Draft Environmental Assessment

Issuance of an Annual Conservation and Management Permit to the

National Marine Fisheries Service

Pacific Islands Fisheries Science Center Protected Species Division and

Pacific Islands Regional Office Protected Resources Division

For Conducting Hawaiian Monk Seal Conservation and Management Activities in

Papahānaumokuākea Marine National Monument

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Prepared by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Pacific Islands Fisheries Science Center and National Ocean Service, Office of National Marine Sanctuaries

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Acronyms and Abbreviations

BE	Biological Evaluation
BMPs	Best Management Practices
CQR	Coastal Quick Release
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EO	Executive Order
EOD	Ecosystems and Oceanography Division
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
FFS	French Frigate Shoals
FWS	United States Fish and Wildlife Service
FONSI	Finding of No Significant Impact
HIMB	Hawaii Institute of Marine Biology
HMSRP	Hawaiian Monk Seal Research Program
HMSRT	Hawaiian Monk Seal Recovery Team
MHI	Main Hawaiian Islands
MTRP	Marine Turtle Research Program
NAO	NOAA Administrative Order 216-6
NEPA	National Environmental Policy Act of 1969
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NWHI	Northwestern Hawaiian Islands
OMAO	Office of Marine and Aviation Operations
ONMS	Office of National Marine Sanctuaries
PEA	Programmatic Environmental Assessment
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office
PMNM	Papahānaumokuākea Marine National Monument
PRD	Protected Resources Division
PSD	Protected Species Division
SMRU	Sea Mammal Research Unit
SPA	Special Preservation Area
USCG	United States Coast Guard

EXECUTIVE SUMMARY

This Draft Environmental Assessment (EA) was prepared in accordance with the National Environmental Policy Act of 1969 (NEPA; 42 United States Code §4321, et seq.), as implemented by the Council on Environmental Quality regulations (40 Code of Federal Regulations Part 1500-1508), and National Oceanic and Atmospheric Administration (NOAA) Administrative Order (NAO) 216-6, which describes NOAA policies, requirements, and procedures implementing NEPA.

Management of Papahānaumokuākea Marine National Monument (PMNM or Monument) is the responsibility of three Co-Trustee agencies: the State of Hawaii through the Department of Land and Natural Resources, the U.S. Department of the Interior through the U.S. Fish and Wildlife Service (FWS), and the U.S. Department of Commerce, through the National Oceanic and Atmospheric Administration (NOAA). These agencies issue joint permits for activities within the Monument as directed in Presidential Proclamation 8031 signed by President George W. Bush on 6 June 2006, establishing the Monument. NOAA's Office of National Marine Sanctuaries (ONMS) proposes to issue, together with the U.S. Fish and Wildlife Service and the State of Hawai'i, an annual conservation and management permit to Dr. Frank Parrish and Ms. Alecia Van Atta of the National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) Protected Species Division (PSD) and Pacific Islands Regional Office (PIRO) Protected Resources Division (PRD) respectively, to enter the Monument and conduct Hawaiian monk seal conservation and management activities through observation and monitoring and utilization of various fishing techniques to lethally remove Galapagos sharks in nearshore areas where preweaned pups are located (hereinafter referred to as the "proposed action").

The purpose of the proposed action is to improve Hawaiian monk seal recovery by increasing juvenile survivorship and the reproductive potential of the subpopulation at French Frigate Shoals Atoll (FFS) within the Monument consistent with NMFS's mandate to protect and recover endangered species and their habitat and the Monument co-trustees' mandate to protect and manage marine resources. The scope of the proposed action involves activities to reduce predation by Galapagos sharks on preweaned and recently weaned pups at FFS by undertaking several different approaches including monitoring and lethal removal of sharks. The proposed action would be conducted at select islets at FFS including Tern, Gin, Little Gin ("the Gins"), Trig and Round Islands.

The proposed action analyzed in this EA includes (1) monitoring Galapagos sharks adjacent to seal pupping areas and (2) conducting fishing activities to lethally remove up to 18 Galapagos sharks observed near seal pupping areas. Proposed fishing methods include shore based techniques such as handline, harpooning, and use of a surprise net (also called the "stealth tangle net") and boat-based methods such as bottom sets and drumlines. All such fishing activities would occur only within shallow waters at FFS that are within 700 m of land (i.e., an island in the atoll) over a two-year period. This analysis presents information on the anticipated effects to the physical environment resulting from the proposed action, as well as potential effects to the biological environment, including marine mammals, sea turtles, fish, birds, and corals. Mitigation measures have been incorporated into the proposed action to avoid entangling or hooking monk seals and sea turtles.

NOAA has determined that the proposed action would have a moderate long-term beneficial indirect effect on the monk seal population survival. The proposed action would also have a minor short-term adverse direct effect on Galapagos sharks and other fish in the immediate area. The proposed action would have an overall negligible cumulative effect on the environment. NOAA has further determined that the proposed action would not have reasonably foreseeable direct or indirect effects on any coastal use or resource of the State's coastal zone.

1 Purpose, Need and Scope

1.1 Purpose and Scope of the Action

The proposed action consists of ONMS' proposal to issue an annual conservation and management permit to Dr. Frank Parrish and Ms. Alecia Van Atta of the NMFS PIFSC and NMFS PIRO Protected Species Division. The permit would allow the following activities at FFS: (1) entrance into the PMNM; (2) observation and monitoring of both Hawaiian monk seals and Galapagos sharks; and (3) utilization of various fishing techniques to lethally remove up to 18 adult Galapagos sharks exhibiting aggressive behavior in nearshore areas where preweaned pups are located. Proposed fishing methods include shore-based use of handline, harpoon, and surprise net and vessel-based use of bottomsets and drumlines. All such fishing activities would occur only within shallow waters at FFS (approximately 700m from the shoreline of the islets proposed).

The purpose of the proposed action is to improve Hawaiian monk seal recovery by increasing juvenile survivorship and the reproductive potential of the subpopulation at FFS within the Monument. This is consistent with NMFS's mandate to protect and recover endangered species and their habitat, and the ONMS mandate to protect and manage marine resources. The proposed action meets goals and objectives identified in the Hawaiian Monk Seal Recovery Plan, which delineate reasonable actions that are necessary to recover and protect listed species.

The scope of the proposed action involves activities to reduce predation of preweaned and newly weaned Hawaiian monk seal pups by adult Galapagos sharks near pupping sites during the monk seal breeding season at FFS by undertaking several different approaches including monitoring and lethal removal of sharks. The proposed action would be conducted at select islets at FFS including Tern, Gin and little Gin Island ("the Gins"), Round and Trig Islands. This EA is intended to last for two years, as long as individual projects are conducted as described in Chapter 2, section 2.3, (proposed action), and the actual impacts associated with implementation remain within the range of impacts as identified in Chapter 4.

1.1.1 Context

Monk seals are ecologically important on regional, national, and even global scales. The genus *Monachus* comprises the Hawaiian monk seal (*Monachus schauinslandi*), the Caribbean monk seal (*Monachus tropicalis*) and the Mediterranean monk seal (*Monachus monachus*), all thought to be among the oldest of all existing seal genera on an evolutionary time scale. The Caribbean species was hunted to extinction for meat, skins, blubber, and museum and zoo specimens. The last wild Caribbean monk seal was seen in 1952, and the species was declared extinct in 2008 (73 FR 32521; June 9, 2008). The Mediterranean monk seal population numbers in the low hundreds and has been reduced to scattered and isolated small groups from North Africa to Greece. This species is the victim of political circumstances in that the remnant small groups reside in the waters of several countries that have failed to achieve a comprehensive and effective recovery program. The outlook for long-term persistence of the Mediterranean monk seal is bleak (NMFS 2007a).

The Hawaiian monk seal, then, may be the best – and perhaps only – chance of saving the genus *Monachus*. Despite the species' low and declining numbers, circumstances in Hawaii may potentially support the recovery of the species because:

- the population has not been segmented into isolated fragments among which dispersal cannot occur, such as in the Mediterranean monk seal;
- its core habitat in the Northwestern Hawaiian Islands (NWHI) is highly protected by the designated Monument mission and regulations
- the species is capable of recovering naturally in the main Hawaiian Islands (MHI), if conflicts with human use and land use can be resolved; and

- the Hawaiian monk seal occurs entirely within the United States and its Exclusive Economic Zone, eliminating the political impediments to recovery involved with the necessity of intergovernmental cooperation. However, this means that the United States government bears total responsibility for the continued existence of the species (NMFS 2007a).

1.1.2 Recovery Targets

The HMSRP lists several criteria for reclassification of the monk seal population from "endangered' to "threatened". The population will be considered for reclassification if:

- aggregate numbers exceed 2,900 total individuals in the NWHI;
- at least five of the six main subpopulation in the NWHI are above 100 individuals and the MHI population is above 500; and
- survivorship of females in each subpopulation in the NWHI and in the MHI is high enough that, in conjunction with the birth rates in each subpopulation, the calculated population growth rate for each subpopulation is not negative.

With the rapidly declining population in the NWHI due to all factors, especially food limitation for juvenile pups and shark depredation on pre-weaned pups, and the limited acceptance of monk seals by humans in inhabited areas in the MHI (competition for use of popular beaches), every pup born is critical for population recovery.

1.2 The Need for Action

The need for the proposed action is to reduce a source of juvenile Hawaiian monk seal mortality which would facilitate the survivorship and the reproductive potential of the juvenile subpopulation within FFS. The total abundance of Hawaiian monk seals in the NWHI has declined by 75% since the late 1950s. The causes of decline have varied over time and from place to place, but since the early 1990s the decline has been driven, in large part, by low rates of juvenile survival. Archipelago-wide many of these young animals have failed to thrive due to malnutrition, and only about one of every five live to reach maturity. The age structure of the population is therefore biased toward continually aging individuals, with little recruitment into the breeding population. The population estimate throughout the Hawaiian Archipelago as of 2011 is 909 seals in the NWHI and 146 in the MHI. Estimated abundance is declining by 3.4% annually (approximately 50 seals per year). At present rates, the Hawaiian monk seal species will decrease to less than 1,000 individuals within five years and will be, for all purposes, extinct within 50 years (Harting et al., *in prep.*). FFS, the atoll with the largest pupping population, has been experiencing a 75% decline in beach counts and 35% decline in pup births since 1989 (decreasing from 120 pups in 1990 to 37 pups in 2011) (Figure 1). On top of decreasing births, 12% to 21% of the pups continue to be lost to shark predation (for every year since 2000) (NMFS 2008) (Figure 2).

History teaches us that the monk seal will continue to face new and unforeseen challenges in the future, including loss of habitat in the NHWI, such as occurred with the disappearance of Whaleskate Islet in FFS in 1998 to 1999 and the finding that islet sizes at FFS were at least 50% smaller in 2004 than in 1963 (Antonelis et al. 2006). Climate change and associated rising sea levels may also contribute to the loss of habitat. But after two decades of poor survival of juvenile seals and precipitous drops in overall numbers and numbers of pups, it is clear that this problem must be addressed immediately.

A recent and troubling trend is the loss of pre-weaned pups to Galapagos shark (*Carcharhinus galapagensis*) predation in FFS since the late 1990s. Losses peaked in 1997 through 1999, with 16 to 28 mortalities recorded each year; the trend has been 6 to 17 losses each year since 2000, equal to 12% to 21% of the annual cohort born at the atoll (Harting et al. *in prep.).*

Reducing shark predation on seal pups is one of four key activities highlighted in the Recovery Plan for the Hawaiian Monk Seal, published by NOAA in compliance with the Endangered Species Act (ESA) in the summer of 2007. The primary activities identified in the Recovery Plan pertinent to the proposed action (NOAA NMFS 2007) are:

- Continue monitoring shark activity and predation events.
- Remove problem sharks.
- Develop general criteria (and site-specific plans) for shark removal.
- Maintain needed permits for shark removal and/or other intervention.
- Be prepared for rapid response to predation events.
- Have trained staff and gear for intervention.
- Characterize trends in shark abundance, movement patterns, and predation losses throughout the NWHI in relation to these interventions and conduct shark behavior research.

Selective fishing to remove predatory Galapagos sharks has occurred for over ten years. Shark removal activities were initiated in 2000 and continued each year thereafter until 2007, with a total of 12 Galapagos sharks removed during the period 2000-2007 by HMRSP staff. Shark removal activities were also conducted via PMNM permit in 2010 and 2011 with a total of two Galapagos sharks lethally removed from FFS (one each year).

1.2.1 The Decline and Specific Threats to Survival of the Hawaiian Monk Seal Population in the NWHI

The Hawaiian monk seal population in the NWHI is declining at almost 4% per year (NOAA NMFS 2007), primarily due to reduced juvenile survival. Survival rates, particularly of pups and juveniles, must increase for the species to recover. A primary goal of the HMSRP is to increase juvenile survival, including survival of pre-weaned pups, to levels sufficient to slow the rate of population decrease to ultimately assist in reversing the current downward trajectory of the population. Hawaiian monk seal pups are generally born between May and September, based on historical data. This section summarizes information about temporal and spatial variability in juvenile monk seal survival, and, importantly, predictability of survival rates.

Table 1. The number of monk seal pup deaths and the number that died due to shark predation (confirmed and inferred kills) in the NWHI, listed by atoll, across the past 5 years. Total pup deaths per location by year are followed by pup deaths attributable to shark predation in parentheses.

Year	Location					
	FFS	LAY	LISI	PHR	MDY	KUR
2007	7(6)	2(0)	0(0)	1(0)	3(0)	0(0)
2008	8(6)	2(0)	1(0)	0(0)	1(0)	2(0)
2009	7(5)	0(0)	1(0)	0(0)	0(0)	0(0)
2010	9(6)	3(0)	1(0)	2(0)	0(0)	1(0)
2011	9(5)	3(0)	1(0)	3(0)	2(0)	5(0)

Table 2. The number of monk seal pups impacted by sharks (injured, confirmed and inferred kills) in FFS, listed by islet during the past 5 years. Islets with no recorded shark incidents on pups across all 5 years are omitted.

Year	Location			
	Trig	Gins	Round	East
2007	5	3	1	0
2008	4	4	0	1
2009	5	1	0	1
2010	4	1	0	1
2011	3	3	0	0

Table 3. The number of sharks removed by NMFS to date and the number of pups impacted by shark predation at FFS between 1997 and 2011.

Year	Galapagos sharks removed*	Pups impacted by sharks
1997	0	27
1998	0	16
1999	0	28
2000	1	12
2001	5	17
2002	2	12
2003	2	14
2004	0	14
2005	2	13
2006	0	17
2007	0	9
2008	Not attempted**	9
2009	Not attempted**	7
2010	1	6
2011	1	6

* All Galapagos sharks were removed from Trig with the exception of 1 from Gin in 2011.
** Shark deterrent testing occurred during these years and shark removals were not attempted.

Individual subpopulations of monk seals show similar patterns in age-specific survival across the NWHI. Juvenile, subadult, and adult survival rates vary significantly over time though general patterns are apparent (NOAA NMFS 2007). Survival during the five- to six-week nursing period tends to be quite high (>90%) at all NWHI subpopulations except at FFS because of maternal attendance, protection and provisioning and few other threats to survival at this stage of life (Johanos et al. 1994). After weaning, juvenile survival rate is relatively low to age 2 years, intermediate to age 4 years, and then relatively high for mature seals (until approximately age 17), after which a decline is observed as seals approach old age.

The causes of these patterns and declines are numerous and complex, and are thoroughly reviewed in the HMSRP (NOAA NMFS 2007). A crucial threat that is contributing to the high rate of population decline in the NWHI is apparent food limitation, especially for younger animals (Craig and Ragen 1999; Yochem et al. 2004). Survival of juveniles recently weaned through age three has declined most dramatically, with smaller body sizes of juveniles consistent with signs of starvation. This condition may be due to competition with other apex predators such as some shark species, carangid fishes, other monk seals, less efficient foraging skills of young seals, and changes in ocean productivity reducing the availability of prey. This situation

contrasts with the MHI, where pups tend to wean much larger than in the NWHI, and thin animals are rarely observed.

Among the six primary breeding sites in the NWHI, FFS has experienced the most precipitous decline, with beach counts, as well as number of pups born generally falling from 1989 through 2008 (Baker 2008). Although FFS was once the most populous site, with over 400 individuals in the late 1980s, the estimated abundance in 2011 was only 195 seals (NMFS, unpublished data). The primary factor in the FFS subpopulation's decline has been poor juvenile survival exacerbated by lower reproductive rates due to lower numbers of breeding females and young females entering the breeding cohort, as at other sites. However, at FFS malnutrition as well as shark predation is responsible for poor juvenile survivorship, with the latter greatly affecting pre-weaned pup survival.

Since about 1997, a marked increase in Galapagos shark predation on pre-weaned monk seal pups born at FFS has occurred (Hawn 2000; Hayes 2002; NMFS 2003, NMFS 2004, NMFS 2005). For example, at Trig and Whaleskate Islets within FFS, the number of predation mortalities from sharks (including both confirmed and inferred losses) peaked in 1997 through 1999 (Table 3). During this period, 16 to 28 pups, representing 38-69% of the cohort, suffered predation each year by Galapagos sharks (confirmed and inferred losses). Additional individual pups were maimed by shark bites, including amputation of body parts, potentially reducing diving and foraging ability, as well as reproductive potential, as maimed animals presumably have a lower potential to mate. Also, pre-weaned pup survival was lower at FFS than at other breeding site over the last decade (see Table 1 for years 2007 to 2011). Definitions of criteria for and categorization of shark predation of Hawaiian monk seal pups is included in Appendix A.

Subsequent to this peak of losses in 1997 through 1999, pre-weaned pup mortalities from Galapagos sharks declined, though to a level of loss that is unsustainable for this severely declining subpopulation of this critically endangered species. Between 1997 and 2010, the number of shark incidents (bite wounds, disappearances categorized as shark-related and confirmed shark kills) on pups (pre-weaned and newly weaned) was 207 of 854 (24.2%) born at FFS. Over the last decade, the number of pre-weaned pup impacted by shark predation (bite wounds, disappearances categorized as shark-related and confirmed shark kills) at FFS atoll-wide has ranged from 6 to 17 per year. However, with fewer pups being born at FFS in recent years (37 in 2011 compared to more than 100 in the late 1980s), a lower number of pups lost to predation has exacted an increasingly heavy toll on smaller cohorts. Brief summaries of shark predation impacts on incoming cohorts of monk seals at FFS during the last five years follows.

In 2007, at least 8 of the 43 pre-weaned pups born at FFS were lost due to shark predation and one severely-bitten pup died post-season due to extent of its wounds. In 2008, 12 pre-weaned pups died or disappeared (30%) out of 41 births in FFS, with eight of the losses due to sharks (confirmed or inferred). The disappearances of three of these pups were categorized as unknown because they were born late in the season after routine data collection had ceased, though shark-predation cannot be ruled out. In all, shark predation (confirmed and inferred losses) affected 25% of the pups born on Trig Islet in 2008 (NOAA NMFS 2008). Shark depredations were catastrophic on the two Gins Islets in 2008, with four losses to sharks out of 6 births, with an additional non-lethal but multiple bite wound attack on a pup (Farry et al. 2009). One pup disappeared after the regular season; its cause of death was categorized as unknown.

In 2009, there were 7 incidents of shark predation on pups, and as a result 5 pups died. This represented 14.7% (5 of 34 monk seal pups born) of the annual cohort (see Table 1 & 2 for a comparison of pup losses at FFS over the last 5 years). On Trig islet, Galapagos shark predatory activity was directly observed on 12 occasions; 12 additional sightings were recorded via a remote camera system temporarily installed on the islet. There was also one sighting of a Galapagos shark at Gin.

In 2010, there were 9 incidents of shark predation on pups, and as a result 6 pups died. This represented 16.2% (6 of 37 pups born) of the annual cohort (Table 1 & 2). On Trig islet, Galapagos shark predatory activity was observed on 2 occasions during onsite monitoring by HMSRP and/or recorded with the remote

video camera. To increase the chance of observing sharks, HMSRP camped on Trig as much as was feasible; however shark sightings remained rare, especially after the removal of a Galapagos shark at Trig on 13 July 2010.

In 2011, there were 6 incidents of shark predation on pups, and as a result 5 pups died. This represented 13.5% (5 of 37 pups born) of the annual cohort. Staff camped for a total of 84 days, 51 days on Gin and 33 days on Trig. The focus of monitoring was at Gin during the first half of the season because more pups were born there than at Trig. HMSRP sighted Galapagos sharks twice; a shark with no distinctive fin marks was observed attempting to attack a pup in the nearshore and a second individual with a "notched" fin was captured and removed (see below). The remote camera system was installed at Trig; however, it was non-functional despite several attempts at fixing it throughout the season. No Galapagos sharks were directly sighted at Trig in 2011.

A standing hypothesis developed by experts familiar with this predator-prey system at FFS is that a small number of Galapagos sharks are involved in pre-weaned pup predation. This hypothesis is currently being tested by researchers from the Hawaii Institute of Marine Biology (HIMB) using an acoustic tagging study at FFS (Antonelis et al. 2006, NOAA NMFS 2008, NOAA NMFS 2009 *in prep*). Based on tagging and other distinguishing features of individual sharks, a minimum of 14 identified Galapagos sharks were observed patrolling or pursuing pre-weaned pups at Trig Islet in 1998. One of the previously sighted and tagged Galapagos sharks from 1998 was again sighted around Trig islet during the pupping season and was identified with the killing of a pre-weaned pup that year (Harting et al. *in prep*.).

A Galapagos and tiger shark tagging study was conducted by Carl Meyer, PhD. of HIMB. In the 2009 monk seal pupping season (May-August), 189 bottomsets were made; totaling 1570 hooks and 6850 soak hours. These bottomsets used large tuna heads and shark tissue as bait. Bycatch was minimal and limited to elasmobranch species. In total 68 Galapagos and 40 tiger sharks were tagged with sonic tags; additional individuals were tagged with spaghetti tags. Four Galapagos sharks were tagged near islets with monk seal pups (5.9% of the sampled population captured in a stratified fishing scheme that attempted to evenly fish across shallow and deep lagoonal areas and deep areas outside the breaking reef at FFS). This tagging research represents the greatest effort in terms of time devoted to sampling the shark population FFS to date (aside from commercial fishing in 1999). This research suggest that 1) using a small bottomset is a very effective way of capturing sharks and avoiding bycatch; 2) very few sharks utilize the shallow waters around the pupping sites. (Dale et al. 2010).

By multiplying the proportion of the transmitter-equipped Galapagos sharks that were detected in the shallows around Trig from 2009 to 2011 (N=13, 19.1% of 68 total) against the mark-recapture population size estimate for Galapagos sharks at FFS (668 individuals), the number of Galapagos sharks utilizing shallow habitats at Trig during this period is estimated at 127. However only a subset of these individuals displayed behavior consistent with observations of sharks involved in pup predation (i.e. others were only detected around Trig in winter, or just passed through on one solitary occasion). Thus, overall, the data suggest the number of Galapagos sharks involved in pup predation is probably in the low tens. (Carl Meyer per comm. (30 September 2011)

Additional information on the HMSRP and uncertainty, risks and benefits faced by NMFS in its mandate to recover the Hawaiian monk seal is detailed in the Environmental Assessment entitled, "Programmatic Environmental Assessment of the Program for Decreasing or Eliminating Predation of Pre-Weaned Hawaiian Monk Seal Pups by Galapagos Sharks in the Northwestern Hawaiian Islands – Pacific Islands Fisheries Science Center (PIFSC), Protected Species Division (PRD), Hawaiian Monk Seal Research Program (HMSRP) Honolulu, Hawaii – March 13, 2009," (NOAA NMFS, 2009) and is incorporated here by reference.

Adult female Hawaiian monk seal (seal on left) turns to protect her pup against attack by Galapagos sharks

1.2.2 Past Actions

Based on the losses occurring in 1997 through 1999, personnel attempted to haze predatory Galapagos sharks away from pupping and pups in FFS, especially Trig Islet, in 1998 through 2001. This management strategy proved unsuccessful in decreasing predation on pre-weaned pups and may have precipitated increased wariness by sharks toward humans (Harting et al. *in prep*.). This wariness may have contributed to a decrease in day predation and an increase in night predation (when observation of attacks is not possible) effectively maintaining the overall number of shark incidents at a relatively constant level though the observed, confirmed attacks are rare. Selective fishing via bottomset, handline, drumline and harpoon to remove predatory Galapagos sharks was initiated in 2000 and continued each year thereafter until 2007, with a total of 12 Galapagos sharks removed during from 2000-2007 by HMRSP staff. An additional two Galapagos sharks were removed one each in 2010 and 2011.

The experimental removals were based on the assumption that only a limited number of sharks were involved, specifically those that had discovered the high density of mother-pup pairs at Trig Island after Whaleskate islet had disappeared and also the numerous pup carcasses at beaches, resulting from male aggression in 1997-1998. In addition, in July and October 1999, over 50 Galapagos sharks were removed from FFS by commercial fishers, partially operating in the deep lagoonal area of the atoll. This 1999 removal was associated with the greatest drop in pre-weaned pup losses to shark predation to date (Table 3) (Vader 2003, Harting et al. *in prep*.) A drop in shark predation impacts on pups is also apparent between 2006 and 2007 onward (Table 3) after a total of 12 Galapagos sharks had been removed by HMSRP at FFS around Trig; however decreasing annual monk seal cohort size may also have contributed to this trend.

1.3 Hawaiian Monk Seal Recovery Plan Actions Not Included within Scope of EA

The HMSRP also conducts other actions in support of Hawaiian monk seal recovery across the Hawaiian Archipelago that are not included within the scope of this EA. The program includes monitoring monk seal population abundance, assessment, and dynamics; foraging studies; disentangling seals from marine debris; conducting disease and health assessments; and conducting limited translocation of weaned juveniles to areas within the NWHI, especially from Trig Islet to Tern Islet within FFS and from FFS to Nihoa. Both Tern Island and Nihoa have historical lower probability of shark attack. In the past, the HMSRP has also deployed shark deterrent devices at islets in FFS including electromagnetic, auditory, and physical deterrents (e.g. floats and buoys), and has translocated weaned juveniles with evidence of starvation to care facilities in Oahu for a year before releasing them back into the NWHI (NOAA NMFS 2007b). These actions are not included within the scope of this EA.

2 Proposed Actions and Alternatives

The scope of this EA is limited to the assessment of the potential environmental effects of conducting conservation and management activities related to reducing the mortality of weanling and juvenile Hawaiian monk seals by Galapagos sharks at FFS in the PMNM. This EA focuses on the proposed action of lethally removing up to 18 adult Galapagos sharks to improve the long- and short-term reproductive potential of the critically endangered Hawaiian monk seal population. The proposed targeted small-scale shark removal program specifically addresses the following actions identified in the 2007 Recovery Plan:

- Continuing monitoring;
- Continuing to remove problem sharks using a suite of fishing methods; and
- Continuing and expanding the HMSRP research and cooperation with other researchers regarding shark population dynamics, monk seal losses and shark predatory behavior.

2.1 No Action Alternative

Under the no action alternative, a PMNM conservation and management permit would not be issued to NMFS to monitor, observe, or conduct fishing activities for Galapagos sharks at FFS that are designed to facilitate the survival of juvenile Hawaiian monk seal pups. This alternative would remove one management option that NMFS has utilized over the last several years to support the recovery of the Hawaiian monk seal. NMFS is mandated by both the Endangered Species Act and the Marine Mammal Protection Act to manage the recovery of the endangered Hawaiian monk seal by implementing the actions identified in the recovery plan (NOAA NMFS 2007).

Personnel would not be deployed to FFS to conduct shark monitoring activities, Galapagos shark predation on juvenile monk seals would go unrecorded and unobserved and the objectives of the HMSRP which aim to increase juvenile monk seal survivorship would not be met. The only activities at FFS that would occur would involve regular seal monitoring activities (e.g. monitoring monk seal population abundance, assessment, and dynamics; foraging studies; disentangling seals from marine debris; and conducting disease and health assessments at Islands and Atolls within the NWHI which are conducted under separate PMNM permits).

Under the no action alternative, activities in the HMSRP would continue including translocation of weaned pups from areas in the NWHI where pups are at increased risk for starvation or shark predation to areas with less risk; has conducted captive care programs both in the NWHI and MHI for fattening yearlings to get them past that first critical year before release back into the NWHI, and conduct medical interventions on seals found ill in the NWHI (NOAA NMFS 2007b). Again, the aforementioned activities are covered under separate PMNM permits.

2.2 Alternative 1: Issue an Annual Conservation and Management Permit to Implement Monitoring Program

Under alternative one, monitoring pups at FFS would occur. A monitoring plan would be implemented by HMSRP and involve monitoring seal populations, and Galapagos shark populations within FFS. As part of their monitoring of the Hawaiian monk seal population, observers would document the presence of Galapagos sharks in the vicinity of pupping areas.

Under this alternative, PMNM would issue an annual conservation and management permit to allow the monitoring of Hawaiian monk seal survival and shark behavior. A suite of monitoring activities would occur at FFS under alternative one including shark observation and monitoring through establishing overnight camps at select islands within FFS, continued operation and maintenance of remote viewing

cameras installed on Trig Island, and erection of an observation tower for observation and monitoring purposes on Trig Island.

Alternative one would encompass three main components:

1. Erection of an observation tower to monitor shark presence;
2. Shark observation/monitoring including camping overnight; and
3. Continued maintenance and operation of remote viewing cameras.

2.2.1 Methods: Shark Observation/Monitoring

2.2.1.1 Observation Tower

The first proposed method is to passively monitor shark presence and movement patterns at three main pupping sites (Trig Island, Round Island and the Gins) with historically high shark incidence. Observation would consist of using systematic surveys from a 12-foot tower, the ground, and/or patrolling in small boats. The tower is a 12-foot structure made of scaffolding that would be erected on Trig, located approximately 40 meters from the south end of the island. Under the proposed action, a 12-foot portable observation tower made from scaffolding with a 4-foot x 6-foot base may be erected primarily to use for visual monitoring. When stored, the tower has a less than 25 sq. ft. "foot print". In past seasons, when the observation tower was in place in 2000 through 2004, it was observed that shark presence decreased as time progressed, indicating that the tower itself may function as a visual deterrent. Therefore, the program proposes installing the portable tower again to serve this purpose. The tower would primarily be erected in the daytime, but may, on occasion, be used at night for monitoring purposes. The program may also choose not to erect the tower.

The geography and land mass of other pupping sites prohibits observation tower installation because of the relatively large footprint of the tower and little available land mass; therefore, surveys would be conducted from the ground or small patrolling boat at these sites.

On the rare occasion when a Galapagos or tiger shark is sighted within the vicinity of pupping sites (including exhibiting predatory behavior or attacking), identifying characteristics and behaviors would be recorded on a standardized data form. This standardized form is based on worksheets used in "time scan sampling" in the tower observation procedure (2000-2004) and an International Shark Attack File questionnaire created by the Elasmobranch Society. Historically, "time scan sampling" involved intensive, continuous observation of shark activity in the nearshore waters surrounding major pupping sites (a detailed description of the monitoring protocols are available in previous reports or upon request). Observations were historically conducted from both the ground and from the elevated tower on Trig Island.

2.2.1.2 Overnight Camping

NMFS personnel may request permission for camping (2-14 nights at a time) in order to collect information during crepuscular periods. During overnight observations, the shark monitoring team may employ night-vision goggles to enable observations in low-light conditions (nocturnal and pre-dawn hours). No more than four people would overnight at study sites, campsites would involve minimum requirements typically used for backpacking (e.g., food, small, low profile tents and sleeping bags) and all waste material would be removed and transported to Tern Island for disposal in an appropriate manner. Such short camps have been successfully completed at Trig Island, the Gins and Round Island in the past without causing harm to the environment or the wildlife. Seal monitoring would occur approximately 6 days per week at Trig Island, Round Island and the Gins.

In order to conduct monk seal population assessment activities (under separate PMNM permit), NMFS personnel would continue to visit Trig Island Round Island and the Gins on a daily or near-daily basis so

that missing pups, shark-injured pups, or elevated shark activity would be immediately detected. If sharks are observed, monitoring intensity would be immediately increased to evaluate the predation risk.

2.2.1.3 Remote Viewing Camera

Remote viewing cameras may be of a variety of technical specifications (mounting, pole diameters, etc.). The existing remote viewing camera at FFS consists of a mounted camera atop a pole and is designed to avoid, minimize, and mitigate any impacts to wildlife from its operation. The technical specifications identified for the proposed temporary remote viewing camera consists a 10–foot aluminum bracketed pole with a power supply at its base. The pole is padded with foam-type material (as designed in consultation with the United States Fish and Wildlife Service (FWS)) to mitigate the potential of any injury should a bird fly into the pole). The pole was designed with no guy-wires, but, rather, utilizes brackets and a weighted base to allow the structure to stand erect in heavy winds, etc. All electronic wiring is protected inside of the pole itself. The installation of a remote camera recording system(s) would allow shark observation during days and times when NMFS personnel are not present.

While alternative one would monitor shark predation on seal populations at FFS and record valuable data related to observed shark predation incidents, it would not directly address the issue of shark predation incidents on seal pups and would not implement active Galapagos shark fishing activities identified in the 2007 Recovery Plan and is therefore does not fully address the purpose and need for the action as stated in Chapter one.

2.3 Alternative 2 (Proposed Action): Issue an Annual Conservation and Management Permit to Monitor and Lethally Remove Up to 18 Galapagos Sharks Using Various Shore and Vessel-Based Fishing Methods

The proposed action would issue an annual conservation and management permit which incorporates monitoring activities discussed in alternative one and authorize fishing activities to lethally remove up to 18 Galapagos sharks observed near seal pupping areas. Proposed fishing methods include shore based techniques such as handline, harpooning, and use of a surprise net (also called the “stealth tangle net”) and vessel-based methods such as bottom sets and drumlines. These methods are discussed below.

2.3.1 Fishing Methods and Techniques Proposed to Catch and Remove Galapagos Sharks

Up to 18 Galapagos sharks in shallow waters near pupping sites are proposed for removal under the proposed action. A crew of 2 to 4 staff familiar with safe and effective methods for shark fishing and removal would be tasked with conducting boat surveys and removing adult Galapagos sharks that they encounter in the vicinity of pupping sites. Boat surveys may be conducted during daylight hours at select times and days around each main pupping site on a regular basis throughout the field season for shark surveillance. Additionally, if observers sight a shark from shore of a pupping site (ground or observation tower) they would alert the fishing crew who would commence shore-based fishing at that time. If the fishing crew deems a removal personally unsafe or unfeasible, they would attempt to harass the shark away from shore by herding the shark into deeper water by throwing dead coral rubble and being physically present in the nearshore area where the shark is sighted.

Sharks would be removed by one or a combination of five fishing techniques:

- Handline
- Harpoon
- Bottomset
- Drumline

- Surprise Net

2.3.1.1 Handline

For the handline technique, a hook would be baited with dead tuna or mackerel or shark remains from a previous removal, and fished from shore in water 2-3 m deep and up to 50 meters from shore. Bait soak time would be limited to three hours and back-to-back soaks may occur. Currents would be noted, and the bait would be placed in an area that would avoid excessive risk of scent emanating from the bait to attract other sharks or put seals at additional risk. Gear would be tended to ensure that it did not impose a hazard to that green seal turtles and monk seals.

2.3.1.2 Harpoon

Harpoon may be used from shore when a shark is observed to be very close to the shoreline. A barbed shaft, delivered by hand, would be attached to wire cable and connecting line that would be used to retrieve sharks to the beach for euthanasia.

2.3.1.3 Bottom Set

Bottomsets would be made to the specifications identical to those used in Meyer's project permitted in the Monument to catch sharks in 2009. A maximum of 10 hooks would be used on each set. The gear is designed for sandy substrate with no potential for snagging. For example, approximately 200- 350m long ½ inch polypropylene mainline with 5 overhand loops at regular intervals (40-60m) for gangion (branch line with hook) attachment would be used. Each end of the mainline would have a buoy line consisting of 1/2-inch polypropylene with a cleat at the top and a Danforth anchor (9-12 lb) at the bottom. The buoy line length would be contingent on target set depth, for example setting at 25 ft depth would require 75ft of buoy line on each side (a scope of 1:3). Gangions would consist of a stainless steel lobster trap clip (snaps onto mainline loops) with 2m of 1/2 inch polypropylene, a large swivel, 2m of 7/19 strand stainless steel aircraft cable (bite leader) to a 20/0 Mustad circle hook. Sets would be made from a small boat, and with short soak times of a maximum of 3 hours (in the daytime only), back-to-back soaks may occur. Bottomsets would be set on sandy substrate within 700m of the shoreline of Trig and the Gins; at approximately 25 feet depth. This water depth is needed to optimally use the bottomset design described. A single bottomset would be set at any one time and in conjunction with drumlines. All bottomsets would be monitored constantly to reduce overall bycatch and mortality that might occur as a result of nontarget species being hooked by bottomset gear.

2.3.1.4 Drumline

The drumline would be of either of the following two designs. It may consist of a large buoy, with a chain trace attached to it and single baited hook, shackled to the other end of the chain trace. A baited hook would be suspended approximately 10 feet above the sea floor. A ground line would be shackled to the drum with a swivel, attached to a Danforth or Coastal Quick Release (CQR) anchor and anchored to the bottom substrate. A scope of 3-4 times the water depth would be used. Alternatively, it may consist of 20ft of ½ in. polypropylene substituting for a chain trace, connected to the same branchline type used for the bottomsets described above. The opposite end of this mainline would be shackled to a float-line buoy that serves as the 'drum'. A chain would be run through this buoy with the other end shackled to an 8' yellow marker line. The other end of the yellow line would then be shackled to a large red buoy with the connected float line (same used for bottomsets). The drumline set-up is a modification of what was used in 2010 so that the single baited hook rests on the bottom and does not suspend in the water column. This is preferred because that the species targeted (Galapagos sharks) typically spend most of the time on the bottom feeding on demersal fishes (i.e. when not in the wavewash, or at water depths of 1-3m attempting to or attacking monk seal pups). With this design, the drum-buoy functions as a 'bobber' that would sink or move when an animal is hooked. Drumlines would be set on sandy substrate within 700m

of the shoreline of Trig and the Gins; within this approximate distance from shore, water depths reach 25 ft. Up to 5 drumlines would be set at any one time and in conjunction with a bottomset. All drumlines would be monitored constantly to reduce the overall bycatch and mortality that might occur as a result of nontarget species being hooked by drumlines.

2.3.1.5 Surprise Net

The surprise net to be used by PIFSC would be based upon a system developed by scientists at the Sea Mammal Research Unit (SMRU), Scottish Oceans Institute, University of Saint Andrews, Scotland (Figure 1). Faced with difficulties capturing animals in some situations and the desire to minimize disturbance, SMRU developed a radio-controlled net deployment apparatus. This technology was created to enable the subtle deployment of tangle-nets in front of animals in shallow nearshore areas, and is used to capture harbor seals and grey seals, which are very wary of human presence and readily flee into the water at human approach. The device is a barrier/tangle net which is compressed into a long, horizontal, submerged tube anchored along the bottom, and deployed in an arc enclosing a prescribed area of shoreline or nearshore waters. The bottom of the net is weighted, and the top of the net is a hose which can be inflated with air and which is attached to portable air cylinders. Inflation of the hose is controlled remotely via solenoid switches and valves between the cylinders and the hose. When the hose is inflated the top of the net rises quickly from the bottom to the surface, trapping the desired animals between the arc of the net and the shore. The target animals become tangled if they attempt to swim through the net, or if they remain untangled they can be captured by pulling the net in to shore.

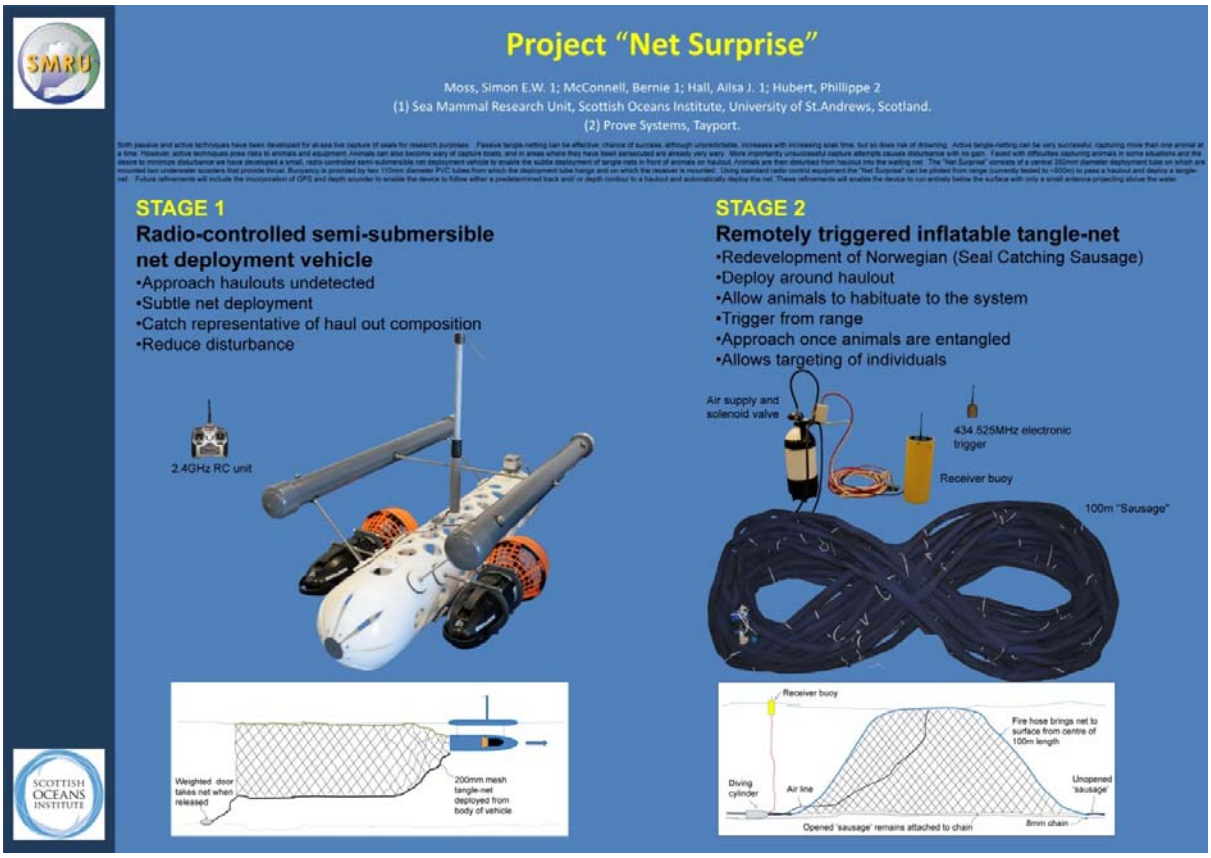

Figure 1. Prototype Surprise Net (Stage 2 Only)

The NOAA NMFS/PIFSC version of the surprise net consists of a central 350mm diameter deployment canvas or heavy mesh tube containing the tangle net. The deployment tube is attached to a heavy (8mm)

anchor chain of equal length to the tube, and the ends may be attached to Danforth anchors on the shore to increase stability. The tube is held together longitudinally by velcro. Each tube (and therefore each surprise net) is 30 m long (note, much shorter than the 100m depicted in Fig 1). The tangle net (folded within the tube) is constructed of nylon, multifilament fiber (4" diameter stretch mesh), suspended from a 2" diameter inflatable hose. Each end of the hose is attached to a diving cylinder (also encased in the deployment tube) via air line and a regulator and pressure relief valve. The diving cylinder supplies air to provide thrust and quick deployment of the tangle net. Receivers with small antennae are connected to the diving cylinders via solenoid valves, and can be remotely triggered from the beach using standard radio equipment. The height of the net would be 5 m from bottom chain to surface float line. Precise location of the receiver is to be determined, either attached to a floating buoy or on the shore.

The PIFSC version would not include a remote-controlled deployment vehicle (Stage 1 in Fig. 1); the net would be deployed manually.

***Surprise Net* deployment methods**

The deployment tube would be used in discrete areas of the nearshore habitat in islet sectors where sharks have been observed to patrol or pursue pups. The tube would be laid by hand or via small boat in a semi-circle configuration, arcing out approximately 5-10m from the shoreline, with each end on shore. Up to two tubes may be deployed at once. The duration of deployment at any one location would vary according to the amount and locations of observed predatory shark activity, but would not exceed 72 continuous hours. At times when no personnel are present at the deployment site, all valves would be shut to prevent accidental deployment. The tube would be removed from the water if inclement weather and accompanying higher currents and/or wave surge is forecast.

Specific sites of deployment would vary according to the location of mother/pup seal pairs, which would determine the vicinity in which predatory sharks are patrolling. At Trig Island, based on observed predatory events in past years, it is anticipated that most activity to be at the southeast area of the island (Fig. 2).

Figure 2. Trig Island Showing Typical Surprise Net Deployment Site (Red Dots Inscribe 30m Arc of Net)

Deployment at Gin Island would most likely be on the west or northwest side of the island. Deployment at Little Gin would likely occur on the west side of the island

All deployments would occur on sandy bottom or coral rubble bottom. No living coral would be within the arc of the net. If mother/pup pairs (and patrolling sharks) are adjacent to deep water or living coral areas, the net would be deployed at the sandy/coral rubble area in closest proximity to the mother/pup pair. Because the height of the net would be 5 m all deployment would be in water no deeper than 5 m.

Triggering net and shark capture

The surprise net would be triggered by personnel on shore only when a Galapagos shark estimated to be of sufficient size is within the arc of the net. Moreover, the net would not be triggered if any seals or turtles are within the arc of the net, either in the water or on shore. If the net surrounds a shark, or if the shark becomes entangled, the net would be pulled in to shore from the ends manually by field personnel. The shark would be euthanized with a 0.44 caliber bang stick. Post catch procedures would follow those described in 2.3.1.7 below.

2.3.1.6 Fishing size limits

The only shark species that is likely to be confused with the Galapagos shark is the grey reef shark. However, in Galapagos sharks, there is a very distinct ridge along the back between the first and second dorsal fins. Also, the maximum size of 20 grey reef sharks caught across the NWHI was 159 cm (total length) in a 2003 study and in 2011 at Trig and Gin by HMSRP (3 5-foot grey reefs were caught and released). Therefore, based on the absence of the dorsal ridge and a threshold size requirement over 200 cm for removal, a misidentification and removal of a shark that is actually a grey reef is highly unlikely.

2.3.1.7 Post-catch euthanasia and procedures

Any sharks captured via the fishing methods described above would be brought to the beach, adjacent to the vessel, or aboard and euthanized with a 0.44 caliber bang stick. As agreed upon by FWS and NMFS (August 18, 2001), information concerning the removal of each shark would include environmental conditions at the time of removal, criteria used to determine the shark targeted for removal, identifying tags and physical features of the shark removed, history of previous shark sightings, removal methodology, and method of euthanasia. Information and materials collected from each shark carcass would include morphometric measurements, genetic samples, stomach contents, vertebrae and reproductive status. Tissue samples from sharks may be analyzed to quantify compounds of potential concern at acceptable detection limits to include total metals, polychlorinated biphenyls, organochlorine pesticides, percent lipid and moisture, and fatty acid profile analysis for detection of possible monk seal consumption. Teeth and ventral (belly) skin would be retained and made available for cultural purposes. Vertebrae and skin samples would be collected for isotope to detect marine mammal consumption and genetic analysis. Stomach contents would be retained for diet analysis; genetic screening for monk seal DNA may occur on unidentified digesta if necessary. Preservation of samples would be as follows: vertebrae samples in 95% ethanol or frozen and tissue samples for DNA analysis in a 20% dimethyl sulfoxide solution or frozen. After all samples and data have been collected, shark carcasses would be discarded following appropriate Monument disposal protocols and Native Hawaiian protocols.

Native Hawaiian cultural protocols, based on extensive practitioner input, would be included in all shark removal efforts as appropriate. Ongoing consultation with Hawaiian practitioners would advise fishing personnel on traditional fishing techniques, along with the feasibility for an on-site practitioner to conduct activities, including the collection of shark parts for cultural use (remains to be determined).

2.3.2 Avoidance and Minimization Measures Developed for the Proposed Action

Over the last several years a number of measures have been incorporated into the project description of the proposed action to avoid and minimize adverse impacts to the quality of the human environment.

These measures have been developed in coordination with members of the PMNM Management Board, scientists in the field, and Native Hawaiian cultural practitioners. These methods have been developed to reduce the adverse impacts to the human environment while also improving the efficacy of removing Galapagos sharks that prey on Hawaiian monk seal pups at FFS. These measures include:

- Targeting Galapagos sharks that exhibit predatory behavior towards monk seal pups
- Limiting the fishing to the shallow waters around pupping sites
- Inviting Native Hawaiian cultural practitioners to provide input on the proposed procedures
- Actively monitoring all fishing activities in order to minimize bycatch
- Restricting fishing activities to the monk seal breeding season.

2.4 Alternatives Considered but Rejected from Further Analysis

The following alternatives have been considered, but rejected from further analysis because they are not practical or feasible from either a technical or economic standpoint.

2.4.1 Electromagnetic, Visual, and Auditory Deterrent Devices

Monument permits to deploy electromagnetic, visual and auditory devices to deter Galapagos sharks within select areas at FFS were issued in 2008 and 2009. HMSRP tested the feasibility of deploying a number of methods (e.g., visual implements, acoustic playbacks and electric devices) aimed at deterring shark predation in the nearshore area of Trig islet in 2008. Between May and July 2008, HMSRP conducted a feasibility trial of the following types of devices: 1) electric, 2) visual, and 3) acoustic, in a shallow sand flat (1 to 3m depth) on the north side of Trig. If a device remained functional for the duration of the trial and did not disturb wildlife other than sharks, it was considered feasible for further testing. HMSRP then conducted a controlled study in 2009 of the devices demonstrated to be the most feasible in 2008.

For the controlled study, HMSRP compared shark presence and predatory behavior toward pups across two experimental treatments: 1) acoustic playback and a moored boat, and 2) continuous human presence, versus a control at Trig and the Gins. Each treatment was applied on a one-week rotating basis on the islets as long as pups were present. Shark presence in nearshore areas was determined by viewing video recorded during daytime hours with an all-weather remote camera system installed at Trig (826 hrs of video viewed across 57 days) and predation incidents from bite wounds or the disappearance of pups at Trig and the Gins (across 94 days). Thirty-one pups were born at FFS between 18 May and 19 August 2009, 14 at Trig and 2 at the Gins. Pups were present on Trig for 94 days, ranging from 1 to 10 pups at once, and the Gins for 50 days, ranging from 1 to 2 pups. The three treatments were applied for 144 days. Shark activity was rare (12 sightings on video and 6 incidents) but similar to recent years (2006-2008). Sharks were present during 12 of 57 days of video examined, spread across all treatments. The greatest number of shark sightings occurred during the human presence treatment; however shark presence at Trig was not statistically significant among treatments (R^2 =0.05, n = 57, Likelihood ratio χ^2_2 = 2.6, p = 0.27, exact multinomial test $p > 0.05$). Although the greatest number of shark predation incidents occurred during the control, the frequency of shark incidents did not vary with treatment at Trig and the Gins combined (R^2 =0.10, n = 144, Likelihood ratio χ^2_2= 4.88, p= 0.08), nor when stratified by islet (Cochran-Mantel-Haenszel test χ^2_1 = 1.64, p= 0.20). Though these new approaches provide additional insight, detection of sharks and deterrence of predation continues to be a challenge to recovering the Hawaiian monk seal. In other words, the shark deterrent methods where statistically ineffective at keeping sharks away from the pupping beaches and therefore not practicable.

2.4.2 Large-Scale Shark Removal to Minimize Predation and Competition

The predation of Hawaiian monk seal pups at FFS could potentially be reduced by conducting a large-scale shark removal program in and around the atoll. This alternative would use an indiscriminant method of fishing (e.g., surface shallow-set longline, trolling) to catch as many sharks as possible to lower the probability that any shark would attack a monk seal. This alternative is very different than the proposed action because the proposed action would only target Galapagos sharks that exhibit predatory behavior towards monk seals in the vicinity of pupping sites. While this alternative may be effective, it would be contrary to the purpose and goals of the Monument and therefore not practical or feasible.

2.4.3 Use of Barriers with Electromagnetic Devices

Physical barriers such as netting or wire mesh to exclude sharks from nearshore areas have been discussed at several workshops as a possible means to reduce or eliminate presence of Galapagos sharks from pupping areas. Barriers would require openings to allow passage of non-elasmobranch species (i.e., species other than sharks and rays). Such openings could be fitted with electromagnetic devices to selectively discourage or prevent elasmobranchs from transiting through them. However, placing any type of net or mesh in nearshore reef environment would likely result in the incidental capture of fish, turtles, or birds. At this time, this action is rejected from further analysis because implementing an unproven, experimental barrier that has the potential to indiscriminately capture wildlife in the remote NWHI is infeasible and impracticable.

2.4.4 Use of Lights for Deterring Predatory Sharks

The potential for adverse effects on green sea turtle and sea birds may be unacceptable because lights may disorient these species. The effectiveness of lights as a shark deterrent is still questionable, and it has been found to attract sharks in some cases. Since this method would have undesirable effects on protected species and may not meet the purpose and need for this action, use of lights as a deterrent was not further considered as an alternative to the proposed action.

2.4.5 Attaching Deterrent Devices of Acoustic Tags to Preweaned Pups

Although this might be considered in the future, marking pups with magnetic shark point-source deterrents and/or with acoustic tags for collecting data was not considered at this time as the effect on mother/pup bonds and pup health and development are unknown. Due to this uncertainty, this alternative was not further considered in this EA.

2.4.6 Rebuilding Whaleskate Islet and/or Creating a Manmade Reef at Trig Islet

These actions were considered by the HMSRP to reduce shark access to pre-weaned pups and provide more pupping beaches to potentially decrease pup density on Trig Islet. The feasibility of such actions is unknown. It is also unknown if breeding females would use any created beaches for pupping or if they do use them, if shark access to pre-weaned pups would be reduced. Due to this uncertainty, rebuilding pupping beaches of mothers was not further considered in this EA.

3 Affected Environment

The Monument is situated in the northwestern portion of the Hawaiian Archipelago, located northwest of the Island of Kaua‘i and the other main Hawaiian Islands. A vast, remote, and largely uninhabited region, the Monument encompasses an area of approximately 139,797 square miles (362,075 square kilometers) of the Pacific Ocean. Spanning a distance of approximately 1,200 miles (362,075 square kilometers), the 115-mile-wide (100 nautical mile/185.2 kilometer) Monument is dotted with small islands, islets, reefs, shoals, submerged banks, and atolls that extend from subtropical latitudes to near the northern limit of coral reef development (Monument Management Plan, 2008). The affected environment, including a description of all the main islets and atolls is described in detail in the Monument Management Plan and is incorporated by reference into this EA (Monument Management Plan 2008). Because the proposed action would occur in the FFS area, a detailed description specific to FFS is included below. The following categories are not affected by the proposed action and are therefore not further included in the analysis: Terrestrial invertebrates, soils, ocean circulation, and educational/recreational opportunities.

3.1 Biological Environment

Trig Island, Round Island and the Gins are similar in their respective nearshore marine communities to other islets in FFS in that they reflect the characteristics of tropical atolls with coral reefs, sandy expanses, and shallow lagoons. Seabirds, endangered Hawaiian monk seals, and threatened Hawaiian green turtles depend on this environment for food resources and habitat. The diverse fauna has been the subject of research during the 1970s and early 1980s (Grigg and Pfund 1980, Grigg and Tanoue 1984).

The Northwestern Hawaiian Islands Reef Assessment and Monitoring Program (NOW-RAMP) expedition of August-October 2000 greatly expanded knowledge on all of the NWHI marine communities. The assessment reported that the marine ecosystem in the NWHI, with the exception of the waters around Midway, is one of the most pristine in the world.

The diverse marine community in the NWHI includes 45 species of coral (Maragos and Gulko 2002) and at least 133 species of fish. Nineteen species of cetaceans have been observed in Hawaiian waters, generally in the deeper waters around FFS.

3.1.1 Hawaiian Monk Seals

The Hawaiian monk seal is the most endangered pinniped in U.S. waters and is second only to the northern right whale as the nation’s most endangered marine mammal (Marine Mammal Commission 1999). It was designated depleted in 1976 under the Marine Mammal Protection Act, and was listed as endangered under the ESA following a 50% decline in beach counts from the late 1950s to the mid-1970s. Beach counts conducted in the 1950s were of aerial surveys of the leeward islands only, and during the beach counts researchers estimated that approximately one third of the population remained at sea (Kenyon and Rice 1959; Rice 1960). The historical abundance of the Hawaiian monk seal is unknown, although the first estimate of monk seal numbers was made in 1958, when a total of 1,206 seals were counted.

The Hawaiian monk seal breeds only in the Hawaiian Archipelago and Johnston Atoll, with most monk seals inhabiting the remote, largely uninhabited atolls and surrounding waters of the NWHI. More than 90% of all pups are born at six major breeding colonies located at FFS, Laysan Island, Pearl and Hermes Atoll, Lisianski Island, Kure Atoll and Midway Islands. A few births also occur annually at Mokumanamana (Necker), Nihoa and Ni‘ihau and in the main Hawaiian Islands. Although monk seals occasionally move between islands, females generally return to their natal colony to pup. Since 1990, there has been an apparent increase in the number of monk seal sightings and births in the main Hawaiian Islands (Forney et al. 2000).

The largest monk seal sub-population is currently found at FFS, but this was not always the case. Human disturbance caused by the U.S. Navy from 1942 through 1948, and by the USCG from 1944 through 1952 on East Island, depressed that sub-population. The US Coast Guard remained on Tern Island (but not East Island) until 1979. Following the departure of the Coast Guard from FFS, a dramatic increase occurred in seals hauling out on Tern Island. In 1986, the mean count at FFS (excluding pups) was 284 (NMFS, unpublished data), approximately six to eight times higher than the number had been in the late 1950s.

The factors responsible for poor juvenile survival at FFS are being investigated. Refer to section 1.2.1 for more data regarding the decline and specific threats to the survival of the Hawaiian monk seal population in the NWHI. In addition to shark predation, evidence suggests that decreased prey availability is the major factor. As early as 1991, researchers detected an exceptionally high proportion of juvenile and subadult seals in emaciated condition (Gilmartin 1993a). Pups and immature seals born at FFS in the early 1990s tended to be smaller than seals of the same age at Laysan Island, and smaller size at weaning was correlated with lower survival from weaning to age two. After 1995, the decline in weaning sizes at FFS moderated, and early survival has generally improved slightly since 1999. Nonetheless, the survival rates of pups and juveniles continue to be well below their historic rates.

Several factors, alone or in combination, may have caused the food limitation that has affected monk seals at FFS. Ecosystem-wide productivity decreased in the late 1980s and early 1990s, probably due to a decadal scale oscillation in oceanographic conditions. This appears to have resulted in declines in the abundance of coral reef fishes at FFS. Monk seal population growth during the 1960s, 1970s, and 1980s may have brought the sub-population to carrying capacity. Hence, while the impact of oceanographic events may have affected monk seals throughout the NWHI, the combination of a population at carrying capacity and decline in fish abundance may have magnified the impact of ocean productivity oscillations at FFS. In addition, during the last three decades, lobster fishing occurred on banks near FFS. While monk seals are known to eat lobsters, the importance of lobster in the monk seal diet has not been quantified and is the subject of ongoing studies.

Specific mortality agents, perhaps indirectly related to food limitation and resultant poor physical condition, have reduced survival of juvenile seals at FFS. Data from 1984 to 1994 suggest that the number of severe injuries attributable to shark predation increased substantially after 1987, especially at Trig Island within the atoll. Most FFS pups were born at Trig Island after the main pupping islet in the atoll, Whaleskate Island, gradually eroded and eventually disappeared between 1994 and 1999. Adult male aggression also accounted for some of the juvenile mortality during the 1990s. Three males killing pups at or near the time of weaning were removed by euthanasia (one in 1991) or by translocation to Johnston Atoll (two males in 1998). Entanglement in marine debris also contributes to an unknown amount of mortality. In addition to poor survival of juveniles, the onset of reproduction is later and the mean fecundity for mature females is lower at FFS compared to Laysan Island. The factors causing this low reproductive performance are unknown, but may be related to the nutritional factors described above. Low fecundity coupled with the expected paucity of reproductively active females in coming years indicates that a prolonged decline in abundance at FFS is likely. The respective importance of the various causes of the decline at FFS is not known with certainty. Regardless of the underlying causes, the high mortality of juveniles and the consequent loss of reproductive potential would significantly impede recovery of this subpopulation.

3.1.2 Green Sea Turtles

The NWHI are the primary nesting grounds for the Hawaiian population of the green turtle, while the main Hawaiian Islands are the primary foraging grounds. Although scattered low-level nesting occurs throughout the Hawaiian archipelago, over 90 percent of the nesting is at a few sandy islets within FFS including East and Tern Island (NMFS and U.S. Fish and Wildlife Service 1998). Nearshore waters contain adults that migrate to breed at these key sites. Mating occurs in the water, yet both males and

females arrive on land to bask. Approximately 200 to 700 adult green turtle females nest on FFS annually. Since protection by state law in 1974 and by the ESA in 1978, the nesting population of the Hawaiian population of green turtle has increased dramatically (Balazs and Chaloupka 2004).

3.1.3 Fish

The waters around FFS support a diverse fish community, apex predators, such as sharks and jacks dominate fish communities on the reefs at FFS. In addition, abundance and biomass estimates indicate that the reef community is characterized by a smaller proportion of herbivores such as surgeonfish (Family *Acanthuridae*), and more carnivores, such as damselfish (Family *Pomacentridae*), goatfish (Family *Mullidae*), and scorpionfish (Family *Scorpaenidae*) (PMNM Monument Management Plan, Environmental Assessment p. 94 Vol II, 2008). This section will focus on describing Galapagos sharks because they are the target species.

The distribution of Galapagos sharks is circumtropical and they occur most commonly around oceanic islands such as those found at FFS. Galapagos sharks are generally not considered economically important because of their typical remote habitat, but some localized harvesting near inhabited locations may occur (Compagno 1984). In the 1990's sharks (primarily Galapagos and sandbar sharks) were targeted by fishers in the MHI and NWHI for their fins using longline gear (Haight and Dalzell 2000). However, on July 1, 2010, the state prohibited the possession, sale, or distribution of shark fins, which effectively led to the end of this fishery. Between 1959 and 1976, Galapagos sharks also were caught as part of the state of Hawaii's shark control program (Haight and Dalzell 2000). While the program targeted tiger sharks for their reported attacks on people, 237 Galapagos sharks were caught during the program (Haight and Dalzell 2000).

Galapagos sharks are usually abundant around oceanic islands. This common but habitat-limited tropical shark occurs close inshore to well offshore near or over the insular of continental shelves; it may occur in shallow water approximately 2 m in depth or range into the open ocean adjacent to islands from the surface to depths of 180 m; juveniles seem to be restricted to shallow water less than 25 m in depth; adults occur in water of varying depths; and they seem to favor clear and rugged coral and rocky bottoms (Compagno 1984). Litter size ranges from 4-16 pups, mating and parturition apparently occur early in the year, and gestation is estimated to be about 12 months (Weatherbee et al. 1996). Galapagos are known to prey on a variety of different food types which include teleosts, cephalopods, crustaceans and pinnipeds, including monk seals (Compagno 1984, Weatherbee et at. 1996, Craig et al. 1999).

Population size of Galapagos sharks at FFS is difficult to determine; however a likely range is determinable. DeCrosta (1984) estimated the population at that time to be 703 individuals based on the area within the180 m depth contour of the atoll. The population size estimate of Galapagos sharks was conducted using bottomset fishing methods (approximately 32 hooks) by DeCrosta (1984). However, the Galapagos shark population has likely grown with an ecological release associated with the restriction of longline fishing in the Monument since then (Holzworth et al. 2006). Based on data from towed-diver surveys conducted in 2000 through 2003 (Holzworth et al. 2006), the population can be estimated at 4,380 individuals (based on an area of 1540 km^2, 80% of shark biomass as Galapagos shark species, and average Galapagos shark weight of 0.15 metric tons), though this may an overestimate because Galapagos sharks are attracted to towed divers (Parrish et al. 2008). Based on an ECOPATH model approach, the population is estimated at 1,604 individuals (J. Parrish, NMFS PIFSC EOD *per comm, March 2009*). Thus, the available data and population estimates suggests a stable or increasing population, though survey methods were admittedly not consistent across studies.

Galapagos sharks in the Hawaiian Archipelago are typically found in deeper waters (NMFS 2008) and experts have suggested that some Galapagos sharks frequenting the shallow waters of pupping beaches at FFS may be exhibiting distinctive and atypical behavior. Movement patterns of FFS Galapagos sharks have not been extensively studied yet and their dispersal across the NWHI Archipelago is not known.

Thus, the FFS Galapagos shark population may or may not behave, feed and travel in patterns typical for the species. The Hawaii Institute of Marine Biology (HIMB) preliminary studies using acoustic tagging indicate that Galapagos sharks are likely more abundant outside the barrier reef in deeper waters and are site-attached. Four Galapagos sharks caught and tagged at Trig Islets subsequently visited pupping sites (at least one of four possible pupping sites) on numerous occasions, spending a substantial amount of time in shallow waters (Wetherbee & Lowe 2003). However, all four sharks also spent a fraction of their time outside the atoll and individual movement histories were highly variability. Only one of 13 Galapagos sharks tagged outside the FFS atoll was found to subsequently enter the atoll. A tagging program conducted in O‘ahu produced similar findings, with only two of 25 sharks detected in shallow waters for a limited duration of time.

3.1.4 Coral Reefs

FFS consists of 67 acres (0.27 square kilometers) of total emergent land surrounded by approximately 230,000 acres (931 square kilometers) of coral reef habitat, with a combination of sand, rubble, uncolonized hard bottom, and crustose coralline algae in the windward and exposed lagoon areas, and patch and linear coral reefs in more sheltered areas (NOAA 2003b). Within the NWHI, FFS is the center of diversity for corals (more than 41 species, including the genus *Acropora,* which is all but absent elsewhere in Hawaii) and reef fishes (178 species).

3.1.5 Alien & Invasive Species

Marine alien species can be defined as nonnative aquatic organisms that have been intentionally or unintentionally introduced into new ecosystems, resulting in negative ecological, economic, or human health effects. Twelve marine alien invertebrates, fish, and algal species have been recorded in the NWHI. Alien species may be introduced unintentionally by vessels, marine debris, or aquaculture, or intentionally, as in the case of some species of groupers and snappers and algal species. Eleven species of shallow-water snappers (Family *Lutjanidae*) and groupers (Family *Serranidae*) were purposely introduced to one or more of the main islands of the Hawaiian Archipelago in the late 1950s and early 1960s. Two snappers, the bluestripe snapper (taape, *Lutjanus kasmira*) and the blacktail snapper (*L. fulvus*), and one grouper, the peacock grouper (*Cephalopholis argus*), are well established and have histories of colonization along the island chain that are reasonable well documented (Randall 1987). Bluestripe snappers have been by far the most successful fish introduction to the Hawaiian coral reef ecosystem. The population has expanded its range by 1,491 miles (2,400 kilometers), until it has now been reported as far north as Midway in the NWHI. These records suggest an annual dispersal rate of about 18 to 70 nautical miles (33 to 130 kilometers). The other two species have been recorded only as far north as FFS and are present in much lower numbers than bluestripe snappers.

Because the island ecosystems have evolved with little contact with the rest of the world, they are particularly vulnerable to the introduction of invasive species. Invasive plants and introduced mammals are a primary threat to nesting seabirds, indirectly by altering the ecosystem and directly by altering eggs and chicks. A variety of alien plants, animals, and most likely fungi and bacteria have made it to the NWHI. Some of them have proven to be particularly invasive and dangerous to native species. These include such plants as Sandbur, golden crownbeard (*Verbesina encelioides*), and ironwood (*Casuarina equisetifolia*), and such animals as the gray bird locust (*Schistocerca nitens*), house mouse (*Mus musculus*), and several ant species. Much of the routine management of this area revolves around eradicating or controlling existing invasives and preventing the introduction of new ones.

3.1.6 Birds

The NWHI provide vital habitat for more than 14 million nesting seabirds and breeding species, including 99% of the world’s Laysan albatross (*Phoebastria immutabilis*) and 98% of the world’s black-footed albatross (*P. nigripes*) populations. With the erosion and disappearance of Whale-Skate Island, Tern

Island, and East Island are the most important for bird breeding within FFS. No endemic land birds live within FFS. Of the 18 seabird species nesting at FFS, the black footed albatross, Laysan albatross, red-footed booby (S*ula sula*), masked booby (*Sula dactylatra*), brown noddy (*Anous stolida*), black noddy (*A. minutus*), and frigate bird (*Fregata minor*) regularly nest on Trig, Round, Little Gin, and Gin Islands. No endangered birds populate FFS. The short-tailed albatross (*Phoebastria albatrus*) has been sighted on six occasions at FFS since 1938 (FWS 2000), with the most recent sighting at Tern Island in 2002 (FWS unpub. data).

3.2 Physical Environment

3.2.1 Topographical and Physical Features

FFS is an atoll, open to the west and partially enclosed by a crescent-shaped reef to the east. It lies about midpoint in the Hawaiian Archipelago. The largest land area in the shoals is Tern Island (about 34 acres), and a number of smaller islets, including Whaleskate (which eroded away in the late 1990s), the Gins, Round, East, Shark, and Trig, are scattered along the westerly reef of the crescent (totaling 44 acres).

The lagoon at FFS is unusual in that it contains two exposed volcanic pinnacles representing the last vestiges of the high island from which the atoll was derived, as well as nine low, sandy islets. The sand islets are small, shift position, and disappear and reappear. These islets provide highly important habitat for the world's largest breeding colony of the Hawaiian monk seal and nesting sites for 90 percent of the threatened green turtle population breeding in the Hawaiian Archipelago.

3.2.2 Air Quality

FFS has a tropical climate dominated by northeasterly tradewinds. Most of the precipitation occurs during the winter months, and storms typically occur from October through March (Blumenstock and Price, 1967). The mean annual temperature is 76.4 F. The warmest months are August and September, and the coolest months are February and March. Surface tradewinds prevail from an easterly direction and the annual mean wind speed is 12.4 knots. Wind speeds are higher from November through March and lower from April through October. Trig Island, Round Island and the Gins are exposed to storm waves that break on the atoll's northern fringing reef margin and re-form across the reef flat. The island receives direct impact from these re-formed waves along the northern, eastern, and western shores. The southern, or leeward, shoreline of Trig Island is more sheltered by the interior expanse of the shoals. FFS has no sources of air pollution. Occasionally small boats used near the shore release exhaust, but this activity does not detract from the island's extremely high air quality.

3.2.3 Noise

French Frigate Shoals has no sources of anthropogenic (human-caused) noise pollution, with the exception of seasonal, rare aircraft operations on Tern Island, and small boat noise.

3.3 Social Environment

3.3.1 Land Use

The FWS facility at Tern Island is used to house researchers and provide storage for research equipment. There are no facilities on Trig Island, Round Island or the Gins. Short overnight camping activities have occurred on the islets (Trig Island, East Island and the Gins) for multiple nights at a time in the past. Small groups of researchers typically conduct short stays of 2-14 nights at a time. Researchers sleep in low-profile tents and remove all waste for proper disposal at Tern Island upon conclusion of their stays. Day trips to the aforementioned islets within FFS have also occurred for researchers conducting monitoring activities on sharks, monk seals, birds and turtles. Such short camps have been successfully completed at Trig Island on numerous occasions in the past without causing harm to the environment or

the wildlife. Seal monitoring would occur approximately 6 days per week at Trig Island Round Island, and Gin/Little Gin Island.

In the past, temporary monitoring equipment has been installed on Trig Island, including a 12-ft high photographic observation tower made of scaffolding with a 4x6 foot base utilized during daylight hours, and the placement of a 10-foot remote viewing camera system made of an aluminum bracketed pole with a power supply at its base. When stored and not in use, the observation tower has a "footprint" less than 25 sq. ft. The tower was used continually during 2000 – 2004 for observation and monitoring activities and the remote viewing camera was used continually between 2008 - present.

3.3.2 Archaeological/Historic Resources

Archaeological and cultural resources are present in the NWHI. Archeological remains exist at Nihoa and Necker (Mokumanamana) Islands at the eastern end of the chain. Historic records indicate at least seven ships lost at FFS. To date, three shipwreck sites have been discovered and surveyed within the FFS area, none are close to Trig Island, Round Island and Gin / Little Gin Island.

3.3.3 Economic Considerations

Monument and station operations contribute to the local and state economy through expenditures on food, supplies, equipment, contracting of vessels and aircraft charters, wages for staff, and occasional contracts for infrastructure maintenance at FFS. On-site personnel at FFS have played in important role in search and rescue operations and have responded to vessel groundings. Environmental disasters and loss of human life have been prevented by the ability of on-site personnel to respond to emergencies.

3.3.4 Aesthetics

Trig Island, Round Island and the Gins are barren islands that have no vegetation and are composed entirely of coral sand and rubble. However, the wildlife on these islands have conspicuous aesthetic value. Green sea turtles and monk seals haul out on the sand beaches and several species of seabirds occur on the interior of these small islands.

3.3.5 Description of Native Hawaiian Cultural Considerations Regarding Sharks

As described in the Cultural Impact Assessment section of the Final Environmental Assessment for the Papahānaumokuākea Marine National Monument Management Plan (NOAA 2008), which is incorporated by reference, it is difficult to encapsulate traditional Hawaiian views of nature and culture in western terminology. As discussed on page 24 of the PMNM EA Kepa Maly briefly summarizes:

> In a traditional Hawaiian context, nature and culture are one and the same; there is no division between the two. The wealth and limitations of the land and ocean resources gave birth to, and shaped the Hawaiian world view. The ʻāina (land), wai (water), kai (ocean), and lewa (sky) were the foundation of life and the source of the spiritual relationship between people and their environs. Every aspect of life, whether in the sky, on land, or of the waters was believed to have been the physical body-forms assumed by the creative forces of nature, and the greater and lesser gods and goddesses of the Hawaiian people. Respect and care for nature, in turn meant that nature would care for the people. Thus, Hawaiian culture, for the most part, evolved in a healthy relationship with the nature around it, and until the arrival of foreigners on Hawaiian shores, the health and well-being of the people was reflected in the health of nature around them.

Similarly, a description of how sharks are viewed in traditional Hawaiian culture is complex (Taylor 1993). The perceptions of sharks will likely differ between different people or groups depending upon

the geographic location in the Hawaiian archipelago being considered, the species or type of sharks being discussed, and the context in which the description is being made. Some sharks were traditionally revered as influential spirits by Native Hawaiians living in certain places such as Pearl Harbor on the island of O‘ahu and Hālawa Valley on the island of Moloka‘i (Taylor 1993). An ‘aumakua may take the form of a shark, serving as a beneficial guardian, a family protector, or a fishing helper (Taylor 1993). Often an ‘aumakua is believed to be a deceased relative that assumes a physical manifestation. ‘Aumakua were also believed to take other physical forms such as owls, mudhens, sea turtles, eels, caterpillars, sea cucumbers, rocks, and plants (Taylor 1993). Another less prevalent influential spirit that took the form of a shark was an ‘unihipili. An ‘unihipili is a spirit that would do the bidding of its caretaker. It is important to note that in most cases in the historical record, both ‘aumakua and ‘unihipili are individuals that are identifiable to their caretakers. However, ‘aumakua in common contemporary understandings has been generalized to encompass an entire species or even broader classifications.

When discussing traditional Hawaiian considerations of sharks in western language it is important to consider the terminology that is being used. This document has used common names (e.g., Galapagos shark) and scientific names (e.g., *Carcharhinus galapagensis*) to describe some of the 34 shark species that are found in the State of Hawaii. Meanwhile, it is believed that there are nine different Hawaiian words for sharks (Taylor 1993). This difference in the number of terms is likely a function of the fact that historically Native Hawaiians did not encounter certain species of sharks (i.e., deep-sea sharks) and that some Hawaiian words may have been lost over time, misinterpreted by translators, or not recorded in writing (Taylor 1993). For this document it is more important to consider that the terminology used in English and Hawaiian for types of sharks is different and not completely understood, rather than discussing all the differences and similarities between the two languages. However, it should be noted that Galapagos sharks are referred to by the Hawaiian word manō (Taylor 1993). Manō is also often used with qualifiers, such as manō ‘ula, in much the same way that shark can be qualified in English, such as whitetip reef shark (Taylor 1993). Aggressive predatory sharks, such as tiger and white sharks, are known as niuhi (Taylor 1993).

Historically, sharks were also actively fished in the Hawaiian archipelago. As described by Taylor (1993):

> We know from artifact and story that the ancient Hawaiians actively fished for sharks for food, for teeth to be used as the cutting edges of tools and weapons, for skin to stretch as drum heads, and for ceremonial purposes. Lacking metal, Hawaiian shark fishermen (and they were fishermen because such fishing was kapu for women) used large wooden hooks tipped with whale bone; leaders and lines were heavy, braided sennit.

Along with using shark meat, teeth, and skin, Native Hawaiians incorporated sharks in stories, proverbs, and design features.

4 Evaluation of Environmental Consequences

The following impacts apply to the alternatives that involve conducting active conservation and management activities on monk seals in the NWHI. Alternative one (section 2.2) comprises monitoring activities on Hawaiian monk seals at FFS. The proposed action (alternative two; section 2.3) comprises the monitoring and observation activities described in alternative one, coupled with conducting lethal shark removal activities using various shore-based and nearshore fishing techniques. The impacts to Hawaiian monk seals, cetaceans, and ESA listed species associated with the presence of biologists monitoring the seal population and shark predation levels have been evaluated in detail in the Environmental Assessment on the Effects of NOAA Fisheries Permitted Scientific Research and Enhancement Activities on Endangered Hawaiian Monk Seals (Permit No. 10137) and are incorporated here by reference. The Finding of No Significant Impact (FONSI) was signed on June 30, 2009. The aforementioned EA was adopted by the Office of National Marine Sanctuaries for the issuance of Monument research and conservation and management permits. The FONSI was signed on August 3, 2009.

Therefore, the analyses of impacts under the current program of monitoring and translocating Hawaiian monk seals to areas of lower predation in the NWHI have already been found to have no significant impacts per NEPA and are not likely to jeopardize the continued existence of the species per ESA. Therefore, the impact analyses will focus on the impacts of Alternative two (proposed action).

4.1 Biological Environment

4.1.1 Hawaiian Monk Seals

Alternative one (monitoring and observation activities) would have limited short and long-term beneficial impacts on Hawaiian monk seals as it would allow the continuation of data collection and observations of Galapagos shark, Hawaiian monk seal, and shark-seal interactions at FFS. This would be beneficial to the HMSRP as monitoring activities would continue within FFS and there would be no gap in data collection activities that have occurred within FFS since the early eighties. Alternative one would also allow additional opportunities for field personnel to witness and record shark attacks on seal pups, note their location and record estimated shark size and distance from shore. In past seasons, when the observation tower was utilized in 2000 through 2004, it was observed that shark presence decreased as time progressed, indicating that the tower itself may function as a visual deterrent.

In addition to monitoring and observations, alternative two (proposed action) would have moderate long-term indirect beneficial impacts by providing the greatest potential benefit to the recovery of the endangered Hawaiian monk seal by mitigating the loss of preweaned pups at Trig, Round Island, and the Gins in FFS. The proposed action would also yield scientific information to evaluate the use of various targeted fishing methods to reduce shark predation and enhance monk seal recovery without adversely affecting the marine ecosystem.

On July 24, 2007, the NMFS PIRO consulted on proposed monitoring and shark fishing procedures at French Frigate Shoals—procedures which included monitoring seals through use of an observation tower, camping, and deploying fishing gear and anchored equipment. In the analysis, NMFS PIRO determined that 1) disturbance from humans and equipment to protected species is temporary and insignificant and does not exceed those actions previously consulted on; 2) the likelihood of an entanglement or hooking with a protected species is discountable; 3) the likelihood of a vessel colliding with a monk seal is discountable; and 4) a potential exists for beneficial effects from the project to monk seals. The PIRO concurred that the project was Not Likely to Adversely Affect ESA-listed Hawaiian monk seals and would have no effect on designated critical habitat.

On May 7, 2010 the PIFSC re-initiated consultation under the ESA to include use of the surprise net to lethally remove sharks at FFS. The PIRO concurred that use of the surprise net, along with monitoring, use of the harpoon, spear gun, and handline fishing techniques to mitigate the high predation rate by Galapagos sharks on Hawaiian monk seals is Not Likely to Adversely Affect ESA-listed Hawaiian monk seals or designated critical habitat. It is noted that both the 2007 and 2010 consultations were conducted for their impacts to Hawaiian monk seals *and* green sea turtles – information on the consultation on green sea turtles is broken out in section 4.1.2 below.

The no action alternative would result in the continued loss of monk seal pups at FFS and directly contribute to the already declining numbers of endangered monk seals. The indirect effect of not conducting monitoring and targeted limited removal of adult Galapagos sharks near pupping islets would likely alter biodiversity in the long-term from a predictable decline in the number of monk seals at FFS. This long-term alternation of biodiversity could potentially result in a cascade of adverse effects to all species that interact with monk seals in the NWHI.

4.1.2 Green Sea Turtles

Alternative one would have negligible short- and long-term adverse impacts on sea turtles, their breeding habitat, or the turtle "haul-out" beaches within FFS. Alternative one would involve small groups of personnel camping, walking on beaches and sitting in the observation tower on Trig Island to collect data and observe shark-seal interactions. There may be a temporary disturbance to basking green turtles as a result of people being present and conducting monitoring activities on the beaches. The Environmental Assessment on the Issuance of a Permit for Field Research and Enhancement Activities on the Endangered Hawaiian Monk Seal (FONSI signed June 30, 2009), includes monitoring activities on Hawaiian monk seals and states, "Green sea turtles which are asleep and basking on the beach are generally unaware of unobtrusive human presence such as observing seals. However, some activities may awaken basking turtles, causing them to move into the water. Impacts to green sea turtles would be minimized by personnel being aware and avoiding resting turtles whenever possible." In order to avoid nesting and hatchling turtles, no personnel would walk the beaches from dusk to dawn where nesting activity is known to occur; therefore monitoring activities on beaches where sea turtles are present would be negligible.

The proposed action would involve fishing techniques including use of a handline, harpoon, bottomset, drumline, and surprise net. The proposed action would have negligible short- and long-term adverse impacts on sea turtles, their breeding habitat, or the turtle "haul-out" beaches within FFS. On July 24, 2007, the NMFS PIRO consulted on proposed shark fishing procedures at French Frigate Shoals—procedures which included working in green sea turtle habitat, monitoring seals and deploying anchored equipment. In the analysis, NMFS PIRO determined that 1) disturbance from humans and equipment to protected species is temporary and insignificant and does not exceed those actions previously consulted on; 2) the likelihood of an entanglement or hooking with a protected species is discountable; 3) the likelihood of a vessel colliding with a green turtle is discountable; and 4) a potential exists for beneficial effects from the project to monk seals. The PIRO concurred that the project was Not Likely to Adversely Affect ESA-listed green turtles, and would have no effect on designated critical habitat.

On May 7, 2010 the PIFSC re-initiated consultation under the ESA to include use of the surprise net to lethally remove sharks at FFS. The PIRO concurred that use of the surprise net, along with the harpoon, spear gun, and handline fishing techniques to mitigate the high predation rate by Galapagos sharks on Hawaiian monk seals is Not Likely to Adversely Affect ESA-listed green turtles or their designated critical habitat.

Impacts of the no action alternative would result in no additional human presence around turtles above and beyond the separately permitted turtle monitoring program.

4.1.3 Fish

Alternative one would have no impact on Galapagos sharks or other fish species because it involves primarily land-based intensive monitoring of Galapagos sharks, Hawaiian monk seals, and shark-seal interactions.

The proposed action is expected to have only minor short-term adverse impacts to the Galapagos shark population because the lethal removal of up to 18 sharks is a small fraction of the greater FFS Galapagos shark population. Research removals and historic commerical takes, all involving the removal of tens to hundreds of Galapagos sharks at a time, did not appear to have adversely impacted the population. Removal of up to 18 Galapagos sharks over the next two years compared to the aforementioned population estimates (discussed in Section 3) of 703 (DeCrosta 1984); 4,380 (Holzworth et al. 2006); or 1,604 (J. Parrish, NMFS PIFSC EOD per comm, March 2009) is a small fraction (0.01 – 5.7%) of the FFS Galapagos shark population, whichever estimate is used; therefore removal of 18 Galapagos sharks is anticipated to have a negligible impact to the population at FFS.

The proposed action would have minor short-term adverse impacts to other fish populations located at FFS. These impacts would be limited to only nearshore reef fish species (such as ulua and reef sharks) that would be attracted to the bait and have large enough mouths to get caught on the relatively large hooks that would be used. During previous fishing activities at FFS, the incidental capture of ulua (*Carnax ignobilis*), whitetip reef sharks (*Traenodon obesus*), tiger sharks (*Galeocerdo cuvier*), and grey reef sharks (*Carcharhinus amblyrhynchos*) has occurred, however as indicated in table four below, bycatch was minimal and the non-target fishes caught were released alive with minimal mortailty. In 2011 one ulua spun line around itself and died in the middle of the fishing season and a swivel was added to the handline to prevent the occurance from happening in the future.

Table 4. Species bycatch as a result of Galapagos shark removal activities for 2010 and 2011

Year	Gear Type	Species	Number	Mortailty
2010	Bottomset	Ulua	3	No
2010	Bottomset	Tiger shark	3	No
2010	Bottomset	White tip reef shark	1	No
2011	Handline	Tiger shark	5	No
2011	Handline	Grey reef shark	4	No
2011	Handline	Ulua	1	Yes

The no action alternative would result in negligible adverse impacts to fish located at FFS.

4.1.4 Coral Reefs

Alternative one (monitoring and observation activities) would have no short or long-term impacts to coral reefs. All monitoring and observation activities are conducted from land and do not require interaction with coral reefs.

The proposed action may result in short-term adverse impacts to the coral reef located in the project area. These impacts would be from accidental, temporary, and localized strikes to the coral reef from the fishing gear or during boating activities. The impacts may include having a small of piece of coral being broken off by a wayward chain or fishing line, or by having sand stirred up into suspension while an anchor is being set. More specifically, small boat operations (e.g., anchoring), placement of the surprise net, and fishing activities have all been designed to avoid impacting corals (i.e., being located in sandy

areas). However, the potential to impact coral reefs exists if strong wave action knocks a small boat off course or if a caught shark pulls the fishing line around a coral head. The Monument has additional mitigation measures including "Best Management Practices for Small Boat Operations at Tern Island (PMNM BMP #013)" that require small boat operators to operate at low speeds in shallow waters in order to avoid striking coral reefs. Per Monument permit condition(s) small boats would only be anchored on sandy substrate and anchors would never be dropped on coral reefs. In addition, bottomset gear and drumlines must be set and anchored on sandy substrate for the proposed action to be effective, thereby avoiding fishing gear interaction with coral reefs. Along with bottomset gear and drumlines, the surprise net and any handlines would be operated well away from coral reef areas and monitored at all times.

The 'no action' alternative would have no impact to coral reefs as no shark monitoring or fishing activities would be conducted within FFS.

4.1.5 Alien & Invasive Species

Alternative one would have negligible short- and long-term impacts in the additional introduction or spread of alien and invasive species. Tern Island in FFS is not a quarantine island, and therefore quarantine procedures including freezing clothing and equipment are not required. Trig Island, the Gins and Round Islands are uninhabited, comprised mainly of sand and coral rubble and have very low potential to sustain alien and invasive species because they are extremely resource-limited (no soil or water). Regardless, strict procedures are used to minimize the potential introduction of alien and invasive species by research activities conducted at remote, uninhabited field sites. All tents would be placed and all work would be conducted on the perimeter of the island. Per standard procedure for permittees conducting activities on uninhabited islands, stringent Best Management Practices (BMPs) would be used to ensure that no species are introduced to the islands. These BMPs are included in the PMNM permit as an attachment entitled, "Special Conditions and Rules for Moving Between Islands / Atolls and Packing for Field Camps" (PMNM BMP #007). These BMPs include:

- 48-hour freezing of all non-sensitive food and equipment;
- Removal of all packaging materials which may harbor foreign plants or animals;
- Packing all food, personal effects, and small equipment in plastic bags which are in turn placed in sterilized 5-gallon plastic buckets;
- Packing all large equipment in either plastic cases or pallet tubs, all of which are fumigated prior to landing;
- All soft gear (daypacks, straps, nets, bags, bedding, tents, clothing, footwear) used at each field site is either new or has not been used at any other location;
- No use of any fresh food item which either may become established (tomatoes, sunflower, mustard, or alfalfa seeds) or foods which may harbor molds or fungi would be used.

The proposed action would have negligible short- and long-term impacts in the additional introduction or spread of alien and invasive species. The addition of fishing activities to lethally remove Galapagos sharks would not raise the risk of spread or introduction of alien and invasive species. Similar to alternative one, the aforementioned BMPs would be implemented as per standard procedure for all permittees conducting activities on uninhabited islands within PMNM.

The no action alternative would have no impact in the additional introduction or spread of alien and invasive species, as no permit would be issued to conduct shark removal, or seal-shark monitoring activities within FFS. The no action alternative would also result in the continued loss of pups and directly contribute to the already declining numbers of endangered monk seals as no monitoring, observations or Galapagos shark removal activities would take place within FFS.

4.1.6 Birds

Alternative one is expected to have negligible adverse short- and long-term effects on birds within FFS. The potential exists that seabirds could fly into the temporary observation tower or remote camera with resultant injury or mortality. However, erection of the temporary observation tower occurred annually during 2000-2004 (over 3000 hours) with no bird strikes. Any adverse impacts therefore are likely to continue to be negligible.

As in past years, the remote viewing camera would be constructed in coordination with FWS to ensure it would not entangle or kill any birds. The pole would likely be padded with a foam-type material designed to minimize the effects of an accidental bird strike. The pole would also be designed with no guy-wires (which would pose an entanglement hazard), but, rather, would utilize brackets and a weighted base to allow the structure to stand erect in heavy winds. As in past years, in order to monitor effects on birds, recorded footage would be examined periodically to determine if wildlife is interacting with the equipment.

NMFS personnel monitor all installations daily for any adverse impact on wildlife. In the unlikely event that a seabird does hit the tower, the tower would be taken down and reported to Monument managers.

No additional effects are anticipated as a result of the proposed action, all fishing activities would be constantly monitored by personnel. Use of the handline, harpoon, bottomset, drumline and surprise net are not expected to cause any short or long-term impacts to birds. In the past, no bird interactions have resulted from the use of the aforementioned fishing methods, no birds have been hooked or entangled in fishing gear.

The 'no action' alternative would not impact birds above and beyond the separately permitted seabird monitoring program which consists of annual monitoring activities (e.g. counting, banding, etc.) of birds within FFS.

4.2 Physical Environment

4.2.1 Topographical and Physical Features

Negligible impacts on the topographical or physical features of Trig Island are expected as a result of the temporary erection of the 12-foot observation tower and the remote monitoring camera system. Both the tower and remote camera system would temporarily be installed on Trig Island which consists of mostly sand and rubble and would not permanently alter the physical features of Trig Island. Beneficial impacts are expected as a result of collecting data and observing shark-seal interactions through utilization of the tower during daylight hours and reviewing data collected from the remote viewing camera system.

The proposed action would have negligible impacts on the topography or physical features of Trig Island within FFS. Along with the observation tower and remote viewing camera, personnel would be conducting limited fishing activities. The proposed action would not involve any construction, dredging, or alteration of Trig Island or the other islets within FFS (namely the Gins or Round Islands), and therefore would have negligible impact.

The no action alternative would have no effect on the topography of the aforementioned islets within FFS, as no tower or camera would be constructed. However the no action alternative would result in the continued loss of pups and directly contribute to the already declining numbers of endangered monk seals as data would not be collected on seal-shark interactions through utilization of the observation tower and / or the remote viewing camera.

4.2.2 Air Quality

Exhaust from small boats may have short-term less-than significant impacts through the implementation of alternative one. A maximum of three small boats would be utilized under alternative one to conduct

activities at the aforementioned islands. Small boats would be utilized for both day and overnight trips. In the past there has been no observable impact to the environment from small boat activities within FFS. In addition, Monument permits contain conditions requiring the use of small boat engines that meet Environmental Protection Agency (EPA) emissions requirements.

The proposed action would not increase impacts on air quality beyond the use of small boats. Small boats would be used at the same frequency regardless of whether personnel are authorized to implement activities under alternative one or the proposed action.

The no action alternative would have no impacts on air quality, as no personnel would visit Trig, the Gins, and Round Islands to conduct monitoring and fishing activities. Small boats would continue to be utilized within FFS as part of the respective Hawaiian monk seal and green sea turtle monitoring programs. The no action alternative would also result in the continued loss of pups and directly contribute to the already declining numbers of endangered monk seals as no monitoring, observations or Galapagos shark removal activities would take place within FFS.

4.2.3 Noise

Alternative one would have negligible effects as it would not significantly increase noise pollution above and beyond daily seabird noise. Small groups of NMFS personnel would conduct observation, monitoring and camping activities. There would be no additional construction or other types of anthropogenic noise as a result of implementing alternative one.

The proposed action would also have negligible effects as it would not significantly increase noise pollution through the addition of fishing activities.

The no action alternative would not have impacts on noise as no personnel would visit islands within FFS to conduct monitoring and fishing activities. The no action alternative would also result in the continued loss of pups and directly contribute to the already declining numbers of endangered monk seals as no monitoring, observations or Galapagos shark removal activities would take place within FFS.

4.3 Social Environment

4.3.1 Land Use

Alternative one would have short-term minor adverse impacts to land use, as it would utilize a number of personnel and some time spent at FFS to conduct observation and monitoring activities. Therefore visits to Trig Island, Round Island and the Gins (daily and overnight camping) which would increase the level of human presence and, therefore the potential to disturb wildlife. It is important to note that personnel are specially trained to avoid disturbing all wildlife and special precautions are taken to ensure all activities cause the lowest possible impact. All camping activities would be conducted utilizing minimal equipment (backpacks, low profile tents) and all waste would be removed for proper disposal on Tern Island. Temporary storage of the observation tower at Trig Island would utilize less than 25 square feet of land when not in use; and the tower would be stored away from areas where protected species are known to haul out and rest. Use of the tower (Trig only), daily monitoring trips and short camps have been successfully completed at Trig Island, Round Island, and the Gins on numerous occasions in the past without causing harm to the environment or the wildlife.

The proposed action would not increase the number of personnel visiting islands within FFS above and beyond the number of personnel discussed in alternative one; therefore the short- and long-term effects would be negligible.

The no action alternative would have no impacts to land use within FFS as it would not increase the level of human presence at Trig Island, Round Island or the Gins. The no action alternative would also result in the continued loss of pups and directly contribute to the already declining numbers of endangered

monk seals as no monitoring, observations or Galapagos shark removal activities would take place within FFS.

4.3.2 Archaeological/Historic Resources

Alternative one would have no impacts to archaeological or historic resources as all observation and monitoring activities would be conducted well away from areas where shipwrecks have been documented. In addition, all activities would be conducted away from areas where additional shipwrecks or downed planes are typically found.

Similar to alternative one, the proposed action would have no effect on archaeological or historic resources listed or eligible for listing on the National Register of Historic Places. This is because all fishing activities would be conducted away from known shipwreck sites and areas where shipwrecks are known to occur. Furthermore, the work is conducted on and around sandy beach areas, which are highly dynamic systems with sand and coral rubble constantly moving around. Consequently, it is highly unlikely that any previously unknown resources would be present on the sandy beaches because they would have been washed away by wave action long ago. Should any cultural or maritime heritage resources be located during the proposed action, all work would cease and a Native Hawaiian cultural expert or maritime archaeologist would be contacted.

The no action alternative would also have no impact on archaeological and historic resources. The no action alternative would also result in the continued loss of pups and directly contribute to the already declining numbers of endangered monk seals as no monitoring, observations or Galapagos shark removal activities would take place within FFS.

4.3.3 Economic Considerations

Alternative one would have minor beneficial impacts to the economy as it would increase revenues to local businesses for air and vessel charters and expenditures on fuel, food supplies and equipment by NMFS personnel working within FFS.

In addition to alternative one, the proposed action would also slightly increase beneficial impacts to the economy as it would also require the purchase of fishing gear, including the surprise net. Sufficient funding is available to conduct the proposed action within FFS. If Galapagos shark predation spreads to other islands and atolls throughout the NWHI, costs associated with monitoring and mitigating the problem would increase and additional funding would be necessary.

The no action alternative would have no impact to the economy as nothing additional would be purchased to conduct shark-seal monitoring and fishing activities. The no action alternative would also result in the continued loss of pups and directly contribute to the already declining numbers of endangered monk seals as no monitoring, observations or Galapagos shark removal activities would take place within FFS.

4.3.4 Aesthetics

Alternative one would have short-term temporary minor adverse impacts on aesthetics with the construction of the 12-foot-tall observation tower and the remote viewing camera at Trig Island. A slightly higher, human-constructed observation tower and remote viewing camera within a marine monument may seem unsightly to people. The tower and camera would be erected and used seasonally (May – October); the observation tower would be utilized during daylight hours and stored when not in use. The benefits of having an observation tower and a remote viewing camera to record shark-seal interactions far outweighs the short-term less than significant impacts on aesthetics. The proposed action would not have additional impacts on aesthetics beyond the construction of the temporary observation tower and the remote viewing camera.

The no action alternative would have no impact on aesthetics within the PMNM as no tower or camera would be constructed.

4.3.5 Effects of Lethal Shark Removal in the Context of Hawaiian Culture

When analyzing the effects of natural resources management actions in the context of traditional Hawaiian culture, it is important to consider the many different perspectives that make up the Native Hawaiian community. It would be presumptuous to lump a large and diverse group of people into only one viewpoint.

The conservation and management actions that are being evaluated in this document may be viewed by some people in the Native Hawaiian community as not being pono. While there is no single word in English that expresses the meaning of pono in the Hawaiian language, it is commonly regarded as meaning "right" or "just". In the context of the natural cultural landscape, pono can be thought of as being in harmony, balance, and alignment. Alternative one consists of non-invasive observation and monitoring activities to record seal-shark interaction and may have minor adverse impact to the Native Hawaiian community, as some Native Hawaiians would have the opinion that mere presence of field personnel to record and observe sharks within FFS is not pono. Conversely, other members of the Native Hawaiian community would have the opinion that non-invasive monitoring and observations of shark-seal interactions is acceptable to learn more about animal interactions and gain insight into why Galapagos sharks target seal pups at specific islets within FFS.

In addition, the proposed action of lethally removing up to 18 Galapagos sharks may be viewed as disrupting or interfering with the existing natural balance at FFS. This would be considered an adverse impact by some people. Furthermore, as discussed at section 3.3.1, some sharks are viewed as influential spirits (e.g., ʻaumakua, ʻunihipili) by some in the Native Hawaiian community. This would also be considered an adverse impact by some people. .

Conversely, others in the Native Hawaiian community may view the proposed action as being undesirable but necessary. Necessary in the sense that Hawaiian monk seals and sharks are part of the whole entity of landscape and culture, and that the well-being of monk seals (i.e., survival as a species) is tied into the harmony of the natural cultural landscape. In other words, the current endangered status of the Hawaiian monk seal population is a consequence (in part) of human actions that historically were not pono (e.g., hunting seals for food, commercial whaling, fishing activities, guano mining, and military activities). As such, the proposed action would attempt to restore the natural balance of all species that occur at FFS. Therefore the proposed action would be considered a beneficial impact by some people. While being undesirable, the impacts of the proposed action could be minimized by conducting the activities in ways that respect the natural cultural landscape, including making offerings (hoʻokupu) and conducting appropriate protocols.

The no action alternative would have no impact in the context of Native Hawaiian culture as no field personnel would be present with the specific intent to conduct monitoring and observations or deploy fishing gear and lethally remove sharks.

5 Cumulative Effects

Cumulative impacts resulting from the proposed action would be negligible because the lethal removal of sharks would be conducted on a very small-scale and targeted at Galapagos sharks that occur in the near-shore waters of known Hawaiian monk seal pupping sites within FFS. As discussed in section 1.2.2 and 2.3, the fishing methods being proposed have been used in the past to specifically catch Galapagos sharks in nearshore waters around the islets and atolls of FFS. The scale of the proposed action is tiny compared with the number of sharks that are caught in the waters around Hawaii as part of the recreational and commercial fisheries.

The proposed action has been conducted in the same area since 2000, and occurred in 2000, 2002, 2003, 2005, 2006, 2007, 2010 and 2011, with a total of 12 Galapagos sharks removed during the period 2000-2007 by HMRSP staff. An EA was prepared for this action (NMFS 2002b) with a finding of no significant impact. Shark removal activities were also conducted in 2010 and 2011 with a total of two Galapagos sharks lethally removed from FFS (one each year). These activities have had moderate beneficial indirect effect on pre-weaned monk seal pups by reducing the rate of mortality due to shark predation.

The primary environmental concern relating to cumulative effects of the proposed action is on fish, particularly Galapagos sharks that occur in and around FFS. The PMNM currently prohibits commercial fishing activities within the boundaries of the Monument. Therefore the potential for overfishing Galapagos sharks at FFS is negligible. However, fishing was historically conducted in the NWHI (i.e., within the current boundaries of the PMNM prior to its establishment) and did target sharks occurring around the islands. Most notably, in the 1990's sharks were targeted for their fins.

Currently, commercial longline tuna and swordfish fishing occur around the NWHI but outside of the 50 nautical mile boundary of the PMNM. The major fishing method around Hawai'i is longline, in which a single line up to 70 miles long is deployed with numerous branchlines and baited hooks. From the period 1987 to 2004, the combined average annual catch of sharks in the Hawaii-based longline fishery was 1,933,200 pounds (Gilman 2007). Generally less than 1% of the shark catch is retained for sale to market (Gilman 2007). According to the 2010 annual logbook report (PIFSC 2011), the fishing activities in the NWHI EEZ (i.e., between 50 and 200 miles off shore) set 2,154,924 hooks and caught 4,628 sharks. The overwhelming majority of sharks caught are Blue sharks (*Prionace glauca*). No Galapagos sharks were reported caught, but up to five of the "other sharks" listed in the report may include Galapagos sharks. While most of these sharks are released alive, many die on the line or after release as a consequence of being caught. For the entire Hawai'i-based longline fishery, 39,001,014 hooks were set and 70,812 sharks were caught. Of these 70,812 sharks, none were reported to be Galapagos sharks, but up to 941 of the "other sharks" may include Galapagos sharks. Therefore, given small number of Galapagos sharks caught and distance from the location of the proposed action that most other sharks are caught incidentally by the Hawai'i-based longline fishery, the potential for cumulative impacts to sharks from the proposed action is negligible.

Other research projects that could potentially contribute to cumulative impacts on marine resources in conjunction with the proposed action are summarized in Table 5. The table includes short descriptions of these projects. Four of these projects have been categorically excluded from further analysis under NAO 216-6 because their potential adverse impact on marine biological resources have been analyzed and found to be not significant. A fifth project (project number 3: "Hawaiian Monk Seal Research and Monitoring Activities") had an EA prepared for this action entitled, "Environmental Assessment on the Effects of NOAA Fisheries Permitted Scientific Research and Enhancement Activities on Endangered Hawaiian Monk Seals" (Permit No. 10137). The Finding of No Significant Impact (FONSI) was signed on June 30, 2009. A sixth project (project number 6: "Marine Turtle Research Program") had a programmatic environmental assessment (PEA) prepared for this action entitled, "Programmatic Environmental Assessment of the Marine Turtle Research Program at the Pacific Islands Fisheries Science Center (NMFS 2006)." The FONSI was signed on July 7, 2006.

A review of Table 1 indicates that all of the projects are proposed to concurrently occur with the proposed action. Projects 4 and 5 cover the support vessels that would be utilized to carry out the proposed action. Project 6 occurs at all islands within FFS with the majority of the project occurring at Tern and East Island. Projects 1 and 2 would tag and study the movement of top predators including Galapagos sharks; project 4 and 5 would facilitate research and conservation and management activities in the Monument. With the exception of project 3 and 6, none of the proposed actions in Table 1 would occur around Trig Island, Round Island, or the Gins, and therefore would offer no potential for cumulative impacts when considered together with the proposed action.

Table 5: Relevant Projects within the PMNM

Number	Project Name	Time Frame	Purpose and Scope
1	Movements of Top Predators (Jacks, Grouper and Wahoo) throughout the Monument (C. Meyer)	June – September 2011	The proposed action is to issue a research permit to tag additional predator specimens and download data from 21 existing underwater receivers in Monument, and deploy 8 additional receivers. This project occurred from 2005 – present.
2	Movements of Sharks within FFS Atoll (C. Meyer)	June – September 2011	The proposed action is to issue a research permit to equip large sharks with electronic tags and monitor their movements using acoustic receivers and satellites. This project occurred from 2005-present.
3	Hawaiian Monk Seal Research and Monitoring Activities	June – December 2011	The proposed action is to issue a research permit to continue monitoring, translocation and research activities on the Hawaiian monk seal (*Monachus schauinslandi*) throughout the Monument. This project occurred from 1980 – present
4	Support for Permitted Activities Aboard NOAA Ship OSCAR ELTON SETTE	June – December 2011	The proposed action is to issue a conservation and management permit to NOAA Ship OSCAR ELTON SETTE to serve as a support platform for the above activities throughout the Monument. This project occurred from 2003 – present.
5	Support for Permitted Activities Aboard NOAA Ship HI‘IALAKAI	June – December 2011	The proposed action is to issue a conservation and management permit to NOAA Ship HI‘IALAKAI to serve as a support platform for the above activities throughout the Monument. This project occurred from 2004-present.
6	Marine Turtle Research Program	January – December 2011	The Marine Turtle Research Program is conducted in the NWHI under the PMNM Conservation and Management, Manager’s permit to conduct research and monitoring of green sea turtles throughout FFS. This project occurred from 1972 – present.

The “Hawaiian Monk Seal Research and Monitoring Activities” project (project number 3 on table 5) has conducted research and monitoring activities on the Hawaiian monk seal since 1980, and is planned to continue into the reasonably foreseeable future concurrent with the proposed action. The project includes takes of Hawaiian monk seals and incidental disturbance of green sea turtles. Some of the activities would pose a potential risk of injury to Hawaiian monk seals, including sedation and handling activities, and some of the activities would result in intentional death from euthanasia, and potentially unintentional

mortalities from sedation and/or handling. The effects on the individual target animals of disturbance, capture, restraint, and sampling proposed in the application [for the current program and permit] are known, as the activities proposed are commonly used and not new. A review of the literature on the effects of these research techniques on pinnipeds can be found in the EA on the Effects of NMFS Permitted Scientific Research Activities on Threatened and Endangered Sea Lions (NMFS 2002). In general, the available information (including that reviewed in the 2002 EA) indicates that, when performed correctly by experienced personnel, these types of research activities are not likely to pose a significant risk of adverse impacts on the animals. As previously described, the proposed action would have little to no impact on Hawaiian monk seals; therefore, no cumulative impacts on that species would result when considered with the Hawaiian Monk Seal research project.

The Marine Turtle Research Program (MTRP) (project number 6 on table 5) has conducted research and monitoring activities in the NWHI since 1972 and is planned to continue into the reasonably foreseeable future concurrent with the proposed action. The project contains activities including handling and tagging activities and some of the activities may result in intentional death from euthanasia and potentially unintentional mortalities from handling. The effects on the individual target animals of disturbance, capture, restraint, and sampling are known, as the activities are commonly used and not new. A review of the literature on the effects of green sea turtle research and monitoring methodology can be found in the PEA entitled, "Programmatic Environmental Assessment of the Marine Turtle Research Program at the Pacific Islands Fisheries Science Center (NMFS 2006)," and are incorporated by reference into this EA. In general, the available information (including that reviewed in the 2006 PEA) indicates that, when performed correctly by experienced personnel, these types of research and monitoring activities are not likely to pose a significant risk of adverse impacts on the animals. As previously described, the proposed action would have negligible impacts on green sea turtles; therefore, no cumulative impacts on that species would result when considered with the MTRP.

Hawaiian monk seal, green sea turtle, and lethal removal of Galapagos sharks have occurred in conjunction with each other at FFS in the past (2006, 2007, 2010, and 2011) with no observable negative impacts. Future actions may occur within FFS, specifically at Trig Island, Round Island and the Gins, as it is anticipated that future Monument permits may be issued annually for (1) Hawaiian monk seal research and monitoring; (2) Marine turtle research program and (3) Galapagos shark observation, monitoring and removal activities. There are currently no Monument applications pending which include activities proposed near any of the aforementioned islets within FFS; therefore, no cumulative effects, significant or otherwise, are anticipated.

6 Environmental Permits, Approvals, and Compliance

6.1 Permits

6.1.1 Papahānaumokuākea Marine National Monument Permit

NMFS has submitted an application for a Monument conservation and management permit to authorize shark observation, monitoring, and removal activities within the PMNM. This EA is being prepared to support a decision on permit applications submitted for the proposed action in 2012 and 2013.

6.1.2 Other Permits

No other permits are necessary for these activities, as the activities contained herein would not result in an incidental disturbance or take of Hawaiian monk seals, green sea turtles or cetaceans.

6.2 Other Laws and Authorities Considered

6.2.1 Executive Order 13089: Coral Reef Protection

Executive Order (EO) 13089 requires all Federal agencies whose actions may affect U.S. coral reef ecosystems to (1) identify these actions; (2) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and (3) ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems.

This assessment has considered EO 13089 and has determined that, while it may have a limited effect on U.S. coral reef ecosystems in the NWHI, the proposed action (Alternative 2) would not degrade the conditions of any U.S. coral reef ecosystem, including the coral reef ecosystems in the NWHI. The permits issued by the PMNM have several controls, conditions, and best management practices (anchoring of small boats on sandy substrate only and intensive monitoring of handlines and the surprise net, etc.) to ensure protection for natural coral reefs and the associated flora and fauna in the vicinity of the project site. In addition, the ecological monitoring related to this study would provide important information about the possible changes in the coral reef ecosystem. Such information would be very useful in making future management decisions concerning the mitigation of shark predation to enhance recovery of the endangered Hawaiian monk seal.

6.2.2 Magnuson-Stevens Fishery Conservation and Management Act

The site for the proposed action (Alternative 2) comprises coral reef and sand habitat and a portion of the surrounding water column, and no adverse direct impacts to the species present are expected. In addition, no commercial fishery occurs in this habitat because of its status as a Marine National Monument. The sand and coral bottom habitat surrounding the project site is inhabited by invertebrate infauna, burrowing fish, bottom-dwelling fish, and a wide variety of coral reef fish, and no adverse direct impacts to the habitat or the species present are expected. No adverse impacts to Essential Fish Habitat are expected. Also, cumulative or synergistic impacts are not expected as a result of the proposed action because a vast amount of similar habitat and species remain unaffected in the adjacent islands within FFS.

Although there is no fishery for the Galapagos shark, the population is considered a pelagic unit management species under the Western Pacific Fisheries Management Council's pelagic fisheries management plan authorized under the Magnuson-Stevens Fishery Conservation and Management Act.

An ongoing coral reef monitoring program is being undertaken in conjunction with this project to ascertain possible changes in the ecosystem over time. This assessment has determined that the proposed action would not have a significant effect on Essential Fish Habitat.

6.2.3 Endangered Species Act

NMFS has determined that the proposed action would not adversely affect the Hawaiian monk seal or affect the green sea turtle occurring at Trig Island. The short-tailed albatross, an endangered species under FWS' purview, has been observed at FFS only six times during the last 68 years and only at Tern Island. Therefore, NMFS has determined that the proposed action would not affect the short-tailed albatross since it is highly unlikely that this seabird would occur at Trig Island during the shark deterrent experiment. All precautions would be taken not to disturb Hawaiian monk seals or green sea turtles, and the necessary PMNM permits would be in place before actions are taken to deter and monitor Galapagos shark predation on preweaned monk seal pups. The HMSRP staff involved in the project would coordinate all activities with staff from the FWS to ensure that no threatened or endangered species would be affected by the proposed action.

As previously stated, in 2007 the NMFS Pacific Islands Regional Office (PIRO) consulted on proposed shark fishing procedures at French Frigate Shoals—procedures which included monitoring seals and lethally removing sharks via harpoon, spear gun and handline fishing. In the analysis, NMFS PIRO

determined that 1) disturbance from humans and equipment to protected species is temporary and insignificant and does not exceed those actions previously consulted on; 2) the likelihood of an entanglement or hooking with a protected species is discountable; 3) the likelihood of a vessel colliding with a monk seal or green turtle is discountable; and 4) a potential exists for beneficial effects from the project to monk seals. The PIRO concurred that the project was Not Likely to Adversely Affect ESA-listed Hawaiian monk seals and green turtles, and would have no effect on designated critical habitat.

On May 7, 2010 the PIFSC re-initiated consultation under the ESA to include use of the bottomset, drumline, and surprise net to lethally remove sharks at FFS. The PIRO concurred that use of the surprise net, along with the harpoon, spear gun and handline fishing techniques to mitigate the high predation rate by Galapagos sharks on Hawaiian monk seals is Not Likely to Adversely Affect ESA-listed Hawaiian monk seals and green turtles or their designated critical habitat.

6.2.4 National Historic Preservation Act (NHPA)

Under the provisions of Section 106 of the National Historic Preservation Act of 1966, the Secretary of the Interior has compiled a national register of sites and buildings of significant importance to America's history. The proposed action would not cause any negative impacts to registered sites or buildings on shore or any such submerged site, such as shipwrecks.

6.2.5 Marine Mammal Protection Act

The Marine Mammal Protection Act authorizes NMFS to take measures to protect marine mammals that may involve setting aside habitat required by various life stages, although the chief provision is the prohibition of "taking" marine mammals directly or indirectly. None of the activities proposed herein should directly or indirectly interact with monk seals or other marine mammals such as dolphins or whales.

6.2.6 Environmental Justice

Consistent with the President's Executive Order on Environmental Justice (February 11, 1994) and the Department of Commerce's Environmental Justice Strategy, the proposed action would not have any disproportionately high and adverse human health or environmental effects on minority or low income populations.

6.2.7 Executive Order 12866

Implementation of the activities herein described does not constitute a "significant regulatory action" as defined by Executive Order 12866 because (1) it would not have an annual effect on the economy of $100 million or more, or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities; (2) it would not create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) it would not materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; and (4) it would not raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

7 Appendix A – Codes for Galapagos Shark and Hawaiian Monk Seal Monitoring

A. Codes for Shark Behavior

Code 1: Cruising, no obvious signs of predatory behavior

Code 2: Patrolling, apparently hunting pups

Code 3: Making directed approach to a seal

Code 4: Charging Seal, clearly attempting to attack

Code 5: Injuring or killing pups

B. Codes for Hawaiian Monk Seal Age Classes

Definitions:

Pre-weaned or Nursing Pup: Pups sized as P1 through P-5 at last sighting, commonly still with mothers, and nursing.

Weaned Pup: Pups that have been weaned <30 days, when mothers are commonly absent and nursing behavior is not evident.

Codes:

P1: Pup that is nursing and has wrinkles, typically full term, as defined by full developed pelage, whiskers, nails, and oral cavity. If a perinatal death is evident and size is not given, pup is recorded as a P1, rather than as a fetus.

P2: Pup that is nursing, has no wrinkles and has black pelage.

P3: Pup that is nursing, has a blimp-shaped body and has black or reddish-brown pelage prior to molt.

P4: Pup that is nursing, has a blimp-shaped body and is molting.

P5: Pup that is nursing, has a blimp-shaped body and has molted (note: not all pups reach P5 before weaning).

C. Codes for Bite Severity Classes:

Severity 1: The total combined exposed area of all gaping injuries is <8 cm (approximately 50 cm^2), less than half of a flipper is missing, and/or head/eye results in a partially opaque eye (Hawaiian Monk Seal Field Manual, Chapter 9: Survival Factors).

Severity 2: The total combined exposed area of all gaping injuries is ≥ an 8 cm (approximately 50 cm^2) and a <20 cm diameter circle area (approximately 314 cm^2), ≥ half a flipper is missing and/or injury to head/eye results in a totally opaque/blinded eye (Hawaiian Monk Seal Field Manual, Chapter 9: Survival Factors).

Severity 3: The total combined exposed area of all gaping injuries ≥ a 20 cm diameter circle area (approximately 314 cm^2) and/or total loss of function critical for survival, such as both hind flippers are amputated (Hawaiian Monk Seal Field Manual, Chapter 9: Survival Factors).

D1. Criteria for and Categorization of Shark Predation of Monk Seal Pups

Category 1 - Shark Confirmed Predation

Category 2 - Shark Inferred Predation

Shark Confirmed Predation:

Injured by Shark: A pup of the year sustains an injury inflicted by a large shark of any severity and "survives" or does not fall into the dead or probably dead categories below. Here, large sharks are defined as all sharks other than the cookiecutter shark (*Isistius brasiliensis*). These injuries include shallow punctures or lacerations in the skin, deep lacerations, gaping wounds, and amputated limbs. The characteristic crescent shape of these wounds reflects the shape of the shark's jaw (Hiruki et al.1993).

Died due to Shark Injury: Confirmed deaths only (the death or body of the pup is observed). A pup of the year is observed being killed by sharks, or sustains moderate to severe shark injuries and subsequently dies. To be considered a cause of death an injury must, at minimum be of the following severity: the total combined exposed area of all gaping injuries to the body must be ≥ an 8 cm (approximately 50 cm^2), ≥ ½ flipper is amputated, and/or injury to the head/eye results in a totally opaque/blinded eye. Shark attack will be judged to be the primary cause of death if the seal is not otherwise compromised to a larger degree due to factors such as pre-existing emaciation or injury due to other causes (HMS Field Manual, Survival Factor Section).

Disappeared/Probable Death due to Shark Injury: A pup of the year sustains a moderate to severe shark injury, subsequently disappears, and is classified as a probable death. Shark attack will be judged to be the primary cause of the disappearance if the seal is not otherwise compromised to a larger degree due to factors such as pre-existing emaciation or injury due to other causes. To be classified as a probable death the minimum sustained injury must be of the severity level described above, and one of the following conditions must also be satisfied:

The pup is lethargic, has trouble moving, and/or floated listlessly in the water and disappears more than a week before the end of data collections, or

The pup is in deteriorating condition (loss of weight, enlargement of abscesses, sloughing skin) and disappears at least 10 surveys or a month before the end of data collection (whichever is longer).

Shark Inferred Predation:

Disappeared/Probable Death – Shark inferred: Young apparently healthy pups are also considered to have probably died if they disappear within 3 weeks of birth (>7 days old and ≤21 days old) and are not seen for at least 10 surveys or a month before the end of data collection. Unknown-age pups are also included in this category if they were unmolted at the time of disappearance. The cause of these probable

deaths is unknown but considered shark inferred if the pup is over 7 days old, predatory shark behavior has targeted nursing/newly weaned pups in the current year and at that location, and there is no other probable cause. The pup's mother is typically observed to be in good condition, with a single pup, and parenting normally prior to disappearance and often searching for her pup at the time of disappearance. Other probable causes of disappearances that must be absent for a shark-inferred mortality to be concluded include: aggressive adult male monk seals, extreme environmental conditions and maternal abandonment. Adult male monk seals may injure weaned pups and inflict mounting injuries that are distinguished by their distinctive scars and lacerations (Hiruki et al. 1993). Adult female seals (mothers) vigorously defend their pups from adult males during the nursing period (Johanos et al. 1994). Thus, pre-weaned pups are typically not vulnerable to male aggression. Unless a flagrantly aggressive male is observed at a pupping site within the current year, pre-weaned pup disappearance in the historical data is safely attributed to shark predation unless other compromising factors are present, such as extreme environmental conditions. Extreme environmental conditions include high tides and/or strong currents. They are considered a factor in pup disappearance primarily for islets that would go awash at extreme high tides, e.g., Round, Mullet, Bare, Disappearing, and potentially Whaleskate & Shark.

Suspicious Disappearance/Likely Dead – Shark Inferred: Slightly older apparently healthy pups that disappear while still with their mothers or newly weaned are considered to have suspiciously disappeared, and to be likely dead if they are not seen for at least 10 surveys or a month before the end of data collection. Pups in this category are over 21 days old at the time of disappearance (or molting/molted if of unknown age), with a cut-off age of 2 weeks post-weaning. Pups over 2 weeks post-weaning are not included in any shark-inferred category. The cause of these suspicious disappearances is unknown but considered shark inferred if there is no other probable cause (see discussion above about probable cause above).

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