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Guam Community Juvenile Rabbitfish Grow-out Project

Environmental Assessment

Sustainable Fisheries Fund II Project

Western Pacific Regional Fishery Management Plan

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Guam Community Juvenile Rabbitfish Grow-out and Youth Education Project

Draft Environmental Assessment

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Abstract:
This Environmental Assessment (EA) analyses two alternatives and resulting potential impacts of federally funded aquaculture project in Guam. The preferred alternative would support a project that will capture juvenile (*dagge)* rabbitfish in Guam's nearshore waters that would be grown-out in on-land tanks and then reintroduced to natural habitat at around 6 months. This project will educate Guam youths on socio-cultural importance of rabbitfish, provide youth with outdoor education opportunities related to marine ecology, and teach youth traditional fishing practices. The project may also provide some benefit to the local rabbitfish population by stock enhancement by growing-out juveniles that otherwise would be subject to high natural mortality. The project will use the University of Guam's existing aquaculture facilities and follow established procedures to ensure quality and safety. The project lead would be Guam's 4-H program working in close coordination with the Guam's Fishermen's Cooperative Association. Other Project partners include the University of Guam, and Guam's Department of Agriculture. No significant effects to the human environment are expected to occur as a result of the proposed action.

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Chapter 1: Introduction

This Environmental Assessment was drafted in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA regulations at 40 CFR 1508 et seq., and NOAA's agency NEPA guidelines (NOA 216-6).

1.1 Responsible Agencies

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1.2 Purpose and Need

Every year juvenile rabbitfish (*manahak)* recruit to Guam's nearshore areas in vast numbers to feed on algae. For thousands of years, Guam fishermen have been targeting the *manahak* in hopes of catching them just prior to their first feeding on the algae. When first appearing, and prior to them eating algae, the small fish are harvested as a delicacy. After eating the algae, the rabbitfish are no longer palatable, and are called *dagge*. Juvenile rabbitfish are subject to high levels of predation from other fish species and subject to mortality from starvation related to lack of juvenile habitat and quality food sources (algae).

The purpose of this project is to provide funding to support opportunities for youth education related to marine ecology, aquaculture, and traditional and contemporary practices and to support a stock enhancement program that would reduce juvenile rabbitfish natural mortality through on-land grow-out and reintroduction into the wild at larger sizes. Older, larger rabbitfish, as compared to sizes at first recruitment, are subject to less predation and have an easier time finding food.

The need for this project is to enhance local resources through cooperative community projects, as identified in Guam's Marine Conservation Plan and the Council's cooperative agreement funding proposal. It has long been recognized that a healthy rabbitfish population provides socio-economic and cultural benefits to the people of Guam. Through project activities, participating students, fishermen, and other interested community members will gain knowledge of rabbitfish lifecycles, and importance of nearshore habitat to the species, which will promote conservation and management of this traditionally harvested species that holds considerable socio-cultural value on Guam.

1.3 Background Information

The proposed project was identified in the Guam Marine Conservation Plan (MCP) and will be funded under the Council's Sustainable Fisheries Fund pursuant to the Magnuson-Steven Fishery Conservation and Management Act Section 204(e)(7). This project is included in the Council's cooperative agreement NA11NMF4410270.

As described in the Guam MCP, there are several organizations interested in establishing a rabbitfish restocking program on Guam including Guam's 4-H Youth Development Program, Guam Cooperative Extension Service, Guam Fisherman's Cooperative Association, University of Guam's Guam Aquaculture and Training Center (GADTC), University of Guam's Marine Laboratory, and Guam's Division of Aquatic and Wildlife Resources.

Guam's 4-H Youth Development Program would be the lead in coordinating youth education, fishing, and restocking activities. Guam's 4-H Youth Development Program is sponsored by the University of Guam and offers classes for children 8 to 15. Classes offered throughout the year include training in fishing and marine sciences. Student participants may join or form a 4-H club at their schools. Fishing has been a part of Guam life throughout the centuries. Basic fishing has been passed down from generation to generation. Guam's 4-H program conducts workshop that provide students with basic knowledge about tides, currents and phases of moon, oceanography, marine sciences, water pollution and the environment. The program offers both traditional and modern fishing techniques, such as net fishing, spearing, testing lures and hooks, trolling, proper fishing equipment, fish and place names and fishing safety.

Chapter 2: Description of the Alternatives

2.1 Alternative 1- No Action

Under this alternative, the Council would not fund a rabbitfish grow-out demonstration or fishery-related youth education project on Guam.

2.2 Alternative 2- Conduct a Demonstration Project to enhance local rabbitfish population on Guam (Preferred)

Under this alternative, the Council would fund a demonstration project that would collect approximately 2,000 *dagge* to grow out and reintroduce the fish into natural habitat at around 6 months of age. *Manahak i*s currently harvested in Guam inshore waters, but the *dagge* (post-*manahak*) life stage is not a desired food item because consumers consider it inedible during this phase of approximately 6 months.

Participants in the Guam 4-H development project would collaborate with Guam Fishermen's Cooperative Association (GFCA) members to collect approximately 2,000 *dagge*. The *dagge* will be caught in the summer months after the moon's last quarter by GFCA members that are expert *dagge* fishermen and who will teach youth throw net techniques. The nets, which are fine mesh and delicate, will not be thrown over corals to avoid damaging corals as well as the net, which often cost more than $500 per net. The 2,000 fish will be collected from a single run and potentially from multiple locations (Tumon Bay, East Hagatna Bay, Pago Bay, Paseo shoreline). The areas determined for harvesting are juvenile fish aggregations and contain a suitable habitat (sandy areas, no corals) for the harvest and provide good access. Seagrass beds will be avoided during the collection portion of the project.

Approximately 5 individual fishermen and up to 20 students would be involved. Only the traditional shoreline throw net (*talaya*) will be used to harvest *dagge* over sandy areas free of corals. Guam 4-H participants would be trained by GFCA members to avoid damage to essential fish habitat, particularly corals and seagrasses during the collection process. Once transferred to the Guam Hatchery for holding, the *dagge* would be fed naturally occurring algae, which is removed and disposed of daily from the beach from Tumon Bay for tourism reasons, and commercially available aquaculture feed treated with antibiotics. Fish health will be monitored by Guam Hatchery staff and will not be released if in poor health. After about 6 months,, Guam 4-H participants and GFCA members will transport the *dagge* in transportable storage tanks and release them. The exact location that the *dagge* may be released is not determined, but the location would be either in Tumon Bay alone, or divided between the areas where they were caught, including Tumon Bay, East Hagatna Bay, Pago Bay, or Paseo shoreline. The amount of fish taken and returned to these areas will constitute a small percentage of the overall biomass in the original population. Most fish will be released within 10 ft from shore in sandy areas free from corals. Some fish may be released off of vessels beyond the reef in suitable habitat. Vessels used would be launched from authorized boat ramps and operated using best practices to avoid anchoring and disturbing habitat.

Release areas in Tumon Bay and other identified areas will be chosen for their protective habitat to ensure survivability. The natural defense of the rabbitfish is to blend with its environment, mainly coral or rock formations. Releasing the fish in adjacent sandy areas will allow the group to school, and then seek protective shelter.

The Guam Aquaculture and Training Center has previous experience with rabbitfish and has conducted rabbitfish spawning and rearing. The proposed project would follow all of the required biosecurity procedures in place at this facility and the project will be closely monitored. No point source effluent into the ocean will occur from project. Depending on funding, this is project is anticipated to up to 3 years.

No federal or local permits would be required to be obtained to implement this project.

2.3 Alternatives Considered but Not Analyzed in Further Detail

Other fish species were considered for the grow out project, such as jacks and goatfish, but these species do not have the socio-cultural value as *manahak,* are more difficult to catch during their juvenile life stage, and do not satisfy the purpose of the project as identified in Guam's Marine Conservation Plan. For these reasons, other fish species were not considered in detail. The locations identified as potential areas to collect the rabbitfish (Tumon Bay, East Hagatna, Pago Bay, Paseo shoreline) were chosen due to their suitable, sandy habitat and access to the shoreline. Rabbitfish recruit to other areas of Guam, but fishermen access to such areas are not feasible due to the terrain, parking, waves, etc. For these reasons, alternatives that contain other locations for harvest and release are not included.

Chapter 3: Affected Environment

3.1 Guam Aquaculture Development and Training Center (GADTC)

The grow-out phase of the proposed project would be located at the Guam Aquaculture and Training Center (GADTC), which is administered by the University of Guam. The GADTC is a bio-secure facility on a five acre site, fully fenced on three sides and bordered by a rugged coast on the fourth side. Facilities include an indoor hatchery with larval and artemia hatching tanks, a phytoplankton laboratory, a feed preparation room and a tool/work room. The facility also has both fresh and salt water supplies, an automatic generator back-up system, a separate office building, a duplex of two-bedroom living quarters and a refrigerated feed storage container. There are 14 concrete ponds on the site, including six 200 sq. meter Swedish ponds and four 200 sq. meter raceways. Several fiberglass tanks fill the area ranging in size from 0.5 to 20 metric tons. The rabbitfish project will only utilize a small portion of the available facility. There is no point source effluent that enters the ocean or treatment of discharge from the Guam Hatchery.

3.1.1 GADTC Biosecurity

The Guam Aquaculture Development and Training Center began a disease testing monitoring program in cooperation with the Aquaculture Pathology Laboratory of the University of Arizona in the fall of 2003. The results were negative. There have been no positive or suspicious results during the five year history of testing.

Since initiation of the disease monitoring program, the GADTC has continued to add additional diseases to its monitoring program and currently test for the eleven viruses by molecular methods (PCR/RT-PCR):

1. WSSV White spot syndrome virus

2. IHNNV Infectious hypodermal and haemopoietic necrosis virus
3. TSV Taura syndrome virus
4. YHV Yellowhead disease virus
5. GAV Gill associated virus
6. LOV Lymphoid organ virus
7. MoV Mourilan virus
8. IMNV Infectious myonecrosis virus
9. MBV Peneaus monodon-type baculovirus
10. BP Baculovirus penaei
11. HPV Hepatopancreatic parvovirus
12. BMNV Baculovirial midgut gland virus (also known as Baculovirial midgut gland necrosis virus)

GADTC monitors the above pathogens and one additional virus by histology.

3.2 Guam Island

Guam is the southernmost island of the Mariana Archipelago, located at 13 deg N latitude, 144 deg E longitude (Bureau of Statistics and Plans, 2006). It has been an unincorporated U.S. territory since 1898. Although it is the largest island in Micronesia, Guam is relatively small in both land area (209 miles) and surrounding Exclusive Economic Zone (EEZ).

Approximately 30 miles long and 4–12 miles wide, Guam is a volcanic island over which limestone deposits formed during geologic epochs when sea level was higher. The relatively flat northern portion of Guam is a limestone plateau rising sharply from the shoreline. The southern half of the island is mountainous with river valleys, wider beaches, and some of the most protected bays on the island. The steep topography creates numerous watersheds drained by small rivers (Porter et al., 2005). Guam's shoreline of about 116 miles is bordered by about 80 miles of reef flats (Bureau of Statistics and Plans, 2006).

An important aspect of Guam's climate and environment is the regular occurrence of natural disturbances, most notably typhoons and super typhoons. These not only affect the island's population and economy, but impact fishing infrastructure and boats, fish habitat, and fishermen's ability to fish. Amesbury (2005-2006) provides a timeline showing environmental events affecting Guam.

According to the 2010 U.S. Census, Guam had a population of 159,358, representing an increase of 2.9 percent from the population of 154,805 reported in the 2000 census. . Although in some cases commercial fishing contributes substantially to household income, nearly all Guam domestic fishermen hold jobs outside the fishery (Myers, 1993;). Domestic fishing on Guam supplements family subsistence, which is gained by a combination of small-scale gardening, ranching and wage work (Amesbury and Hunter-Anderson, 1989).

Guam is organized into 19 election districts, often referred to as villages, each having a mayor; the districts vary in population size, per capita income, household size, median age and other demographic characteristics.

3.3 Target Species

Rabbitfish are an important food source in Guam. There are five species, three of which are relatively uncommon that occur in small groups or pairs below the edge of the reef flat. The two most abundant species *Siganus argenteus* and *Siganus spinus*, are each targeted in the local fisheries.

The first fishery occurs when young rabbitfish arrive from the open sea as tiny silvery, transparent post-larvae called *manahak* in Chamorro. This usually happens during a few days around the time of the moon's last quarter in April or May and occasionally in October.

The harvesting of *manahak* is seasonal and has been a long-standing cultural tradition with Chamorro people. With the increase in jet ski and other motorized craft activity in east Agana Bay, where fishermen usually await the runs, an Executive Order was issued by the Governor of Guam in 1991 which provided for the closure of the bay by the Department of Parks and Recreation during the peak of the *manahak* season. Although *manahak* are caught off most Guam coasts, east Agana Bay is considered the traditional site for *manahak* to arrive.

Manahak arrive in large tightly-packed schools containing thousands of individuals. Fishermen scoop them up in fine-mesh nets. A highly-prized delicacy, *manahak* is eaten fried or pickled in salt and lemon juice and served as a condiment.

Within a few days of reaching the reef, *manahak* begin to feed on algae and adopt their color pattern. At this stage, they are known as *dagge*. Their taste changes and they are not considered very good to eat for several months until they reach adult size (*hiteng* and *sesyon*) (Guam Division of Fish and Wildlife Resources, website accessed Feb. 17, 2012).

The second fishery targets adult rabbitfish. Adults are caught primarily by nets and spears, but some are caught by hook and line using *lumot,* a green stringy algae, as bait. *Hiteng* usually occur in large schools that roam the reef feeding on algae scraped from the bottom. They tend to live in deeper lagoon areas or the outer slope beyond the reef edge. *Sesyon* sometimes occur in large schools but usually are found in small groups and live primarily on reef flats and in shallow lagoons. *Hiteng* reach a size of 14 inches and *sesyon* reach a size of about 11 inches (Guam Division of Fish and Wildlife Resources, website accessed Feb. 17, 2012).

The estimated annual catches of rabbitfish are provided in figure 2. Reductions in estimated catch over the time series could be related to several factors: 1) resource depletion, 2) less fishing, 3) less reporting, and/or 4) less fishable areas due to

implementation of locally managed Marine Protected Areas (MPAs), which were established on Guam in the early 2000's. However, it is also believed that juvenile rabbitfish are subject to high levels of predation from other fish species and subject to mortality from starvation related to lack of juvenile habitat and quality food sources (algae) on Guam (Manny Duenas, pers. comm. September 2013). Recent genetic and current studies suggest that Guam is self seeding for rabbitfish. Thus, local over-harvest of this species may contribute to future declines in catch.

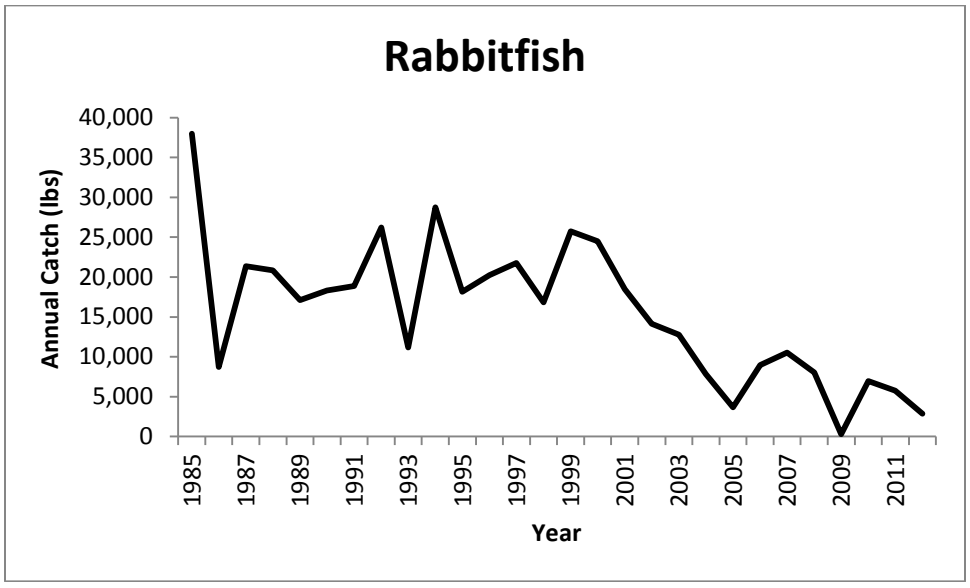

Figure 1: Annual catches of rabbitfish (all species) on Guam, 1985-2012.
Source: WPacFIN unpublished data.

3.4 Shoreline and Inshore Fishing

Prior to Western-contact (1500's), Guam's inhabitants were dependent on inshore fisheries for a large portion of their subsistence (Jennison-Nolan et al., 1979). A detailed cultural code guiding when, where and who participated in shoreline fishing likely existed in these times (Amesbury, 2006).

Despite a general decline in fishing from the 1700s into the 20th century (Amesbury and Hunter-Anderson, 1989), inshore fisheries were active in the pre-World War II period. According to a government survey (Office of Strategic Services, 1942), there were at least 200 outrigger canoes used for inshore fishing in various locations around the island. This number is believed to be conservative. Canoes were used to set fish nets in seine dragging operations and to maintain fish weirs and traps located in deeper waters of bays. Other prewar fishing activities included gleaning of shells and clams, spearing, pole and line fishing and throw netting (Jennison-Nolan, 1979b). Fishing at this time remained a cooperative effort, as evidenced by the practice of sharing of canoes and fishing tackle in several municipalities prior to World War II Jennison-Nolan, 1979b).

In addition, the throw net (*talaya*) was made with varying mesh dimensions and could be adapted for catching a variety of reef fish. The *chenchulu* was a long nylon net requiring the cooperation of several people to catch *atulai* (bigeye scad) and other schooling fish. The *lagua* was a short net held in place by two fishermen, while others beat the water with coconut fronds to chase juvenile rabbitfish (*manahak*, family *Siganidae*) and goatfish (*ti'ao*, family *Mullidae)* into the waiting net (Jennison-Nolan, 1979b).

On the Agat coast and probably other areas, the use of *chenchulu* and *lagua* involved a long-established system for dividing the catch; half went to the net owner or to the owners of the canoe and net together. Of the remaining half, one-third was allocated to swimmers who herded the fish toward the net and the other two-thirds to other helpers, such as net holders and watchers (Jennison-Nolan, 1979b).

The number of people engaged in shore fishing during the 1970s was still large, especially considering that about 90 percent of the food consumed on the island was being imported (Jennison-Nolan et al., 1979). In an island-wide random sample of 180 Guam households surveyed by the University of Guam in 1975, 65 percent reported some participation in fishing (Klimek, 1975), which was presumably shore fishing as a result of the low level of boat ownership at the time.

Catch-per-unit-effort (CPUE) in Guam's shore-based fisheries for reef fish (pole, spear, cast net, surround and gill net) declined sharply in the 1980s and has not recovered according to inshore creel surveys conducted by the Guam Division of Aquatic and Wildlife Resources (Porter et al., 2005). Offshore (boat-based) catches of reef-associated fish have remained relatively constant since 1992, whereas inshore catches that accounted for the majority of the reef fish harvest during the 1990s presently account for the minority of the total harvest.

The most notable trends in inshore fishing methods are an increase in spearing over the last 10 years and a decline in cast netting. Much of the traditional harvest on Guam is from pulse fishing that targets seasonal runs of juvenile rabbitfish, goatfish, bigeye scad (*atulai, Selar Crumenophthalmus*) and jacks family (*i'e*, family C*arangidae*).

Vaughn (1999) conducted a detailed study of the inshore fishing behaviors and spatial patterns of the three largest resident fishing cultures on Guam: Chamorro, Micronesian and Filipino. He found that Chamorros comprised about ¾ of the 260 fishing parties he encountered, concluding that the Chamorro fishing culture usually dominated the fisher population of the reef areas. Micronesians constituted about 17 percent of the fishing parties and Filipinos about 7 percent. Vaughn (1999) documented a number of contemporary reef fishing methods on Guam, including gleaning, hand line, rod and reel, *talaya* (cast net), *tekken* (gill net), *chenchulu* (surround net), and spearfishing.

From his observations, interviewing and historical review, Vaughn (1999)

concluded that explicit rules governing permanent marine ownership do not exist on Guam but that Chamorro fishermen maintain a strong identification with village and municipal space. This village relationship included the reef during the early part of the 20th century but that has since largely disappeared. Still, the concept of marine tenure remains and manifests itself in a system of "pliant tenure" (a vestige of traditional marine tenure) recognized by the resident fishing cultures on Guam.

Some fishing parties consisted of groups of men, women and children, each of whom would use a different method within the same general fishing area. Some of these fishers obtain seafood lower down the seafood chain, such as sea cucumbers and some species of shellfish not typically harvested by Chamorros.

Based on creel surveys of fishermen in the mid-1980s, about one-quarter to one-third of the inshore catch was sold. The remainder entered noncommercial channels (Knudson, 1987). Reef fish continues to be important for social obligations, such as fiestas and food exchange with friends and families. One study found a preference for inshore fish species in noncommercial exchanges of food (Amesbury and Hunter-Anderson, 1989). The local harvest of reef fish is insufficient to meet demand, and there are substantial imports from the Federated States of Micronesia and the Philippines.

3.7 Current Inshore Fishing Issues

Reduced Fishing Access and Resulting Cultural Impacts
Based on a map developed by the Guam Fishermen's Cooperative Association, a substantial proportion of Guam's coast is presently inaccessible for shore fishing. Loss of inshore marine resources and reduced coastal access are viewed by fishermen as threatening the perpetuation of indigenous cultures and communities in Guam. The decline in subsistence fishing is a significant issue to Chamorros because teaching local fishing methods to younger generations by elders is one of the principal ways of perpetuating cultural identity and practice (Beukering et al., 2007). The group labor involved in some forms of fishing (e.g., *chenchulu*) and widespread distribution of the catches reinforce family cohesion and communal identity (Vaughn, 1999).

Vaughn (1999:19) warns that "A resurfacing of municipal tenure is unlikely as village life continues to become more fragmented and individualized. At present, Chamorros are in transition from a concept of municipal ownership over resources and the space used to acquire those resources." As village cohesion faded, pliant tenure emerged as the chief form of marine tenure on Guam.

Without safe places to teach traditional fishing techniques, fishermen fear that cultural harvest practices are less likely to be sustained and passed on to future generations.

Marine Preserves
The government of Guam established five marine preserves in 1997. The size of

the preserves varies but all preserves extend from 10 m above the mean high tide mark to the 600-ft depth contour. Dip netting, gill netting, drag netting, surround netting, spear fishing, the use of gaffs, shell collecting, and gleaning are prohibited in all five marine reserves.

Trolling is allowed in all preserves from the reef margin seaward but only for pelagic fish. Bottomfishing may be conducted seaward of the 100-ft contour in Tumon Bay Marine Preserve. Limited fishing is allowed in Tumon Bay, Pati Point and Achang Reef Flat Marine Preserves. In Tumon Bay, hook and line fishing and cast net (*talaya*) fishing from shore and along the reef margin are permitted for certain species. All other fishing methods are prohibited. From shore, catch is limited to rabbitfish, juvenile goatfish, juvenile jacks, and convict tangs (*kichu*, family Acanthuridae). All other fish must be released immediately. Cast net fishing along the reef margin is allowed for rabbitfish and convict tang only.

There are no species restrictions for fishing in Pati Point Marine Preserve, although fishing methods are limited to hook-and-line from shore. Limited cultural takes are permitted in Achang Reef Flat Marine Preserve adjacent to the village of Merizo for seasonal runs of juvenile rabbitfish and bigeye scad. No fishing is allowed in Piti Bomb Holes and Sasa Bay Marine Preserves (Porter et al., 2005).

Marine Habitat Degradation

Sediment discharge and terrestrial runoff from mountainous southern Guam watersheds are the principal anthropogenic threats to nearshore water quality and coral reef ecosystems in that area (Golabi et al., 2005; Khosrowpanah et al., 2002). The effects of land runoff on stony corals appear to be cyclical, with no long-term change in live coral distribution patterns in Fouha Bay (Rongo, 2004). Corals recolonize areas closer to the river mouth during dry periods but die back as a result of runoff and sedimentation during wet periods (Rongo, 2004).

Seaweed and seagrass beds are also affected by terrestrial runoff. Community leaders state that commercial jet ski operations in east Agana Bay and removal of an intertidal green seaweed species (*lumot*, family Enteromorpha, the primary food of the *dagge*) by beach raking at low tide along the shores of east Agana and Tumon bays have major adverse effects on shallow marine habitat (Blas, 2005). A 2005 survey of 400 Guam households found that residents are most concerned about the effects of pollution and its threat to Guam's coral reefs (Beukering et al., 2007). The effects on herbivores of daily beach raking in Tumon Bay to remove algae are not known; however, larger rabbitfish typically feed farther offshore and beyond the surge line as opposed to *dagge*.

3.8 Protected Species

The Council's Mariana Archipelago Fishery Ecosystem Plan contains information on protected species in Guam. Information presented in the FEP are incorporated as reference herein.

Two listed ESA-listed species that may occur in the action area hawksbill sea turtles and green sea turtles. Nesting surveys for green sea turtles have been done on Guam since 1973 with the most consistent data collected since 1990. There have been up to 60 nesting females observed annually, with a generally increasing trend over the past 12 years aerial surveys done in 1999– 2000 also found an increase in green sea turtle sightings around Guam (Cummings 2002). One hawksbill sea turtle nest was found in November 1991 on Guam (NMFS and USFWS 1998c); however this was highly unusual as nesting individuals are otherwise virtually unknown on Guam (Eldredge 2003)**.**

Cetaceans listed as endangered under the ESA that have been observed in Mariana Archipelago comprise the humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), and sei whale (*B. borealis*).

Table 1: Non-ESA listed Marine Mammals found in the Marianas Archipelago

Common Name	Scientific Name
Bottlenose dolphin	*Tursiops truncatus*
Bryde's whale	*Balaenoptera edeni*
Cuvier's beaked whale	*Ziphius cavirostris*
Dwarf sperm whale	*Kogia simus*
Killer whale	*Orcinus orca*
Melon-headed whale	*Peponocephala electra*
Short-finned pilot whale	*Globicephala macrorhynchus*
Spinner dolphin	*Stenella longirostris*
Spotted dolphin	*Stenella attenuata*
Striped dolphin	*Stenella coeruleoalba*
Pygmy sperm whale	*Kogia breviceps*
Risso's dolphin	*Grampus griseus*
Rough-toothed dolphin	*Steno bredanensis*

Source: 2009 Marianas FEP

There have been no reported or observed interactions between protected species and coral reef fisheries in Federal waters around the Mariana Archipelago and the potential for interactions is believed to be low due to the gear types and fishing methods used. Following consultations under section 7 of the ESA, NMFS has determined that the coral reef ecosystem fisheries will not adversely affect any ESA-listed species or critical habitat in Guam. NMFS has also concluded that the Guam coral reef commercial

fisheries will not affect marine mammals in any manner not considered or authorized under the Marine Mammal Protection Act.

See the Council's Marianas Archipelago Fishery Ecosystem Plan for more information.

Chapter 4 Environmental Impacts

The following sections discuss the potential effects of Alternative 1 (No Action) and Alternative 2 (Proposed Action) on environmental factors.

4.1 Impacts to Physical Environment and Habitat

The physical environment of Guam is comprised of its geology and topography, as well as surrounding ocean layers, ocean depth zones, ocean water circulation, surface currents, transition zones, eddies and deep-ocean currents. Under both Alternative 1 (No Action) and Alternative 2 (Proposed Action), Guam fisheries would continue to be adaptively managed by Guam's Department of Aquatic Resources and by the Council under the Marianas Archipelago Fisheries Ecosystem Plan (FEP). Under the FEP, essential fish habitat and habitat areas of particular concern have been designated for coral reef fish and bottomfish that occur around Guam.

Current fisheries and other marine activities that occur on Guam may affect the physical environment and habitat through gear lost and physical interaction with vulnerable substrate.

Alternative 1 (No action) would maintain the current level of impacts to the physical environment.

Alternative 2 (Proposed Action) is not expected to negatively impact Guam's physical environment and essential fish habitat. Under this alternative, *dagge* would be collected by Guam fishermen for receiving at the Guam Hatchery. *Dagge* form small schools and shelter in shallow waters in reef environments or in sea grass beds. As *dagge* often shelter over corals, seagrass, and sandy areas, throw net fishing will be conducted to ensure that *dagge* are captured over sandy areas. Capture depths are very shallow inshore waters, less than 5 feet. *Manahak* and *dagge* feed on benthic algae. Small throw nets will be used for catching *dagge*, which occur in schools over shallow sandy substrate. These sandy areas are naturally inhospitable to live coral due to temperature fluctuations and lack of hard substrate for attachment. The amount of individual dagge will be a small portion of the population in the area, thus their removal are not expected to have any subsequent habitat impacts from reduced herbivorous grazing.

A holding tank would be reserved for this population in an area that is closed off from the hatchery to maintain biosecurity for the rest of the hatchery. The time and place of release would be decided by 4-H, GFCA, Guam Dept. of Agriculture. All captured *dagge* would be released after approximately 6 months at Tumon Bay, (or other identified areas such as East Hagatna Bay, Pago Bay, or Paseo shoreline). Guam 4-H development project participants would release the fish by carrying them offshore in 200-gallon containers. Per best management practices, participants will avoid corals and seagrasses when releasing *dagge*. The enclosure of a holding tank by 4-H would not be expected to have any negative impact on Guam's physical environment and habitat for rabbitfish or non-target inshore species. No impacts to EFH are expected to occur as a result of the

capture of rabbitfish using throw nets or from the release into sandy nearshore areas during project. Best practices will also be followed to ensure that only clean water and fish without disease are released into the environment. Although the fish would be given feed containing antibiotics while in the hatchery, no feed or antibiotics would enter the environment when the fish are released, and the fish are not fed once they are released into the bay.

Table 2: EFH and HAPC for species managed under the Pelagic, Pacific Remote Island Areas; the Mariana Islands, and the American Samoa Fishery Ecosystem Plans (Crustaceans, Bottomfish and Seamount Groundfish, Precious Corals, and Coral Reef Ecosystem Management Unit Species)

SPECIES GROUP (FEP)	EFH (juveniles and adults)	EFH (eggs and larvae)	HAPC
Pelagic	water column down to 1,000 m	water column down to 200 m	water column down to 1,000 m that lies above seamounts and banks.
Bottomfish	water column and bottom habitat down to 400 m	water column down to 400 m	all escarpments and slopes between 40-280 m, and three known areas of juvenile opakapaka habitat
Seamount Groundfish	(adults only): water column and bottom from 80 to 600 m, bounded by 29°-35°N and 171°E -179°W	(including juveniles): epipelagic zone (0-200 nm) bounded by 29°-35°N and 171°E -179°W	not identified
Precious Corals	Keahole, Makapuu, Kaena, Wespac, Brooks, and 180 Fathom gold/red coral beds, and Milolii, S. Kauai and Auau Channel black coral beds	not applicable	Makapuu, Wespac, and Brooks Bank beds, and the Auau Channel
Crustaceans	bottom habitat from shoreline to a depth of 100 m	water column down to 150 m	all banks within the Northwestern Hawaiian Islands with summits less than 30 m
Coral Reef Ecosystems	water column and benthic substrate to a depth of 100 m	water column and benthic substrate to a depth of 100 m	all Marine Protected Areas identified in FEP, all PRIAs, many specific areas of coral reef habitat (see FEP)

4.2 Impacts to Target and Non-Target Fish Species

A total of approximately 2,000 small rabbitfish (*dagge* life stage) would be captured in the project from potentially four locations (Tumon, East Agana Bay, Pago Bay, and Agat) during the period July 2013 to July 2014. Based on earlier rabbitfish experiments at the Guam Hatchery, the expected mortality of *dagge* during the 6 months that they are held in captivity at the Guam Hatchery is much lower than the naturality mortality in the wild. Pre and post release surveys will be conducted to assess contribution of grow-out project to local rabbitfish population.

Annual Catch Limits for 2012 have been established for several species of fish, crustaceans and precious corals in Exclusive Economic Zone (EEZ) waters off Guam. These include an annual limit of 26,120 pounds of rabbitfish that are allowed to be harvested in Guam's EEZ (www.wpcouncil.org/meeting, October 2012 meeting). The average weight of adult rabbitfish is estimated to be approximately 0.5 lb. average weight of dagge is estimated to be 0.0011 lbs. Harvesting 2,000 dagge would result in less than 3 lbs of cumulative weight of rabbitfish, a very small percentage of the rabbitfish ACL.

The Territory of Guam has sole management authority for submerged lands, marine resources and regulated fisheries within the territorial waters from 0 to 3 miles from its shorelines. The National Marine Fisheries Service (NMFS) and the Council work closely with the Guam Division of Aquatic and Wildlife Resources on cooperative monitoring and reporting programs for Federal fisheries. Offshore marine species, including those regulated as Federal fisheries, would not be impacted by inshore actions.

Neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) would change the current framework of management, accompanying regulations, or fishery management strategies.

Neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) would be expected to change existing fishing methods, gear or catch rates for *rabbitfish*. The *dagge* stage of rabbitfish life is not considered desirable as food once they have recruited to the nearshore and have eaten algae. Under Alternative 2, a relatively small quantity of *dagge* (no more than 2,000 individuals) would be collected by Guam fishermen for receiving at the Guam hatchery. This represents only small fraction of the rabbitfish ACL and thus the preferred alternative would not result in exceeding the rabbitfish ACL. Moreover, the preferred alternative would be expected to enhance the local rabbitfish population by growing out individuals that otherwise would likely have been subject to natural mortality. Rabbitfish are a well researched and hearty aquaculture species and the amount of mortality due to fish handling and survival in the grow-out tank are low (SPC2 2008). Although the rabbitfish that are to be collected may likely serve as a food base for predatory fish species such as jacks and snappers, it is believed that the relatively small amount of fish to be collected (orders of magnitude smaller than total recruitment levels) will not impact the success of such predatory species in finding other prey items.

Under both Alternative (No Action) and Alternative 2 (Proposed Action), the status and trends of target and non-target species would continue to be evaluated annually. Stock assessments for which MSY can be estimated for coral reef fisheries of Guam have not been conducted, and as such MSY values for rabbitfish have not been established.

A Federal permit is required to participate in coral reef fisheries in the EEZ that surrounds Guam (3 to 200 miles offshore) for potentially harvested coral reef taxa. No federal permits have been issued to date. The possible impacts of both Alternative 1 (No Action) and Alternative 2 (Proposed Action) would be limited, however, to inshore waters off Guam that are excluded from the federal permit requirement. Local permits are not required for the harvest of *dagge* using cast net methods.

4.3 Impacts to Protected Species

Under both Alternative 1 (No Action) and Alternative 2 (Proposed Action), no additional impacts to protected species would be expected on Guam. Best Management Practices called for in Attachment A would be used to prevent protected species interactions. The practitioners of the proposed project would be from the Guam 4-H development program and fishermen of the Guam Fishermen's Cooperative Association. Fishermen will follow the BMPs when capturing *dagge* to avoid protected species and adverse habitat impacts. The use of throw nets also limit the potential for protected species bycatch as this is actively tended fishing gear in shallow-water.

No impacts on any sea turtles, seabirds or other protected species are anticipated under either Alternative 1 or 2, as fishing will not occur in the presence of these species. Using best practices, cast nets will not be thrown when sea turtles are visually observed in area of the *dagge* school.

NMFS evaluates the potential impact of existing fisheries and future potential fishery actions that may affect species listed as threatened or endangered under the Endangered Species Act (ESA), and considers the impacts to sea turtles, marine mammals and seabirds. By law, fishery activities within the U.S. EEZ that affect listed species cannot jeopardize the continued existence of those species. All fishery management actions are reviewed for compliance with the provisions of the ESA. Fishery management actions are also reviewed for compliance with the Marine Mammal Protection Act (MMPA).

Under both Alternative 1 (No Action) and Alternative 2 (Proposed Action), agencies (NMFS, the Council, Guam DAWR) would continue data collection programs (e.g., logbooks, observers) through which interactions with protected species can be monitored by NMFS and, where applicable, prevented, reduced or mitigated. Implementation of future management plan changes or regulatory amendments to the Fishery Ecosystem Plan would be subject to the appropriate NEPA analysis and other statutes, such as ESA or MMPA at the time of their consideration.

4.4 Impacts to Public Health and Safety

Alternative 1 (No Action) would maintain opportunities for Guam inshore fishermen to captured *dagge*, although this life stage of the rabbitfish is considered undesirable for food. Alternative 2 would increase Guam fishermen's opportunities to capture *dagge* for removal to holding tanks within an area of the Guam Hatchery that is protected from public use and handling so as to maintain biosecurity of the facility. Neither alternative would increase impacts to public health and safety, although Alternative 2 (Proposed Action) would increase fishermen's involvement and therefore human risk in the process of handling *dagge* during and after capture.

Neither Alternative 1 (No Action) or Alternative 2 (Proposed Action) would be expected to change the general operation of Guam fishermen who target rabbitfish or other inshore fish species. Traditional fishing methods (e.g. cast net) may still be used by some fishermen after the project is completed.

4.5 Impacts to Fishing Community

Guam is listed as a fishing community pursuant to the Magnuson-Stevens Act. The Western Pacific Regional Fishery Management Council has developed fishery ecosystem plans that recognize the importance of community-based management approaches (WPFMC 2005). This distinguishes that responsible actions by citizens and communities are necessary for long-term wise use of marine resources. The Council's fishery ecosystem plans are focused on community collaboration, participation and partnerships (WPFMC 2005). In Guam, where village-level systems still maintain a strong level of influence over fishing and marine resource use, the involvement of local communities in natural resource management is critical (Allen and Bartram 2008).

Alternative No. 1 (No Action) would not have a significant impact on Guam's fishing community, which would continue to rely on rabbitfish (although not the less popular *dagge*) as a traditional food.

Alternative No. 2 (Proposed Action) would result in the opportunity for 4-H personnel to conduct outreach activities that could have positive impacts on enhancing community education on the importance of maintain healthy coral reef fisheries.

When compared to Alternative 1 (No Action), Alternative 2 (Proposed Action) would positively impact fishery participants and communities in Guam by increasing local expertise. Alternative 2 (Proposed Action) would also be positive as scientific information and human needs are integrated in a manner that would increase the involvement of local communities in the management and conservation of inshore fishery resources. This should be done in a manner that is understandable to fishery participants and with minimum regulatory burden.

Implementation of future management changes or regulatory amendments could impact the Guam community favorably. These would be subject to the appropriate NEPA analysis and other applicable laws at the time of their consideration.

4.6 Impacts to Biodiversity and Ecosystem Function

Inshore fishing is actively conducted for rabbitfish and other species in Guam's inshore waters. A total of approximately 2,000 small rabbitfish (*dagge* life stage) would be captured in the project from potentially four locations (Tumon, East Agana Bay, Pago Bay, and Agat). *Dagge* are often found in seagrass and near corals. The use of throw nets will limit any impacts to the coral reefs or seagrass as the net will not be cast over any live corals. The weight of the nets also is such that it will not impact seagrass. In addition, throw netting is tended gear, which lessens the potential for bycatch. The number of fish collected is a minuscule fraction of the total Guam rabbitfish population and the throw net method used will not contribute to any loss of ecosystem function or loss of biodiversity. Releasing a small number of individuals in areas where they were not caught is not expected to have any impacts on biodiversity or ecosystem function as the released rabbitfish would not number in the amount that would result in overgrazing of the reef algae or change the trophic structure of reef fish community. The amount of fish released would be a small fraction of the local herbivore population in that particular area. Neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) is expected to adversely impact biodiversity or ecosystem function,

Under both alternatives, Guam fisheries would continue to be managed under existing management plans. Neither alternative would change current Federal or Territorial regulations or designations of essential fish habitat or Habitat Areas of Particular Concern off Guam. The impacts of current activities under existing management plans would continue as at present.

Alternative 1 (No Action) would allow existing levels of inshore fishing for rabbitfish and other species to continue without additional regulation or management. Alternative 2 (Proposed Action) would increase the level of harvest of the rabbitfish life stage known as *dagge* but would return most of the fish temporarily stored at the Guam Hatchery back into the wild after a 6-month period. This alternative is expected to benefit Guam community awareness and knowledge about *dagge* to a greater extent than Alternative 1. Alternative 2 could possibly lead to increased rabbitfish population, which would be viewed as positive to the ecosystem and associated fish biomass.

4.7 Impacts to Management and Enforcement

The management of ocean and coastal activities in Guam is conducted by a number of agencies and organizations in the Federal, Territorial, village or community levels. These groups administer programs and initiatives that address often overlapping and sometimes conflicting ocean and coastal issues.

Neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) is expected to immediately generate a need for further fishery management rule changes.

Implementation of future management plan changes or regulatory amendments would be subject to the appropriate NEPA analysis and other applicable laws at the time of their consideration.

4.8 Cumulative Effects

Cumulative impacts must be considered pursuant to the Council of Environmental Quality (CEQ) regulations 40 CFR 1508.7, which define cumulative impacts as the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.

There are wide-ranging factors (that change over time) that affect fishing participants as well as fishing communities in Guam's inshore areas. Current factors in Guam include high fuel costs, increased seafood imports and restricted access to traditional fishing grounds. High fuel costs affect fishing participants in that it is simply increasingly expensive to go offshore fishing. The effect is that fishery participants reduce fishing trips, switch to less fuel-intensive fisheries or simply do not go fishing at all.

Neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) is expected to increase nearshore or offshore fishing that utilizes vessels. Alternative 2 might increase the fishing pressure on the *dagge* life stage of rabbitfish, which is not currently harvested in significant numbers due to it being an unpopular food fish. However, the amount of individuals collected is a tiny fraction of the available biomass at this lifestage around Guam. Rabbitfish is not subject to overfishing and its ACL has been exceeded. The reproductive success of rabbitfish would not be in jeopardy as a result of the project, but on the contrary, the rabbitfish reproduction may be enhanced as individuals will be grown out and released that otherwise may have not likely survived in the wild due to predation. No adverse impacts to EFH are expected from the use of throw nets in the collection of individual *dagge*. Best Management Practices called for in Attachment A would reduce the potential for direct, indirect, and cumulative impacts on protected species.

Effects unrelated to the proposed action on target and non-target species, EFH, and protected species are ongoing on Guam. The relatively small number of *dagge* to be captured is minor compared to the larger Guam rabbitfish population and cohort abundance and will not lead to adverse cumulative effects on Guam's rabbitfish population. EFH is continually being exposed to impacts on Guam from both natural and anthropogenic sources; however, the proposed project, which will use hand thrown, small mesh nets will not deployed over corals and will not adversely affect EFH, thus no cumulative effects to EFH are anticipated. The food for the *dagge* in captivity will be from the daily shore raking in Tumon Bay by the hotel industry, and so no food will be removed from the shoreline that was not already planned for removal. The 2,000 fish

subject to this action is a small percentage of the overall allowable rabbitfish ACL, and neither removal nor re-release of this number of fish into the environment is expected to affect availability of food resources for the rabbitfish population, predation rates on the population, or population dynamics. Lastly, the proposed projects will not lead to cumulative impacts to protected species because the gear used is believed to have zero to very small potential to interact with protected species, thus not contributing to the existing protecting species situation on Guam nor resulting in any cumulative impacts.

4.8.1 Climate Change Impacts

In a 2007 report, the Intergovernmental Panel on Climate Change (IPCC) states that: "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level (IPCC 2007)."

The major ways climate change will affect marine life and habitats are; 1) changes in reproductive potential; 2) loss of habitat due to sea level rise; 3) alterations to foraging habitats and prey resources; 4) changes in phenology and reproductive capacity that correlate with fluctuations in sea surface temperature; and 5) potential changes in migratory pathways and range expansion.

The impacts associated with Alternative 1 and Alternative 2 are not believed to exacerbate any on-going or future climate change impacts. Also, neither Alternative 1 (No Action) nor 2 (Proposed Action) would result in a change to Guam's inshore fishery that would affect climate change by substantially changing the consumption of energy or release of greenhouse gases by the fishery participants. The effects to Guam's rabbitfish populations from increased sea surface temperatures and ocean acidification as a result of increased atmospheric carbon dioxide are unknown. Bleached or dead coral reefs present two contradictory scenarios for rabbitfish: reduced coral cover may result in less area for rabbitfish to hide from predators, whereas low coral cover may be replaced with algae, providing more food available for herbivorous rabbitfish. Climate change effects are unlikely to be observed over the short-term period of the proposed action.

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Appendix A

Best Management Practices (BMP) for Guam Rabbitfish Grow-out Project

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NMFS Protected Resources Division recommends implementation of the following BMP to reduce potential adverse affects on protected marine species. These BMP are in no way intended to supersede or replace measures required by any other agency including, but not limited to the ACOE, USFWS, USEPA, or NMFS Habitat Conservation Division, and compliance with these BMP shall always be considered secondary to safety concerns.

All workers associated with this project, irrespective of their employment arrangement or affiliation (e.g. employee, contractor, etc.) shall be fully briefed on these BMP and the requirement to adhere to them for the duration of their involvement in this project.

A. Constant vigilance shall be kept for the presence of ESA-listed marine species during all aspects of the proposed action, particularly in-water activities such as boat operations, diving, and deployment of anchors and mooring lines.

1. The project manager shall designate an appropriate number of competent observers to survey the areas adjacent to the proposed action for ESA-listed marine species.
2. Surveys shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one half hour. Periodic additional surveys throughout the work day are strongly recommended.
3. All work shall be postponed or halted when ESA-listed marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed within 50 yards after work has already begun, that work may continue only if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s). For example; divers performing surveys or underwater work would likely be permissible, whereas operation of heavy equipment is likely not.
4. Special attention will be given to verify that no ESA-listed marine animals are in the area such that they could become encircled within collection nets.
5. All nets used as part of this project shall be under observation and positive control throughout their deployment, and shall remain deployed only as long as needed to properly accomplish the required task.
6. When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.

7. Reduce vessel speed to 10 knots or less when piloting vessels at or within the ranges described above from marine mammals and sea turtles. Operators shall be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity, and if practicable, reduce vessel speed to 5 knots or less.
8. If despite efforts to maintain the distances and speeds described above, a marine mammal or turtle approaches the vessel, put the engine in neutral until the animal is at least 50 feet away, and then slowly move away to the prescribed distance.
9. Marine mammals and sea turtles shall not be encircled or trapped between multiple vessels or between vessels and the shore.
10. Do not attempt to feed, touch, ride, or otherwise intentionally interact with any ESA-listed marine species.

B. No contamination of the marine environment shall result from project-related activities.

11. All project-related materials and equipment placed in the water shall be free of pollutants.
12. Fueling of project-related land-based vehicles and trailer vessels shall take place at least 50 feet away from the water, preferably over an impervious surface. Alternatively, fueling of in-water vessels shall be done at approved fueling facilities.
13. A plan shall be developed to prevent wastes from entering or remaining in the marine environment during the project. This includes the requirement to ensure that all parts of any nets used in this action will be completely removed from the water.