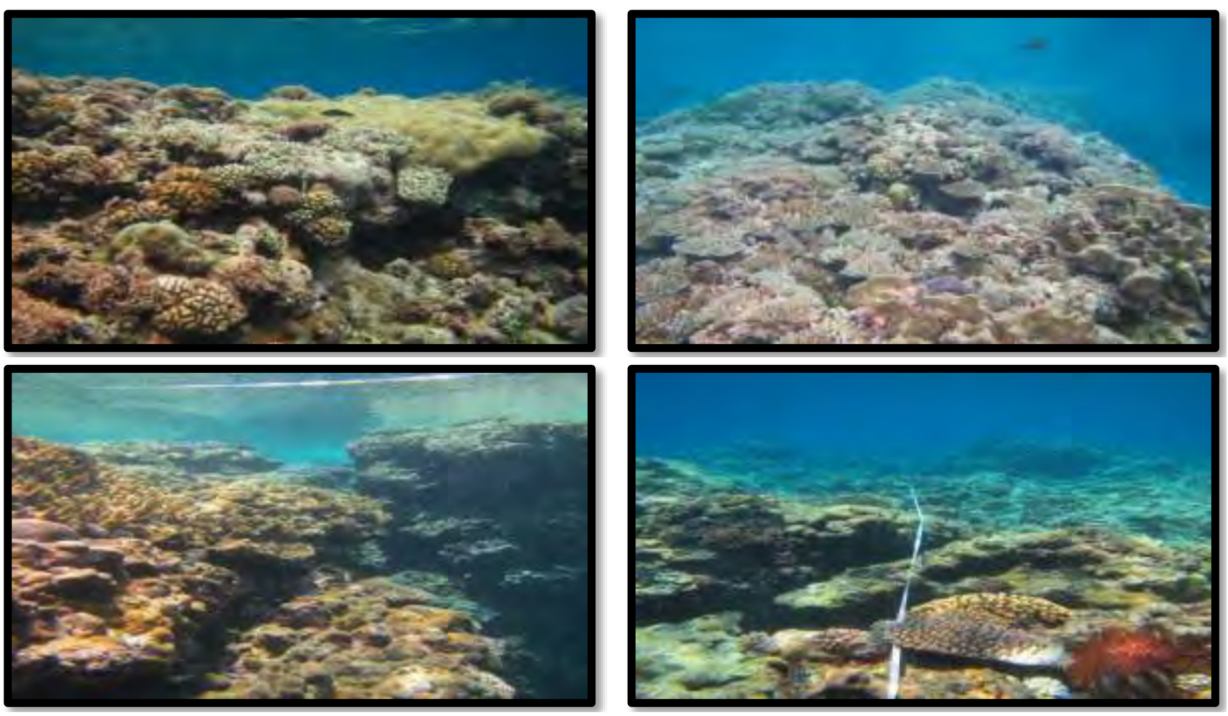
Figure 3.10-4
Unai Babui Coral Cover

3.10.4.3.3 Unai Lam Lam

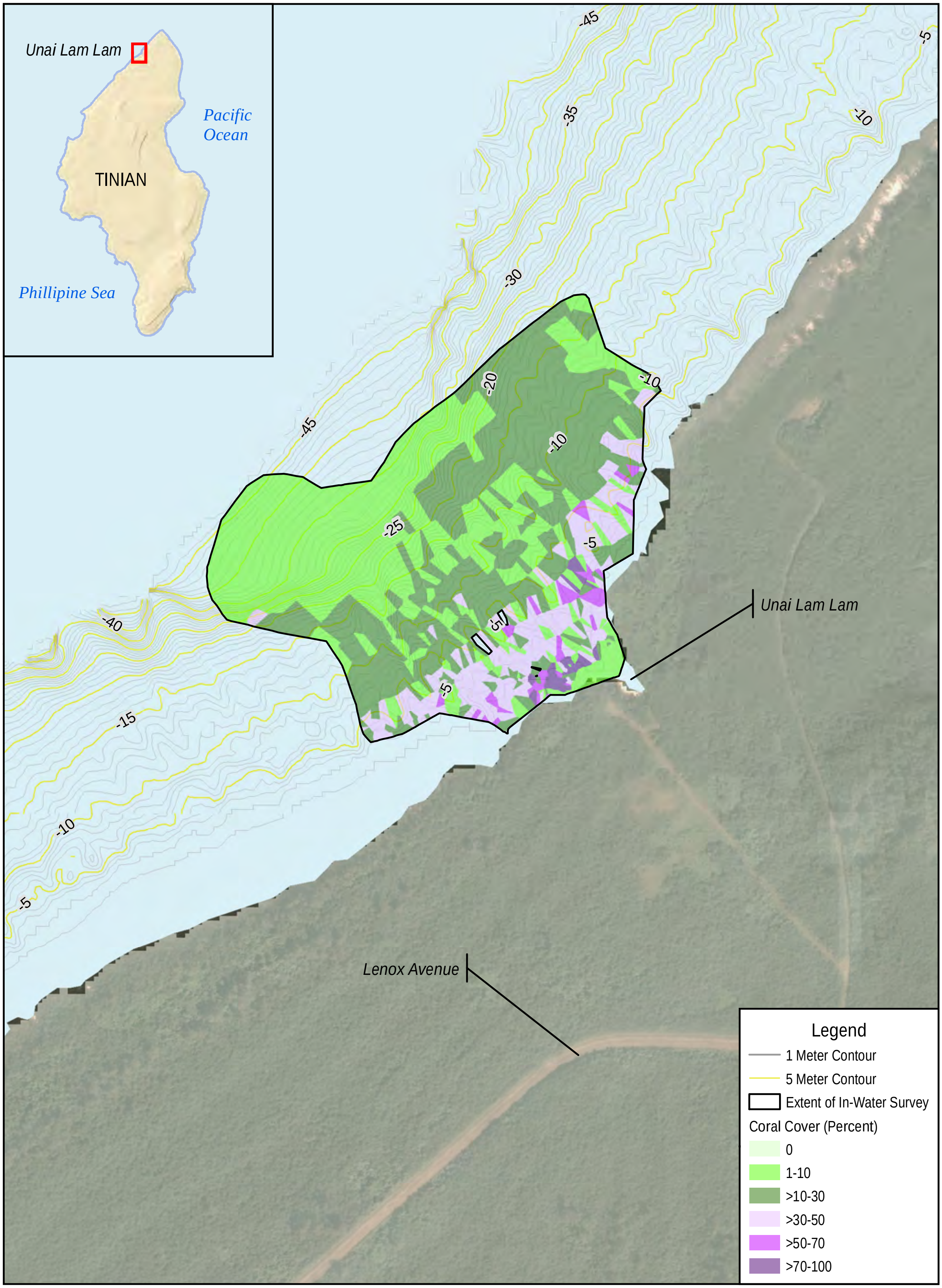
The reef area at Unai Lam Lam is physically complex, with regularly spaced grooves that are very deep in the fore reef and transition rapidly to deep fore reef. A groove aligned with the center of the pocket beach is strewn with cobble and boulder-sized rubble, while most other grooves are lined with coarse sand. This feature is a sign of past human disturbance to the groove aligned with the center of the pocket beach. Metal debris observed in this area also suggests past human activities. Many spurs are undercut by grooves interconnecting with other grooves, resulting in a network of tunnels, grottoes, fissures, and chimneys penetrating from the fore reef under the reef crest, and occasionally from under the reef flat (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*).

Reef zonation at Unai Lam Lam includes distinct deep fore reef, shallow fore reef, reef crest, outer reef flat, inner reef flat, and beach zones. The reef crest and outer reef flat are broad and well developed relative to Unai Babui and Unai Chulu. To the south of the beach the reef flat zone transitions to a shallow bench. This zone has high coral cover (90%). The habitat is somewhat heterogeneous across different depths and relatively homogeneous within the same depth, but this distinction is less pronounced than at Unai Chulu and Unai Babui. Zonation is still identifiable, but each zone is richer in species diversity than its counterpart at Unai Chulu and Unai Babui. Unai Lam Lam has several unique coral species and growth forms that are not found at the other surveyed beaches, especially branching Acropora species.

Overall, Unai Lam Lam has moderate to high topographic complexity, moderate coral cover, and low sand cover, except for one large offshore patch of 90-100% sand. Areas of Unai Lam Lam have very high coral cover (70%-90%). Among the 108 coral species recorded, the most abundant coral species was *Goniastrea retiformis* (DoN 2014a). Representative images of Unai Lam Lam are presented below (Photos 3.10-3). Unai Lam Lam coral cover is shown in Figure 3.10-5.



Photos 3.10-3. Representative Images of Unai Lam Lam
(Clockwise from top left: reef crest from inside a groove; shallow fore reef; transition from shallow to deeper fore reef; fissure through reef crest)



0 100 200 400 Feet

0 20 40 80 Meters

NORTH

Figure 3.10-5
Unai Lam Lam Coral Cover

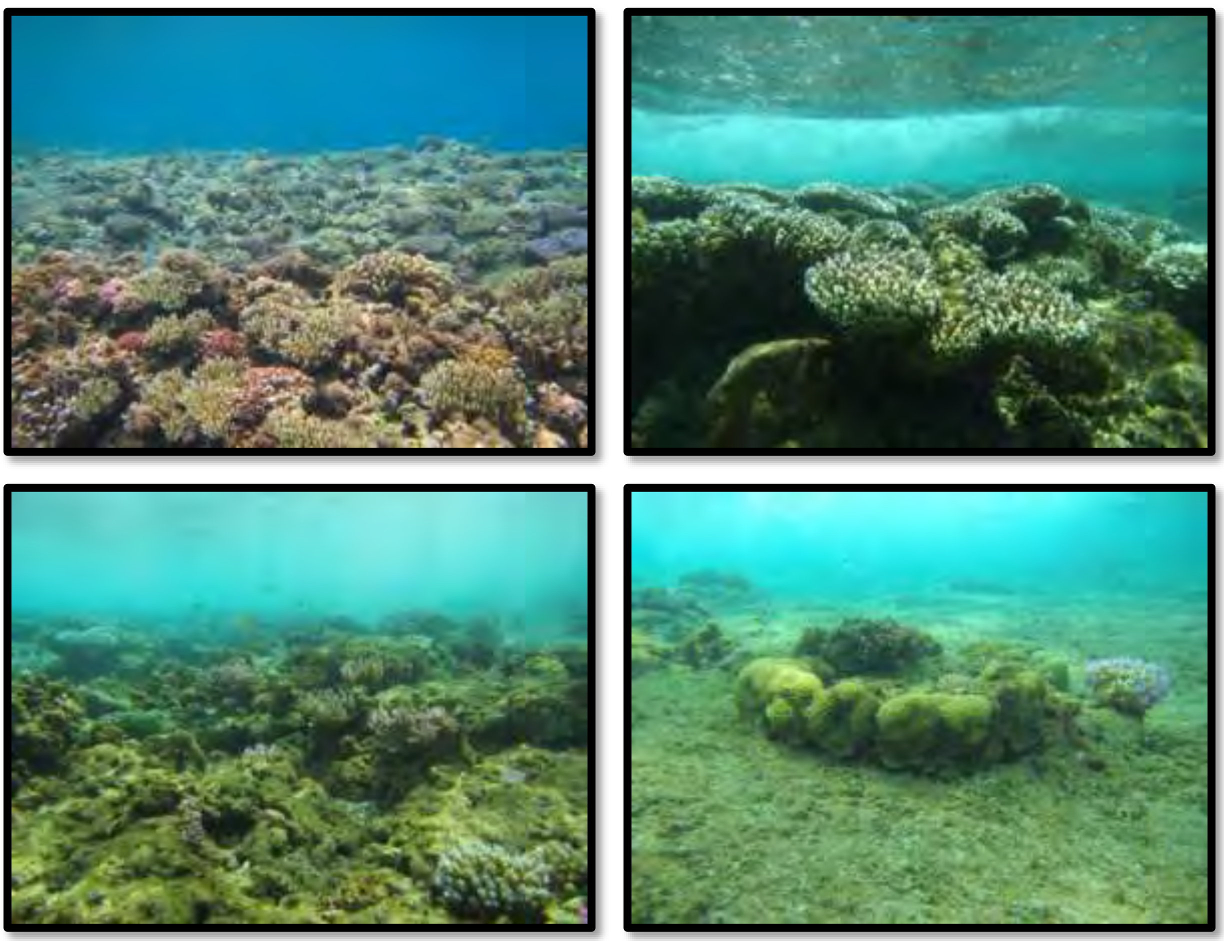
Data Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.4.3.4 Unai Masalok

The reef area at Unai Masalok is physically complex, and includes regularly spaced grooves that are moderately deep in the fore reef, transitioning quickly to deep fore reef that is much more topographically complex than the deep fore reef at Unai Chulu, Unai Babui, or Unai Lam Lam. Relatively few spurs are undercut or tunneled. Most of the reef flat area has low topographic complexity, low coral cover (10%-30%), and low sand cover. The reef flat area is physically and biologically homogeneous.

Among the 113 coral species that were recorded during the survey, the most abundant species was *Goniastrea retiformis* (DoN 2014a).

The habitat changes abruptly across different depths and is relatively homogeneous within the same depths. Most of the reef flat at Unai Masalok was lacking in numbers and variety of species characteristic of inner reef flat habitat. Representative images of Unai Masalok are presented below (Photos 3.10-4). The reef survey area at Unai Masalok was not contiguous due to sea state conditions. Coral cover within the survey area is shown in Figure 3.10-6.



Photos 3.10-4. Representative Images of Unai Masalok
(Clockwise from top left: shallow fore reef; outer reef crest; outer reef flat; inner reef flat)

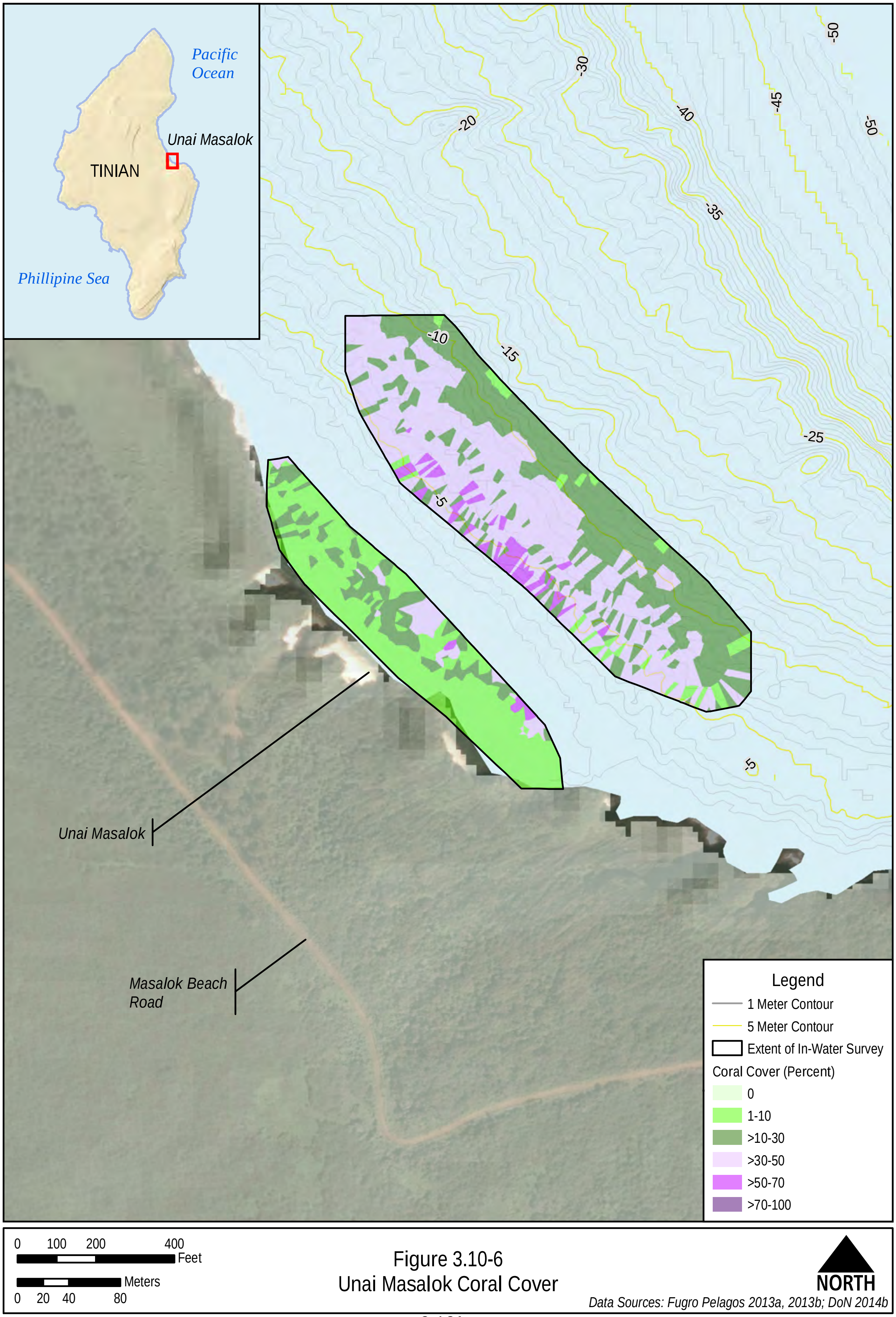


Figure 3.10-6
Unai Masalok Coral Cover

Data Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.4.4 Fish

Myers and Donaldson (2003) report 1,106 fish species known in the Mariana Islands and adjacent waters; 1,020 of these are inshore species that inhabit coral reefs. Mariana Archipelago Reef Assessment and Monitoring Program's standard approach to reporting fish species richness and biomass (the total mass of organisms in a given area) is to calculate the number or mass of fish per square meter or per 100 square meters. The Mariana Archipelago Reef Assessment and Monitoring Program found Tinian's total fish biomass is going up over time; however, total fish biomass on Tinian was low compared to other sites surveyed in the CNMI in 2003, 2005, and 2007, respectively.

In 2003, reef sharks made up over half of the overall mean biomass on Tinian. Stingrays (*Dasyatidae*) made up 45% of the total biomass in the 2005 Tinian survey. Barracudas (*Sphyraendidae*) and sharks made up the largest portions of the total fish biomass in the 2007 survey. In 2007, 11 sharks were encountered including whitetip reef sharks (*Triaenodon obesus*), black tip reef sharks (*Carcharhinus melanopterus*) and tawny nurse sharks (*Nebrius ferrugineus*). Total biomass was higher in the 2007 surveys than the previous years (Brainard 2012). The fish biomass recorded for 2007 on Tinian was higher than the average observed for the southern islands, but was still low relative to other islands in the Mariana Islands. Surgeonfish (*Acanthuridae*) and parrotfish (*Scaridae*) accounted for over half the total mean fish biomass when averaged over all three surveys (Brainard 2012).

The Mariana Archipelago Reef Assessment and Monitoring Program's 2003, 2005, and 2007 Tinian surveys found similar fish species richness within the fore reef habitats surveyed at sites around Tinian (Brainard 2012). Overall, the most abundant fish families documented during the Mariana Archipelago Reef Assessment and Monitoring Program surveys on Tinian were surgeonfish, parrotfish, wrasse (*Labridae*), and damselfish (*Pomacentridae*), with the three most common damselfish species being the princess damselfish (*Pomacentrus vaiuli*), jewel damselfish (*Plectroglyphidodon lacrymatus*) and the midget chromis (*Chromis acares*). The two most common surgeonfish species include the striated surgeonfish (*Ctenochaetus striatus*) and the orange-spine unicornfish (*Naso lituratus*) (Brainard 2012).

Tinian, along with Saipan and Rota, supports much of the CNMI's bottomfish fishery, which includes snapper (particularly the long-tail snapper [*Etelis coruscans*]), grouper (particularly the eight-banded grouper [*Epinephelus striatus*]), and the redgill emperor (*Lethrinus rubrioperculatus*) and other emperor-type fish. Managed species targeted by the bottomfish fishing industry are described in more detail in Section 3.10.4.1.6, *Essential Fish Habitat*.

Damselfish live within coral reefs and depend on these reefs for shelter, reproduction, habitat, and food. Other fish species are not as heavily reliant on coral reef habitats. Several damselfish species are currently in decline due to degradation of certain coral reef habitats, caused by mass bleaching events and ocean acidification. Threats such as ocean warming and ocean acidification may directly affect these damselfish species by impairing sensory capabilities, behavior, and aerobic capacity (ability to get oxygen to the muscles) (Center for Biological Diversity 2012).

During the various marine resources surveys conducted in support of this EIS/OEIS, fish species were also recorded and summarized in a species list report. The survey found 265 fish species around Tinian. Unai Chulu had 175 species, Unai Babui had 158 species, Unai Lam had 67 species, and Unai Masalok had 101 species.

3.10.4.5 Special-status Species

3.10.4.5.1 Marine Invertebrates

Seventeen marine invertebrates have been designated by the CNMI Division of Fish and Wildlife as Species of Special Conservation Need. Five of the 17 have been reported in Tinian waters (Berger et al. 2005), see Table 3.10-3.

Table 3.10-3. CNMI Marine Invertebrate Species of Special Conservation Need of Tinian

Common Name/ Scientific Name	*Reported within Tinian Waters*
Ghost Crab (*Ocypode* spp)	No
Rock Crab (*Grapus* spp)	No
Spiny Lobster (*Panulirus* spp)	Yes
Land Hermit Crab (*Coenobita* spp)	No
Surf redfish (sea cucumber) (*Actinopyga mauritiana*)	Yes
Black teatfish (sea cucumber) (*Holothuria whitmaei*)	Yes
Sea urchin (*Toxopneustidae*)	No
Giant clam (*Tridacna* spp)*	Yes
Pectinate venus (*Gafrarium pectinatum*)	No
Common spider conch (*Lambis lambis*)	No
Horned helmet shell (*Cassis cornuta*)	No
Tapestry turban shell (*Turbo petholatus*)	No
Rough turban (*Turbo setosus*)	No
Silver-mouth turban (*Turbo argyrostoma*)	No
Triton's trumpet shell (*Charonia tritonis*)	Yes
Octopus (*Octopus* spp)	No

Note: *Tridacna spp includes the Fluted giant clam (*Tridacna squamosa*) and the Elongate giant clam (*Tridacna maxima*).
Source: Berger et al. 2005.

3.10.4.5.1.1 Coral Species

Twenty-two coral species are listed under the federal Endangered Species Act; 20 of which were newly listed in August 2014. Fifteen of the newly listed species occur in the Indo-Pacific, four are likely to occur in the CNMI, *Acropora globiceps*, *Acropora retusa*, *Pavona diffluens*, and *Seriatopora aculeata* (National Marine Fisheries Service 2014a; Veron 2014).

Based on the *Coral Marine Resources Survey Report* conducted in support of this EIS/OEIS (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*), *Acropora globiceps* was the only coral species listed under the federal Endangered Species Act that was reported in Tinian nearshore waters; however the presence of the other three listed coral species is conceivable. *Acropora globiceps* was recorded at Unai Chulu, Unai Babui, Unai Lam, and Unai Masalok (Table 3.10-3) (DoN 2014a). *Acropora globiceps* colonies ranged in size from smaller than 7.9 inches (20 centimeters) to 36.6 square feet (3.4 square meters) (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*).

Species profiles for the special-status coral species listed in Table 3.10-4 can be found in Appendix L, *Biological Resources Supporting Documentation*.

Table 3.10-4. Special-status Coral Species of Tinian

Coral (Genus/Species)	*Endangered Species Act Status*	*Reported within Tinian Region of Influence*[1]
Acropora globiceps	Threatened	Yes; C B L M [2]
Acropora retusa	Threatened	No
Pavona diffluens	Threatened	No
Seriatopora aculeata	Threatened	No

Notes: [1] The region of influence for marine biological resources includes the waters surrounding Tinian from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore.
[2] C = Unai Chulu, B = Unai Babui, L=Unai Lam, and M= Unai Masalok.
Sources: DoN 2014a; National Marine Fisheries Service 2014a.

Acropora globiceps grow in small colonies and are usually described as digitate (having divisions arranged like those of a bird's foot or small hand). Each of the "digits," or branches, has varying size and appearance depending on the level of wave action and exposure; however, branches are always short and compacted closely together. Colonies are found in the intertidal zone, upper reef slopes, and reef flats in water depths shallower than 26 feet (8 meters). *Acropora globiceps* can be found in areas exposed to heavy wave action (Brainard et al. 2011).

Acropora retusa coral colonies are usually brown in color. They have a digitate morphology similar to *Acropora globiceps*, and form plates with thick short branchlets. Axial corallites are indistinct and radial corallites lay flat down the sides of branchlets (Brainard et al. 2011). The species is often confused with others in the digitate group with such as *Acropora globiceps* (Veron 2014). *Acropora retusa* occurs on upper reef slopes and tidal pools. They occur at depths ranging from 1 to 15 feet (0.3 to 5 meters). This species provides habitat structure for organisms small enough to shelter in branches of relatively compact colonies.

Pavona diffluens has a very narrow latitudinal and longitudinal distribution and is found in the region of the Red Sea and Arabian Gulf. It has also been reported in the northern Mariana Islands and American Samoa; however, it is considered unlikely to occur in the CNMI (Brainard et al. 2011). *Pavona diffluens* has been reported in most reef habitats in water depths ranging from 16 feet (5 meters) to 67 feet (20 meters) (Brainard et al. 2011).

Seriatopora aculeata coral colonies have short, tapered branches, typically fused in clumps. They have irregularly distributed corallites and their tentacles are commonly extended during the day. The colonies are pink or cream, and branches are thicker than other *Seriatopora aculeata* (Brainard et al. 2011). *Seriatopora aculeata* occupies shallow reef environments ranging in depths from 10 to 131 feet (3 to 40 meters) (Brainard et al. 2011). With irregular clumps of thick short branches, this species contributes to the overall reef structure and small-volume habitat.

3.10.4.5.2 Fish Species

Special-status fish species documented in the CNMI include the scalloped hammerhead shark (*Sphyrna lewini*), humphead wrasse (*Cheilinus undulatus*), and gray reef shark (*Carcharhinus amblyrhynchos*) (Table 3.10-4). The scalloped hammerhead shark Indo-West Pacific Distinct Population Segment is listed as threatened under the Endangered Species Act. The National Marine Fisheries Service considers the humphead wrasse a Species of Concern. This species has also been designated by the CNMI Division of Fish and Wildlife as a Species of Special Conservation Need. The CNMI also lists the gray reef shark as a

Species of Special Conservation Need (Table 3.10-4) (Berger et al. 2005). Species profiles of the species listed in Table 3.10-5 can be found in Appendix L, *Biological Resources Supporting Documentation*.

During the various marine resources surveys conducted in support of this EIS/OEIS, fish species were also recorded and summarized in a species list report. The humphead wrasse was observed at Unai Lam. The scalloped hammerhead shark was not observed at any site on Tinian during the surveys conducted in support of this EIS/OEIS (DoN 2013b), but it has been observed within the Mariana Islands (Dr. T. Donaldson, University of Guam, personal communication, 2014). It is possible that the Endangered Species Act-listed scalloped hammerhead shark may be present within the vicinity of Tinian, but it has not been documented in the nearshore environment of the CNMI. Tinian is located within the range of this migratory species, and the offshore pelagic waters, coral reefs, and turbid, nearshore waters surrounding the island of Tinian have the potential to serve as foraging, breeding, and nursery habitat for the scalloped hammerhead shark. The possibility that scalloped hammerhead sharks could occur in areas of potential impact by physical disturbance, acoustics, or indirect impacts is considered remote. Such occurrence would probably involve the transient occurrence of a small number of individuals whose most likely response would be to leave the immediate area in response to underwater noise and poor foraging conditions due to previous disturbance to the habitat.

Table 3.10-5. Special-status Fish Species of Tinian

Common Name/ Scientific Name	*Endangered Species Act Status*	*National Marine Fisheries Status*	*CNMI Status*[3]	*Reported within Tinian Region of Influence*
Scalloped hammerhead shark (*Sphyrna lewini)*	Threatened (Indo-West Pacific Distinct Population Segment)	—	None	No[(1)]
Humphead Wrasse (*Cheilinus undulatus)*	None	Species of Concern	Species of Special Conservation Needs	Yes[(2)]
Gray reef shark (*Carcharhinus amblyrhynchos)*	None	None	Species of Special Conservation Needs	Yes[(1)]

Notes: [1]Not observed during surveys in support of the EIS/OEIS (DoN 2014a), but reported in Tinian waters in other sources (Dr. T. Donaldson, University of Guam, personal communication, 2014; Berger et al. 2005).
[2]Observed at Unai Lam during surveys in support of the EIS/OEIS (DoN 2014b).
[3] The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.
Sources: Berger et al. 2005; National Marine Fisheries Service 2013, 2014b; DoN 2014a.

3.10.4.5.3 Sea Turtles

Sea turtle species and their expected occurrences in the Tinian region of influence are listed in Table 3.10-6.

Table 3.10-6. Special-status Sea Turtle Species of Tinian

Common Name/Scientific Name	*Endangered Species Act Status*	*CNMI Status* [2]	*Reported within in the Tinian Region of Influence*
Green sea turtle (*Chelonia mydas)*	Threatened	Species of Special Conservation Need	Yes[1]
Hawksbill sea turtle (*Eretmochelys imbricata)*	Endangered	Species of Special Conservation Need	Yes[1]
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	None	Yes

Notes: [1]Observed during 2013 surveys in support of the EIS/OEIS (DoN 2014b).
[2] The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.

The green sea turtle occurs in most oceans, including the western, central, and eastern Atlantic, Mediterranean Sea, western, northern and eastern Indian, southeast Asia, and the western, central, and eastern Pacific. In the Pacific, the green sea turtle occurs around most of the islands, including the Hawaiian Island chain, American Samoa, Guam, and CNMI (DoN 2014b). The hawksbill sea turtle occurs throughout the tropics, from 30 degree North latitude to 30 degrees South latitude in the Atlantic, Pacific, and Indian Oceans and associated water bodies, including the Caribbean Sea and Gulf of Mexico. In the Pacific, the hawksbill sea turtle occurs around most islands, including the Hawaiian Islands, American Samoa, Guam, and CNMI. The green turtle and the hawksbill turtle have nearshore resident juvenile populations in the Mariana Islands, based on flipper tag data (Summers et al. 2012). A separate migratory population of nesting green turtles also occurs across the archipelago, based on satellite telemetry data (Summers 2011).

The leatherback turtle is the most widely distributed of all sea turtles, found from tropical to subpolar oceans; however, is uncommon in the Tinian region of influence (Gilman 2008; Myers and Hays 2006; National Marine Fisheries Service and U.S. Fish and Wildlife Service 1992). Leatherbacks are also the most migratory sea turtles and are able to tolerate colder water than other species. Leatherback and olive ridley turtles are thought to remain primarily in the open ocean throughout their lives. There have been two reliable observations of the leatherback turtle (Hadpei, personal communication, 2013) in pelagic waters. The leatherbacks were sighted by a CNMI sea turtle biologist in 2004 and 2008 during personal recreational offshore fishing southwest of Marpi Reef, approximately 5 miles (8 kilometers) offshore of Banzai Cliff on Saipan. The sightings were identified as adults coming up for breaths of air. One turtle was observed just north of the buoy and one was observed between Banzai Cliff and the buoy.

One olive ridley turtle account (Pritchard 1977) in the Mariana Islands was document in the 1970s and recent available data suggest this species is not present in the region of influence. The loggerhead turtle nests north of the Mariana Islands and migrates to foraging grounds in Mexico; however, oceanographic conditions may be a barrier to its regular occurrence within the Mariana Islands. No sighting of a loggerhead sea turtle has been documented in the Mariana Islands. The rarity of olive ridley and loggerhead sea turtles in the Mariana Islands, in addition to their pelagic existence minimizes the potential of any impacts to these three species from this action to discountable; therefore, these species will not be discussed further in this EIS/OEIS.

Because of continued poaching of both nesting and in-water sea turtles in the populated Southern Mariana Islands (Berger et al. 2005; Maison et al. 2010), sub-adult and adult sea turtles are generally skittish in the presence of humans. Based on observations during the *Sea Turtle Marine Resources Survey Report* (DoN 2014b, Appendix M, *Marine Biology Technical Memo and Survey Reports*), recent recruits and smaller juveniles may not be as adversely conditioned to humans (DoN 2014b). The *Comprehensive Wildlife Conservation Strategy for the CNMI* (Berger et al. 2005) states that the “green sea turtles are considered a delicacy and are generally reserved for special cultural occasions, primarily by the Carolinian community.” Poaching of hawksbill sea turtles for the curio trade was also a noted threat in the *Comprehensive Wildlife Conservation Strategy for the CNMI* (Berger et al. 2005).Previous sea turtle research on Tinian is detailed in the *Sea Turtle Marine Resources Survey Report* (DoN 2014b, Appendix M, *Marine Biology Technical Memo and Survey Reports*). The green sea turtle is the only sea turtle species known to commonly occur in nearshore waters of Tinian. Based on 1999-2001 data, there were an estimated 832 green sea turtles within the waters of Tinian in 2001 (Kolinski et al. 2004). Hawksbills are also observed from time to time, and are expected to frequent nearshore areas within the vicinity of known nesting areas, as well as adjacent suitable foraging areas. Recent survey efforts to gain a better understanding of the nearshore habitat use by sea turtles near strategic sites, mostly in Guam, Tinian, and Saipan, have documented hawksbill sea turtles migrating from Tinian to Guam (Jones and van Houtan 2014).

During the July 2013 *Sea Turtle Marine Resource Survey* conducted in support of this EIS/OEIS (DoN 2014b), an estimated 255 sea turtles were observed in Tinian waters. Surveys of various methods were conducted in the northwest, west, southwest, east and northeast zones around the island. Sea turtle densities are not uniform across Tinian. Along the northwestern coast of Tinian, specifically in the waters fronting Unai Chulu, Unai Babui, and Unai Lam Lam, sea turtle densities based on the towboard and swim transect surveys were relatively low. Sea turtle densities on Tinian are highest along the northeast, southeast, and southwest, with high density pockets of sea turtles in sheltered waters of the western coast. The survey estimates the sea turtle population on Tinian to be between 845 and 1,178 individuals. This equals between 46-471 sea turtles per square mile (18-182 sea turtles per square kilometer), depending on survey method used. Approximately 94% of the sea turtles observed were identified as green sea turtles, and approximately 75% of the green sea turtles were juvenile (Photo 3.10-17). Based on the this information, there is an estimated population of 795 to 1,107 green sea turtles and 50 to 71 hawksbill sea turtles in the waters around Tinian (DoN 2014b).

Details on the survey methods (e.g. cliffline surveys, snorkel/scuba swimming surveys, and opportunistic sightings) are provided in the *Sea Turtle Marine Resources Survey Report* (DoN 2014b, see Appendix M, *Marine Biology Technical Memo and Survey Reports*).

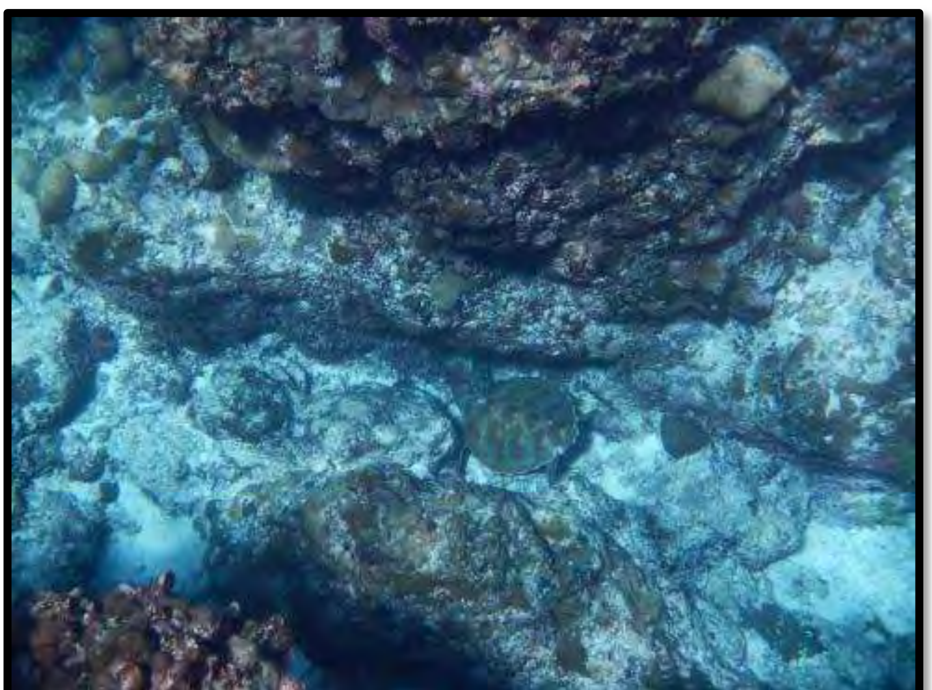


Photo 3.10-17. Juvenile green sea turtle observed feeding during DoN 2013 survey at Unai Chulu on Tinian

3.10.4.5.4 Marine Mammals

Historically, the Mariana Islands were a prominent whaling ground in the eighteenth century, with many catches of humpback whales and a lesser number of sperm whales (Townsend 1935). In the 1960s and 1970s, Japanese whaling companies conducted extensive tag (i.e., discovery tags) and recovery programs for large commercially hunted whale species in the North Pacific, including the Mariana Islands (Masaki 1972; Ohsumi and Masaki 1975). Most of the marine mammal information from this island group before 2006 comes from information attained after a marine mammal strandings/beaching, which is a relatively infrequent occurrence (Kami 1976, 1982; Donaldson 1983; Eldredge 1991, 2003; Trianni and Kessler 2002; Wiles 2005; Trianni and Tenorio 2012) and opportunistic sightings (Eldredge 1991, 2003; Miyashita et al. 1996; Wiles 2005; Jefferson et al. 2006). A marine mammal survey (DoN 2014c) was conducted in support of this EIS/OEIS (see Appendix M, *Marine Biology Technical Memo and Survey Reports*) and the survey results are summarized in the following paragraphs.

Earlier marine mammal surveys were limited to large-scale surveys that briefly passed through the Mariana Islands (Miyazaki and Wada 1978; Miyashita et al. 1996; Shimada and Miyashita 2001; Ohizumi et al. 2002). A few single-species surveys were directed primarily at humpback whales (Darling and Mori 1993; Yamaguchi 1995, 1996; Yamaguchi et al. 2002). Beginning in 2006, dedicated marine mammal surveys were conducted in the southern Mariana Islands (Mobley 2007; Oleson and Hill 2010; HDR 2011, 2012; Ligon et al. 2011; Hill et al. 2012, 2013). In January-April 2007 there was a large-scale, visual and acoustic line-transect survey of cetaceans and sea turtles conducted for the entire Mariana Islands Range Complex (DoN 2007). Analysis of some of the data from this Mariana Islands Sea Turtle and Cetacean Survey was later published and has provided current density estimates for some cetaceans in waters surrounding the Mariana Islands (Fulling et al. 2011; Norris et al. 2012).

Several marine mammal species have been detected or observed in the nearshore environment within 3.0 nautical miles (5.6 kilometers) of Tinian (E. M. Oleson and Hill 2010; Fulling et al. 2011; Ligon et al. 2011; Hill et al. 2012, 2013; DoN 2014c). According to the five-year report (Hill et al. 2014), spinner dolphins were the most frequently encountered species (54% of encounters). All of the locations where these encounters occurred were in depths less than 300 meters, and the vast majority of the locations were in depths less than 100 meters. Spinner dolphins were also encountered at offshore reefs (Marpi Reef and Rota Bank; 17-18 kilometers from shore). Ligon et al. (2011) did not sight spinner dolphins off Tinian during a survey around the island, but did report anecdotal evidence of ferries seeing spinner dolphins off Tinian Harbor on the southwestern coast of the island. This species is highly likely to be island-associated with single groups associated with more than one island. No individuals have been documented moving between the southern islands of the CNMI and Guam or Rota Bank. Genetic evidence suggests a more diverse population than the visual data supports. Martien et al. (2014) suggest that the genetic transfer within the Marianas may be facilitated by offshore individuals that make temporary visits to nearshore populations or by males moving among the insular populations.

According to the five-year report (Hill et al. 2014), pantropical spotted dolphins were the second most frequently encountered species. The groups were encountered in the widest range of depths, as well as the deepest depths (333 meters to 3012 meters). Bottlenose dolphins ranked third highest in encounter rates. In addition, one sighting of spotted dolphins (offshore of Saipan near Malakis Reef a.k.a Ruby Seamount) was the farthest from shore (52.8 kilometers) of all cetacean encounters. Four groups of bottlenose dolphins were observed during encounters with one or more other species (short-finned pilot whales, false killer whales, rough-toothed dolphins, and spinner dolphins). Their locations ranged 18-734 meters in depth and 0.3-18.7 kilometers distance from shore. Genetic analysis has indicated that bottlenose dolphins around the Mariana Islands contain genetic material common with Fraser's dolphin (*Lagenodelphis hosei*), a pelagic dolphin species. This suggests that the local population has some level of hybridization with Fraser's dolphin (Martien et al. 2014). Bottlenose dolphins would be expected to have island associated and pelagic populations. Photo-identification and telemetry data suggest that a nearshore population is distributed among the southern islands of CNMI and as far north as Sarigan in the Northern Mariana Islands (Martien et al. 2014).

According to the five-year report (Hill et al. 2014), short-finned pilot whales were the fourth most observed species by National Marine Fisheries Service. They were encountered in depths that ranged from 215 meters to 967 meters. Two groups of pilot whales were associated with bottlenose dolphins. Genetic analysis revealed significant genetic differences between individuals off Saipan, Tinian, and Aguigan (3-Islands complex) and those collected from individuals off Guam and Rota suggesting limited gene flow and interaction between the populations (Martien et al. 2014). Individuals resighted between these locations suggest that the genetic differences may be a reflection of the groups not mixing socially, that there is male-mediated gene flow, or that the 3-islands region is an area of overlap between the two populations, one population's range extending to the north and the other extending south to Guam (Martien et al. 2014).

National Marine Fisheries Service false killer whale encounters occurred in depths that ranged from 88 meters to 2107 meters and distances from shore of 0.7-7.9 kilometers (Hill et al. 2014). Blainville’s beaked whale and Cuvier’s beaked whale may also occasionally occupy the waters near Tinian, as they have been acoustically detected; however, these species have not been confirmed within 3.0 nautical miles (5.6 kilometers) of shore (Baumann-Pickering et al. 2012; DoN 2014c). The humpback whale, minke whale, sei whale, pygmy killer whale, rough-toothed dolphins, short-finned pilot whale, blue whale, and fin whale are also known to occur in Tinian waters as discussed below (DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014). However, the blue whale and fin whale have been heard in Tinian waters; however, blue whale and fin whale calls can be heard over great distances (thousands of miles) and cannot be used to determine the presence of these species in particular areas.

Sperm whales have been visually and acoustically detected near Tinian (Hill et al. 2012, 2013; Norris et al. 2012; DoN 2014c). Sperm whales were encountered three times by National Marine Fisheries Service, at depths of 374 meters, 1971 meters, and 1617 meters depth, at varying distances from land (1.1 kilometers, 22.0 kilometers and 19.4 kilometers, respectively (Hill et al. 2014). Evaluation of the sperm whale acoustics suggests the CNMI waters are predominantly used by females with possible social links between the eastern and western North Pacific Ocean (Hill et al. 2013).

Humpback whales have been observed within 3.0 nautical miles (5.6 kilometers) of Tinian during the winter and spring months (Hill et al. 2012, 2013; DoN 2014c). Humpback whales currently are not considered to have island-associated populations due to their annual migrations (Hill et al. 2013; DoN 2014c; DoN 2007). Potential breeding behaviors, including singing) have been acoustically and visually documented in the nearshore waters of Tinian and Saipan (Norris et al. 2012; DoN 2014c; DoN 2007). Observed potential breeding behaviors suggest these areas may represent important wintering/breeding habitats (Fulling et al. 2011; Norris et al. 2012; DoN 2014c; DoN 2007). In addition, research indicates that there is overlap of acoustic features between humpback whales in the waters of Hawaii and the CNMI, as well as possibly with the Philippines (Norris et al. 2012).

Minke whales have been acoustically detected in the proximity of the Mariana Islands during the winter and spring (DoN 2014c). Acoustic detections have originated from the waters east of Tinian and Saipan, near some of the deepest parts of the Mariana Trench (Norris et al. 2012). It is believed that these waters likely represent wintering areas for minke whales. Sei whales were visually and acoustically detected during the winter/spring surveys of Norris et al. (2012), with most sightings associated near, but not in, the deepest parts of the Mariana Trench. Previous studies have found sei whales to be a frequently sighted species (DoN 2007; Fulling et al. 2011).

Melon-headed whales have been sighted within 3.0 nautical miles (5.6 kilometers) of the coast of Tinian (Oleson and Hill 2010; Fulling et al. 2011; Hill et al. 2012, 2013). Melon-headed whales have been encountered twice by National Marine Fisheries Service in relatively large group sizes (300-400 animals at a depth of 1,014 meters 15.1 kilometers from shore and approximately 100 animals at a depth of 1,975 m 6.5 kilometers from shore (Hill et al. 2014).

Acoustic and visual data collected during the summer and winter-spring months documented eight marine mammal species in Tinian waters during both time periods (Hill et al. 2013). These include common bottlenose dolphins, false killer whales, pantropical spotted dolphins, pygmy killer whales, rough-toothed dolphins, short-finned pilot whales, spinner dolphins and sperm whales (DoN 2007, 2014c; Norris et al. 2012; Hill et al. 2013). Rough-toothed dolphins were encountered at depths that ranged from 260 meters to 616 meters and the distances from shore were 0.4-10.4 kilometers (Hill et al. 2014).

In total, 14 marine mammal species have been documented in the waters surrounding Tinian, with 8 confirmed within 3.0 nautical miles (5.6 kilometers) of the shore (Mobley 2007; E. M. Oleson and Hill 2010; Fulling et al. 2011, 2011; Hill et al. 2012, 2013; Norris et al. 2012; Trianni and Tenorio 2012; DoN 2014c; DoN 2007). These species are presented in Table 3.10-7. Species profiles for the species listed in Table 3.10-6 can be found in Appendix L, *Biological Resources Supporting Documentation.*

Table 3.10-7. Marine Mammals Species with Reported Occurrence in the Region of Influence Surrounding Tinian

Common Name/Scientific Name	***Marine Mammal Protection Act Status[1]***	***Endangered Species Act Status***	***CNMI Status[2]***	***Regional Occurrence in Guam-CNMI Waters[3]***		***Reported within the Tinian Region of Influence[4]***
				Summer (Jun-Nov)	***Winter (Dec-May)***	
Sperm whale (*Physeter macrocephalus*)	Depleted	Endangered	-	Regular	Regular	Yes
Sei whale (*Balaenoptera borealis*)	Depleted	Endangered	-	Rare	Regular	No
Blue whale (*Balaenoptera musculus*)	Depleted	Endangered	-	Rare	Rare	No
Fin whale (*Balaenoptera physalus*)	Depleted	Endangered	-	Rare	Rare	No

Table 3.10-7. Marine Mammals Species with Reported Occurrence in the Region of Influence Surrounding Tinian

Common Name/Scientific Name	*Marine Mammal Protection Act Status*[1]	*Endangered Species Act Status*	*CNMI Status*[2]	*Regional Occurrence in Guam-CNMI Waters*[3]		*Reported within the Tinian Region of Influence*[4]
				Summer (Jun-Nov)	*Winter (Dec-May)*	
Humpback whale (*Megaptera novaeangliae*)	Depleted	Endangered	-	Rare	Regular	Yes
Common Minke whale (*Balaenoptera acutorostrata*)	-	-	-	Rare	Regular	No
Short-finned pilot whale (*Globicephala macrorhynchus*)	-	-	-	Regular	Regular	Yes
False killer whale (*Pseudorca crassidens*)	-	-	-	Regular	Regular	Yes
Melon-headed whale (*Peponocephala electra*)	-	-	-	Regular	Regular	Yes
Common bottlenose dolphin (*Tursiops truncatus*)	-	-	-	Regular	Regular	Yes
Pantropical spotted dolphin (*Stenella attenuata*)	-	-	-	Regular	Regular	Yes
Spinner dolphin (*Stenella longirostris*)	-	-	Species of Special Conservation Need	Regular	Regular	Yes
Blainville's beaked whale (*Mesoplodon densirostris*)	-	-	-	Regular	Regular	No
Cuvier's beaked whale (*Ziphius cavirostris*)	-	-	-	Regular	Regular	No

Notes:[1] Status from Carretta et al. 2014. All marine mammals are protected under the Marine Mammal Protection Act. Populations or stocks that have fallen below the optimum sustainable population level are considered "Depleted." The Hawaii stocks of sperm whale, sei whale, blue whale, fin whale, and the American Samoa stock of humpback whale are also listed as "Strategic" under the Marine Mammal Protection Act; this status would apply if research determines that these are the stocks that inhabit CNMI waters.

[2] The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.

[3] Regular = a species that occurs as a regular or usual part of the fauna of the area, regardless of how abundant or common it is; Rare = a species that occurs in the area only sporadically. Occurrence designations from the Navy's Mariana Islands Marine Resource Assessment (DoN 2012/2013, updated with new information as described in DoN 2013, (DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014).

[4] The region of influence for marine mammals includes the waters surrounding Tinian from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore. However, the potential for acoustic effects due to pile driving/extraction extends to approximately 7.3 nautical miles (13.6 kilometers) from shore.

Sources: DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014.

The *Marine Mammal Survey* conducted in support of this EIS/OEIS (Appendix M, *Marine Biology Technical Memo and Survey Reports*) collected data about the occurrence and distribution of mammals around Tinian and Pagan. The study area selected for the survey was between 0 and 3.0 nautical miles (5.6 kilometers) from the coast of Pagan and Tinian; which is the same as the region of influence for this EIS/OEIS. Data collection events were conducted on the leeward inshore waters of Tinian in 2 days. A total of 38.8 nautical miles (71.8 kilometers) of predetermined transect lines were completed at Tinian and no marine mammals were sighted.

3.10.5 Pagan

3.10.5.1 Marine Habitats

The Pagan coastline is rocky and rugged, but several beaches allow access to the northern part of the island (Sukhraj et al. 2010). Pagan is a younger active volcanic island, and its coral communities are mostly a thin layer on top of igneous substrate, rather than built-up limestone reef (Suhkraj et al. 2010). In general, Pagan has patch reef habitat, particularly on the southern half of the island and in the deeper waters adjacent to South Beach (Suhkraj et al. 2010; DoN 2014a). Green, Red, and Blue Beach are on the west (leeward) shore of Pagan. North Beach is a small, isolated beach on the northern tip of the island. South Beach is a long, crescent-shaped beach on the east (windward) side of Pagan that experiences constant wave energy due to the persistent trade winds from the east. Gold Beach is also on the windward side of Pagan and is located at the end of an irregularly shaped, cliff-lined cove (DoN 2014a).

Figure 3.10-7 provides an overview of marine habitat around Pagan. Table 3.10-8 summarizes the amount of various physical characteristics (e.g., coastline, seafloor area, total reef habitat, and reef flat) for the Mariana Islands, and Pagan.

Table 3.10-8. Estimates of Select Total Physical Characteristics Compared to Pagan

Physical Characteristics	*Mariana Islands (†MC)*	*Pagan (†VHC)*
Coastline	313 miles	25 miles
Seafloor area from 0-98 feet (0-30 meters) depth	49,984 acres	4,025 acres
Total Reef Habitat	65,920 acres	4,416 acres
Reef flat‡	1,728 acres mostly on Guam	Possibly 0.22 acre

Notes: † Estimations. See below for estimation confidence levels below; ‡ other habitat types (i.e., reef crest, fore reef, and deep bank), or particular values could only be approximated with confidences below Medium Confidence. Because their inclusion would not be informative, the estimates were not presented. Measurements and estimations have different uncertainties associated with them. For the purposes of this discussion, uncertainty is expressed using the Intergovernmental Panel on Climate Change treatment of uncertainties (Intergovernmental Panel on Climate Change 2007, 2013). The uncertainty guidance draws a distinction between levels of confidence in scientific understanding and the likelihood of specific results. Confidence and likelihood here are distinct concepts but are often linked in practice. The standard terms used to define levels of confidence in this report follow the Intergovernmental Panel on Climate Change approach, namely: VHC= Very high confidence; MC= Medium confidence;.

Sources: Analytical Laboratories of Hawaii 2004; Bearden et al. 2008; Brainard et al. 2012; National Oceanic and Atmospheric Administration and National Centers for Coastal Ocean Science 2005; Riegl et al. 2008.

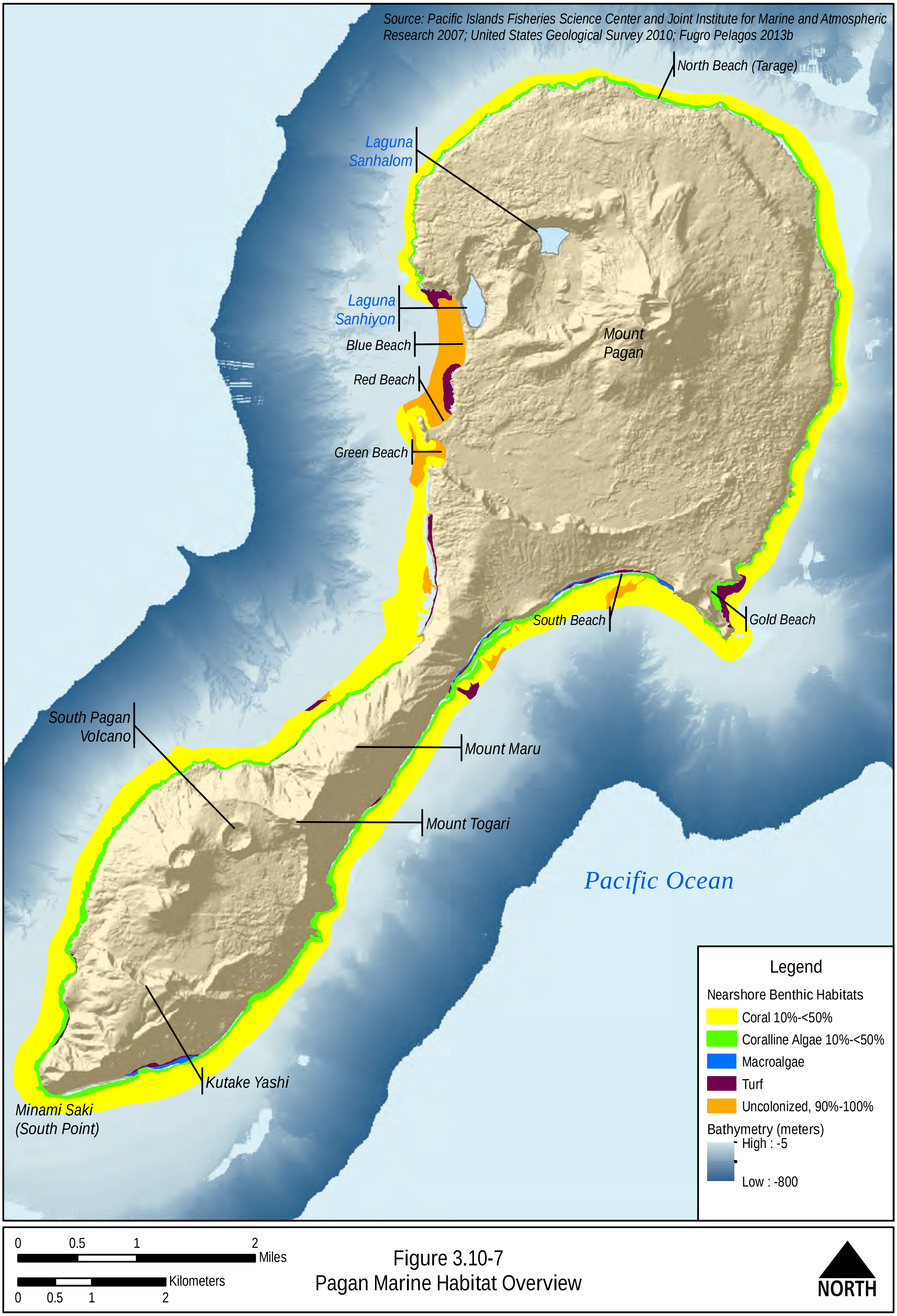


Figure 3.10-7
Pagan Marine Habitat Overview

3.10.5.1.1 Hard Shores

Coastline within the region of influence for Pagan is dominated by hard shores, as is the case for the CNMI in general, though Pagan is interspersed with soft shores (resulting in beaches that allow access to the northern part of the island). In the vicinity of Blue Beach, Sukhraj et al. (2010) noted the northern and southern ends of Laguna Bay have hardened shorelines extending into the ocean (hard bottom habitat).

3.10.5.1.2 Soft Shores

Soft shore habitat in Pagan includes the following beaches: North Beach, Gold Beach, South Beach, Green Beach, Red Beach, and Blue Beach. In the general vicinity of South Beach, Sukhraj et al. (2010) determined that the beach (soft shore) immediately transitions to hard bottom habitat (spur-and-groove formations). This area is exposed to high energy conditions due to onshore winds and lack of a protective embayment.

In the southern portion of Blue Beach, Sukhraj et al. (2010) noted there is a semi-protected embayment (Laguna Bay), this beach does not have a reef flat, having instead a sandy bottom with occasional rocks and boulders to a depth of at least 30 feet (10 meters). Similarly, surveys performed in the vicinity of Green Beach noted the lack of a reef flat and a sandy substrate with sporadic rocks and patches of coral (hard bottom) to the north and south of the sandy area. A semi-protected embayment in the vicinity of Red Beach also lacks a reef flat and has a sandy bottom bounded to the north and south by patches of coral (hard bottom).

3.10.5.1.3 Hard Bottoms

Hard bottom habitat in the South Beach region is characterized by large coral reef features (reef benches and platforms) that are exposed at low tide and decrease rapidly to depth beyond the reef flat boundary (Suhkraj et al. 2010).

The distribution and cover of hard bottom habitat consisting of coral reef around Pagan are described in detail under Section 3.10.5.3, *Marine Invertebrates,* and general coral nearshore benthic habitat is illustrated in Figure 3.10-7. Coral reef habitat (hard bottom) covers approximately 4,416 acres (1,787 hectares) of the area around Pagan and is estimated to have 0.22 acre (0.08 hectare) of reef flat (Brainard 2012).

3.10.5.1.4 Soft Bottoms

There are no lagoons in Pagan (Minton et al. 2009).

3.10.5.1.5 Aquatic Beds

There are no mangrove areas around Pagan (International Business Publications, USA 2011) and seagrass was not noted in any of the surveys referenced for this section. Detailed information on macroalgal cover within the region of influence can be found under Section 3.10.5.2, *Marine Flora.*

3.10.5.1.6 Essential Fish Habitat

Designated Essential Fish Habitat categories for Pagan are those defined for Pacific pelagics, bottomfish and seamount groundfish, crustaceans, and coral reef ecosystems (Western Pacific Regional Fishery

Management Council 2009). The entire water column and seafloor, from the shoreline to the boundary of the Exclusive Economic Zone, is considered Essential Fish Habitat for at least one species.

3.10.5.2 Marine Flora

In 2003, mean macroalgae cover on Pagan fore reefs was 46% (Brainard 2012). The northernmost part of the west region of the island had the highest mean macroalgal cover (Brainard 2012). The dominant habitat in this area was spur and groove pavement with rock boulders. Sand flats were interspersed throughout the area. Mean cover of crustose coralline red algae on Pagan fore reef habitats was 7% in 2003. The highest cover was found on west region of the island on pavement and rock boulder habitats.

In 2005, mean macroalgae cover on Pagan fore reefs habitats was 18%. The highest areas of cover were in the north region of the island west of Tarage (North Beach). The 2005 survey reported 12% mean cover of crustose coralline red algae with the highest cover in the south region of the island. Mean macroalgae was reported at 17% in 2007 with the highest cover in the south region of the island. *Asparagopsis* (red algae), *Padina* (brown alga), *Halimeda* (green alga), and cyanobacteria were the dominate species reported (Brainard 2012). Mean crustose coralline red algae cover was 14% in 2007. Unlike other years, the area with the highest cover was along the northwest coast of the island.

Overall, the highest cover of macroalgal populations were in the northern areas of Pagan and included *Halimeda* (green alga), *Caulerpa* (green algae), *Neomeris* (green alga), *Padina* (brown alga), *Asparagopsis* (red algae), *and Liagora* (red algae).

3.10.5.3 Marine Invertebrates

Like Tinian, the most common types of non-coral invertebrates found along Pagan's reefs are starfish, sea urchins, sea cucumbers, mollusks, and tube worms. During the *Coral Marine Resource Survey* conducted in support of this EIS/OEIS (see Appendix M, *Marine Biology Technical Memo and Survey Reports*), giant clams were observed at all six surveyed beaches on Pagan (DoN 2014a). Spider conchs were observed at Green and Red Beaches (DoN 2014a).

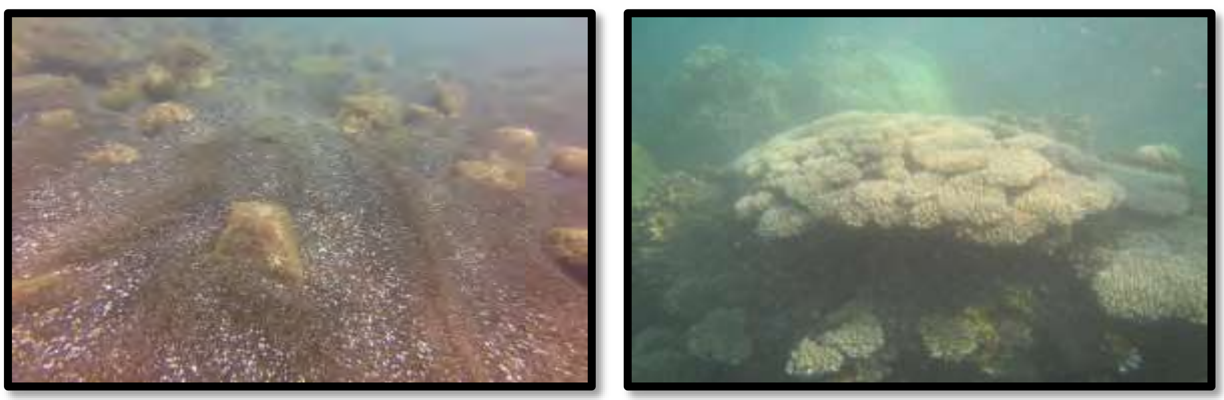
Pagan is surrounded by heterogeneous habitat types including shore-attached fringing reefs, non-constructional volcanic sediments (from boulders to sand beaches), uncolonized volcanic substrate, and uncolonized primary coral framework (old coral limestone that currently only supports scattered corals), which is unique to Pagan (Riegl and Dodge 2008; Houk and Starmer 2010). Pagan has no reef flat habitats that can be readily measured. Patch reef habitat is located on the southern half of the island and in the deeper waters adjacent to South Beach (Suhkraj et al. 2010; DoN 2014a). Most of the reef habitat on Pagan has 5-20% coral cover, but patches to 50% cover are not uncommon (Suhkraj et al. 2010; Brainard et al. 2011; DoN 2014a).

A *Coral Marine Resource Survey*, provided in Appendix M (*Marine Biology Technical Memo and Survey Reports*), was conducted in support of this EIS/OEIS and is summarized in the subsections below. The survey focused on substrate shallower than 12 feet (4 meters) (DoN 2014a).

3.10.5.3.1 Green Beach

Overall, Green Beach has low topographic complexity, low coral cover, and high sand cover. There is a relatively large and contiguous area in the center of Green Beach that has especially low cover for organisms and high cover for sand. The central portion of Green Beach is largely devoid of sessile plants or animals. The visibility and apparent water quality at Green Beach is degraded relative to the other leeward beaches on the island, potentially from human sources. The seafloor had a number of kitchen scraps including chicken and cow bones (DoN 2014a).

A total of 70 coral species were recorded during the survey. Green Beach has relatively large heads of *Porites* corals, with one of the largest measuring 98 feet (29.8 meters) in circumference. These large corals were found across the entrance to Green Beach oriented from north to south, though many were also growing throughout the northern and southern rock formations. Representative images (Photos 3.10-28) of Green Beach are presented below. Green Beach coral cover is shown in Figure 3.10-8 (DoN 2014a).



Photos 3.10-28. Representative Images of Green Beach
(Center of beach; corals on northern rocky outcrop)

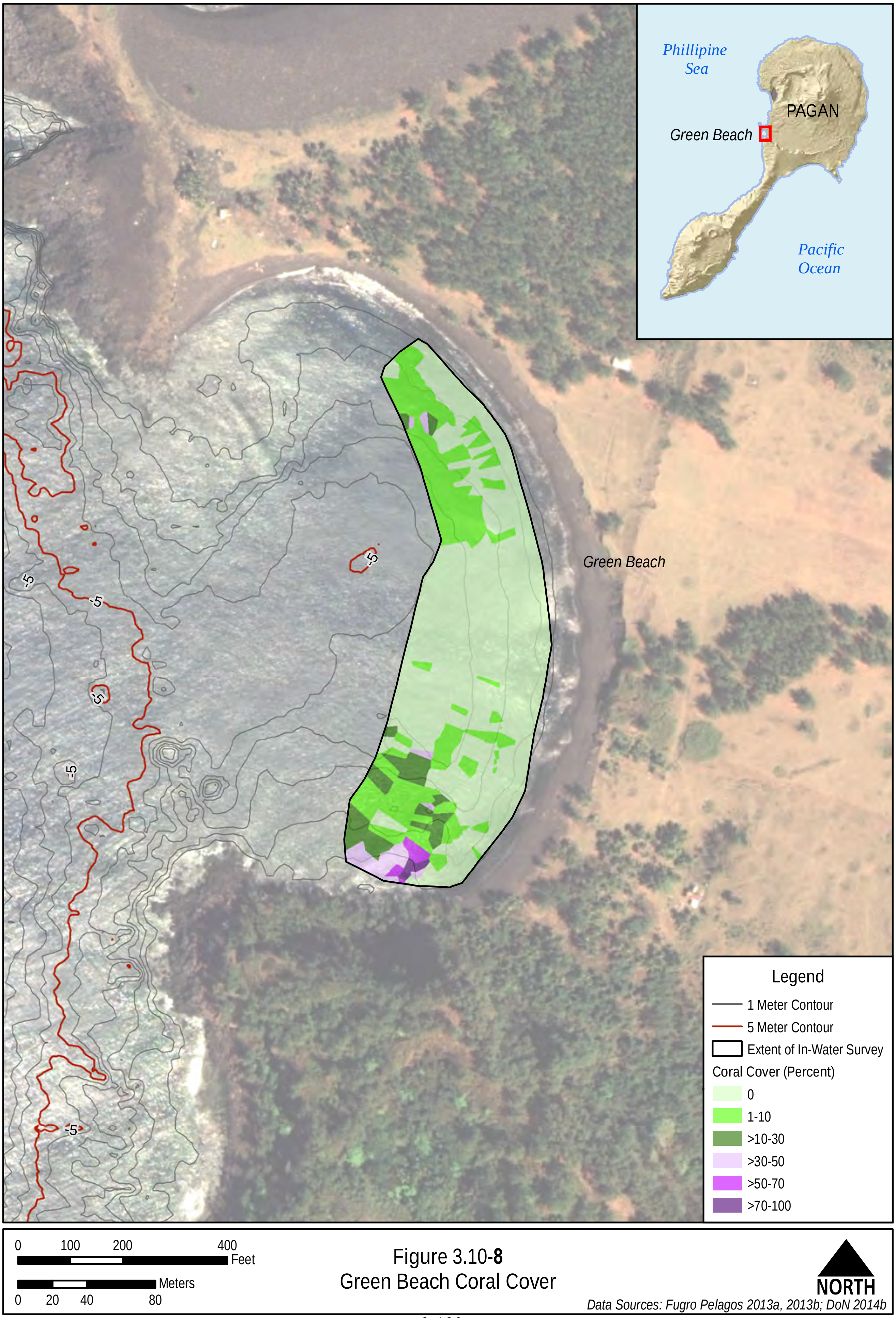
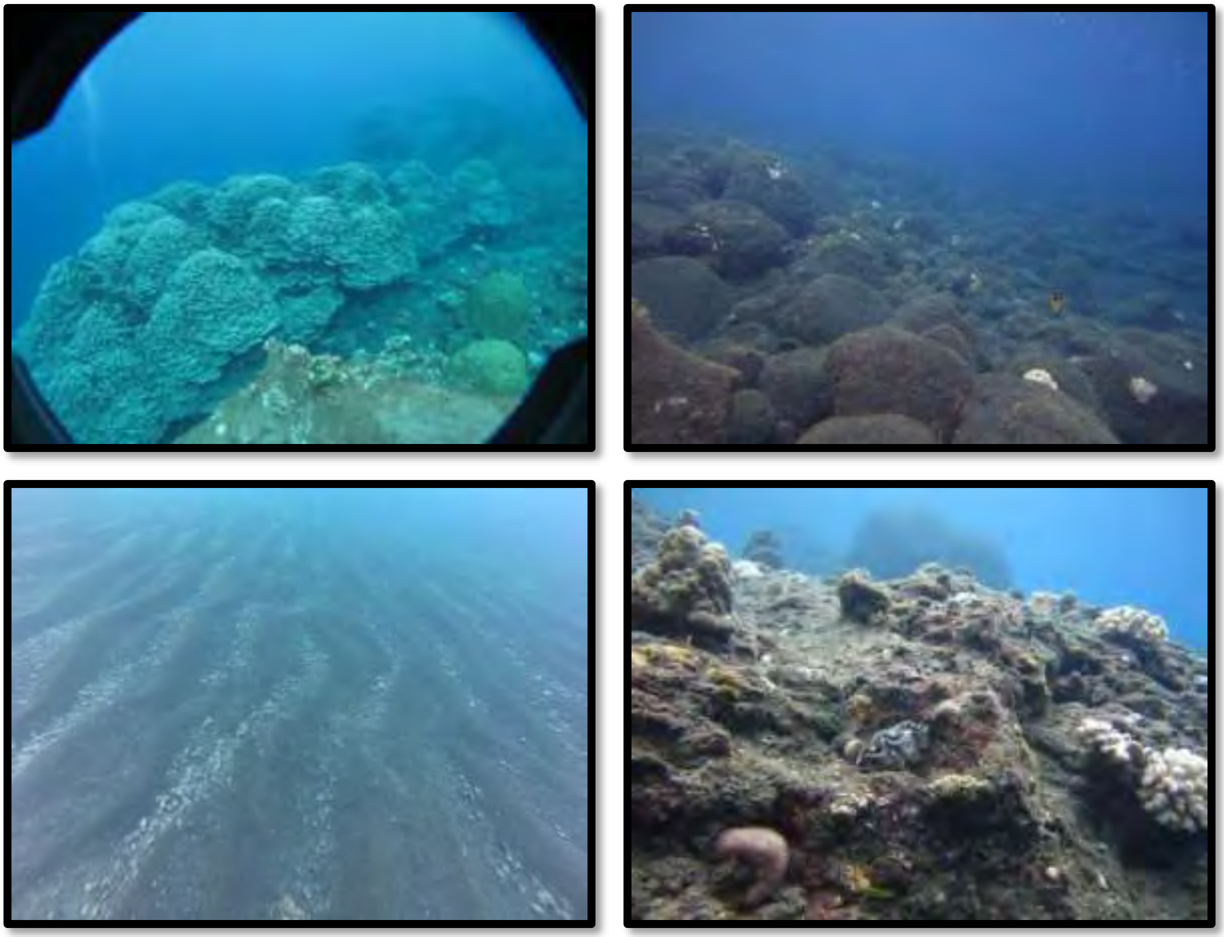


Figure 3.10-**8**
Green Beach Coral Cover

3.10.5.3.2 Red Beach

The majority of the area surveyed at Red Beach has low topographic complexity, low coral cover, and high sand cover. No portions of the Red Beach seafloor were of high complexity, and none had moderate or high coral cover. A total of 90 coral species were recorded during the survey (DoN 2014a). The majority of the coral was observed at depths shallower than 12 feet (4 meters) at the headlands to the north and south of Red Beach, but not directly in front of the sandy beach. Representative images of Red Beach are presented below. Red Beach coral cover is shown in Photos 3.10-29 and Figure 3.10-9.



Photos 3.10-29. Representative Images of Red Beach
(Clockwise from left: large *Porites rus* colony on southern headland; northern headland – inner; southern headland, showing many small coral colonies and juvenile giant clam; center of beach)

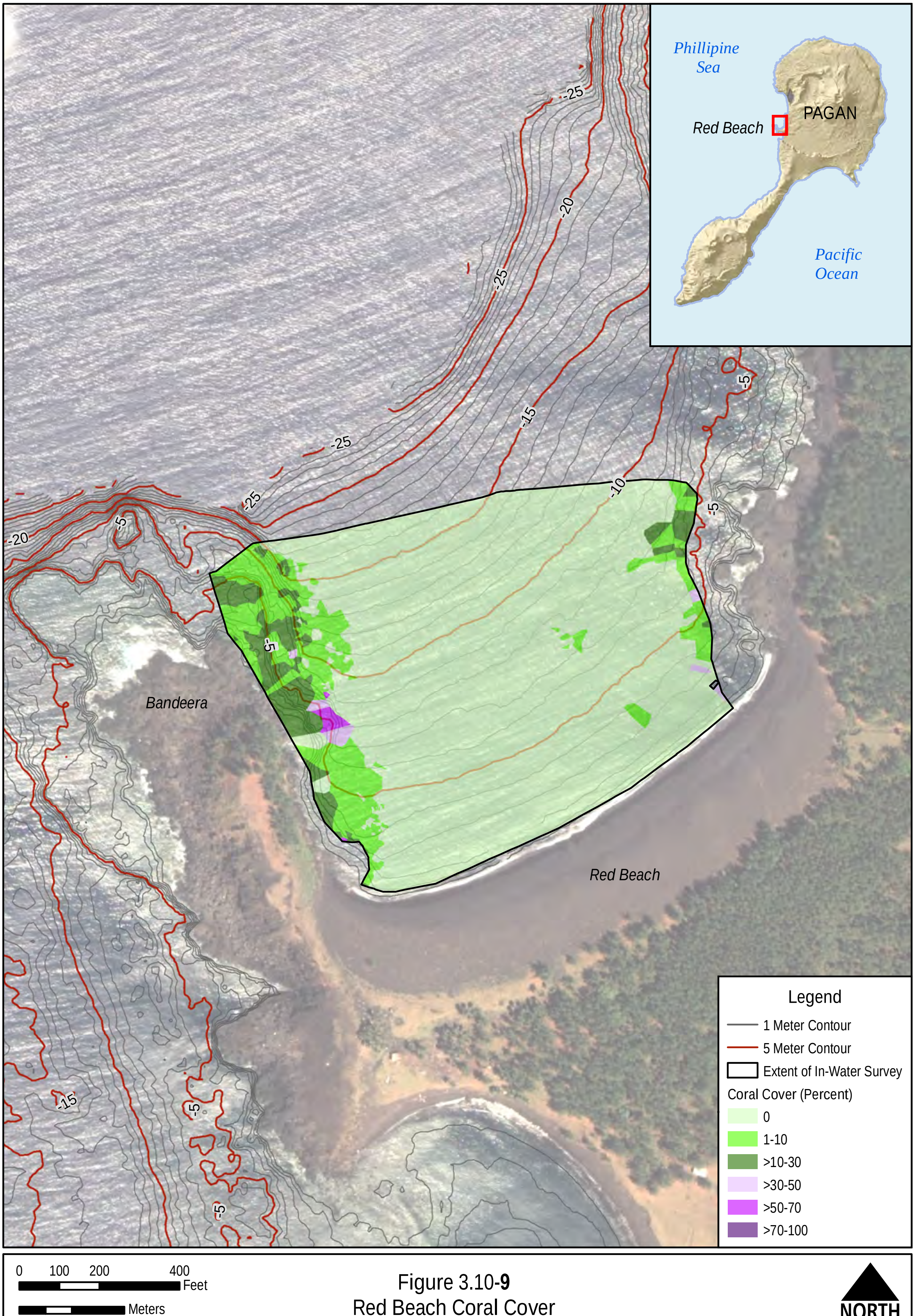
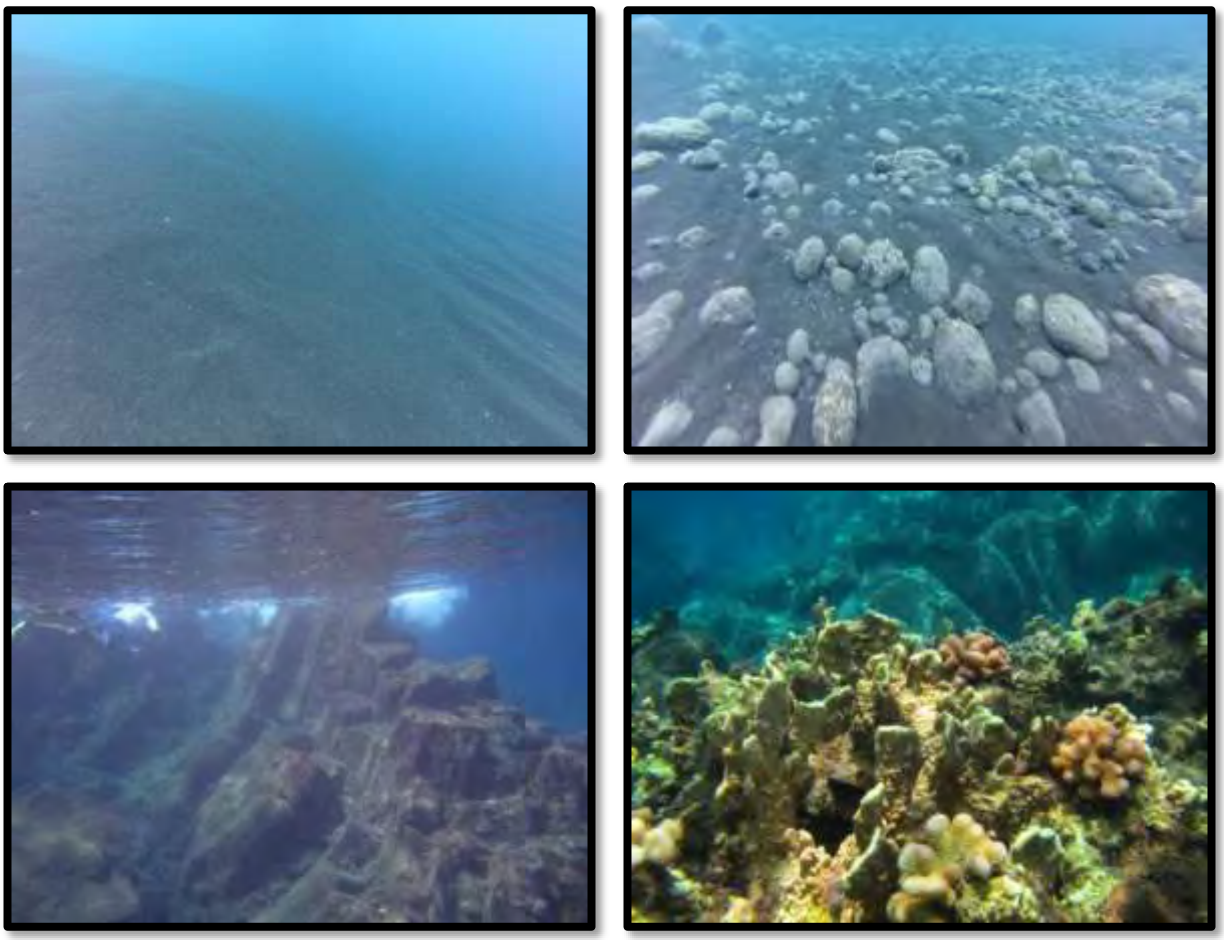


Figure 3.10-**9**
Red Beach Coral Cover

Data Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.5.3.3 Blue Beach

Blue Beach is in a semi-protected embayment on the northwest coast of Pagan and is not fronted by a shallow reef flat. Most of the area surveyed at Blue Beach has low topographic complexity, low coral cover, and high sand cover. Within the survey area, there are no portions of the Blue Beach seafloor that have high complexity, nor have moderate or high coral cover. The bottom substrate is coarse-grain igneous sand and cobble. Where corals occur, the dominant substrate is igneous and there is no evidence of carbonate framework buildup (DoN 2014a). A total of 108 coral species were recorded during the surveys. Representative images of Blue Beach are presented below. Blue Beach coral cover is shown in Photos 3.10-30 and Figure 3.10-10.



Photos 3.10-30. Representative Images of Blue Beach
(Clockwise from top left: center of beach; center of beach; patches of richer coral growth at northern headland; southern headland)

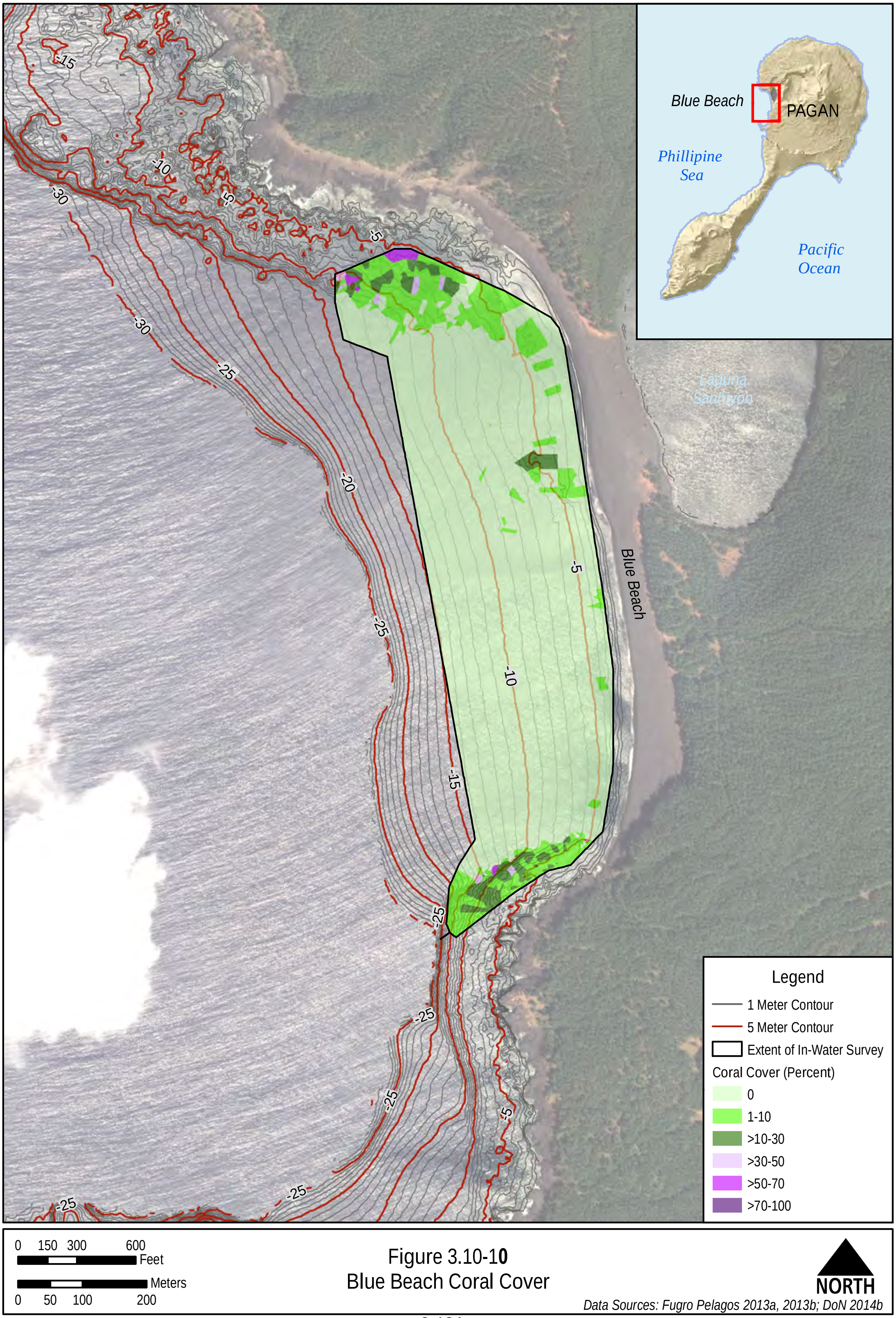
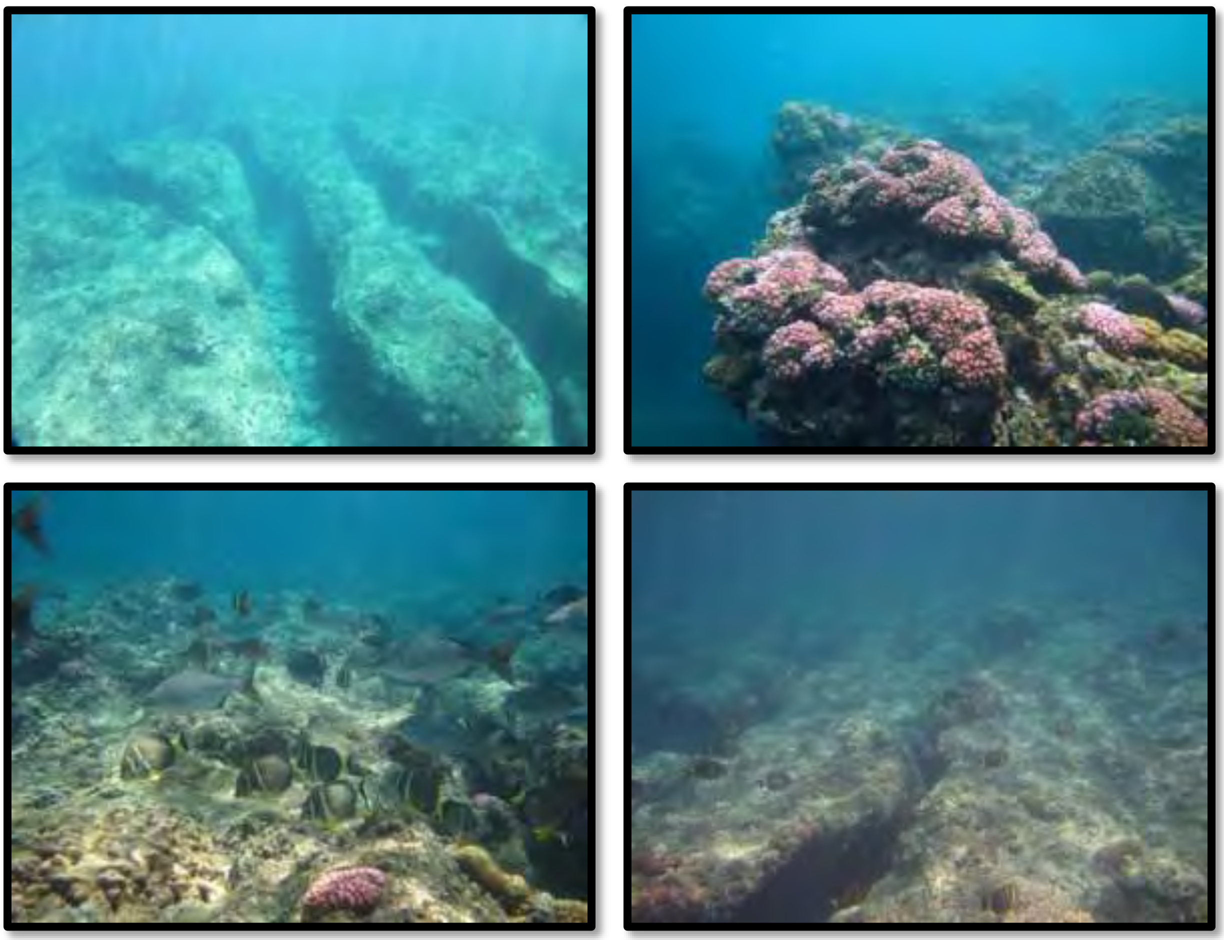


Figure 3.10-10
Blue Beach Coral Cover

3.10.5.3.4 North Beach

The shoreline of North Beach is a shore-attached fringing reef crest with karst characteristics (chemically weathered limestone). Grooves are relatively regular, narrow, and deep. Other narrow grooves run diagonally to the shore's normal spur-and-groove pattern, and these have the physical characteristics of cracks or fissures. Many of the spurs are deeply undercut, and fracturing seems likely in this geologically active setting (Riegl and Dodge 2008). The bases of grooves often have polished surfaces indicating high-energy sediment transport and erosion. Thirty-three coral species were recorded at North Beach, which is low relative to other sites on Pagan (DoN 2014a). Representative images of North Beach are presented in Photos 3.10-31.



Photos 3.10-31. Representative Images of North Beach

(Clockwise from top left: fissures in shallow fore reef; corals on shallow fore reef; fissures in fore reef; typical shallow fore reef)

3.10.5.3.5 South Beach

South Beach is fronted by a fringing reef. Most of the area surveyed at South Beach has low to moderate topographic complexity, low to moderate coral cover, and low to high sand cover in various locations. The reef area is physically complex, with narrow regular grooves in the shallow fore reef transitioning rapidly to deep fore reef morphology of low-relief relict spurs, punctuated by large *Porites* colonies (typically 10-20 feet [3-6 meters] in diameter). The bottom substrate is limestone, and no igneous substrate or clasts were visible. The bases of grooves shallower than 16 feet (5 meters) often had polished surfaces and polished cobble-sized clasts, indicating high-energy sediment transport and erosion. The shoreline of South Beach is a shore-attached fringing reef crest with karst characteristics (chemically weathered limestone). Shallower than 10 feet (3 meters), the South Beach fringing reef is homogenous. An exception is the prominent sand channel running from offshore to inshore just east of the center of South Beach. This sand channel is about 330 feet (100 meters) wide and runs up to the exposed shore-attached fringing reef crest. A total of 101 coral species were recorded at South Beach. Representative images of South Beach are presented in Photos 3.10-32. South Beach coral cover is shown in Figure 3.10-11.

Photos 3.10-32. Representative Images of South Beach
(Clockwise from top left: typical shallow fore reef; typical deeper fore reef; typical large *Porites* head; deeper sand channel)

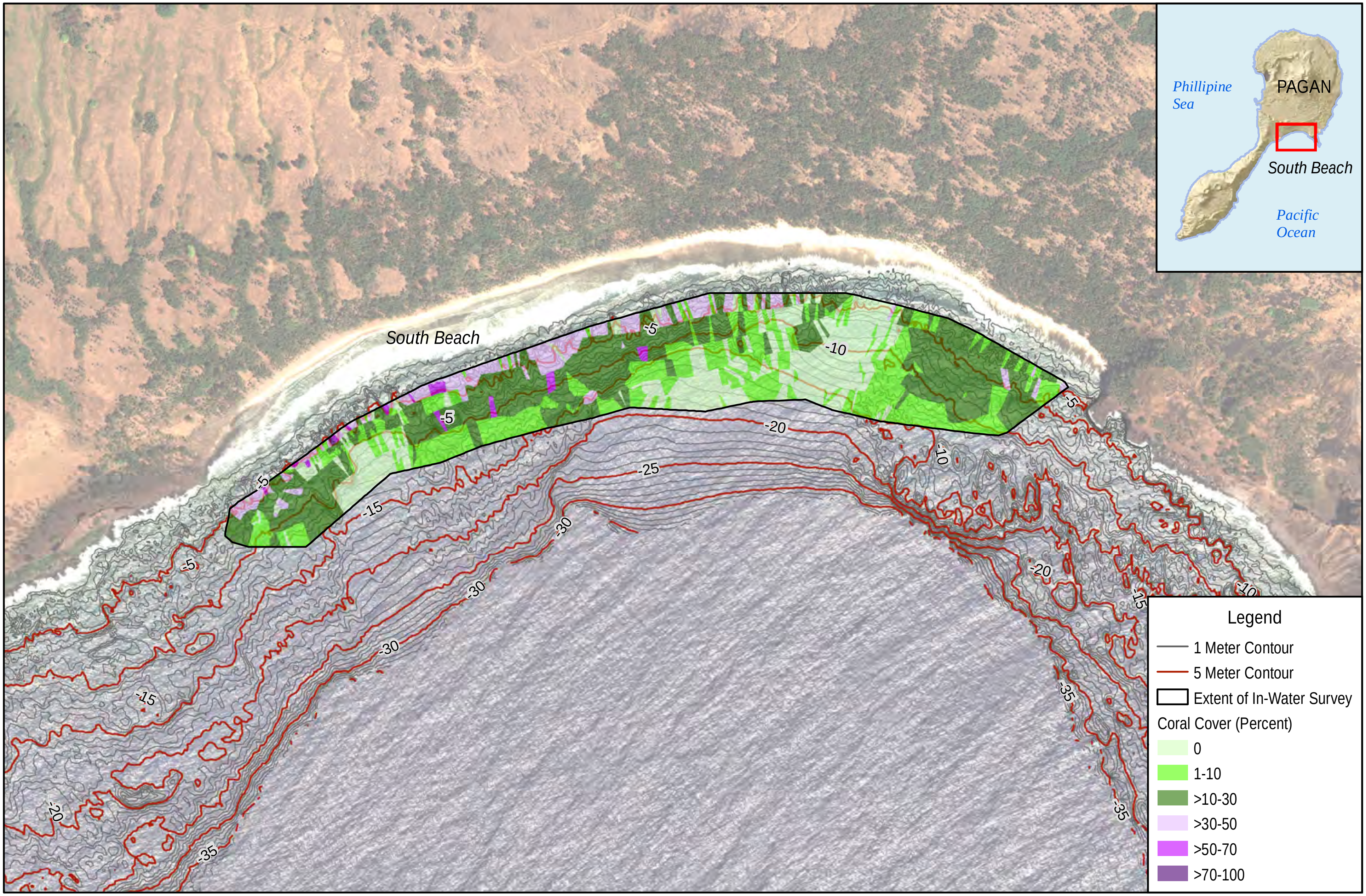


Figure 3.10-11
South Beach Coral Cover

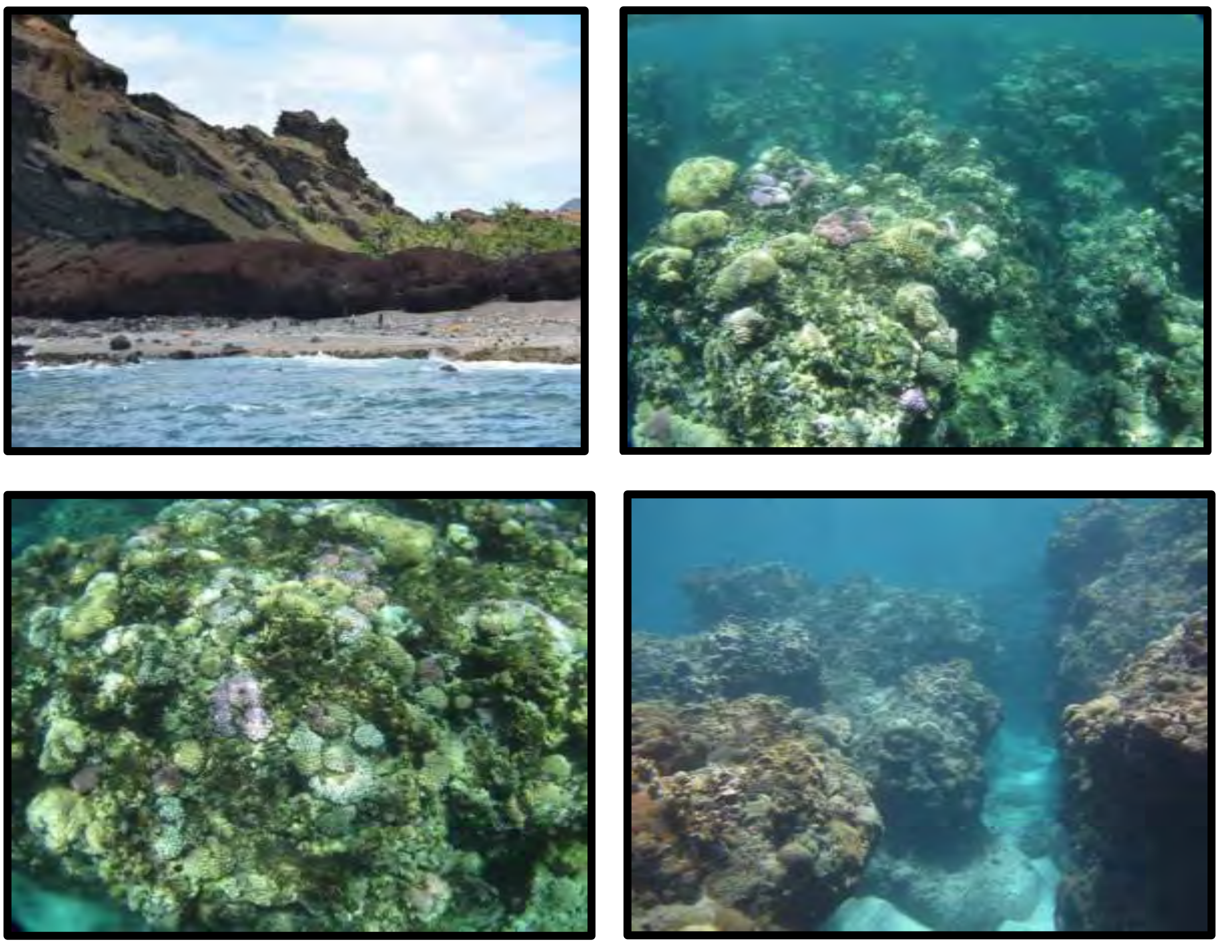
0 150 300 600 Feet
0 50 100 200 Meters

NORTH

Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.5.3.6 Gold Beach

Gold Beach is located at the end of an irregularly shaped, cliff-lined cove. The shoreline of Gold Beach is a shore-attached fringing reef crest. The cliff walls and steep fringing reef are a result of incoming waves from several directions. This wave action often results in rough seas and dangerous waves. This water motion transports sand to deeper waters. Gold Beach has moderate topographic complexity, high coral cover, and low or no sand cover. The bottom substrate is limestone. The reef area is physically complex, with deep irregular grooves and fractures. The bases of grooves have polished surfaces, indicating high-energy sediment transport and erosion. Because of dangerous conditions, most survey efforts could not be safely conducted in the shallows of Gold Beach (DoN 2013a). Habitats shallower than 6 feet (2 meters) were inaccessible and areas shallower than 12 feet (4 meters) were too rough to survey (DoN 2013a). During the limited survey effort, a total of 92 coral species recorded at Gold Beach. Representative images of Gold Beach are shown in Photos 3.10-33, and Gold Beach coral cover is shown in Figure 3.10-12.



Photos 3.10-33. Representative Images of Gold Beach
(Clockwise from top left: Southern half of Gold Beach, topographically complex shallow fore reef, topographically complex deeper fore reef, typical shallow fore reef)

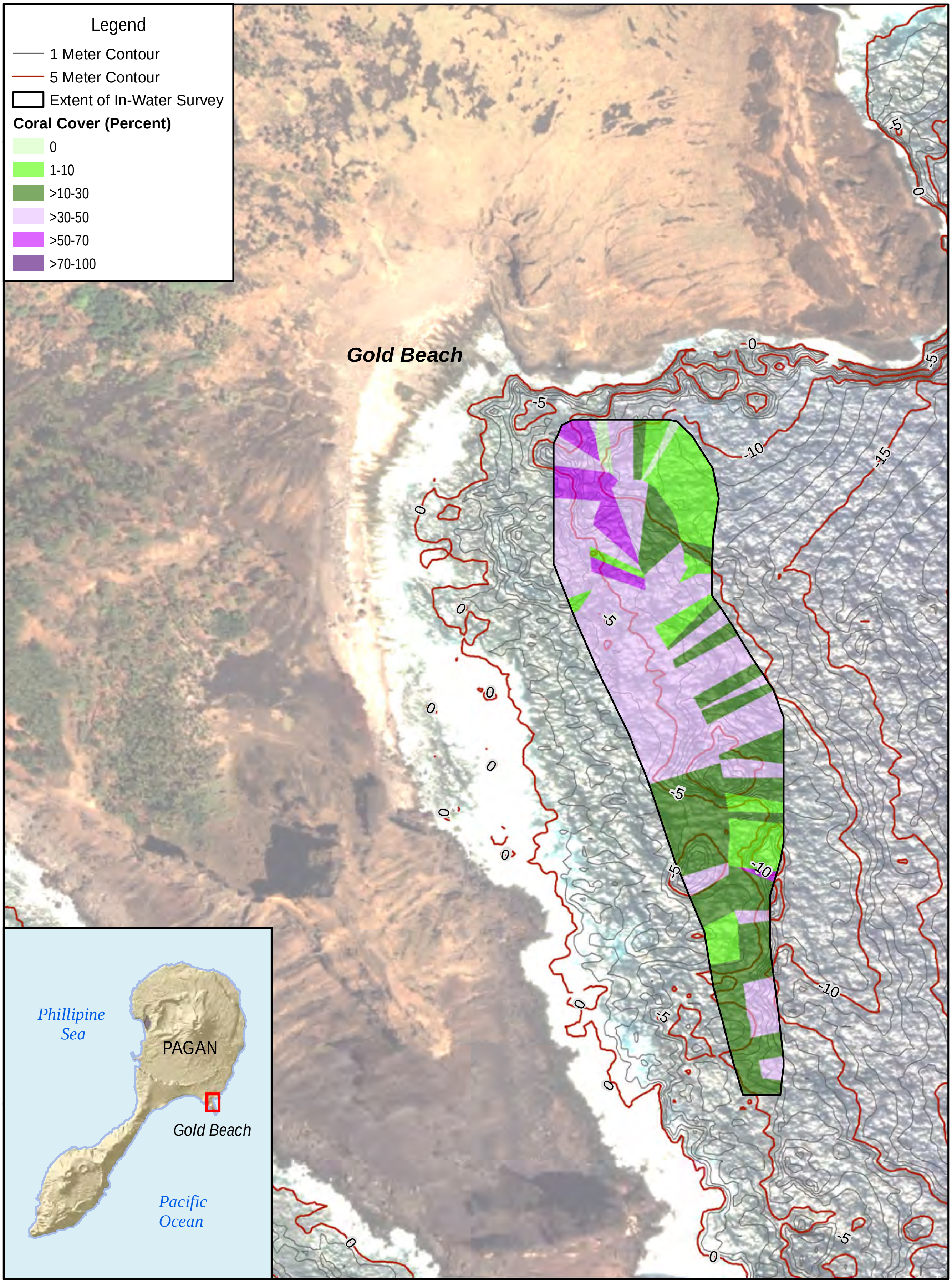


Figure 3.10-12
Gold Beach Coral Cover

Sources: Fugro Pelagos 2013a, 2013b

3.10.5.4 Fish

The Mariana Archipelago Reef Assessment and Monitoring Program conducted Pagan fish surveys in 2003, 2005, and 2007, and provide the basis of information in this section. The surveys found that total fish biomass on Pagan was high compared others Mariana Islands.

In 2003, snappers and reef sharks dominated in terms of biomass at Pagan. Surgeonfish, mainly the orangespine unicornfish (*Naso lituratus*), also largely contributed to Pagan's 2003 total fish biomass. Surgeonfish were the dominant species in 2005 and 2007, but total fish biomass results were similar to that in 2003.

The Mariana Archipelago Reef Assessment and Monitoring Program surveys found similar fish species richness for the fore reef habitats surveyed at various survey sites around Pagan. The fish species richness remained consistent for all three years, with wrasses being the most represented family, recording an average of 27 species per year. Overall, the most abundant fish families include wrasse and damselfish, with the most common species being the ornate wrasse (*Thalassoma pavo*), Vanderbilt's chromis (*Chromis vanderbilti*), and the midget chromis.

During the various marine resources surveys conducted in support of this EIS/OEIS, fish species were recorded and summarized in a species list report. The survey found 278 species of fish at Pagan. Green Beach had 82 species, Red Beach had 180 species, Blue Beach had 64 species, North Beach had 35 species, Gold Beach had 86 species, and South Beach had 160 species.

3.10.5.5 Special-status Species

3.10.5.5.1 Marine Invertebrates

Seventeen marine invertebrates have been designated by the CNMI Division of Fish and Wildlife as Species of Special Conservation Need; nine of which are confirmed to be present in Pagan waters (Table 3.10-9) (Berger et al. 2005).

Table 3.10-9. Marine Invertebrates Identified by the CNMI Division of Fish and Wildlife Marine Species of Special Conservation Need in Pagan

Common Name/Scientific Name	*Reported in Pagan Region of Influence* [1]
Ghost Crab (*Ocypode* spp)	Yes
Rock Crab (*Grapus* spp)	No
Spiny Lobster (*Panulirus* spp)	No
Land Hermit Crab (*Coenobita spp*)	No
Surf redfish (sea cucumber) (*Actinopyga mauritiana*)	Yes
Black teatfish (sea cucumber) (*Holothuria whitmaei*)	Yes
Sea urchin (*Toxopneustid* spp)	No
Giant clam (*Tridacna spp)* [2]	Yes
Pectinate venus (*Gafrarium pectinatum*)	Yes
Common spider conch *(Lambis lambis*)	No
Horned helmet shell (*Cassis cornuta*)	Yes
Tapestry turban shell (*Turbo petholatus*)	Yes
Rough turban (*Turbo setosus*)	Yes
Silver-mouth turban (*Turbo argyrostoma*)	Yes
Triton's trumpet shell (*Charonia tritonis*)	No
Octopus (*Octopus* spp)	Yes

Notes: [1] Reported by Berger et al. 2005.
[2] *Tridacna* spp includes the Fluted giant clam *(Tridacna squamosa)* and the Elongate giant clam *(Tridacna maxima).*
Source: Berger et al. 2005.

3.10.5.5.1.1 Coral Species

Coral species that are listed under the Endangered Species Act and confirmed to occur in Pagan's nearshore environment are provided in Table 3.10-10. Based on the *Coral Marine Resources Survey* conducted in support of the EIS/OEIS (see Appendix M, *Marine Biology Technical Memo and Survey Reports*), one coral species listed under the Endangered Species Act*, Acropora globiceps*, was recorded at Green Beach, Red Beach, Blue Beach, North Beach, Gold, and South Beach (Table 3.10-10) (DoN 2014a).

Table 3.10-10. Special-status Coral Species of Pagan

Coral (Genus/Species)	*Endangered Species Act Status*	*Reported within Pagan Region of Influence*[1]
Acropora globiceps	Threatened	Yes; Gr R B N S Gd[2]
Acropora retusa	Threatened	No
Pavona diffluens	Threatened	No
Seriatopora aculeata	Threatened	No

Notes: [1] The region of influence for marine biological resources includes the waters surrounding Tinian and Pagan from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore.
[2] Gr = Green Beach, B = Blue Beach, R = Red Beach, N= North Beach, S=South Beach, Gd=Gold.
Sources: DoN 2014a; National Marine Fisheries Service 2014a.

The *Coral Marine Resources Survey Report* conducted in support of this EIS/OEIS (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*) surveyed and recorded Endangered Species Act coral species at each beach.

Acropora globiceps was recorded in the vicinity of Green Beach, Red Beach, Blue Beach, North Beach, Gold Beach, and South Beach (DoN 2014a). Surveys conducted at Green Beach recorded 20 colonies of *Acropora globiceps*. The average size of a colony was 16 square inches (106 square centimeters) with the largest colony measuring 73 square inches (471 square centimeters). A total of 31 colonies were recorded at Red Beach with an average colony size of 11 square inches (73 square centimeters) and 5 colonies were recorded at South Beach, averaging in size of 30 square inches (196 square centimeters). *Acropora globicep* was not found directly in front of the sandy beach at Blue Beach, or at depths shallower than 12 feet (4 meters). Survey efforts at Gold Beach were limited due to rough sea conditions.

Acropora retusa, Pavona diffluens, and *Seriatopora aculeata* were not observed during the survey (DoN 2014a); however, their presence is conceivable.

3.10.5.5.2 Fish

Special-status fish species documented in the CNMI include the scalloped hammerhead shark, humphead wrasse, and gray reef shark. During the various marine resources surveys conducted in support of this EIS/OEIS, fish species were also recorded and summarized in a species list report. No Endangered Species Act listed or candidate species were observed on Pagan (DoN 2013b).

3.10.5.5.3 Sea Turtles

The green sea turtle, hawksbill sea turtle, and leatherback sea turtle are potentially found in the Pagan region of influence. These species and their expected occurrences in Pagan waters are listed in Table 3.10-11.

Table 3.10-11. Special-status Sea Turtle Species of Pagan

Common Name/Scientific Name	*Endangered Species Act Status*	*CNMI Status* [3]	*Confirmed in Pagan Region of Influence* [1]
Green sea turtle (*Chelonia mydas)*	Threatened	Species of Special Conservation Need	Yes[2]
Hawksbill sea turtle (*Eretmochelys imbricata)*	Endangered	Species of Special Conservation Need	Yes[2]
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	None	No

Notes: [1]The region of influence for marine biological resources includes the waters surrounding Pagan from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore.
[2]Observed during 2013 surveys in support of the EIS/OEIS (DoN 2014b).
[3]The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase “species of special conservation need.” Berger et al. 2005 outlines the criteria used to select species for this designation.

Assessments using the Kolinski 2003 data estimated the Pagan sea turtle population to be between 21 and 83 sea turtles, with 96% identified as green sea turtles and 4% hawksbill sea turtles (Kolinski 2003). The July 2013 *Sea Turtle Marine Resource Survey* (see Appendix M, *Marine Biology Technical Memo and Survey Reports*) conducted in support of this EIS/OEIS identified green and hawksbill sea turtles (Photo 3.10-33) in Pagan nearshore waters (DoN 2014b). Based on the survey, the sea turtle population at Pagan is estimated at 448 individuals. No conclusion could be made regarding any seasonal or infrequent transient sea turtles to the area or regarding the resident sea turtle home range or foraging habits across the islands. The population results from Kolinski's survey and the survey conducted in support of this EIS/OEIS differ; although this analysis cannot determine the cause of the difference, possible explanations include seasonality, changes in habitat or sea turtle behavior, or an increase in sea turtle population (DoN 2014b).

Photo 3.10-33. Hawksbill Sea Turtle Observed during 2013 Survey near South Beach on Pagan

On Pagan, surveys of various methods were conducted along the northwest, west, south, east, and the Green-Red-Blue Beach complex zones around the island. Sea turtle densities appear relatively uniform based on towboard data, with density calculations of 122 sea turtles per square mile (47 sea turtles per square kilometer). Cliffline data for the two sectors (northwest and west), provided the highest density estimates, of 196 sea turtles/square mile (75.8 sea turtles/square kilometer) and 262 sea turtles/square mile (101 sea turtles/square kilometer), respectively. Along the northwest coast, the difference in calculated densities between the two methods could be due to a greater density of sea turtles occurring closer to shore; topography prohibited conducting the towboard survey closer to shore due to diver safety issues. The cliffline density estimates for the west sector result largely from observations at a single location, where a greater extent of available habitat and sheltered waters may support an increased density in this portion of the west sector of Pagan.

Based on the total number of sea turtles identified during the DoN 2013 survey, there are an estimated 297 green sea turtles, consisting mostly of juveniles and subadults. An estimated population of 151 hawksbill sea turtles was recorded, also consisting of mostly juveniles and subadults (DoN 2014b). Hawksbill sea turtles are a substantial percentage of the sea turtles in the waters around Pagan, which is unique for the CNMI as these sea turtles are rarely recorded in waters around the Rota, Guam, Aguijan, Tinian, and Saipan (DoN 2014b).

3.10.5.5.4 Marine Mammals

Several studies have included Pagan waters within their study areas (Yamaguchi 1995; Ohizumi et al. 2002; Trianni and Kessler 2002; Norris et al. 2012; DoN 2007; Fulling et al 2011), including the 2013 survey conducted in support of this EIS/OEIS summarized in the section below.

The *Marine Mammal Survey* conducted in support of this EIS/OEIS identified five marine mammals in the nearshore waters of Pagan using both acoustic and visual methods. These included sperm whales, common bottlenose dolphins, spinner dolphins, Cuvier's beaked whales, and Blainville's beaked whales. The five marine mammal species confirmed in the nearshore environment of Pagan, and their Marine Mammal Protection Act and Endangered Species Act designations, are presented above in Table 3.10-12.

Table 3.10-12. Marine Mammals with Reported Occurrence in the Region of Influence Surrounding Pagan

Common Name/Scientific Name	*Marine Mammal Protection Act Status*[1]	*Endangered Species Act Status*	*CNMI Status*[2]	*Reported within the Pagan Region of Influence*[4]
Sperm whale (*Physeter macrocephalus*)	Depleted	Endangered	-	Yes
Common bottlenose dolphin (*Tursiops truncatus*)	-	-	-	Yes
Spinner dolphin (*Stenella longirostris*)	-	-	Species of Special Conservation Need	Yes
Blainville's beaked whale (*Mesoplodon densirostris*)	-	-	-	Yes
Cuvier's beaked whale (*Ziphius cavirostris*)	-	-	-	Yes

Notes: [1] Status from Carretta et al. 2014. All marine mammals are protected under the Marine Mammal Protection Act. Populations or stocks that have fallen below the optimum sustainable population level are considered "Depleted." The Hawaii stocks of sperm whale, sei whale, blue whale, fin whale, and the American Samoa stock of humpback whale are also listed as "Strategic" under the Marine Mammal Protection Act; this status would apply if research determines that these are the stocks that inhabit CNMI waters.

[2] The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.

[3] Regular = a species that occurs as a regular or usual part of the fauna of the area, regardless of how abundant or common it is; Rare = a species that occurs in the area only sporadically. Occurrence designations from the Navy's Mariana Islands Marine Resource Assessment (DoN 2012/2013), updated with new information as described in DoN 2013, (DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014).

[4] The region of influence for marine mammals includes the waters surrounding Pagan from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore. However, the potential for acoustic effects due to pile driving/extraction extends to approximately 7.3 nautical miles (13.6 kilometers) from shore.

Sources: DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014.

The marine mammal survey conducted in support of this EIS/OEIS was the first systematic survey that focused on the Pagan nearshore environment (within 3.0 nautical miles [5.6 kilometers]) (DoN 2014c).

Most spinner dolphin sightings and detections were on the east side of Pagan, and all sightings were within 0.54 nautical mile (1.0 kilometer) of shore (DoN 2014c). Generally, spinner dolphins were sighted near Green Beach on the west side (DoN 2014c). Of the spinner dolphins observed, 75% of the groups included calves (DoN 2014c). Results of the photo-identification analyses indicate that spinner dolphins identified at Pagan were later resighted in the same survey.

Bottlenose dolphins were observed twice on Pagan, both on the west side of the island, although one sighting was near the northern tip. Both sightings were within 0.54 nautical mile (1.0 kilometer) of shore and one was 0.25 nautical mile (0.46 kilometer) from Blue Beach. This sighting was in relatively shallow water of 118 feet (36 meters), while the other was in moderately deep water of 1,535 feet (468 meters).

There were three sightings of unidentified dolphins, all on the west side of the island, although one was near the southern tip. They were seen in a range of water depths, from 95 to 2,385 feet (29 to 727 meters) and at a range of distances from shore, 0.27 to 1.1 nautical miles (0.5 to 2 kilometers). One of the unidentified groups was thought to be spinner dolphins, due to their slim profile. The other two groups were thought to be bottlenose dolphins, based on slightly robust bodies and pronounced dorsal fins. The body proportions of these dolphins was too short and not robust enough to be larger species, such as melon-headed whales or pygmy killer whales (DoN 2014c).

In addition to the confirmed sightings, recordings of unidentified dolphins and assumed Delphinid vocalizations were collected and compared to pre-recorded vocalizations of rough-toothed dolphins, false killer whales, spotted dolphins, striped dolphin (*Stenella coeruleoalba*), spinner dolphins, and bottlenose dolphins (DoN 2014c). Vocalizations that matched the striped/spinner category were most likely associated with spinner dolphins (DoN 2014c).

The sperm whale was the only large species of whale detected during the survey. The acoustic detection of sperm whales indicates its presence; however, the sonobuoy methods used in this study are not able to estimate the locations of the vocalizing animals. The sperm whales were detected off the west side of the island from using sonobuoys off Red Beach and Blue Beach, and Green Beach areas(DoN 2014c).

Two species of beaked whales, Cuvier's and Blainville, were also identified. The Cuvier's beaked whale was detected visually within 1.5 nautical miles (2.7 kilometers) of shore off the southwestern end of the island, while the Blainville's beaked whale was detected acoustically in the more northern waters (DoN 2014c); however the precise location cannot be determined from the acoustic detection As with sperm whales, both beaked whale species are usually associated with deep waters. The presence of these species within 3.0 nautical miles of shore is likely attributed to the proximity of deep waters close to the Pagan shore. All detections came from deep water, close to shore, and both species are likely common around Pagan as the are other Mariana Islands (DoN 2014c).