UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

APR 26 2010

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act (NEPA), an environmental review has been performed on the following action.

TITLE: Financial Assistance for the Sea Turtle Conservation Program of the Western Pacific Regional Fishery Management Council
NOAA Grant # NA10NMF4410219

LOCATION: Kagoshima, Miyazaki, and Wakayama Prefectures, Japan; Papua, Indonesia; Huon Coast, Papua New Guinea; Baja California Sur, Mexico; American Samoa

SUMMARY: The National Marine Fisheries Service is proposing to provide financial assistance over the five-year grant period to the Western Pacific Regional Fishery Management Council for their Sea Turtle Conservation Program for education and outreach, census patrols, research monitoring, nesting beach management, and bycatch mitigation. Alternatives to the proposed action and potential environmental impacts are disclosed in this Environmental Assessment. None of the alternatives or the actions considered, as part of the alternatives, would have significant negative impacts on sea turtle populations nor provide significant socio-economic impacts in locations where the activities occur. None of the actions considered would result in irreversible or irretrievable commitments of resources and none would result in significant or unavoidable adverse impacts.
Grant #: NA10NMF4410219
Grantee: Western Pacific Regional Fishery Management Council

RESPONSIBLE OFFICIAL: Michael D. Tosatto, Acting Regional Administrator, National Marine Fisheries Service, Pacific Islands Regional Office
1601 Kapiolani Blvd. Suite 1110, Honolulu, HI 96814
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The environmental review process led us to conclude that this action will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be prepared. A copy of the finding of no significant impact (FONSI) including the supporting environmental assessment (EA) is enclosed for your information.

Although NOAA is not soliciting comments on this completed EA/FONSI we will consider any comments submitted that would assist us in preparing future NEPA documents. Please submit any written comments to the responsible official named above.

Sincerely,

for Paul N. Doremus, Ph.D.
NOAA NEPA Coordinator

Enclosure

Environmental Assessment

Financial Assistance for the Sea Turtle Conservation Program of the Western Pacific Regional Fishery Management Council

April 21, 2010

Prepared By:

Western Pacific Regional Fishery Management Council
and
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Pacific Islands Region

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Environmental Assessment
Financial Assistance for the Sea Turtle Conservation Program of the Western Pacific Regional Fishery Management Council

April 23, 2010

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Abstract: The National Marine Fisheries Service is proposing to provide financial assistance over the five-year grant period to the Western Pacific Regional Fishery Management Council for their Sea Turtle Conservation Program for education and outreach, census patrols, research monitoring, nesting beach management, and bycatch mitigation. Alternatives to the proposed action and potential environmental impacts are disclosed in this Environmental Assessment. None of the alternatives or the actions considered, as part of the alternatives, would have significant negative impacts on sea turtle populations nor provide significant socio-economic impacts in locations where the activities occur. None of the actions considered would result in irreversible or irretrievable commitments of resources and none would result in significant or unavoidable adverse impacts.

SUMMARY

This Environmental Assessment analyzed the following alternatives for the scope of the Western Pacific Fishery Management Council's Sea Turtle Conservation Program.

Alternative 1- No Action
Alternative 2- Education and Outreach, and Census Patrols
Alternative 3- Education and Outreach, Census Patrols, Research Monitoring, Nesting Beach Management (Including Predator Mitigation)
Alternative 4- Education and Outreach, Census Patrols, Research Monitoring, Nesting Beach Management, and Bycatch Mitigation (Preferred Alternative)

Based on expert advice of the Council's Sea Turtle Advisory Committee, the Council has identified the following activities to implement the Council's Sea Turtle Conservation Program:

- Nesting beach census to count females and nests to quantify baseline nesting data such as number of emergences, nesting females and nests per season;
- Research monitoring of live turtles to tag and collect biological data (e.g., measurements, presence of injuries) at nesting beaches and in-water habitat;
- Research monitoring of post-hatching nests to determine hatching success rates and conditions;
- Nesting beach management to relocate nests determined to have low chances of survival;
- Nesting beach management and predator control to reduce anthropogenic impacts (including depredation of nests by feral animals) and maximize hatching success of *in-situ* nests;
- Education and outreach in communities where conservation activities are taking place
- Research monitoring of stranded turtles to quantify mortality and determine potential cause of death
- Mitigation of bycatch in fisheries through testing of alternative gear, fishing method, and technology to reduce at-sea anthropogenic mortality

The proposed activities under the preferred alternative will not have significant negative impacts on sea turtle populations nor provide significant socio-economic impacts in locations where the activities occur. Positive benefits to sea turtle populations are anticipated to result from the proposed activities as well as minor positive socio-economic impacts.

Summary of impacts of the alternatives

	Alternatives*			
Resource	1	2	3	4
Sea Turtles	-	+	++	+++
Socioeconomic Environment	-	+	++	++

*0 (no impact); + (positive impact); - (negative impact)

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CHAPTER 1: INTRODUCTION

This chapter provides background information and the purpose and need for the Western Pacific Regional Fishery Management Council's (WPRFMC or Council) sea turtle conservation program. This Environmental Assessment fulfills the requirements of the National Environmental Policy Act (NEPA) and the National Oceanic and Atmospheric Administration's Administrative Order 216-6.

1.1 Background Information

All sea turtles that occur in U.S. waters are listed as either endangered or threatened under the Endangered Species Act (ESA). Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and hawksbill *(Eretmochelys imbricata)* sea turtles are listed as endangered. Loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and olive ridley (*Lepidochelys olivacea*) sea turtles are listed as threatened, except for breeding colony populations of green turtles in Florida and on the Pacific coast of Mexico and breeding colony populations of olive ridleys on the Pacific coast of Mexico which are listed as endangered. Of these, Western Pacific leatherback turtles and the Northern Pacific loggerhead turtles are of particular concern to the Council, as these two species historically had high levels of bycatch in the Hawaii-based longline fishery. In addition, American Samoa green turtle population is of concern due to their interactions with the American Samoa longline fishery.

Following the closure of the swordfish component of the Hawaii-based longline fishery in 2001, sea turtle bycatch mitigation strategies in the form of circle hooks and deep setting have been implemented. As a result, sea turtle interactions in longline fishery since the reopening in 2004 have been reduced by approximately 90% compared to the pre-closure levels (Gillman et al., 2007). Recognizing that the reduction of sea turtle bycatch in Hawaii-based longline fishery alone will not recover the leatherback and loggerhead populations, and that recovery efforts at nesting beaches and impact mitigation at foraging grounds are critical to the recovery of sea turtle populations, the Council initiated its conservation program in 2003. An *Environmental Assessment for Nesting Beach Management of the Western Pacific Regional Fishery Management Council's Sea Turtle Conservation Program* was prepared in 2005.

1.2 Statement of Purpose and Need

The purpose of the Council's proposed sea turtle conservation projects is to address anthropogenic and environmental impacts at nesting beaches and foraging grounds of sea turtle populations that interact with fisheries in the Western Pacific region. There is a clear need for this work as nesting beach conservation and reductions in fisheries interactions are critically important for the recovery and continued existence of sea turtle populations.

1.3 Proposed Activities

The National Marine Fisheries Service Pacific Islands Regional Office proposes to provide financial assistance over the five-year grant period to fund the following activities under the Council's sea turtle conservation program:

- Nesting beach census to count females and nests to quantify baseline nesting data such as number of emergences, nesting females and nests per season;
- Research monitoring of live turtles to tag and collect biological data (e.g., measurements, presence of injuries) at nesting beaches and in-water habitat;
- Research monitoring of post-hatching nests to determine hatching success rates and conditions;
- Nesting beach management to relocate nests determined to have low chances of survival;
- Nesting beach management and predator control to reduce anthropogenic impacts (including depredation of nests by feral animals) and maximize hatching success of *in-situ* nests;
- Education and outreach in communities where conservation activities are taking place
- Research monitoring of stranded turtles to quantify mortality and determine potential cause of death
- Mitigation of bycatch in fisheries through testing of alternative gear, fishing method, and technology to reduce at-sea anthropogenic mortality

Details of these activities are provided in Chapter 2.

1.4 History of the Council's Sea Turtle Conservation Program

In November 1999, a federal court order severely restricted the Hawaii-based longline fishery due to its interactions with sea turtles, and by March 2001 the swordfish component of the fishery was effectively closed. Although the Council had been working for several years to reduce protected species interactions with Hawaii-based longliners, this closure highlighted the need for a greater focus on sea turtles. Since this time, the Council has worked in partnership with the National Marine Fisheries Service (NMFS), industry (Hawaii Longline Association) and international collaborators to develop gear and technological solutions to reduce bycatch, implement research to better understand migratory sea turtles, and promote sea turtle conservation activities. In April 2004, after almost five years of regulatory changes, the swordfish component of the Hawaii-based longline fishery was reopened based on the implementation of new circle hook technologies that have been found to significantly reduce interactions of pelagic longline gear with sea turtles (Watson *et al.*, 2005).

There are two primary sections (4 and 7) of the ESA, which outline how fishery management and the ESA interact. Under Section 4 of the ESA, Recovery Plans are the "roadmaps" for eliminating or reducing threats to a species' existence. For recovery, all methods and procedures should be employed which are necessary to bring any listed species to the point where the measures provided for in the ESA are no longer necessary. Under section 7 (Interagency Cooperation), all federal agencies shall utilize their authorities to further the ESA by carrying out programs for the conservation of listed species.

The regional fishery management councils have been encouraged by NMFS to carry out the actions identified in the 1998 ESA Recovery Plans that are necessary to "recover" species (Williams 2002). To "protect and manage turtles on nesting beaches" and "protect and manage populations in marine habitat" are categorized as highest priority actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future in both ESA recovery plans for leatherback and loggerhead sea turtles (NMFS 1998a, 1998b). Additionally, the Bellagio Blueprint Action Plan for the recovery of Pacific sea turtles (Worldfish Center 2004) as well as the FAO Expert Consultation on Fisheries (2004) state explicitly, "the protection of nesting beaches as well as the reduction of sea turtle bycatch in high seas and coastal fisheries are key to population recovery."

Under the direction of Sea Turtle Advisory Committee (STAC), the Council has been supporting conservation measures considered to offset impacts of the Hawaii-based longline fishery while concurrently supporting population recovery since 2003 (WPRFMC 2003). The STAC was formed by the Council at the 114th Council meeting (August 2002) to direct and advise the Council on its turtle conservation activities. The STAC generally meets once a year and is comprised of eight world-renowned sea turtle biologists and scientists: Dr. Colin Limpus (Queensland Parks Authority, Australia), Mr. George Balazs (NMFS-PIFSC), Dr. Peter Dutton (NMFS-SWFCS), Dr. Milani Chaloupka (Ecological Modelling Services, Australia), Dr. Jeffrey Polovina (NMFS-PIFSC), Dr. Naoki Kamezaki (Sea Turtle Association of Japan, University of Tokyo), Ms. Raquel Briseno Duenas (BITMAR, Unidad Academica Mazatlan, Mexico), and Dr. Nicolas Pilcher (Co-Chair IUCN, Marine Turtle Specialist Group, and President, Marine Research Foundation, Malaysia).

1.4.1 Council's Sea Turtle Program: Progress to Date

Wermon Beach, Papua Indonesia – Nesting Beach Management

The Council has contracted with the World Wildlife Fund-Indonesia (WWF-Indo) since November 2003 to hire village rangers to protect the Wermon nesting beach at Bird's Head Peninsula in Papua, Indonesia. This project builds on the existing program established by WWF-Indo since 1990 at the Jamursba-Medi beach, the largest known leatherback nesting site in Indonesia and in the western Pacific region. Prior to project implementation, disturbance was unchecked at Wermon: poaching affected more than 60% of all nests and pig predation impacted much the remaining nests (Starbird and Suarez 1994). To date, WWF-Indo has achieved success in eliciting the support and involvement of local people and the Indonesian government. In December 2005, 26 million hectares comprised of 126,499 km of beaches (including Jamursba Medi and Wermon) were designated as a local marine protected area or MPA (ABUN MPA decree No. 142/2005).

This project monitors and protects one third of the known leatherback nesting beach habitat along the north coast of Papua, Indonesia and results in the protection of leatherback nests from predation by feral pigs, beach erosion and egg collectors. Protection is achieved through nightly beach patrols, placing bamboo grids on nests to prevent predation, relocating eggs from erosion-prone areas to more stable terrain, and deterring poachers through monitoring presence. Standardized techniques for data recording is applied with community-based beach rangers employed to patrol nightly, PIT tag nesting females and record nesting data (including impacts: predation and inundation).

Prior to implementation of the Council-funded Wermon conservation project, egg harvest and predation were considerable threats (Hitipeuw et al. 2007; Starbird and Suarez 1994). As documented by Starbird and Suarez (1994), poaching at unprotected Wermon Beach exceeded 60% and pig predation impacted nearly 40%. With the establishment of the year round monitoring project in 2003/04, coastal patrols are currently being conducted to prevent disturbance and exploitation of the beach, with an average of approximately 70% of nests laid conserved (2003/04 through 2006/07 nesting seasons; see Table 1).

To date, impacts from predation have been significantly reduced (by 90%), and through the process of implementing this program it has been realized that the beach is of far greater importance than previously assumed. It has become an excellent new research platform for Western Pacific leatherbacks, including aerial surveys, genetic sampling, hatching success, and nest relocation studies. Approximately 5,493 nests and 196,226 hatchlings have been conserved by this project (Table 1).

Table 1: Summary of conservation activities at Wermon beach, 2004-2007

Year	Nests laid	Nests conserved	Est. eggs conserved	Est. hatchlings produced[2]
2002/03 (baseline)	1,788	NA	NA	NA
2003/04	2,881	2,039	154,964	72,833
2004/05	2,080	1,160	88,160	41,452
2005/06	1,346	1,198	91,048	42,792
2006/07	1,319	1,096	83,296	39,149
Total[1]	7,626[1]	5,493	417,468	196,226

[1] not including 2003 baseline numbers
[2] Estimated by 76 eggs per clutch and 47% hatching success rate (Tapilatu and Tiwari 2007)
NA = not applicable
Source: WWF project reports to WPRFMC 2004-2007 (Thebu and Hitipeuw 2004; Wurlianty and Hitipeuw 2005, 2006, 2007)

It is generally estimated that 1 egg out of 1000 eggs will survive to become an adult sea turtle (Kobayashi 2009). Based on this simple model, this conservation project is estimated to produce approximately 417 adult leatherback turtles in the future. Note that prior to implementation of this project, nearly 100% of all eggs laid at Wermon beach were thought to have been lost to depredation, direct harvest, or inundation. A recent economic analysis of three leatherback conservation strategies found that activities to recruit hatchlings at nesting beaches are not only effective in producing adult turtles, but may also be substantially less costly per adult turtle generated than certain fisheries regulations and closures to mitigate bycatch (Gjertsen in press). In the analysis, Gjertsen compared current conservation activities at Jamursba-Medi and Wermon nesting beaches in Indonesia with the Hawaii shallow-set longline regulations and California drift gillnet time area closure. The results indicated that activities at nesting beaches are over 10 times more cost effective per turtle than the shallow-set regulations and over 100 times more cost effective per turtle than the drift gillnet closure (Gjertsen in press).

Kei Islands, Western Papua Indonesia – Coastal Harvest Reduction
The Council contracted with WWF-Indonesia and later with SIRaN, a locally-based NGO (as a subcontract with Marine Research Foundation) from 2003 to 2007 to provide information, education and outreach, and work with local villagers to reduce direct harvest pressure of leatherback turtles in the coastal foraging habitats of Kei Kecil Islands of western Papua, Indonesia.

The traditional practice of harvesting leatherback turtles is of high socio-cultural value to indigenous people of the Kei Islands. These practices reflect the vital linkage of people to land/water, reinforce spiritual beliefs that govern their existence and responsibility to their natural resources, and serve as a tool for passing on the socio-cultural knowledge to future generations. Accordingly, sustainable resource management (including conservation) needs to consider both the social and cultural aspects of local communities. This project strived to operate within the socio-cultural and economic perspectives of the local community, as well as Indonesian law that preserve indigenous harvest rights, relating to leatherback turtles to determine the best approach for conservation and adaptation of the local customary institutional frameworks.

This project began by first studying and quantifying the parameters associated with leatherback hunting to establish a harvest baseline and to investigate option means of livelihood to support sustained management over time. Throughout the project duration, a greater understanding of the socio-cultural issues associated with local harvest has been achieved. The harvest rate is not as significant as previously believed, suggested by Suares (1999) to be 100 turtles/yr. Findings from this project estimate that approximately 45 turtles/yr are harvested (Table 2). Council funding for this project was terminated after 2007 due to the relatively low harvest rate compared to the former estimate, and relatively low priority level for Council's sea turtle conservation program.

Table 2: Summary of leatherback turtle harvest observed in Kei Kecil, Papua, Indonesia 2003-2006

Year	Harvest/yr	Conservation activities
Baseline	100[1]	NA
2003/04 (yr 1)	29	Education & outreach, community meetings
2004/05 (yr 2)	44	Education & outreach, community meetings
2005/06 (yr 3)	30	Education & outreach, community meetings, soccer tournament implemented (to engage local community in alternative option activity)
2006/07 (yr 4)	58	Education & outreach, community meetings, alternative activities implemented, turtle sighting network established.

[1] Estimate by Suares (1999)

Huon Coast, Papua New Guinea – Nesting Beach Management
The Huon Coast Leatherback Turtle Conservation Project (HCLTCP) began at the Kamiali Wildlife Management Area (KWMA) in November 2003 and by late 2005 expanded to incorporate three additional communities of Labu Tale, Busama and Paiawa which were identified via aerial surveys (Benson, Kisokau, and Ambio et al. 2007), historical accounts (such as Hirth et al.1993), and community leaders to have significant leatherback nesting. During the 2006/07 nesting season, three additional communities of Sapa, Kobo and Salus were incorporated into the project. The HCLTCP project sites are located 20 to 60 km southeast of Lae, Papua New Guinea (PNG), and in total results in approximately 20 km of monitored (or protected) beach. Project expansion from one site to seven has been made possible by funding from the WPRFMC through partnerships with PNG Department of Environment and Conservation and the Village Development Trust (a locally based NGO). The Marine Research Foundation provides scientific and management oversight and anthropological consultancy is provided by the University of Papua New Guinea.

The Huon Coast hosts over 70% of leatherback nesting activity in PNG (Benson, Kisokau, and Ambio et al. 2007), and is among the largest population in the western Pacific, second only to Papua, Indonesia (Dutton et al. 2007). Primary threats to leatherback turtle survival and recovery results from direct harvest, predation and beach erosion. Significant nest-loss occurs through beach erosion and wave inundation (up to 100% loss in some locations); egg collection by villagers in areas outside the HCLTCP monitoring zones or project sites; continued harvest and/or killing of adult turtles; and high instances of dog depredation (up to 80% of unprotected nest). Given their critical status, maximizing hatchling production is seen as most vital to the welfare of leatherback turtles in PNG.

The HCLTCP employs a community-based approach, similar to other turtle conservation projects (Marcovaldi and Marcovaldi 1999, Troeng and Rankin 2005; Hitipeuw et al. 2007) which involve local communities in monitoring activities and beach management / conservation initiatives. Staff duties are geared to reduce nesting beach impacts and to optimize hatchling production. Specifically, the objectives of the HCLTCP staff are to monitor nesting activities of leatherback turtles, to implement beach management measures (such as bamboo grids) to maximize hatchling production, to increase local awareness and understanding of sea turtle conservation issues, and to share knowledge with other communities to promote sustainable management of leatherback resources.

Over the past several years there has been a conscious effort to change local perceptions and overall program focus from "tagging turtles" to "protecting nests." Past research and monitoring efforts (prior to 2003) focused almost entirely on tagging turtles, and thus only this information was transferred to local monitors. However, tagging will not conserve or recover the species. To preserve sea turtles, one must ensure that nests hatch and hatchlings reach the water. The HCLTCP strives to provide local villagers with more appropriate skills and knowledge to influence leatherback conservation. Overall, poaching and dog predation has been reduced at beaches of participating communities and hatchling production has increased.

Communities that participate in the HCLTCP agree to an egg and turtle harvest moratorium. This is consistent with PNG national wildlife legislation which prohibits harvest of leatherback turtles and their eggs. The size of the moratorium has been variable over time, beginning within the KWMA during the 2002/03 season of 0.5 km of beach and then expanding: 2 km in 2004, 3 km in 2005, and 10 km (full scope of the beach) in 2006. As of the 2006/07 field season the seven participating communities also agreed to the egg harvest moratorium resulting in approximately 20km of protected beach throughout the Huon Coast. Additionally, as of the 2006 Monthly market surveys undertaken by the PNG Coastal Fisheries Management and Development Program (NFA 2006) and a recent survey of the Eye Grease Market (Kinch et al. 2007), confirm that no turtle eggs are being openly sold in Lae. Nesting beach trends for Huon Coast are provided in Table 3.

Table 3: Huon Coast nesting beach trends

Year	Monitoring area	Nests laid	Est. eggs laid	Est. hatchlings produced
2003/04	Kamiali	Unknown	Unknown	Unknown
2004/05	Kamiali	197	Unknown	Unknown
2005/06[1]	Kamiali, Busama, Labu Tale, and Paiawa (incomplete monitoring)	249	22,434	11,330[2]
2006/07	Kamiali, Busama, Labu Tale, Paiawa, Sapa, Kobo, and Salus	236	23,863	10,394[3]
2007/08	Kamiali, Busama, Labu Tale, Paiawa, Sapa, Kobo, and Salus	270	28,701	19,660[4]
2008/09	Kamiali, Busama, Labu Tale, Paiawa, Sapa, Kobo, and Salus	210	20,664	12,234[5]
Total		1162	95,662	53,618

[1] First year that predator mitigation (bamboo grids) implemented to address dog predation
[2] Estimated by 90.1 eggs per clutch and 50.1% hatching success rate (Pilcher 2006)
[3] Estimated by 101 eggs per clutch and 38.4% hatching success rate, with 86% margin of error (Pilcher 2007)
[4] Estimated by 106.3 eggs per clutch and 68.5% hatching success rate (Pilcher 2008)
[5] Estimated by 98.4 eggs per clutch and 59.2% hatching success rate (Pilcher 2009)
Source: Dr. N. Pilcher, Marine Research Foundation, project reports to WPRFMC (2006-2009)

Beaches along the Huon Coast have deep-water approaches reaching surf and shore-lines. This subjects the narrow nesting beaches to seasonal or storm-related erosion and deposition (accretion) cycles, which leads to nest loss when portions of the beach succumb to changes in current direction or velocity (Benson, Kisokau, and Ambio et al. 2007). Rivers frequently breach at different times of the year and at different sites depending upon the level of rainfall. Leatherback turtle nests located close to the banks of these rivers and other natural drainage systems are exposed and have been destroyed during high tides and heavy rainfall (Pritchard 1971, Quinn et al. 1983).

During the 2004-05 nesting season, approximately 40% of nests and at the KWMA were lost to erosion (Kisokau 2005). At Paiawa all (28) nests laid were washed away during the 2005-06 season, and erosion continues to be an issue (Pilcher 2006). During a 25 km beach survey undertaken on January 20-23, 2006 from Labu Tale to Busama, many of the 181 nests observed had been washed over in several locations and considerable flotsam covered nests, suggesting periodic inundation (Kinch 2006).

Predation by feral and domestic dogs (*Canis familaris*) has been documented and characterized as a 'great threat' to hatchlings and nests laid along the Huon Coast (Kisokau 2005; Pilcher 2006). Dog predation occurs as the hatchlings are digging to the surface (two to three days after initial hatching as hatchlings are digging to the surface, but not after oviposition or during incubation). A high level of depredation by dogs (approx. 80%) was observed and reported for nests during the 2005-2006 season at KWMA (C. Naru pers. comm.; Pilcher 2006), and one report suggests that nearly 100% of all nests were lost during the 2004-2005 season (Ambio, pers. comm.). Crocodiles (*Crocodilus porosus*) have also been documented to occasionally kill leatherback turtles as they emerge to nest (Rei 2005; Hirth et al. 1993; Quinn et al. 1983).

Nest and hatchling protection measures were developed in January 2006 by HCLTCP staff which involved the construction and deployment of locally-made bamboo grids. This was the first time dogs were prevented from causing hatchling loss. Grids were placed over many of the nests within the KWMA monitoring zone to reduce village and feral dog predation; however, outside of the monitoring zone where the grids were not deployed nest loss was still in the region of 80% (C. Naru, pers. comm.). Although grids were not used as comprehensively as might have been possible, they proved effective at combating dog depredation. The grids are a low-cost solution to protecting nests, and while they would likely not be as effective against stronger predators such as pigs, or at high density nesting beaches (where subsequent nesting turtles could displace the grids), after a couple of seasons of use they appear to be effective for local conditions in PNG and have effectively bolstered hatchling production and population recruitment. Bamboo grids are now deployed on all nests.

Using the simple model that estimates 1 egg out of 1,000 eggs will survive to adulthood, the Council's nesting beach conservation project to date in Kamiali, PNG is estimated to produce 95 adult leatherback turtles in the future.

Japan – Nesting Beach Monitoring and Nest Conservation

The Council began supporting nesting beach management activities at several nesting beaches in 2004 through the activities undertaken by Sea Turtle Association of Japan (STAJ). Actions to protect loggerhead nests and hatchlings occur at Minabe-Senri Beach in Wakayama Prefecture, and Myojinyama-Oida Beach in Miyazaki Prefecture, and Inakahama and Maehama Beaches of Yakushima Island, Kagoshima Prefecture. Yakushima Island is the most significant loggerhead nesting location in the North Pacific where more than 30 percent of nesting occurs. Activities include nightly and daily patrols of nesting beaches, relocating nests from erosion prone areas, keeping people away from nests to prevent crushing, and cooling the nests with water to prevent overheating during incubation.

A variety of techniques are employed to reduce egg and hatchling mortality due to both environmental and anthropogenic threats including erosion, extreme temperatures, predation, and nest compression due to human activities. Beaches are patrolled nightly during the summer nesting season. Nesting loggerheads are tagged and nesting data are recorded. Nests laid in erosion-prone locations (e.g., below high tide line or adjacent to streams) are relocated using standardized and internationally recognized methodologies. Nests left *in-situ* and those relocated are protected from predation and human trampling by using mesh and fences. Furthermore, nest temperature is monitored and regulated using water when critical thresholds are exceeded.

The STAJ has implemented nest relocation with an average of 60% hatchling success rates (compared to 0% survival of same nests laid in erosion prone areas). The Council's STAC continues to support nest relocation as a conservation strategy where such methods are found to be appropriate.

This project was initially implemented under the expectation of conserving approximately 6,000 hatchlings per year. However, management activities have been surprisingly successful with over 160,000 hatchlings conserved and released over the past four years that would have otherwise been lost (Table 4).

Table 4: Summary of conservation benefits at five beaches in Japan

Year	Nests laid	Nests relocated	Percent relocated	Eggs relocated	Hatchlings conserved
2004	2,120	238	11.2%	24,900	14,994
2005	2,091	470	22.5%	49,350	29,610
2006	1,315	600	45.6%	63,000	37,800
2007	1,424	463	32.5%	48,615	29,169
2008	4,469	771	17.3%	80,955	48,573
Total	11,419	2,542	22.3%	266,820	160,146

Note: Number of eggs relocated and hatchlings conserved estimated by 105 eggs per clutch (Matsuzawa, pers. comm.) and 60% hatchling success rate (average rate at Inakahama and Maehama beaches: Matsuzawa 2006).
Source: STAJ Reports of nesting seasons 2004-2008 to WPRFMC (Matsuzawa 2005, 2006a, 2007, 2008, 2009)

Assuming 1 out of 1,000 loggerhead eggs will reach adulthood, it is estimated that the Council's nesting beach conservation project in Japan to date will produce 266 adult loggerhead turtles from nest relocations that otherwise would not have survived (in addition to those produced by *in-situ* nests).

Baja California Sur, Mexico – Loggerhead Bycatch Reduction

In 2004, the Council began supporting the bycatch/mortality reduction and gillnet gear mitigation component of the Proyecto Caguama (or ProCaguama) project implemented by the locally-based NGO, ProPeninsula, operating in Baja California SUR, Mexico in communities of

Puerto López Mateos, Puerto San Carlos, Santo Domingo, and Magdalena Bay. This project aims to raise awareness of the bycatch, harvest and mortality issue among Mexican fishers and working with these fishers and their communities to develop mortality reduction solutions. The overall project objective is to reduce the loggerhead turtle mortality due to poaching and fisheries bycatch along the Baja California peninsula, of which many are loggerheads (Koch et al. 2006; Gardner and Nichols 2001). Objectives of the project are being met through activities involving outreach, education, gear research and mitigation, and increased patrolling.

The Council funded ProCaguama to conduct 45 km systematic shoreline surveys at Playa San Lazaro, Baja California Sur and to directly quantify and monitor turtle mortality. In addition to monitoring turtle strandings, ProCaguama assessed turtle bycatch and mortality/harvest rates through a voluntary observer program for the halibut gillnet fleet of Puerto Lopez Mateos, and through semi-structured interviews of fishermen and community members.

In 2004 and 2005, the project focused on understanding the dynamics and characteristics of the fishery. It was during this time that intensive community consultations (workshops) ensued. Potential gillnet mitigation research experiments were identified based on ideas of local fishermen who were working with project personnel to identify feasible solutions. Poaching reduction patrols and enforcement was implemented at hunting hotspots. Additionally, the annual Turtle Festival, along with intensive education and outreach activities, were initiated during this time.

In 2005 and 2006, bottom-set gillnet and bottom-set longline operations were observed. The results indicate that all loggerhead interactions occur when bottom-set gillnets are set at depths between 20-23 fathoms or 120-138 ft. When fishing at those depths, the fishermen were observed to catch 0.65 loggerheads per day, of which 73% caught are dead. Bottom-set longlining in the BCS was observed to have much higher loggerhead interaction rates. In 2005, seven observer trips were made on bottom-set longline vessels, with 26 loggerheads caught on a total of 1200 hooks set, or a bycatch rate of 19.3 per 1000 hooks. Of the turtles caught, 24 of 27 were dead when retrieved, providing an 89% mortality rate. One bottom-set longline trip was observed in 2006, where 21 loggerheads were caught dead from fishing 236 hooks, resulting in a kill rate of 89 turtles per 1000 hooks.

In 2007, representatives from ProCaguama, Grupo Tortuguero and the Santa Rosa Fish Producing Cooperative Society signed the Santa Rosa Declaration – a document that outlines the agreement that several Santa Rosa highline fishermen will no longer fish within the high density loggerhead sea turtle area with bottom longline gear. This agreement is estimated to save approximately 700-900 loggerheads each year (Peckham et al. 2007). Based on fisher and community surveys, changes in fishing techniques and locations is being reported, plus project staff have recognized steep drops in consumption to almost zero across several communities.

CHAPTER 2: ALTERNATIVES CONSIDERED

Leatherback and loggerhead sea turtles are encountered in the Hawaii-based pelagic longline fishery, and the status of these species has been of concern in recent years due to declines in species abundance. In addition, green turtles have been incidentally caught in American Samoa longline fishery. For leatherback sea turtles, the emphasis of Council-supported conservation actions are placed on the western Pacific leatherback stock nesting in the Indo-Malay Archipelago (i.e., Papua, Indonesia and Papua New Guinea) because the majority of interactions with the Hawaii-based longline fishery have been with this stock (Dutton et al. 2000; NMFS 2004). For loggerheads, the Council's emphasis is on the North Pacific stock, because all Hawaii-based longline fishery interactions have been linked to this stock (Dutton et al. 2000; NMFS 2004).

West Pacific leatherback and north Pacific loggerhead turtle stocks continue to face a wide array of threats at their nesting and foraging habitats - human harvest, beach erosion, predation, and bycatch (NMFS 2004) - and therefore urgent management efforts are necessary. Without intervention and appropriate management, continued population declines are imminent (Worldfish Center 2004; FAO 2004). The alternatives listed below are a layering of activities ranging from No Action (Alternative 1: no conservation measures supported) through a gradual increase of activities until full scale nesting beach management and bycatch mitigation is implemented (Alternative 4).

2.1 Description of Alternatives

2.1.1 Alternative 1- No Action

This alternative would not lead to Council funding to support sea turtle conservation programs as described in Chapter 1. This alternative would also result in termination of all on-going sea turtle conservation projects funded by the Council.

2.1.2 Alternative 2- Education and Outreach, and Census Patrols

This alternative would consist of community education and outreach, and census patrols utilizing strict and well-defined protocols. This alternative does not include the touching of turtles or eggs (i.e., no tagging or measurements, and no nest management activities), but entails only the counting of females and nests to quantify simple baseline nesting dynamics (i.e., number of nesting turtles and number of nests laid per season). Nesting beach protection would be achieved by education and outreach initiatives provided to the local community, and by the presence of beach monitors conducting nightly census patrols.

2.1.3 Alternative 3 - Education and Outreach, Census Patrols, Research Monitoring, Nesting Beach Management (Including Predator Mitigation)

This alternative would consist of community education and outreach, census patrols, research monitoring, nesting beach management, and predator mitigation utilizing strict and well-defined protocols. Monitoring would include research efforts consistent with stringent protocols for tagging turtles and collecting biological information (e.g., measurements) at nesting and foraging sites, and quantifying hatching success rates at nesting beaches to obtain a measure of site productivity. Nest management would involve utilizing strict and well-defined protocols to identify and relocate nests laid in erosion prone areas to maximize hatchling production.

To alleviate impacts from predators at nesting sites (e.g. feral dogs/cats, pigs, raccoons, iguanas), management efforts would include the protection of hatchling and/or nest from predators by either *in-situ* management (i.e., construction of protective structures around, near or over non-relocated nests, fences, placement of grates/cages, etc.), or relocation of nests to hatcheries to maximize hatchling production (site specific methods to be identified by the implementing organization). Nesting beach protection would be achieved by education and outreach initiatives provided to the local community to reduce anthropogenic impacts, by the presence of beach monitors conducting nightly census/monitoring patrols, and by the relocation of nests destined for certain (100%) mortality due to beach erosion impacts.

2.1.4 Alternative 4 - Education and Outreach, Census Patrols, Research Monitoring, Nesting Beach Management, and Bycatch Mitigation (Preferred Alternative)

This alternative would consist of community education and outreach, census patrols, research monitoring, nesting beach management, predator mitigation, and bycatch mitigation utilizing strict and well-defined protocols. Monitoring would include research efforts consistent with stringent protocols for tagging turtles and collecting biological information (e.g., measurements) at nesting and foraging sites, and quantifying hatching success rates at nesting beaches to obtain a measure of site productivity. Nest management would involve utilizing strict and well-defined protocols to identify and relocate nests laid in erosion prone areas to maximize hatchling production. Predator mitigation would include protection of hatchlings and/or nests from predators by either *in-situ* management or relocation of nests to hatcheries to maximize hatchling production. Additional nesting beach protection would be achieved by education and outreach initiatives provided to local community to reduce anthropogenic impacts, by the presence of beach monitors conducting nightly census/monitoring patrols, and by the relocation of nests destined for certain (100%) mortality due to beach erosion impacts.

Bycatch mitigation would involve testing of alternative gear or fishing methods known to or predicted to reduce sea turtle bycatch, testing of other mitigation technology (e.g., deterrents such as illumination of gear and use of shark shapes), and education and outreach to fishers and local communities to gain support for bycatch reduction. Other projects directed at understanding sea turtle bycatch issues would involve necropsies of dead stranded sea turtles and monitoring of certain fisheries.

2.1.5 Rationale for Components of the Preferred Alternatives

Rationale for the proposed activities under Alternative 4 are provided in the following sections. Alternative 4 addresses existing threats to sea turtle populations interacting with longline fisheries based in Hawaii and American Samoa. Mitigation of threats at both nesting and in-water habitats are necessary for the effective recovery of sea turtle species (Eguchi 2009)

2.1.5.1 Education and Outreach

Environmental education and outreach is the first level of any conservation or management program. An integrated education and outreach campaign is an essential element to protect nesting beaches and eggs/turtles from harvest or poaching (Brewer 2002; Marcovaldi and Thome 1999). The information provided through education enables individuals or the community to self-regulate their actions by providing them with the essential knowledge to make educated choices regarding resource utilization (Marcovaldi and Thome, 1999). For the success of a project, community involvement and support is essential. Without an integrated education program provided to the local community, conservation efforts become moot. The best and perhaps only way to solidify support from the local community, promote self-regulation, and maintain long-term conservation ethics is through education, outreach and awareness-raising activities (Marcovaldi and Thome, 1999; Marcovaldi and Marcovaldi, 1999; Nichols et al., 2003).

In general, educational materials provide information regarding the turtle's life history, status, biology, ecology, and migratory capabilities. This information allows an individual and the local community to make educated decisions regarding resource use, and empowers communities to care for their environment and sea turtles. Many programs have implemented creative methods to provide awareness such as through theater groups, dance and story telling, festivals, art competitions, posters, and comic books (Brewer, 2002; Dunais, 2000; Godfrey, 1998; Marcovaldi and Thome, 1999; Marcovaldi and Marcovaldi, 1999; Nichols et al., 2003; Petro, 2002;Velasco, 2000).

2.1.5.2 Census Patrols

Nesting beach surveys (or census patrols) are the most widely implemented monitoring tool in use by the global sea turtle community and are an important component of a comprehensive program to assess and monitor the status of sea turtle populations (Schroeder and Murphy, 1999). Assessments are necessary to evaluate the effects of recovery and conservation activities, and provide information on the number of nests deposited annually, the number of nesting females that are annually reproductively active, and the annual beach productivity (Chaloupka and Musick, 1997). Monitoring provides the ability to document and quantify impacts and/or threats to effectively manage a nesting stock by providing the information necessary to address anthropogenic impacts from beach use or harvest/poaching, and reduce threats from predation and/or beach dynamics such as erosion from tidal movements or storms. Additionally, beach monitoring or census patrols can provide protection from beach-related threats such as harvest/poaching or predation based on the nightly presence of personnel.

2.1.5.3 Research Monitoring: Turtle Handling Methods

Research activities inevitably involve handling of an animal (tagging, measuring, clutch relocation, or hatchling release). Thus studies must ensure that benefits of the research outweigh the costs inflicted upon the research subjects (Richardson 1999). There are specific techniques and strict handling requirements or protocols associated with sea turtle research. Strict handling protocols are specific to turtles in general and universal in nature, meaning that regardless of geographic location, any turtle or egg must be handled in the same careful way (Bolten, 1999, Balazs, 1999). Furthermore, there are species-specific, well defined and accepted protocols associated with soft shelled turtles (leatherback turtles) and hard shelled turtles. Only projects utilizing these rigorous handling protocols as described in the comprehensive guide to turtle research and conservation (IUCN, 1999) will be considered for funding under the Council's sea turtle program. Research methods involve the tagging and measuring of turtles.

2.1.5.3.1 Tagging Sea Turtles

Tagging has been the single most valuable activity in advancing the understanding of sea turtle population dynamics. Long-term, saturation tagging and monitoring of a nesting beach population for many years provides an opportunity for measuring recruitment, annual survival, population size, and population trends over time (Chaloupka and Musick, 1997). Studies indicate that there are no adverse effects to sea turtles due to tagging (Balazs, 1999).

Mark-recapture techniques (such as tagging) are an effective tool for estimating abundance in wildlife studies. Turtles, specifically, are tagged to achieve the recognition of individuals or cohorts for research purposes. Tagging turtles, with flipper tags or internal passive integrated transponders (PIT) tags, is widely used in sea turtle studies to obtain valuable information on reproductive biology, growth rates, movement, residency, strandings, and population dynamics (Balazs, 1999). Current technologies for tagging are, however, less than perfect. For example, tag retention can be highly variable (Balazs, 1982). Thus the first goal of a tagging program must be to minimize tag loss to ensure that recognition is retained while not causing any lasting harm to the turtle from the tagging process. The second goal is to measure the extent of tag loss in order to correctly interpret resulting data and to adjust tagging techniques accordingly.

Tagging of sea turtles is defined as the external attachment (to the flippers) of a metal or plastic tag inscribed with numbers and words, or the insertion into the body of a wire tag or microprocessor (PIT tags) that can be detected with a electronic device (see Balazs, 1999 for specific methods and techniques for applying external tags or PIT tags).

Tagging location: External tags used on the front flippers should always be attached at the proximal location (e.g., piercing site is proximal of and adjacent to the first large scale on the posterior edge of the flipper), where swimming strokes will cause minimal up and down movement of the tag (Balazs 1999). Tags have also been applied with success to the hind flippers of turtles (e.g., piercing site is proximal of and adjacent to the first large scale).
PIT tags can be inserted into the shoulder muscle of a sea turtle or under the scales or between the digits of a front or hind flipper. Given that leatherback turtles have a higher rate of conventional tag loss than hard shelled species, PIT tagging has become the preferred tagging method for leatherback turtles (McDonald and Dutton, 1996).

When to tag: The decision of when to tag relates mainly to nesting females. To the extent possible, a turtle emerging to nest should be allowed to lay its eggs before any handling takes place. The best time to tag is immediately after egg deposition when back filling of the egg chamber starts with the hind flippers (Balazs, 1999).

2.1.5.3.2 Measuring Sea Turtles

Sea turtles are measured to accomplish a number of objectives, and there are many techniques and equipment options. To summarize, sea turtles are measured on nesting beaches to relate body size to reproductive output, to determine minimum size at sexual maturity, and to monitor nesting female size for a particular rookery (Bolten, 1999). The size frequency of a population is an important parameter of that population's demographic structure, and analysis of growth rates can indicate habitat quality and physiological status. There are no adverse affects to sea turtles due to measuring (Bolten, 1999).

Measurements: Five standard measurements for turtles are possible: carapace length, carapace width, tail length, head width, and plastron length. For many studies, carapace length may be the only measurement needed. Linear measurements can either be taken with calipers (straight-line measurements) or with a flexible tape measure (curved measurements). The decision is one of accuracy, precision, cost and convenience. Bolten (1999) recommends that projects use the strait carapace length (SCL) rather than the curved carapace length (CCL). Additionally, measurement techniques for leatherback versus hard shelled species are slightly different due to carapace differences. See Bolten (1999) for a detailed description of measurement locations on the turtle.

When to measure: The decision of when to measure relates mainly to nesting females. To the extent possible, a turtle emerging to nest should be allowed to lay its eggs before any handling (tagging or measuring) takes place. The best time to tag and then measure is immediately after egg deposition when back filling of the egg chamber starts with the hind flippers (Balazs, 1999; Bolten, 1999).

2.1.5.4 Nesting Beach Management

Eggs and hatchlings are subject to a number of threats from beach erosion, storms, tidal inundation, temperature, native predators, non-native predators, human activities (from beach use, foot traffic), poaching, and coastal development (Carthy et al., 2003). Management of the nesting site must include management of embryos via their eggs. The best conservation action on the nesting beaches is to leave eggs *in-situ* and to reduce the impacts of predators and poachers (Miller, 1997). However, in certain circumstances, the shifting of eggs to protect them from inundation, predators, or poachers is more effective.

There are at least four response categories to mitigate impacts that threaten nesting beach habitats (Witherington, 1999). The first and best response is to eliminate the threat; for example, restricting sand mining or prohibiting beach driving. A second response is risk reduction, which reduces the probability of a threat occurring or reducing the negative effects of a threat when it does occur. Examples include response to an oil spill, or application of "turtle friendly" beachfront lighting. The third response is risk mitigation. An example is moving eggs from high risk areas to safer natural beach areas or to enclosed hatcheries. The fourth response is to do nothing. If threats either cannot be eliminated or threaten too few nests to justify costly management efforts, this response may be appropriate.

Nesting beach management measures addressed in this document (and by the relevant conservation projects) pertain specifically to methods to reduce environmental impacts through nest relocation, and measures to reduce anthropogenic and predator impacts.

2.1.5.4.1 Nest Relocation

Beach erosion and accretion are natural processes. When these processes become extreme during the nesting season, females can experience difficulty in nesting and eggs can be uncovered, inundated or swept away, resulting in up to 100% mortality of laid clutches. Extreme erosion can occur during storm events, during periods of high wind or when the placement of man-made structures (such as jetties, breakwaters, beach armoring, etc.) modify the natural movement of sand along the coastline. Although the natural events that cause erosion and accretion cannot be stopped, their consequences can be lessened thereby maximizing hatchling production (Bjorndal, 1982; Dutton and Whitmore, 1983; Mortimer, 1999; Witherington, 1999; IUCN, 1999).

The preferred option is always the least manipulative, namely *in-situ* management. As a general rule, however, relocation can be considered for nests laid below the mean high tide line, washed daily, or if they are situated in well documented high-risk areas that routinely experience serious erosion and egg loss (Bjorndal, 1982; Blanck and Sawyer, 1981; Carthy et al., 2003; Dutton and Whitmore, 1983; Mortimer, 1999; Witherington, 1999; Wyneken et al, 1988). The literature does not define when a relocation program should be implemented to alleviate erosion impacts (for example, when 50% clutch mortality is reached), but many resource managers believe that to maintain a healthy nesting population, at least 70% of the clutches laid should be protected (Mortimer, 1999). Consequently, there are stringent protocols associated with the relocation of clutches (Boulon, 1999; Bjorndal, 1982; Carthy et al., 2003; Mortimer, 1999; IUCN, 1999).

Care should be taken not to overestimate the consequences of natural threats such as erosion or seasonal storms, even with the understanding that turtles have evolved to sustain a high mortality of eggs. It is reasonable to assume that the selective pressures of these threats on sea turtles have shaped biological mechanisms to mitigate them and that a nesting location that seems risk-prone may actually provide a fitness advantage to developing hatchlings (Witherington, 1999). Additionally, moving eggs has been criticized to have negative effects including reduced hatching and emergence success, altered hatchling sex ratios, and reduced hatchling fitness (Limpus et al., 1979; Godfrey and Mrosovsky, 1999; Witherington, 1999; Siegal and Dodd, 2000). For these reasons, nests should be relocated only as a last resort.

Although there are studies that indicate that the relocation of nests may lower hatching success rates, when loss of eggs due to poaching, predation, and erosion is included as part of the total estimate of *in-situ* egg survival, relocated nests may have a much higher survival probability on many beaches (Grand and Beissinger, 1997; Garcia et al., 2003). Additionally, with proper handling and management intervention, hatching success rates of relocated nests can be quite successful (WPRFMC, 2005). For example, relocated leatherback nests at Sandy Point, St.

Croix had a nest hatch success of 60.4%[1] compared to *in-situ* nests of 67%[2] (Dutton et al., 1996). Arguably, in cases where the population has already suffered a history of over-exploitation (such as that for leatherback turtles in Papua and PNG), or consistently experiences extreme egg loss due to erosion (such as in Papua and Japan) management intervention must be implemented which promotes 100% of clutch protection in an effort to maximize hatchling production (Dutton and Whitmore, 1983; Mortimer, 1999; WPRFMC, 2005).

Collection and transport: There are stringent handling protocols associated with the collection and transport of nests. Moderate movement or rotation does not adversely affect eggs for approximately the first 12 hours after they are laid (Carthy et al., 2003; Miller, 1997). To minimize embryonic mortality from handling, eggs should be replanted within two to four hours of being laid (Mortimer, 1999; Miller, 1997). Nests can be excavated after the nesting turtle has returned to the sea, or collected during oviposition. Eggs should then be carried, either by hand or in a sack, to the new nest site (see Mortimer, 1999 for detailed description of egg collection and transport).

Reburial: In general, natural nest depth should be measured and duplicated. Clutches should be reburied in a site with a microhabitat approximating its natural nest (Carthy et al., 2003). The new site should provide adequate moisture, gas exchange, and a similar temperature regime to support the developing embryos (Miller, 1997). If nests are relocated to a hatchery, nests should be placed at least one meter apart to minimize their impact upon one another and to allow room for hatchery caretakers to move about (Mortimer, 1999). Nests should be constructed in the shape of a flask or urn, with a rounded bottom and a straight narrow opening leading from the egg chamber to the surface (the top of the reburied eggs should measure approximately 8 to 12 cm below the surface). Again, there is stringent protocol associated with physical reburial of clutches. Namely, eggs should be hand placed gently into the nest one or two at a time; eggs should not be "poured" into the nest (see Mortimer, 1999 for detailed description of egg reburial).

2.1.5.4.2 Reducing Anthropogenic Impacts on Nests

Anthropogenic impacts to nesting beaches originate from direct human activities on and around them, including lights (from cities, structures or vehicles), vehicular activity on a beach or foot traffic, which have the potential to expose or crush eggs or to interfere with the ability of hatchlings to reach the sea or adults to nests (Boulon, 1999). Vehicles can deeply penetrate soft sand leaving ruts that can entrap hatchlings, crush nests or compact sand preventing hatchlings from surfacing.

During the nesting season, vehicular and foot traffic on the beach should be minimized and when possible, eliminated. The best and most effective means to reduce and/or eliminate impacts at nesting beaches originating from human use or foot traffic is to place physical barriers (such as ropes or yellow tape) to restrict human access (Boulon, 1999).

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[1] Relocated clutches are those which would have been lost to erosion, and would have resulted in 0% mortality.
[2] *In-situ* clutches were those that did not need to be relocated because they had been laid by the mother in safer areas, not threatened by erosion impacts.

2.1.5.4.3 Reducing Predator Impacts on Nests

Small mammals, birds, lizards, frogs, crabs, and insects are known predators of unhatched turtle eggs in many parts of the world (Baran and Turkozan, 1996; Baran et al., 2001; Broderick and Godley, 1996; Broderick and Hancock, 1997; Brown and Macdonald, 1995; Leslie et al., 1996; Maros et al., 2003; Stancyk, 1980; Yerli et al., 1997). Some predators, such as wild pigs or dogs, may be dissuaded by the presence of research personnel, and most small mammals and predatory birds are reticent to act in the presence of humans (Boulon, 1999). But often, more rigorous methods are necessary to alleviate impacts from predators (Stancyk, 1982).

Depredation of turtle eggs generally involves the predator digging into a freshly laid nest (usually within the first four days of being laid) or predating on newly hatched hatchlings as they emerge from the nest and are entering the ocean. Predator control may encompass a variety of techniques including the presence of researchers or surveillance personnel on the nesting beach, the construction of protective barriers (cages, grates, fences, etc.), relocation of eggs into a hatchery where they can be appropriately monitored, and predator removal (Stancyk, 1982). Some methodologies may be worth pursuing if depredation constitutes a serious threat; that is, a threat well beyond the natural cycles of the food web (Boulon, 1999). To maintain a healthy nesting population, at least 70% of the clutches laid should be protected (Mortimer, 1999). If predation impacts are determined to be a major impact to the nesting population, management efforts should be considered and implemented (Bjorndal, 1982; Boulon, 1999; Engeman et al., 2003; Limpus and Limpus, 2003; Mortimer, 1999; Stancyk, 1982).

The placement of bamboo grids over nests, placement of wire or rigid plastic mesh just below (and parallel to) the sand surface, or formed as a predator proof cage over and encircling the nest, can deter nest excavation by small mammals (Boulon, 1999; Pilcher, 2008; Stancyk et al., 1980). Mesh size should be small enough to prevent access by the predator, yet large enough to allow the passage of hatchlings to the surface. This method works best if the beach is actively monitored to assist any hatchlings that may inadvertently become trapped by the mesh. However, in some cases, cages have been found to attract predators by identifying nests (Mroziak et al., 2000). Thus some studies have implemented (Engeman et al., 2003; Limpus and Limpus, 2003) or recommend (Mroziak et al., 2000) trapping programs to reduce unwanted pests (see Boulon, 1999 and Stancyk, 1982 for detailed description of predator mitigation methods).

2.1.5.5 Bycatch Mitigation

Incidental captures of sea turtles in fisheries is one of the greatest human-induced mortality for sea turtles (Lutcavage et al., 1997). While significant efforts have been made to successfully mitigate sea turtle bycatch in Hawaii longline fisheries, concerns remain with bycatch occurring in nesting and foraging habitats of loggerhead and leatherback turtles in the North Pacific as well as green turtles around American Samoa. Effective mitigation strategies are highly dependent on factors such as the type of fisheries, type of gear, available legal frameworks, and the local socioeconomic context. As such, a single, most effective approach to mitigation does not exist.

Due to the specificity of gear and interaction types, bycatch mitigation requires steps including, but not limited to, assessment of fisheries, regulatory frameworks, and socioeconomic structures, determination of potential solutions, experimental and commercial testing of modified gear or mitigation technologies, and implementation of modified gear or mitigation technologies (Gilman, 2009). In addition, collaboration with local fishers as well as education and outreach efforts are considered critical in successful bycatch mitigation (Gilman, 2009).

In longline fisheries, loggerhead turtle interactions occur mainly in the form of mouth-hooking, when turtles attempt to forage on baited hooks (Snover, 2008). With leatherback turtles, interactions are mostly external hookings, with very few cases of hooking in the mouth. The use of large circle hooks have been shown in a number of fisheries domestically and internationally to significantly reduce sea turtle interactions (e.g., Gillman et al., 2007; Hall, 2008). In Hawaii-based longline swordfish fishery in particular, the uses of circle hooks and mackerel bait have reduced sea turtle interaction rates by 85 to 90 percent (Gillman et al, 2007). Setting longline at certain depths where turtles are less commonly found has also been suggested as a mitigation method.

In the American Samoa-based longline fishery, green turtle interactions resulting in mortalities have been reported by onboard observers. To continue the longline fishery with the least impact to green sea turtle stocks, the Council recently proposed a regulation to require hooks to be set below 100 meters of the surface in the American Samoa longline fishery to avoid hooks to be set in depths where most sea turtle interactions occur. The use of 16/0 or larger circle hooks was also considered in the alternatives but was not included in the preferred alternative, as the impacts on target albacore catch for the American Samoa longline fishery are unknown. The Council will contract with the Secretariat of the Pacific Community (SPC) under the technical advisory of the Pacific Islands Fisheries Science Center (PIFSC) to carry out experimental trials to test the effectiveness of large circle hooks on target albacore catch rates for the longline fishery in American Samoa. Larger circle hooks have been previously shown to reduce sea turtle catch rates compared to smaller circle hooks or other conventional hooks (e.g., Gillman et al 2007; Hall 2008), ensuring that any sea turtle interactions that may occur during field trials would not exceed what occurs using existing conventional gear. Trials will be conducted for approximately 65,000 experimental hooks in approximately 50 sets, which equals to 1-2 longline trips. This amounts to less than 0.5% of the hooks set in the American Samoa longline fishery in 2009 (approximately 15 million hooks), and thus the potential for sea turtle interactions during the experimental trials are very low. Trials will also use existing longline vessels, and thus will not increase total fishing effort.

Gear types and interactions are much more complex for the types of coastal, static net fisheries commonly used in Mexico and Japan. The most commonly used gear types include gillnets and pound nets, where turtles may become entangled or trapped. Some gear modifications that have been tested with possible effectiveness in reducing sea turtle bycatch while maintaining target fish catch include reduced mesh profile in pound nets, lowered profile in several gillnet fisheries, net illumination in gillnet fisheries, and buoy-less nets in gillnet fisheries (Gilman, 2009). In particular, bouy-less gillnet trials in Baja California Sur, Mexico have shown promising results in potentially reducing loggerhead bycatch, although the study was lacking in statistical power due to the small sample size (Peckham et al., 2009). Additional trials are underway in Mexico to further test the effectiveness of the modified gillnet gear. These trials are designed to test the nets in pairs, with half of the conventional nets replaced with modified gillnets designed to reduce interactions. Sufficient number of sets to achieve statistical power is included in the design, but the total number of sets in the fishery including the experimental trials will not exceed that of the previous year.

Projects shall also follow proper post-interaction handling protocols as developed and recommended by NMFS for any turtles captured during experimental and commercial trials. Fishing gear will be checked as often as feasible to reduce the potential for adverse impacts. Sea turtles that are entangled or hooked in fishing gear will be released immediately on site. If turtles are captured and encountered in a comatose state, resuscitation will be attempted as per NMFS handling protocol to resuscitate comatose turtles.

To further investigate bycatch related issues in several locations, the Council will fund necropsy studies in areas of where dead stranded sea turtles are known to occur. Thorough examination of carcasses and subsequent laboratory tests of preserved tissue allows systematic evaluations of potential causes of sea turtle mortality (Work, 2000). Standard techniques for safe handling of sea turtle carcasses have been established (e.g., Flint et al.., 2009; Wolke & George, 1981; Work, 2000) and would be followed for the safety of the researcher and the public.

2.1.6 Summary of Proposed Project Locations

The activities in Alternative 4 are proposed at nesting and foraging habitats of North Pacific loggerhead and Western Pacific leatherbacks, in-water habitat of green turtles around American Samoa, and associated communities in multiple international locations. Activities at nesting beaches will take place at the following locations: Huon Coast, PNG; Western Papua, Indonesia; and Japan (Kagoshima, Miyazaki, and Wakayama Prefectures). Activities at in-water habitats will take place at the following locations: Baja California Sur, Mexico; American Samoa; and Japan (Table 5). In the future, the Council's Sea Turtle Advisory Committee may recommend additional locations or projects. Bycatch mitigation projects that may occur over the five-year grant period and which are not described in detail in this EA may need additional analysis before implementation.

Table 5: Proposed project locations and target species for activities included in Alt. 4

Activity	Proposed Locations	Target Species
Education and Outreach	Japan (Major nesting areas, including Kagoshima, Miyazaki, and Wakayama Prefectures)	Loggerhead
	Papua, Indonesia	Leatherback
	Huon Coast, PNG	Leatherback
	Baja California Sur, Mexico	Loggerhead
Census Patrols, Research Monitoring, and Nesting Beach Management	Japan (Major nesting areas, including Kagoshima, Miyazaki, and Wakayama Prefectures)	Loggerhead
	Papua, Indonesia	Leatherback
	Huon Coast, PNG	Leatherback
Bycatch Mitigation	Baja California Sur, Mexico	Loggerhead
	Japan	Loggerhead
	American Samoa	Green

CHAPTER 3: AFFECTED ENVIRONMENT

The Council's sea turtle conservation program's primary concerns are the North Pacific loggerhead turtles, Western Pacific leatherback turtle, and American Samoa green turtles. The following sections provide descriptions of the biological and socioeconomic environment affected by the proposed action.

3.1 Biological Environment

3.1.1 Reproductive Biology of Sea Turtles

Successful reproductive activity for marine turtles ensues when conditions are conducive to adult activity, and during conditions which facilitate embryonic development and survival (Miller, 1997). The major aspects of reproduction are very similar among the seven species of sea turtles as a result of similarities in both morphological and ecological constraints. The places and conditions under which sea turtles nest are also very similar; they must have access to beaches with deep, loose sand that are above high tide, the substrate must facilitate gas diffusion, and the substrate must be moist and fine enough to prevent collapse of the egg chamber during construction.

Once a turtle has returned to the region of its birth and selected a nesting beach, it will tend to renest in relatively close proximity (0 to 5km) during subsequent nesting attempts within that nesting season. During a nesting season, a turtle will lay between two and nine clutches per season, depending on the species and the individual turtle (see Table 3.1 in Miller, 1997). The duration of time between reproductive seasons is defined as the remigration interval. The mean remigration interval for a female sea turtle varies among species, but in general, the range in remigration interval is from one to nine years (see Table 3.1 in Miller, 1997). The timing of reproduction follows behind periods of ample food during which the turtles accumulate fat reserves (one to several years), complete vitellogenesis (10 to 12 months) and migrate to the breeding and nesting areas (a few days to a few months).

Nesting Activity: According to Miller (1997), it is not obvious why a population of sea turtles or an individual sea turtle uses a particular beach. However, the result of beach selection and nest site selection is that the eggs incubate in a microenvironment in which eggs develop in a low-salinity, high-humidity, well ventilated substrate which is not inundated during development. The general nesting process is essentially the same in all species of sea turtles: 1) ascending the beach, 2) excavating the body pit, 3) digging the egg chamber, 4) ovioposition, 5) filling the egg chamber, 6) filling the body pit, and 7) returning to the sea.

During the nesting season, a turtle may abort nesting any number of times, either by crawling up but then returning to the sea for no apparent reason (termed "false crawl"), or abort digging the nest chamber (termed "false pit"). Whatever the reason(s) for aborting the nesting attempt, the turtle usually returns to nest the same night or the following night, and most return to the same beach (Miller, 1997).

All sea turtles prepare the nest site to varying degrees before digging the egg chamber. The surface debris is removed by either simultaneous or alternating sweeps of the front flippers. As the area in front of the turtle is cleared the turtle "swims" forward onto the cleared substrate. The hind flippers may be used to clear loose, dry substrate from immediately behind the turtle. The depth of the body pit is related to the dryness of the surface sand and to the size of the turtle. Turtles use their hind flippers to excavate a flask-shaped chamber that has a narrow neck and a wider bottom. At first, the nesting turtle scrapes and flicks sand away from the area where the chamber will be: then it begins to scoop sand from under its posterior using the ventral portion of each hind flipper alternatively. The cup full of sand is placed to the side of the chamber area and the flipper is quickly placed on top of it. The other flipper then flicks sand away from the area immediately under it, and then removes another cup full of sand, and so on until the chamber is completed. This process ensures that during the filling-in process, the sand placed on top of the eggs is moist sand that originated from the chamber as it was dug. Eggs are laid singly or in groups of two or three. Once oviposition is complete the nest chamber is filled in, usually by scraping moist sand from near the opening into the hole with the hind flippers, until the sand above the chamber is higher than the floor of the body pit.

Nest Environment: Sea turtles are characterized by temperature dependent sex determination. The conditions within the nest environment must be within the limits of embryonic tolerance in three areas: gas exchange, moisture and temperature (Miller, 1997; Ackerman, 1997). Marine turtle eggs are very sensitive to desiccation and inundation for extended periods of time (hours) results in increased mortality (Ackerman, 1997). The sex of the hatchling is determined during the middle third of the incubation period by the temperature of the nest (Miller, 1985). Sexual differentiation of embryos is determined by species-specific pivotal temperature, but temperatures, either too high (generally above 33°C) or too low (generally below 23°C) can be lethal (Ackerman, 1997). In general, the reported pivotal temperature occurs over a relatively narrow temperature range from approximately 27.7 to 31°C (Wibbels, 2003). The length of incubation period will vary among species and within nesting beaches, however, typically a clutch will incubate between 50 and 70 days (Mrosovsky and Yntema, 1982). Within the range of 26 to 32°C, a change of 1°C adds or subtracts about five days to the incubation period (Mrosovsky and Yntema, 1982).

3.1.2 Leatherback Sea Turtles

General Distribution

Leatherback turtles are widely distributed throughout the oceans of the world. The species is found in four main regions of the world: the Pacific, Atlantic, and Indian Oceans, and the Caribbean Sea. Leatherbacks also occur in the Mediterranean Sea, although they are not known to nest there. The four main regional areas may further be divided into nesting aggregations. Leatherback turtles are found on the western and eastern coasts of the Pacific Ocean, with nesting aggregations in Mexico and Costa Rica (eastern Pacific) and Malaysia, Indonesia, Australia, Vanuatu, the Solomon Islands, Papua New Guinea, Thailand, and Fiji (western Pacific). In the Atlantic Ocean, leatherback nesting aggregations have been documented in Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida. In the Caribbean, leatherbacks nest in the U.S. Virgin Islands, Puerto Rico, and Costa Rica. In the Indian Ocean, leatherback nesting aggregations are reported in India and Sri Lanka.

Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Morreale et al. 1994, Eckert 1998, Eckert 1999). Leatherbacks have the widest distribution of sea turtles, nesting on beaches in the tropics and sub-tropics and foraging into higher-latitude sub-polar waters. They have evolved physiological and anatomical adaptations (Frair et al. 1972, Greer et al. 1973) that allow them to exploit waters far colder than any other sea turtle species would be capable of surviving. In the Pacific, they extend from the waters of British Columbia (McAlpine et al. 2004) and the Gulf of Alaska (Hodge and Wing 2000) to the waters of Chile and South Island (New Zealand), and nesting occurs in both the eastern and western Pacific (Marquez 1990, Gill 1997, Brito 1998). Leatherbacks undergo extensive migrations to and from their tropical nesting beaches. In a single year, a leatherback may swim more than 10,000 kilometers (Eckert 1998).

Saba et al. (2007) summarized that satellite tracking studies of post-nesting females at Las Baulas, Costa Rica suggest that the turtles follow a southwestern migration corridor along the Cocos Ridge towards the Galapagos Islands (Morreale et al. 1996, Shillinger et al. 2006), followed by an open migration through the eastern equatorial Pacific, the Chile-Peru Humboldt Current System, and the far off-shore waters of Peru and Chile (Shillinger et al. 2006).

In the western Pacific, satellite telemetry work has demonstrated migrations of leatherbacks nesting in Papua, Indonesia, to the waters of the Philippines and Malaysia, into the Sea of Japan, and across the equatorial Pacific to temperate waters off North America (Benson, Dutton, & Hitipeuw et al 2007). Western Pacific leatherbacks nesting during the northern summer (Jun-Aug) in Papua, Indonesia go northeast to productive temperate waters off of the west coast of the U.S (Benson, Dutton, & Hitipeuw et al 2007). In contrast, leatherbacks nesting during the northern winter (Nov-Mar) in Papua migrate southeast after nesting, towards Australian and New Zealand waters (Benson, Dutton, & Hitipeuw et al 2007). Additionally, leatherbacks nesting in PNG have also been documented to migrate southeast after nesting (Benson, Kisokau, & Ambio et al 2007). The north Pacific foraging grounds have animals from both the eastern and western Pacific rookeries (Dutton et al. 1998, 2000; Dutton 2005, 2006), although leatherbacks from the eastern Pacific generally forage in the southern hemisphere in the waters of Peru and Chile (Dutton 2005, 2006). Four of 14 leatherbacks from the western Pacific have also been reported from Chile (Donoso et al. 2000, Dutton 2005, 2006). Based on stable isotope analysis, Paddock et al. (2007) suggested that leatherbacks nesting in Papua, Indonesia, and Papua New Guinea forage in the western Pacific and the eastern Pacific. Leatherbacks tracked from Monterey Bay, California, moved southwest, and one turtle was tracked across the Pacific to north of Papua, Indonesia (Eckert and Dutton 2001, Dutton et al. 2006).

Size and Identification

Leatherback turtles are the largest of the marine turtles, with a curved carapace length (CCL) often exceeding 150 cm and front flippers that are proportionately larger than in other sea turtles and may span 270 cm in an adult (NMFS and USFWS 1998a). The leatherback is morphologically and physiologically distinct from other sea turtles. It has a streamlined body, with a smooth, dermis-sheathed carapace and dorso-longitudinal ridges which may improve laminar flow of this highly pelagic species. Adult females nesting in Michoacán, Mexico averaged 145 cm CCL (Sarti, unpublished data, in NMFS and USFWS 1998a), while adult female leatherback turtles nesting in eastern Australia averaged 162 cm CCL (Limpus, et al., 1984, in NMFS and USFWS 1998a). Satellite telemetry studies indicate that adult leatherback turtles follow bathymetric contours over their long pelagic migrations and typically feed on cnidarians (jellyfish and siphonophores) and tunicates (pyrosomas and salps), and their commensals, parasites and prey (NMFS and USFWS 1998a).

Age at Maturity

Recent studies (skeletochronological data based on scleral ossicles) suggest that leatherbacks in the western North Atlantic may not reach maturity until 29 years of age (Avens et al 2009). This new data may contradict earlier leatherback age at maturity estimates. Pritchard and Trebbau (1984) estimated 2-3 years, Rhodin (1985) estimated 3-6 years, Zug and Parham (1996) estimated average maturity at 13-14 years for Western Pacific leatherback females, and Dutton et al. (2005) estimated 12-14 years for leatherbacks nesting in the U.S. Virgin Islands. Age at maturity remains a very important parameter to be confirmed as it has significant implications for management and recovery of leatherback populations.

Survivorship

Reliable estimates of survival or mortality at different life history stages for leatherbacks are not easily obtained. The annual survival rate for leatherbacks that nested at Playa Grande, Costa Rica, was estimated to be 0.654 for 1993-1994 and 0.65 for those that nested in 1994-1995 (Spotila et al. 2000). Rivalan et al. (2005) estimated the mean annual survival rate of leatherbacks in French Guiana to be 0.91. The annual survival rate was approximately 0.893 (confidence interval = 0.87-0.92) for female leatherbacks at St. Croix (Dutton et al. 2005). For the St. Croix, U.S. Virgin Islands, population, the average annual juvenile survival rate was estimated to be approximately 0.63, and the total survival rate from hatchling to first year of reproduction for a female hatchling was estimated to be between 0.004 and 0.02, given assumed age at first reproduction between 9 and 13 (Eguchi et al. 2006). Spotila et al. (1996) estimated survival in the first year to be 0.0625. The longest observed reproductive lifespan of 18 years has been reported from South Africa (Hughes 1996).

Genetics

Current data from genetic research suggest that Pacific leatherback stock structure (natal origins) may vary by region. Due to the fact that leatherback turtles are highly migratory and stocks mix in high seas foraging areas, and based on genetic analyses of samples collected by both Hawaii-based and west coast-based longline observers, leatherback turtles inhabiting the northern and central Pacific Ocean are comprised of individuals originating from nesting assemblages located south of the equator in the western Pacific (e.g., Indonesia, Papua New Guinea, Solomon Islands, and Vanuatu) and in the eastern Pacific along the Americas (e.g., Mexico, Costa Rica) (Dutton et al. 2000).

The declining eastern Pacific genetic population is likely more limited to foraging primarily in the southeastern Pacific. Genetic studies in Chile and Peru (Donoso et al. 2000; P. Dutton, NMFS, unpublished data) and telemetry studies (Morreale et al. 1996, Eckert and Sarti 1997) have indicated that leatherbacks foraging in the southeastern Pacific are primarily from the eastern Pacific nesting population. Shillinger et al. (2006) tracked leatherbacks at Playa Grande, Costa Rica, and found consistencies with earlier studies that suggested a leatherback "migration corridor" along the Cocos Ridge from Las Baulas National Park toward the Galapagos Islands (Morreale et al. 1996). One of the reasons put forth for the greater collapse of eastern Pacific populations compared to western Pacific populations is the difference in foraging strategies as demonstrated by satellite telemetry work, genetics, and tag returns. The large nesting population in Papua, Indonesia, in the western Pacific uses several foraging areas both near and distant, similar to behavior observed in Caribbean populations, whereas eastern Pacific populations have limited foraging areas that occur primarily in the southeastern Pacific (Dutton 2006).

Global Status

The leatherback sea turtle was listed as endangered throughout its global range on June 2, 1970. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982); that number is probably an overestimation as it was based on a particularly good nesting year in 1980 (Pritchard 1996). By 1995, the global population of adult females had declined to 34,500 (Spotila et al.1996). Pritchard (1996) suggested that the population estimates from Spotila et al. (1996) likely underestimated the actual population size as the data modeled in the time series ended with a particularly low nesting year (1994) while excluding nesting data from 1995, which was a high nesting year. In 2007, NMFS and the USFWS published their five year review of the status of leatherback sea turtles and concluded that the leatherback population should not be delisted or reclassified at this time (NMFS and USFWS 2007a).

Some populations are stable or increasing, but other populations for which information is available are either decreasing or have collapsed. For example, a recent population assessment of North Atlantic leatherbacks estimates a stable population of 34,000-94,000 adults, while eastern Pacific and Malasian populations have collapsed (NMFS and USFWS 2007a). In addition, there is uncertainty over the status of leatherback turtles in the western Pacific Ocean due to a lack of consistent and long-term monitoring and the challenges associated with working in the region. The available information is not sufficient to determine the status or trend of the leatherback population as a whole.

Populations Exposed to the Hawaii-based Longline Fishery

Based on genetic sampling from leatherback interactions (33 samples from 1995-2007) with the deep-set and shallow-set components of the Hawaii longline fishery 100 percent of the leatherback turtles (18 genetic samples) that interacted with shallow-set fishery originated from western Pacific nesting beaches (L. Smith, NMFS PIRO, pers. comm., July 2008). Although turtles could represent individuals from Indonesia (Jamursba-Medi or Wermon), Papua New Guinea, Malaysia (Terrenganu), the Solomon Islands, or Fiji, the abundance of the nesting aggregations in Indonesia relative to the small size of the other nesting aggregations suggests that the interactions between Indonesian leatherback turtles and the Hawaii-based longline fisheries are the most likely scenario.

One leatherback sample taken from an interaction with the deep-set fishery was found to be that of a leatherback that originated from an eastern Pacific nesting aggregation. This interaction occurred in the deep-set tuna fishery at 14° 48' N, 157° 19' W, which is well south of the area the shallow-set fishery occurs (L. Smith, NMFS PIRO, pers. comm., July 2008). This turtle could have been from a nesting aggregation along the coast of Mexico, Costa Rica, or Panama and research has suggested that turtles from these nesting aggregations may occur outside their normal range when oceanic phenomena like El Niño events prevent them from migrating south to the coasts of Peru and Chile. Several investigators who have followed leatherback turtles equipped with satellite tags have reported that leatherback turtles from the beaches of Mexico and Costa Rica migrate through the equatorial current towards the coasts of Peru and Chile (Eckert 1999; Marquez and Villanueva 1993; Morreale et al. 1994). Eckert (1999) suggested that EPO leatherback turtles migrate toward the coast of South America where upwelling water masses provide an abundance of prey.

Impacts and Threats

Anthropogenic threats to leatherback turtles include harvest of eggs and adults, human encroachment on nesting beaches (e.g., development or beach armoring), and incidental capture in fishing gear. A documented traditional harvest of leatherbacks occurs in the Kei Islands (Suarez and Starbird 1996, Lawalata et al. 2006). In addition, human activities create indirect impacts such as beach erosion exaggerated by nearby human development and egg predation by domestic and feral animals such as pigs and dogs. Low hatching success is characteristic of leatherbacks despite high fertility rates (reviewed in Bell et al. 2003), and low hatchling production has been confirmed by current research in Papua (Hitipeuw et al. 2007, Tapilatu and Tiwari 2007).

3.1.2.1 Leatherbacks of the Western Pacific

While there used to be a paucity of information regarding the Western Pacific population, significant new information has been acquired about the leatherback nesting population over the past few years (Dutton et al. 2007; Benson & Dutton et al. 2007; Benson & Kisokau et al. 2007; Hitipeuw et al. 2007; Kinan 2005). There is some evidence, including anecdotal information, suggesting that although there are indications of a long-term decline, this population has not been depleted to the extent found at other major rookeries in the Pacific (Hitipeuw et al. 2007).

Research has been conducted in the last several years to more thoroughly identify leatherback nesting beaches and estimate numbers of nesting animals in the western Pacific (Papua Indonesia, Papua New Guinea, Solomon Islands, and Vanuatu). At the *Western Pacific Sea Turtle Cooperative Research and Management Workshop* sponsored by the Council from May 17 -21, 2004, regional experts identified a total of 28 leatherback nesting sites for the western Pacific region, of which 21 were previously unknown or poorly documented (Dutton et al. 2007; Kinan, 2005). Leatherback turtle nesting among these 28 sites was estimated to be between 2,100–5,700 females nesting annually (Dutton et al. 2007). Dutton et al. (2007) and the Bellagio Blueprint (Worldfish 2004) highlight the need for continued nesting beach monitoring and protection at key leatherback turtle nesting sites in the western Pacific.

There has been uncertainty over the status of leatherback turtles in the western Pacific Ocean due to a lack of consistent and long-term monitoring and the challenges associated with working in the region. The global population assessment by Spotila et al. (1996) estimated the total nesting abundance of leatherbacks in the western Pacific at 700 females nesting annually. However, this is likely an underestimate given that current published information (Dutton et al. 2007) identified

28 nesting sites, 21 of which had never previously been identified, that were not included in Spotila's estimate. Dutton et al. (2007) estimates an approximate total of 5,000–9,100 leatherback nests are laid each by 2,700- 5,100 females per year among 28 identified beaches in the western Pacific, with approximately 75% of this nesting activity concentrated at four sites along the northwest coast (Bird's Head Peninsula) of Papua, Indonesia.

Malaysia

The catastrophic decline of the rookery at Terengganu, Malaysia is well documented (Chan and Liew 1996). The leatherback turtle population rapidly declined from over 3,000 nesters per year in the late 1960s to less than 20 per year by 1993. In recent years, only two or three leatherbacks nested each year (Liew 2002), with much of this decline attributed to systematic overharvest of eggs (Chan and Liew 1996).

Indonesia

The north Vogelkop coast (also known as Bird's Head Peninsula) in Papua, Indonesia is thought to support the largest leatherback nesting population in the Pacific (Hitipeuw et al. 2007). Jamursba-Medi is the principal known nesting site for leatherbacks on Papua, and is comprised of 3 black sand beaches (Wembrak, Warmamedi, and Batu Rumah) that together span 18 km of coastline. A second nesting site is located at Wermon, which consists of a 6-km beach about 30 km east of Jamursba-Medi and halfway between Welos Cape and Wau Village.

The rookery at Jamursba-Medi currently supports ca. 300–900 nesting females annually compared with about 1,000–3,000 before 1985 (not including nesting at Wermon) (Hitipeuw et al. 2007). Hitipuew et al. (2007) recorded 1,865–3,601 nests each season at Jamursba-Medi (compared to 13,000 nests recorded in 1984 by Bhaskar (1985) and as shown in Table 6), and 1,788–2,881 nests at Wermon laid between November 2002 and August 2004. There appears to be a declining trend since 1993 for the Jamursba-Medi nesting population (Table 6). Hitipuew et al. (2007) warn that previous population estimates should be interpreted with caution, because it is clear that Wermon is a sizable rookery that has been overlooked in the past, with as many nests laid on Wermon as on Jamursba-Medi in 2003–2004. It is unclear whether this represents a recent demographic shift or if there has always been this level of nesting on Wermon. Studies are ongoing to determine whether the Papuan leatherbacks consist of two demographically distinct nesting populations (i.e., one that nests primarily between October and March, and another that nests between April and October).

Table 6: Number of nests recorded at Jumursba-Medi, Papua, Indonesia from 1981-2004

Survey Period	Nests no.	Adjusted no. nests	No. estimated females[a]	Reference
Sept 1981	4000+	7143	1232–1623	Salm 1982
Apr-Oct 1984	13,360	13,360	2303–3036	Bhaskar 1985
Apr-Oct 1985	3000	3000	517–682	Bhaskar 1987
June-Sept 1993	3247	4091	705–930	J. Bakarbessy unpubl. data
June-Sept 1994	3298	4155	716–944	J. Bakarbessy unpubl. data
June-Sept 1995	3382	4228	729–961	J. Bakarbessy unpubl. data
Jun-Sept 1996	5058	6373	1099–1448	J. Bakarbessy unpubl. data
May-Aug 1997	4001	4481	773–1018	Lamuasa unpubl. data
May-Sept 1999	2983	3251	560–739	Teguh unpubl. data
Apr-Dec 2000	2264	2194	378–499	KSDA-YAL, unpubl. data
Apr-Oct 2001	3056	3056	527–695	Wamafma unpubl. data
Mar-Aug 2002	1865	1921	331–437	World Wildlife Fund 2003
Mar-Nov 2003	3601	2904	501–660	World Wildlife Fund 2003
Mar-Aug 2004	3183	3871	667–879	World Wildlife Fund 2003

[a] Number of females were estimated by dividing number of estimated nests by average number of nests/female reported by Dutton et al. (2000) (5.8 nests/female) and Sarti et al. (2000) (4.4 nests/female).

Betz and Welch (1992) reported large-scale egg harvest during the 1980s as the main reason for the declining nesting trend. Commercial exploitation of eggs at Jamursba-Medi Beach was relatively intense for many years, with eggs being harvested largely by fishermen from adjacent districts (Sorong, Manokwari, Biak, and North Maluku). For example, in 1984 and 1985, 4 to 5 boats were observed visiting the beach weekly and returning with 10,000–15,000 eggs per boat (Betz and Welch 1992). During the peak nesting season, the beaches would become crowded with temporary dwellings that housed egg collectors and traders. Commercial egg harvest has been effectively eliminated since beach monitoring was established in 1993.

Additionally, information on leatherback nesting is lacking for a large area of coastline stretching from Jamursaba-Medi to the border with Papua New Guinea (Dutton et al. 2007). Low density nesting is also believed to occur along western Sumatra (200 females nesting annually) and in southeastern Java (50 females nesting annually), although the last known information for these beaches is from the early 1980s (*in* Suarez and Starbird 1996, Dermawan 2002).

Papua New Guinea

The Huon Coast of the Morobe Province in Papua New Guinea (PNG) hosts 50% of leatherback nesting activity in PNG (Benson & Kisokau et al. 2007), and is among the largest population in the western Pacific, second only to West Papua, Indonesia (Dutton et al. 2007). The estimates of total nests laid annually at all the sites in the Huon Gulf range from 500 to 1,150 (Dutton et al. 2007). This range reflects the annual variability in nests and is based on preliminary data from 3 years of aerial surveys (S.R. Benson and V. Rei, unpubl. data, in Dutton et al. 2007). However, anecdotal information from Huon Coast villagers and nesting beach surveys undertaken in the 1980s (Hirth et al. 1993; Quinn and Kojis 1985; Bedding and Lockhart 1989) indicates a decline in leatherback nesting females over the past 20-30 years when compared with present nesting levels (Benson & Kisokau et al. 2007, Pilcher 2006). The nesting trends of leatherbacks along the Huon Coast are represented in Figure 1.

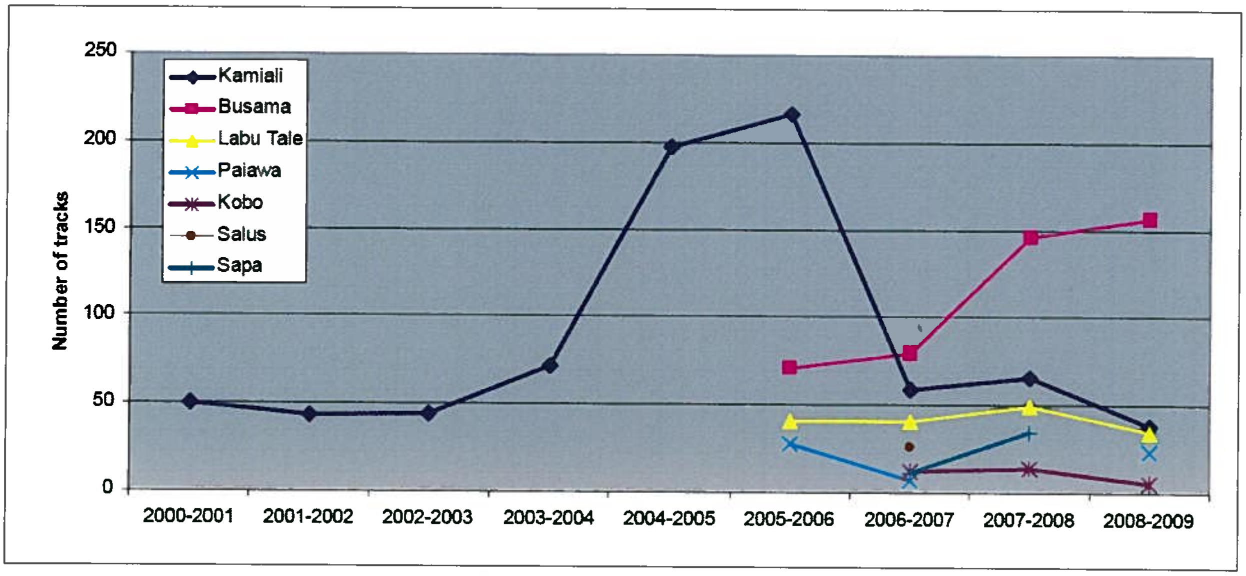

Figure 1: Nesting trends along the Huon Coast, PNG, 1999-2009
Note: Historical data only exists for Kamiali and for one additional season only at Busama, Labu Tale and Paiawa). Source: Pilcher 2009.

The first attempts to quantify leatherback nesting activity along the Huon Coast occurred in the Labu Tale and Busama village areas near the mouth of the Buang River in the early 1980s (identified as the Maus Buang site in subsequent literature). The approximate area surveyed during these initial investigations ranged from 725 meters (Hirth et al. 1993) to approximately 1-2 km (Quinn and Kojis 1985; Bedding and Lockhart 1989). These surveys resulted in population estimates of 1,200 to 300 females per year (Bedding and Lockhart 1989).

In January 2004, aerial surveys of 2,800 km of coastline in north PNG and New Britain Island were completed. A total of 415 nests were located, of which 71% were found within the Huon Gulf region. Within the Huon Gulf region only 29 percent of nests were located in areas other than the two nesting beaches of Kamiali and Maus Bang (also known as Baung Buassi). After applying a correction factor based on missed nests identified from beach walk surveys, the total estimate was 559 nests (Benson & Kisokau et al. 2007).

The Huon Coast Leatherback Turtle Conservation Project (HCLTCP) began at the Kamiali Wildlife Management Area (KWMA) in November 2003 and by late 2005 expanded to incorporate three additional communities of Labu Tale, Busama and Paiawa which were identified via aerial surveys (Benson & Kisokau et al. 2007), historical accounts (such as Hirth et al.1993), and community leaders to have observed significant leatherback nesting. During the 2006/07 nesting season, three additional communities of Sapa, Kobo and Salus were incorporated into the project. The HCLTCP project sites are located 20 to 60 km southeast of Lae, PNG, and in total (as of the 2008/09 nesting season) results in approximately 20 km of monitored (or protected) beach. Project expansion from one site to seven has been made possible by funding from the Council through partnerships with PNG Department of Environment and Conservation, and the Village Development Trust and MAREMCO (two locally based NGOs).

Primary threats to leatherback turtle survival and recovery in PNG are from direct harvest, predation and beach erosion (Pilcher 2006, 2007). Significant nest-loss occurs through beach erosion and wave inundation (up to 100% loss in some locations); egg collection by villagers in areas outside the HCLTCP monitoring zones or project sites; continued harvest and/or killing of adult turtles; and high instances of dog depredation (up to 80% of unprotected nest). Given their critical status, maximizing hatchling production is seen as most vital to the welfare of leatherback turtles in PNG.

Leatherback turtles have been consumed to some extent in different areas of Madang, Morobe, Manus, East Sepik, East New Britain, Milne Bay and Central Provinces (Pritchard 1979; Spring 1982; Lockhart 1989). In some areas, they were part of the subsistence diet or were utilized in extending social relationships through trade, but in general it appears the consumption of leatherback turtles was not widely practiced because their oily flesh is considered unpalatable (Quinn and Kojis 1985; Pritchard 1979), although direct harvest does occur.

Egg harvesting is still widely practiced. Harvest is perpetuated partly because beaches along the Huon Coast are used as pathways for local people that go to and from their gardens or to visit neighboring residential areas, and because local fishers use the beaches at night to catch fish. Turtle eggs are either consumed immediately or distributed through clan and kin networks, or sold at market to generate income for things such as school fees, medical expenses, or church commitments (Hirth et al. 1993, Spring 1982). In historical periods, egg exploitation along the Huon Coast would have likely had a reduced impact on the leatherback turtle populations, as the villages were small and scattered, with little access to markets. After World War II, egg exploitation increased, with leatherback turtle eggs changing from a protein supplement to a commercialized commodity, and it has been suggested that all turtle eggs laid along sections of the Huon Coast were taken soon after laying (Quinn et al. 1983, Bedding and Lockhart 1989). For example, Quinn et al. (1983) witnessed the harvest of all nests laid during their survey period. It is entirely possible that the leatherback population in PNG has experienced near total egg loss for some 40+ years.

Only in recent years has the loss of eggs been curtailed in some locations due to the presence of the HCLTCP. Participating communities of the HCLTCP agree to abide by an egg and turtle harvest moratorium. This is consistent with PNG wildlife law and policy for leatherback turtle resources. Monthly market surveys undertaken by the PNG Coastal Fisheries Management and Development Program (NFA 2006) and a recent WWF survey of the Eye Grease Market (Kinch et al. 2007) confirm that no turtle eggs are being openly sold in Lae.

Predation by feral and domestic dogs (*Canis familiaris*) has been documented and characterized as a 'great threat' to hatchlings and nests laid along the Huon Coast (Kisokau 2005; Pilcher 2006). Dog predation occurs as the hatchlings are digging to the surface (two to three days after initial hatching as hatchlings are digging to the surface, but not after oviposition or during incubation). A high level of depredation by dogs (~ 80%), was observed and reported for nests during the 2005-2006 season at KWMA (C. Naru pers. comm.; Pilcher 2006), and one report suggests that nearly 100% of all nests were lost during the 2004-2005 season (Ambio, pers. comm.). The HCLTCP began deploying bamboo grids since 2006, which has reduced nest loss from dog predation (Pilcher 2009). Crocodiles (*Crocodilus porosus*) have also been documented to occasionally kill leatherback turtles as they emerge to nest (Hirth et al.1993).

Solomon Islands
In the Solomon Islands, the rookery size is estimated to be on the order of 100s of females nesting per year (Dutton et al. 2007). Past studies have identified four important nesting beaches in Isabel Province: Sasakolo, Lithoghahira, Lilika, and Katova. Harvest of adults and eggs by humans has been reported and may continue in some areas (MacKay 2005). In addition, lizards and iguanas have been documented predating on leatherback eggs (Rahomia et al. 2001).

Vanuatu
Leatherbacks are known throughout many islands of Vanuatu. Residents of a number of different islands, from Espirito Santo in the north through Ambae, Aneityum and Efate, to Tanna in the South, indicate that there were formerly at least small nesting populations of leatherbacks on these islands, with most recent nesting in Epi and Malekula (Petro 2005). Nesting events on these islands have significantly declined since the 1980s in response to increasing human population growth and subsistence pressure on nesting females and eggs (Petro et al. 2007). This reduction in leatherback nesting areas is the same trend observed with all species of turtles in Vanuatu, with more remote areas still supporting turtle nesting but needing to be thoroughly surveyed.

A nesting beach survey at Votlo, Southern Epi between November 2003 and February 2004 resulted in counts of 31 nests and 9 tagged leatherbacks. Overall, Epi Island appears to have the largest number of nests, with two nesting areas with southwesterly exposed coasts probably having 20-30 annually nesting females (Petro 2005).

Fiji
In Fiji, leatherbacks are uncommon, although there are recorded sightings and 4 documented nesting attempts on Fijian beaches. They have been seen in the Savusavu region; Qoma, Yaro passage, Vatulele and Tailevu, and researchers estimate approximately 20-30 individual leatherbacks in Fijian waters (Rupeni et al. 2002).

3.1.3 Loggerhead Sea Turtles

General Distribution
Loggerhead sea turtles are circumglobal, and are associated with a broad range of habitat types that vary by life stage and region including continental shelves, bays, estuaries, lagoons and oceanic fronts and eddies in temperate, subtropical, and tropical waters. Major nesting grounds are generally located in temperate and subtropical regions, with scattered nesting in the tropics (NMFS and USFWS 1998b).

Loggerheads can be divided into five regions: the Atlantic Ocean, Pacific Ocean, Indian Ocean, Caribbean Sea and Mediterranean Sea. These regions may be further divided into nesting aggregations. In the Pacific Ocean, loggerhead turtles are represented by a northwestern Pacific nesting aggregation (located in Japan) which may be comprised of separate nesting groups

(Hatase et al. 2002) and a smaller southwestern nesting aggregation that occurs in Australia (Great Barrier Reef and Queensland) and New Caledonia (Limpus 2006).

North Pacific loggerhead turtles nest in Japan, undertake trans-Pacific developmental migrations in the waters of the Central North Pacific, Mexico, and U.S. territorial waters throughout the eastern Pacific, and reside as adults in waters of the Asian region. Loggerheads orginating in Japan travel westward, move seasonally north and south primarily through the region 28–40° N, and occupy sea surface temperatures (SST) of 15–25° C. Their dive depth distribution indicated that they spend 40% of their time at the surface and 90% of their time at depths <40 m. Loggerheads are found in association with fronts, eddies, and geostrophic currents. Specifically, the North Pacific Transition Zone Chlorophyll Front (NPTZCF) and the southern edge of the Kuroshio Extension Bifurcation Region (KEBR) appear to be important forage and migration habitats for loggerheads (Polovina et al. 2004, 2006). Kobayashi et al. (2008) found that loggerhead distribution in the pelagic environment may be associated with the following five environmental variables: sea surface temperature, and chlorophyll-a concentration, earth magnetic force, earth magnetic declination, and èarth magnetic inclination).

Both juvenile and subadult loggerheads feed on pelagic crustaceans, mollusks, fish, and algae. The large aggregations of juveniles off Baja California have been observed foraging on dense concentrations of the pelagic red crab, *Pleuronocodes planipes* (Pitman 1990, Nichols, et al. 2000). Data collected from stomach samples of turtles captured in North Pacific driftnets indicate a diet of gastropods (*Janthina sp.*), heteropods (*Carinaria sp.*), gooseneck barnacles (*Lepas sp.*), pelagic purple snails (*Janthina sp.*), medusae (*Vellela sp.*), and pyrosomas (tunicate zooids). Other common components include fish eggs, amphipods, and plastics (Parker et al. 2005). These loggerheads in the north Pacific are opportunistic feeders that target items floating at or near the surface, and if high densities of prey are present, they will actively forage at depth (Parker et al. 2005). As they age, loggerheads begin to move into shallower waters, where, as adults, they forage over a variety of benthic hard- and soft-bottom habitats (reviewed in Dodd 1988). Subadults and adults are found in nearshore benthic habitats around southern Japan, in the East China Sea and the South China Sea (e.g., Philippines, Taiwan, and Vietnam).

Size and Identification
The loggerhead is characterized by a reddish brown, bony carapace, with a comparatively large head, up to 25 cm wide in some adults. Adults typically weigh between 80 and 150 kg, with average CCL measurements for adult females worldwide between 95-100 cm CCL (Dodd 1988) and adult males in Australia averaging around 97 cm CCL (Limpus 1985, in Eckert 1993). Juveniles found off California and Mexico measured between 20 and 80 cm (average 60 cm) in length (Bartlett 1989, in Eckert 1993). Skeletochronological age estimates and growth rates were derived from small loggerheads caught in the Pacific high-seas driftnet fishery. Loggerheads less than 20 cm were estimated to be 3 years or less, while those greater than 36 cm were estimated to be 6 years or more. Age specific growth rates for the first 10 years were estimated to be 4.2 cm/year (Zug, et al. 1995).

Age at Maturity

Age to maturity for the Japanese loggerhead population is not understood. This parameter is estimated at >30 yr for Atlantic loggerheads (Snover 2002); however Japanese loggerheads nest at a smaller size (Hatase et al. 2004) and potentially at a younger age.

Genetics

Bowen et al. (1995) identified two genetically distinct nesting stocks in the Pacific - a northern hemisphere stock nesting in Japan and a southern hemisphere stock nesting primarily in Australia. This study concluded that 95% of loggerheads in Baja California originated from Japanese nesting beaches, but also identified an apparent presence of Australian origin individuals at foraging areas in the North Pacific, as indicated by a few individuals sampled as bycatch in the North Pacific that had a mtDNA haplotype only found in Australia (Bowen et al. 1995). Hatase et al. (2002) detected this common Australian haplotype at low frequency at Japanese nesting beaches. This finding, taken together with preliminary results from microsatellite (nuclear) analysis, confirms that loggerheads inhabiting the north Pacific originate from nesting beaches in Japan (P. Dutton, NMFS, unpublished data). LeRoux et al. (2007) report additional genetic variation in north Pacific loggerheads based on analyses using new mtDNA primers designed to target longer mtDNA sequences. Kamezaki et al. (in press) report that there are no significant differences in the mtDNA haplotype frequencies between Omaezaki rookery in northern Japan and the Yakushima rookeries in southern Japan, but that there are significant differences in the haplotype frequency between Minabe rookery in the Kii Peninsula and Yakushima rookeries. From limited data available, it appears that there is no latitudinal trend in population structuring (Kamezaki et al. in press).

Global Status

Loggerhead sea turtles inhabit the Atlantic Ocean, Pacific Ocean, Indian Ocean, Caribbean Sea and Mediterranean Sea. The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. It was listed because of direct take, incidental capture in various fisheries, and the alteration and destruction of its nesting habitat.

On March 16, 2010, the NMFS and the USFWS published a 12-month finding in the Federal Register, responding to a petition to reclassify loggerhead sea turtles in the North Pacific Ocean and the Northwest Atlantic Ocean as Distinct Population Segments (DPSs), to change their listing status from threatened to endangered under the ESA, and to designate critical habitat (Federal Register Vol. 75, No. 50 pp.12598-12655). Comments are being solicited on the proposal to reclassify these turtle populations as DPS's with endangered status until June 14, 2010. If found to be prudent and determinable, a subsequent Federal Register notice would be published on the proposal to designate critical habitat for the two DPSs.

Population Exposed to Hawaii-based Longline Fisheries

Of the loggerheads taken in the Hawaii-based longline fishery, all have been determined to have originated from Japanese nesting beaches, based on genetic analyses (Snover 2008). Current scientific evidence based on genetic analyses, flipper tag recoveries, and satellite telemetry suggest that only one population of loggerheads are found north of the equator in the Pacific Ocean (Conant et al. 2009).

Impacts and Threats

Destruction and modification of loggerhead nesting habitats are occurring worldwide throughout the species range (NMFS and USFWS 2007b). The main anthropogenic threats impacting loggerhead nesting habitat include coastal development/construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach nourishment, beach pollution, removal of native vegetation, and planting of non-native vegetation (NMFS and USFWS 1998b).

Beach erosion is a significant impact at Japanese nesting beaches as a result of severe storms (e.g., typhoons), coastal development (such as construction of harbors, jetties, and upriver dams), and beach armoring (Matsuzawa 2006b). Additionally, burgeoning numbers of visitors to beaches may cause sand compaction and nest trampling. For example, on Yakushima in Japan, egg mortality is higher and hatchling emergence success is lower in areas where public access is not restricted and is mostly attributed to human foot traffic on nests (Kudo et al. 2003).

The construction of beachfront armoring (e.g., rigid structures placed parallel to the shoreline on the upper beach to prevent both landward retreat of the shoreline and inundation or loss of upland property by flooding and wave action; includes bulkheads, seawalls, soil retaining walls, rock revetments, etc.) greatly impacts nesting opportunities and hatching success of loggerhead turtles. Armoring structures can effectively eliminate a turtle's access to upper regions of the beach/dune system. Consequently, nests on armored beaches are generally found at lower elevations than those on non-walled beaches. Nests laid at lower elevations are subject to a greater risk of repeated tidal inundation and erosion, which can lead to total nest lost as well as potentially altered thermal regimes, and thus sex ratios (Mrosovsky and Provancha 1992, Mrosovsky 1994, Ackerman 1997).

Egg harvesting no longer represents a problem in Japan (Ohmuta 2006); however, the poaching of adults and juveniles is still a problem in Baja California Sur, Mexico (Koch et al. 2006). As the population of black turtles declined in Baja California Sur waters during the 1990's, poachers switched to loggerheads (H. Peckham, Pro Peninsula, personal communication, 2006).

Incidental capture (bycatch) of loggerheads occurs in various fisheries throughout the range of the species. Longline gear, drift and set gillnet, bottom trawling, fishing dredges, and pot and trap gear are the primary gear types affecting loggerheads (Gilman et al. 2007; Lewison and Crowder 2007; Peckham et al. 2007). In the eastern Pacific, significant bycatch has been reported in gillnet and longline fisheries operating out of Peru (Shigueto et al. 2006).

Ongoing studies regarding loggerhead mortality and bycatch have been conducted in Baja California Sur, Mexico, where significant bycatch in the gillnet and bottom-longline halibut fishery occurs (Peckham and Nichols 2006). Based on fisheries observations and surveys conducted in 2005, 1400 loggerheads were estimated killed by just 2 of the 13 or more small-scale fishing fleets that fish within loggerhead juvenile foraging areas off the coast of Baja California Sur, Mexico (Peckham et al. 2007). The incidental capture of loggerheads in Baja Sur likely exceed 2,000 mortalities per year in that region making it likely the most significant source of mortality identified for the north Pacific loggerhead population and underscores the importance of reducing bycatch in small-scale fisheries (Peckham, Pro Peninsula, pers. comm., December 2007).

Coastal pound nets and other coastal fisheries in Japan and Taiwan are also a significant source of loggerhead mortality. Bycatch reports from Japanese fishermen gathered between October 2006 and September 2007 found that bycatch occurred most in pound nets (72%), followed by gillnets (11%), trawl nets (8%), encircling nets (3%), and other fisheries (6%) (Ishihara 2009). Monitoring of Japanese pound net fisheries at Miyama (Mie Prefecture), Muroto (Kochi Prefecture), and Nomaike (Kagoshima Prefecture) conducted since 2007 indicates that mortality rate of sea turtles at these sites range from 0.0% to 96.6%, with an overall mortality rate of 18.4% (Ishihara 2007). The wide range of mortality rate is due to the difference in pound net design, in which some pound nets are "open" type that are designed to lead catch into an enclosure with an opening at the sea surface, while others are "roofed" type that are designed with submerged traps. Roofed type pound nets have been found to result in very high mortality of captured sea turtles, while open type do not cause mortality or injury. It is estimated that as many as 13,000 pound nets are set around the Japanese coast (Ishihara 2007), but the proportion of fisheries using roofed type nets is unknown. In addition, the extent of sea turtle bycatch at unmonitored pound net sites is unknown, and therefore the full extent of impact of the Japanese coastal fisheries on loggerhead populations is unknown.

Global warming may result in significant impacts to loggerhead turtles as increased temperatures may change hatchling sex ratios, result in loss of nesting beach habitat due to sea level rise, change nesting behavior, and alter foraging habitats and prey abundance.

3.1.3.1 Loggerheads in Japan

In the North Pacific, loggerhead nesting is essentially restricted to Japan on beaches across 13 degrees of latitude (24° N to 37° N), from the mainland island of Honshu south to the Yaeyama Islands, which appear to be the southernmost extent of loggerhead nesting in the western North Pacific. Researchers have separated 42 beaches into five geographic areas: (1) the Nansei Shoto Archipelago (Satsunan Islands and Ryukyu Islands); (2) Kyushu; (3) Shikoku; (4) the Kii Peninsula (Honshu); and (5) east-central Honshu and nearby islands.

Two of the beaches with the greatest nesting in Japan, Inakahama Beach and Maehama Beach, located on Yakushima Island in the Nansei Shoto Archipelago, account for more than 30% of all loggerhead nesting in Japan (Kamezaki et al. 2003). Monitoring on Inakahama Beach has taken place since 1985. Recent work by Kamezaki et al. (in press) suggests an increasing population trend at Yakushima Island and further suggests that there are synchronized,10-15 yr quasi-cyclic nesting beach abundance fluctuations across the archipelago likely due to environmental factors such as foraging area productivity.

Kamezaki et al. (2003) reviewed census data collected from most of the Japanese nesting beaches. Although most surveys were initiated in the 1980's and 1990's, some data collection efforts were initiated in the 1950's. Along the Japanese coast, nine major nesting beaches (>100 nests/season) and six "submajor" beaches (10-100 nests/season) were identified. Census data from 12 of these 15 beaches provide composite information on longer-term trends in the Japanese nesting assemblage. Using information collected on these beaches, Kamezaki et al. (2003) concluded a substantial decline (50-90%) in the size of the annual loggerhead nesting population in Japan in the latter half of the 20th century. However, nesting data from the most recent decade suggest an increasing trend in nesting across the archipelago, according to records from 1998-2008 provided by the Sea Turtle Association of Japan (Table 7). Total loggerhead nesting in the Japanese archipelago in 2008 had the highest on record since the early 1990s, with 11,038 nests.

Table 7: Number of loggerhead turtle nests recorded at all monitored Japanese nesting beaches, 1998-2008

Year	Number of Nests
1998	2447
1999	2255
2000	2589
2001	3122
2002	4035
2003	4568
2004	4854
2005	5167
2006	2947
2007	3668
2008	11,038

Source: 1998-2002: Matsuzawa (2006); 2003-2005: Sea Turtle Association of Japan, presentation at 17th Annual Sea turtle Symposium, Kumano, Japan, Nov. 2006; 2006-2007: Sea Turtle Association of Japan, presentation at 19th Annual Sea turtle Symposium, Akashi, Japan, Nov. 2008; 2008: Matsuzawa (2008).

Mortality of eggs and pre-emergent hatchlings tend to be high in Japanese rookeries due to various factors such as, inundation, erosion, excessive heat, and beach use by tourist, predation (Matsuzawa et al. 2002). For example, hatching success in the Minabe-Senri beach were 24% (1996), 50% (1997), 53% (1998), 48% (1999), 62% (2000), 41% (2001), 34% (2002) (Matsuzawa, unpublished data). Nesting beaches suffer environmental disruption from beach erosion and light pollution. Extreme weather events, such as high temperatures result in overheating of nests, and many nests are washed out or inundated during the many typhoons that strike Japanese nesting beaches during summer months - sometimes up to six per season (Matsuzawa, 2006). Moreover, egg and pre-emergent mortality has been relatively high at certain nesting beaches mainly due to trampling by tourists that has increased over the years (Kamezaki et al. 2003).

Many beaches suffer serious beach erosion due to upstream dams and jetties, and beaches in many locations have been armored with tetrapods (concrete blocks) between the shoreline and the vegetation line. These blocks have been documented to obstruct loggerhead females from prime nesting habitat near dunes and vegetation (Matsuzawa, 2006). As a result, turtles nest closer to shoreline, increasing the risk for nest inundation and loss.

3.1.3.2 Loggerheads in Baja California Sur, Mexico

Loggerhead hatchlings on nesting beaches in Japan undertake developmental migrations in the North Pacific, using the Kuroshio and North Pacific Currents. Tagging programs to study migration and movement of sea turtles and genetic analyses provide evidence that loggerhead turtles undergo trans-Pacific migrations and have been found foraging off Baja California. For example, loggerheads tagged in Mexico and California with flipper and/or satellite transmitters have been monitored returning to Japanese waters (Resendiz, et al. 1998). Based on aerial surveys, it is estimated that between 5,000 and 15,000 juvenile loggerhead turtles reside in the Baja California Sur (BCS) region (Eguchi, NMFS SWFSC, pers. comm., December 2007). Within the BCS area west of Santa Rosa, there appears to be a hotspot where loggerhead turtles aggregate in high densities (Figure 2).

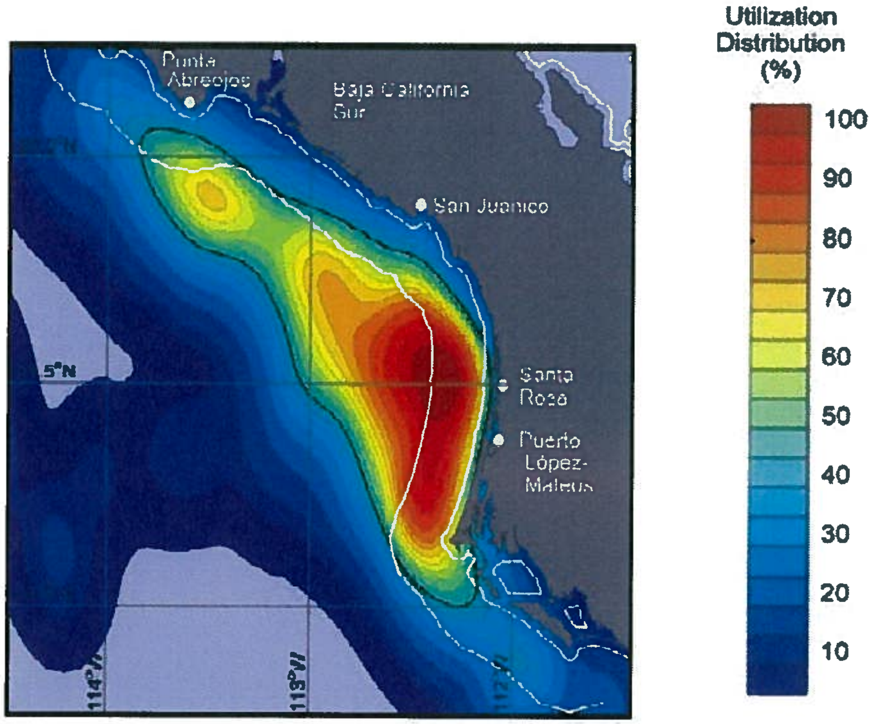

Figure 2: Loggerhead habitat utilization in Baja California Sur, Mexico
Source: Peckham, Pro Peninsula, pers. comm., December 2007

Threats from Baja Fisheries
Gillnet fisheries of Baja California Sur (BCS), Mexico are a leading source of loggerhead turtle mortality in the North Pacific - with a minimum of 1,000 and perhaps up to 2,000 turtles killed per year in the region (Peckham et al. 2007; Peckham and Nichols 2006). In 2005 and 2006, bottom-set gillnet and bottom-set longline operations were observed. The results indicate that all loggerhead interactions occur when bottom-set gillnets are set at depths between 20-23 fathoms or 120-138 ft. When fishing at those depths, the fishermen were observed to catch 0.65 loggerheads per day, of which 73% caught are dead (Peckham et al. 2007). Therefore, bottom-set longlining in the BCS was observed to have much higher loggerhead interaction rates. In 2005, 7 observer trips were made on bottom-set longline vessels, with 26 loggerheads caught on a total of 1200 hooks set, or a bycatch rate of 19.3 per 1000 hooks (Peckham et al. 2007). Of the turtles caught, 24 of 27 were dead when retrieved, providing an 92% mortality rate (Peckham et al. 2007). One bottom-set longline trip was observed in 2006, where 21 loggerheads were caught dead from fishing 236 hooks, resulting in a kill rate of 89 turtles per 1,000 hooks (Peckham et al. 2008). Based on expanded fishery observations in 2007, it is estimated that the incidental capture of loggerheads in Baja Sur likely exceed 1,500 mortalities per year in that region making it likely the most significant source of mortality identified for the north Pacific loggerhead population (Peckham et al. 2008). While one of the bottom-set longline boats observed retired their gear prior to the 2007 season (Rodgers 2008), potentially sparing hundreds of loggerhead individuals from bycatch in 2007 alone, this work provides extraordinary conservation benefits through participatory research and increased community awareness and underscores the importance of reducing bycatch in small-scale fisheries (Peckham et al. 2008).

3.1.4 Green Sea Turtles

General Distribution

Green turtles are found throughout the world, occurring primarily in tropical, and to a lesser extent, subtropical waters. The species occurs in five major regions: the Pacific Ocean, Atlantic Ocean, Indian Ocean, Caribbean Sea, and Mediterranean Sea. These regions can be further divided into nesting aggregations within the eastern, central, and western Pacific Ocean; the western, northern, and eastern Indian Ocean; Mediterranean Sea; and eastern, southern, and western Atlantic Ocean, including the Caribbean Sea Green turtles appear to prefer waters that usually remain around 20° C in the coldest month; for example, during warm spells (e.g., El Niño), green turtles may be found considerably north of their normal distribution. Stinson (1984) found green turtles appear most frequently in U.S. coastal waters that have temperatures exceeding 18° C.

The genus *Chelonia* is composed of two taxonomic units at the population level; the eastern Pacific green turtle (referred to by some as "black turtle," *C. mydas agassizii*), which ranges (including nesting) from Baja California south to Peru and west to the Galapagos Islands, and the nominate *C. m.mydas* in the rest of the range (insular tropical Pacific, including Hawaii). The nonbreeding range of green turtles is generally tropical, and can extend thousands of miles from shore in certain regions. Hawaiian green turtles monitored through satellite transmitters were found to travel more than 1,100 km from their nesting beach in the French Frigate Shoals, south and southwest against prevailing currents to numerous distant foraging grounds within the 2,400 kilometer span of the archipelago (Balazs 1994; Balazs et al., 1994; Balazs and Ellis 1996). Three green turtles outfitted with satellite tags on the Rose Atoll (the easternmost island at the Samoan Archipelago) traveled on a southwesterly course to Fiji, a distance of approximately 1,500 km (Balazs et al. 1994). Tag returns of eastern Pacific green turtles establish that these turtles travel long distances between foraging and nesting grounds. In fact, 75 percent of tag recoveries from 1982-90 were from turtles that had traveled more than 1,000 kilometers from Michoacán, Mexico.

Size and Identification

Green turtles are distinguished from other sea turtles by their smooth carapace with four pairs of lateral scutes, a single pair of prefrontal scutes, and a lower jaw-edge that is coarsely serrated. Adult green turtles have a light to dark brown carapace, sometimes shaded with olive, and can exceed one meter in carapace length and 100 kilograms (kg) in body mass. Females nesting in Hawaii averaged 92 cm in straight carapace length (SCL), while at the Olimarao Atoll in Yap, females averaged 104 cm in curved carapace length (CCL) and approximately 140 kg. In the rookeries of Michoacán, Mexico, females averaged 82 cm in CCL, while males averaged 77 cm CCL (NMFS and USFWS 1998c).

Growth and Age at Maturity

Compared to all other sea turtles, green turtles exhibit a particularly slow growth rate, and age to maturity appears to the longest. Based on age-specific growth rates, green turtles are estimated to attain sexual maturity beginning at age 25 to 50 years (Limpus and Chaloupka 1997, Bjorndal et al. 2000, Seminoff 2002, Zug et al. 2002). The length of reproductivity has been estimated to range from 17 to 23 years (Carr et al. 1978, Fitzsimmons et al. 1995 *in* Seminoff 2002).

Diet

Although most green turtles appear to have a nearly exclusive herbivorous diet, consisting primarily of sea grass and algae (Wetherall 1993; Hirth 1997), those along the east Pacific coast seem to have a more carnivorous diet. Analysis of stomach contents of green turtles found off Peru revealed a large percentage of mollusks and polychaetes, while fish and fish eggs, and jellyfish and commensal amphipods comprised a lesser percentage (Bjorndal 1997). Foraging studies of green turtles in Mexico found the turtles to have consumed primarily algae with small amounts of squid, sponges, tube worms, and other invertebrates in their diet (Seminoff et al. 2002). In the Hawaiian Islands, green turtles are site-specific and consistently feed in the same areas on preferred substrates, which vary by location and between islands (Landsberg et al. 1999).

Global Status

Green turtles were listed as threatened under the ESA on July 28, 1978, except for breeding populations found in Florida and the Pacific coast of Mexico, which were listed as endangered. Using a precautionary approach, Seminoff (2004) estimated that the number of nesting female green turtles has declined by 48 to 67 percent over the last three generations (~ 150 yrs) based on actual and extrapolated changes in subpopulation size at 32 Index Sites around the world. Causes for this decline include harvest of eggs, subadults and adults; incidental capture by fisheries; loss of habitat; and disease. The degree of population change is not consistent among all index nesting beaches or among all regions. Some nesting populations are stable or increasing. A 2007 study looked at global green sea turtle seasonal nesting activity data from all reliable available long-term datasets and found that rates of nesting population increase in the six main rookeries, including four Pacific Ocean-based rookeries in Australia, Japan, and Hawaii, ranged from 4-14 percent per annum over the past twenty to thirty years (Chaloupka et al. 2008).

In the Pacific, the only major (> 2,000 nesting females) populations of green turtles occur in Australia and Malaysia. Smaller colonies occur in the insular Pacific islands of Polynesia, Micronesia, and Melanesia (Wetherall 1993) and on six small sand islands at French Frigate Shoals, a long atoll situated in the middle of the Hawaii Archipelago (Balazs et al.1994).

Population Exposed to the American Samoa-based Longline Fishery

The sea turtle interactions that have occurred in waters around American Samoa have been with juvenile green sea turtles. Because they resulted in mortalities, tissue samples for genetic analysis were taken from several of the turtle specimens. The first sample was collected in 2006, and was identified as being a haplotype which characterizes the northern Australian stock that include nesting populations in the Northern and Southern Great Barrier Reef and Coral Sea and in New Caledonia. This is quite different from the haplotypes of the few samples obtained from nesting females in American Samoa (NMFS PIRO, pers.comm.). The second sample collected in 2007, is a haplotype that researchers have only found in Micronesia, the Marshall Islands and in American Samoa (NMFS PIRO, pers.comm.).

3.1.4.1 Green Sea Turtles in American Samoa

In Samoan folklore, green sea turtles, known in Samoan as *I'a sa* (sacred fish) were believed to have the power to rescue fishermen lost at sea (Craig 2002). The life cycle of the green sea turtle involves a series of long-distance migrations back and forth between their feeding and nesting areas (Craig 2002). In American Samoa, their only known nesting area is at Rose Atoll[3]. The nesting population of Rose Atoll are thought to migrate to various foraging areas in the South Pacific, although the actual distribution of foraging grounds for the Rose Atoll nesting population is unknown.

From 1971-1996, 46 adult female turtles were flipper tagged at Rose Atoll with only three recaptured; two in Fiji and one in Vanuatu, all found dead at the time of recapture. A satellite tagging study, conducted in the mid-1990s tracked eight tagged green sea turtles by satellite telemetry from their nesting sites at Rose Atoll to Fiji (Balazs et al. 1994). Another turtle tagged at Rose Atoll was found dead in Vanuatu (G. H. Balazs cited in Grant et al. 1997), and another was tracked heading east towards French Polynesia near Tahiti. Ninety-six percent of recovered tagged turtles migrated westward after nesting with 58 percent going specifically to Fiji (Craig et al. 2004).

3.2 Socioeconomic Environment

Papua, Indonesia

The authorities responsible for the management of nesting beaches in Papua include the local district government, the Nature Conservation Agency, and Department of Forestry (BKSDA II), but the beach monitoring is carried out by NGOs: Everlasting Nature of Asia (ELNA), WWF-Indonesia, YAL (Yayasan Alam Lestari), and more recently the State University of Papua (UNIPA) through the employment of villagers from the communities on the beaches (Bellagio II proceedings 2008). Monitoring work in Papua has focused on the size of the nesting population, protection of females and nests, and conservation efforts with local communities (Hitipeuw and Maturbongs 2002; Suganuma 2006; Hitipeuw et al. 2007). However, the lack of consistent funding, commitment, and presence on the beach over time has led to piecemeal efforts, poor coordination, and duplication by different groups, which have exacerbated local tensions (Bellagio II proceedings 2008).

The local communities of the Bird's Head Peninsula of Papua are agricultural and rely on subsistence-based economies. At the study site, the land is in private ownership of the local landowner rather than government ownership. Prior to implementation of the beach monitoring project, the local landowner sold egg collection rights to egg collectors. The project, however, employs a number of community members as well as family members of the landowner in monitoring efforts. According to WWF-Indonesia (Hitipeuw 2004), jobs provisioned to local residents for beach patrol, population monitoring and nesting beach management by the conservation program may be offsetting economic impacts associated with conservation activities. Given that Wermon has been proposed by a forest concessionaire to be converted into

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[3] See http://www.nps.gov/archive/npsa/5Atlas/partq.htm#top

a log pond, income generating activities are especially important to ensure the long-term protection of the nesting beach (i.e., the forest concessionaire would provide short-term economic benefit to the community). As part of the education and outreach program, WWF-Indo is also providing the local community with appropriate information to empower them towards community co-management to conserve both their marine and forest resources.

Huon Coast, PNG

The primary area of concern in Papua New Guinea (PNG) is along the Huon Coast, where majority of leatherback nesting in PNG is known to occur (Benson and Kisokau et al. 2007). Seven communities along the Huon Coast (Sapa, Kobo, Paiawa, Kamiali, Salus, Busama, and Labu Tale) have been included in the leatherback conservation project to date. According to a socioeconomic assessment of the area conducted during the 2005-2006 nesting season (Kinch 2006), most communities are experiencing population growth, except for areas where rural services are lacking. Cash income is small, irregular, and widely variable, with all communities experiencing difficulties in realizing income opportunities and no regular transport to markets. Based on the 2005-2006 assessment, the estimated annual household income ranged between 120-2,580 Kina (K; 1 Kina = US$3.30 in 2006), with sources of income including fishing, cash crops, production of garden produce, construction, and the sale of coral lime. In recent years, wages generated by conservation activities, including the Council-funded leatherback project, have become important cash income sources in the communities along Huon Coast. However, cash income from conservation projects to selected villagers also created conflict and inequity among community members. Additionally, it is understood that direct payments in the form of salaries is not a sustainable conservation strategy – whereby when funding expires so will conservation actions (Kinch 2006). In effort to offset this impact, the Council-funded leatherback conservation project in PNG now focuses on community development incentives through which each village is allocated a modest fund for development purposes as incentives to participate in the conservation project (Pilcher 2009).

Resource management practices have traditionally been carried out primarily for the purpose of 'cultural sustainability', in which issues regarding resource distribution and social reproduction are addressed (Kinch 2006). Beliefs regarding 'Western' conservation and ecological sustainability do not traditionally exist in communities along the Huon Coast, as resource management practices are embedded in larger set of customary practices that regulate clan membership, inheritance rights, and a number of other social rights and obligations. It should be noted that this clan-based system does and has posed challenges in regards to community-base social conflict, jealousies, and imbalances of power both within and among participating project communities (Kinch 2006; Bellagio II proceedings 2008). For the monitoring and recovery program of the Huon Coast to succeed, it is important to understand and take into account the historical and current program dynamics that have occurred/occur between the local communities engaged to carry out monitoring and recovery activities, funding agency objectives, visiting scientists, and a myriad of implementing agencies. Care must be exercised to ensure that expectations amongst community implementers are not raised to unrealistic levels in regards to monetary or other benefits (Bellagio II proceedings 2008).

Japan

Yakushima Island

Yakushima Island became the first place in Japan to be designated a World Natural Heritage Site in 1993. Of great significance to the area is the presence of indigenous Japanese cedar, *Cryptomeria japonica*, known as '*Yaku sugi*' which can be over 3,000 years old. The island has a permanent human population of 14,000. Islanders used to live from fishing and farming, but Yakushima has been gaining popularity as an eco-tourist spot, where people can learn about the island's environment at cultural and environmental centers. Tourism is now the island's biggest industry, earning an estimated 10 billion yen (90 million dollars) a year, accounting for some 60 percent of the island's economy (http://www.thingsasian.com/goto_article/article.2882.html). Most nesting beaches of Yakushima Island, including those referred to in this document (Inakahama and Maehama), are also popular eco-tourism sites which support local employment and provide volunteer jobs to university students. With funding support from the Council, the Sea Turtle Association of Japan has been able to provide consistent funding to researchers who in the past worked on a volunteer basis or were minimally supported to conduct research and management activities. Turtle egg collection activities were halted by national decree over 20 years ago, long before Council supported activities ensued.

Baja California Sur, Mexico

The primary area of concern in Mexico is the western coast of the Baja California Sur (BCS), where a large number of loggerhead turtles are known to forage offshore. Many of the communities along BCS are natural resource-dependent, with a large number of inhabitants employed as fishermen who have limited economic alternatives (Gardner and Nichols 2001). Sea turtles have been utilized as food source as well as for decorations, and hold traditional and occasionally spiritual importance in many of the communities in BCS.

A survey of four communities in the Bahia Magdelena region of BCS was conducted in 2004 to assess the factors associated with human consumption, exploitation, and conservation of sea turtles (Delgado 2004). Respondents of the survey (n=159) listed human consumption (44%), poaching (42.8%), fishery bycatch (24.5%), and habitat destruction and pollution (11.3%) as the perceived threats to sea turtle species in the region. The survey results also indicated that most of the respondents (81.1%) believed that people consumed sea turtles because they enjoy the taste, while only 11.3% of the respondents believed that sea turtles are consumed as part of the tradition and only 1.3% of the respondents believed that sea turtles are consumed because people need food. At the same time, most of the respondents believed that it is important that sea turtles are protected.

American Samoa

American Samoa has been a U.S. territory since 1899, in part because of U.S. interests in the harbor at Pago Pago. The Territory is more than 89 percent native Samoan. This population is descended from the aboriginal people who, prior to discovery by Europeans, occupied and exercised sovereignty in Samoa.

There is approximately 199 sq km (~ 77 sq mi) of land divided between five islands and two coral atolls (Rose and Swains Islands). EEZ waters around American Samoa comprise 390,000 square kilometers and are truncated by the EEZs around the other nearby island nations. Under the MSA, the American Samoa Archipelago is recognized as a fishing community.

Approximately 95 percent of the landmass in American Samoa is held under the traditional land tenure system and under the direct authority of the Samoan chiefs known as *matai*. Under this system, traditional land cannot be purchased or sold and the current reigning chief from within the family unit has final say over the disposition of a family's holdings. This system ensures the passage of assets to future generations and serves as the catalyst in the preservation of the Samoan culture.

American Samoa has a small developing economy, dependent mainly on two primary income sources: the American Samoa Government (ASG), which receives income and capital subsidies from the federal government, and the two fish canneries on Tutuila. These two primary income sources have given rise to a third: a services sector that derives from and complements the first two (Department of Labor 2008). Over half of the families in American Samoa live below the national poverty level, with a median household income of $18,219 in 2000 (US Census 2000).

American Samoan dependence on fishing undoubtedly goes back as far as the peopled history of the islands of the Samoan archipelago, which is about 3,500 years ago (Severance and Franco 1989). Many aspects of the culture have changed in contemporary times, but American Samoans have retained a traditional social system that continues to strongly influence and depend on the culture of fishing. Traditional American Samoan values still exert a strong influence on when and why people fish, how they distribute their catch, and the meaning of fish within the society. When distributed, fish and other resources move through a complex and culturally embedded exchange system that supports the food needs of *`aiga* (extended family), as well as the status of both *matai* and village ministers (Severance et al. 1999).

American Samoa-based Pelagic Fisheries

The harvest of pelagic fish has been a part of the way of life in the Samoan archipelago since the islands were first settled some 3,500 years ago (Severance and Franco 1989). Subsistence fishing continues to the present, but the importance of pelagic fisheries as a source of income and employment is increasing. In 1995, small-scale longline fishing began in American Samoa following training initiated by the Secretariat of the Pacific Community (Chapman 1998). Commercial ventures are diverse, ranging from small-scale vessels having very limited range to large-scale vessels catching tuna in the EEZ and distant waters, and delivering their catches to canneries based in American Samoa. Currently the pelagic fisheries of American Samoa are based on supplying fresh or frozen albacore directly to the two large tuna canneries in Pago Pago. These fisheries include small and large-scale longlining; and a pelagic trolling and handline fishery. The longline fishery currently operates under a limited entry program.

More than $11.5 million worth of pelagic species were landed in American Samoa during 2006. Longline fishing dominated (99.6 %) the value of pelagic landings during 2006 for American Samoa. Over 9.2 million dollars worth of albacore dominated (80 %) the value of longline caught pelagic species during 2006 followed by yellowfin ($1 million), bigeye ($0.49 million), and skipjack ($0.26 million) tunas. Wahoo ($370,000), swordfish ($100,000) and mahimahi ($51,000) were the top-value non-tuna species for American Samoa during 2006. The highest value troll landing categories for 2006 in American Samoa were yellowfin tuna ($14,900), miscellaneous species ($12,000) and skipjack tuna ($9,000).

Most participants in the small-scale domestic longline fishery are indigenous American Samoans with vessels under 50 ft in length, most of which are *alia* (locally built twin hulled wooden with fiberglass or aluminum) boats under 40 ft in length. In the mid-1990s American Samoa's commercial fishermen shifted from troll or handline gear to longline gear largely based on the fishing success of 28' *alia* catamarans that engaged in longline fishing in the EEZ around Samoa. Following this example, the *alia* fishermen in American Samoa deploy a short monofilament longline, with an average of 350 hooks per set, from a hand-powered reel. The predominant catch is albacore tuna, which is marketed to the tuna canneries (DMWR 2001). By 1997, 33 *alia* vessels received general longline permits from NMFS to fish in federal waters around American Samoa although only 21 were reported to have been actively fishing on a monthly basis at that time. In recent years the *alia* fleet has been greatly reduced with only two vessels active in 2007 (Table 3), however, there is some evidence that a resurgence of fishing with *alias* is in process to target bottomfish (P. Bartram, pers. comm., Sept. 1, 2007).

Around 2000, the American Samoa longline fishery began to expand rapidly with the influx of large (>50 ft. overall length) conventional monohull vessels similar to the type used in the Hawaii-based longline fishery. These vessels were larger, had a greater range and were able to set more hooks per trip than the average *alia* vessel. The number of permitted longline vessels in this sector increased from three in 2000 to 30 in 2002 (DMWR, unpublished data). Of these, ten permits were believed to be held by indigenous American Samoans as of March 21, 2002 (P. Bartram, pers. comm., March 2002). Economic barriers have prevented more substantial indigenous participation in the large-scale sector of the longline fishery. During 2007 there were 29 vessels engaged in the longline fishery in American Samoa.

CHAPTER 4 ENVIRONMENTAL IMPACTS

This chapter describes the potential direct, indirect and cumulative impacts of the Council's sea turtle conservation projects on the affected components of the human environment as described in Chapter 3.

The alternatives considered in this analysis were constructed to represent a layering of activities (Table 8). Thus, Alternatives 2-4 progressively build upon the previous alternative, with Alternative 4 addressing potential threats to leatherback and loggerhead sea turtle nesting beach management and bycatch mitigation. Table 9, located at the end of Chapter 4, provides a summary of anticipated impacts of the alternatives.

The preferred alternative is Alternative 4: Education and Outreach, Census Patrols, Research Monitoring, Nesting Beach Management, and Bycatch Mitigation.

Table 8: Alternatives Considered

Alternative	Description
1	No Action
2	Education and Outreach, and Census Patrols
3	Education and Outreach, Census Patrols, Research Monitoring, and Nesting Beach Management
4	Education and Outreach, Census Patrols, Research Monitoring, Nesting Beach Management, and Bycatch Mitigation

4.1 Alternative 1: No Action

Numerous threats to sea turtle species, such as predation, direct harvest, nest lost to erosion, and bycatch, would persist if the Council's sea turtle programs are not supported. Following this alternative would consequently terminate all existing programs funded by the Council, which will leave those areas with no or reduced funding to support their individual programs. No action will thus result in reduced documentation and quantification of anthropogenic and environmental threats at nesting and foraging grounds, and threat mitigation activities may be stopped in some program areas.

4.1.1 Impacts of Alternative 1 to Sea Turtles

Without adequate protection of nesting beaches, emerging hatchlings, and adults, the nesting population will likely continue to be at risk for population decline and extinction. In addition, lack of bycatch mitigation in fisheries will continue to contribute to mortality of juvenile, sub-adult, and adult sea turtles at sea, further slowing the recovery of the species.

4.1.2 Impacts of Alternative 1 to the Socioeconomic Environment

Council-supported sea turtle programs are primarily community-based and employ a number of community members as patrollers, field staff, and project managers. In areas with low socioeconomic standing, Council-supported sea turtle programs provide direct economic benefit to some members of the community, and in some instances entire communities may benefit through indirect incentive or development programs, to participate in sea turtle conservation activities. The development incentive scheme (such as that implemented in PNG) is one means by which to balance out any perceived imbalances that may caused by positive cash flow (i.e., salaries) to certain members of a community. This intra- and inter-community impact to village-based economies at study sites cannot be discounted and must be taken into consideration at all project locations in developing countries. In other areas, funding from the Council allow for full compensation of field staff who may otherwise work on a volunteer basis, which improves the quality and detail of work conducted and resulting data gathered. Consequently, the no action alternative may reduce the economic incentive for carrying out sea turtle conservation activities in project areas, negatively impacting both the communities and conservation activities beyond any potential negative community-based conflict within or between communities.

4.2 Alternative 2: Education and Outreach, and Census Patrols

This alternative would consist of community education and outreach, and census patrols utilizing strict and well-defined protocols. This alternative does not include the touching of turtles or eggs (i.e., no tagging or measurements, and no nest management activities), but entails only the counting of females and nests to quantify simple baseline nesting dynamics (i.e., number of nesting turtles and number of nests laid per season). Nesting beach protection would be achieved by education and outreach initiatives provided to the local community, and by the presence of beach monitors conducting nightly census patrols. However, these actions alone are insufficient for the recovery of sea turtle populations, as they do not fully remove anthropogenic and environmental threats at nesting beaches, and do not address at-sea threats.

4.2.1 Impacts of Alternative 2 to Sea Turtles

Education and Outreach: There are no expected adverse impacts to sea turtle species from education and outreach provided to the local communities of proposed project locations.

Census Patrols: There are no expected adverse impacts to sea turtle species from census patrols to monitor the leatherback and loggerhead nesting populations. Census patrols are the most widely implemented monitoring tool in use by the global sea turtle conservation community and are an important component of a comprehensive program to assess and monitor the status of sea turtle populations (Schroeder and Murphy, 1999). As described in Chapter 2.1.4.1.2, census patrols provides important baseline information on the number of sea turtles nesting in a specified location, which leads to a better understanding of sea turtle biology, thus, enhancing sea turtle conservation. To date, census patrols have not been known to adversely affect nesting regimes (Balazs 1999; Bolten 1999). Moreover, presence of patrollers on nesting beaches may result in positive impacts to hatchling production by deterring poachers and some predators (Boulon, 1999).

4.2.2 Impacts of Alternative 2 to the Socioeconomic Environment

Education and outreach raises awareness of and increase support for sea turtle conservation activities, and as described in Section 2.1.5.1. positive cumulative benefits are expected from education and outreach efforts regarding endangered sea turtle species.

Local communities near nesting beaches may also benefit from census patrols if members of the community are employed as patrollers. Communities near leatherback nesting beaches in the western Pacific are often comprised of low-income families and may harvest eggs or adult turtles out of necessity. Employing community members may thus provide alternative income sources that would otherwise not exist if egg or turtle harvest bans were enforced in these communities. Assurances, however, must be taken into account to ensure that salaries and employment do not inadvertently cause community conflict or clan-based power struggles, and that the support or project involvement of one community doesn't negatively impact the species due to increased harvest pressure through the exclusion or non-involvement of another nearby community.

4.3 Alternative 3: Education and Outreach, Census Patrols, Research Monitoring, and Nesting Beach Management

This alternative would consist of education and outreach, census patrols, research monitoring, nesting beach management, and predator mitigation utilizing strict and well-defined protocols. Impacts to education and outreach and census patrols are outlined in section 4.2. Monitoring would include research efforts consistent with stringent protocols for tagging turtles and collecting biological information (e.g., measurements) at nesting and foraging sites, and quantifying hatching success rates at nesting beaches to obtain a measure of site productivity. Nest management would involve utilizing strict and well-defined protocols to identify and relocate nests laid in erosion prone areas to maximize hatchling production, and to reduce impacts from predators. However, this alternative does not address at-sea threats.

4.3.1 Impacts of Alternative 3 to Sea Turtles

Research Monitoring: There are no expected adverse impacts to sea turtle species from research monitoring (tagging and measuring) implemented to collect population dynamics information on the leatherback and loggerhead populations. As per Section 2.1.5.3.1, tagging has been the single most valuable activity in advancing the understanding of sea turtle migrations and population dynamics. Long-term, saturation tagging and monitoring of the nesting beaches provides an opportunity for measuring population recruitment, annual survival, population size, and population trends over time (Chaloupka and Musick, 1997). As per Section 2.1.5.3.2, studies indicate that there are no adverse affects to sea turtles due to tagging or handling (Balazs, 1999; Bolten,1999).

Nesting Beach Management: There are no expected adverse impacts to sea turtle species from nesting beach management activities (to alleviate erosion, anthropogenic and predator impacts) implemented to bolster beach production (i.e., hatchlings) of leatherback and loggerhead turtles. As per Section 2.1.5.4, management activities can effectively reduce impacts from beach erosion or anthropogenic beach use to maximize beach hatchling production. There are stringent protocols associated with measures to address impacts from beach erosion, such as the relocation of clutches (Mortimer, 1999; IUCN, 1999). Nests are moved to microhabitats similar to the original nest. The new site must provide adequate moisture, temperature, and gas exchange to support the developing embryos (Miller, 1997). There are no expected adverse impacts to the beach or to the clutch from relocating nests because nests will be placed in a similar environment as the original nest (meaning not high on the beach in a different temperature or substrate regime, only above the high tide line in an area where they are not as likely to be inundated). Although it is well documented that the relocation of nests may lower hatch success rates, this impact is negligible compared to total (100 percent) mortality of a doomed nest due to environmental factors. Furthermore, the Council's Sea Turtle Advisory Committee endorses and supports the relocation of otherwise-doomed nests to alleviate beach erosion impacts to promote hatchling production (WPRFMC, 2005). As per Section 2.1.5.4.1, management activities can effectively reduce predation to maximize hatchling production. The increased production of hatchlings may provide additional adults into the population of these threatened and endangered species.

4.3.2 Impacts of Alternative 3 to the Socioeconomic Environment

There are no expected adverse impacts to the social and economic environment from research monitoring or nesting beach management. Local communities may benefit economically from research monitoring and nesting beach management through the employment of community members as project staff. There may be some inadvertent negative impacts between and among participating communities that should be recognized and addressed. Nevertheless, the involvement of community members in these activities may provide a sense of ownership of sea turtle conservation projects (Pilcher 2009), strengthening the long-term sustainability of such projects.

4.4 Alternative 4: Education and Outreach, Census Patrols, Research Monitoring, Nesting Beach Management, and Bycatch Mitigation

This alternative would consist of community education and outreach, census patrols, research monitoring, nesting beach management, and bycatch mitigation utilizing strict and well-defined protocols. Impacts to education and outreach, census patrols, research monitoring, and nest management are outlined in section 4.2 and 4.3. Bycatch mitigation would involve testing of alternative gear or fishing method predicted to reduce sea turtle bycatch, testing of other mitigation technology (e.g., fishing deeper or using larger circle hooks), and education and outreach to fishers and local community to gain support for bycatch reduction. Necropsies of dead stranded sea turtles and monitoring of certain fisheries for sea turtle bycatch would provide additional information regarding the extent of bycatch.

4.4.1 Impacts of Alternative 4 to Sea Turtles

Bycatch Mitigation: Due to the specificity of gear and interaction types, bycatch mitigation requires steps including, but not limited to, assessment of fisheries, regulatory frameworks, and socioeconomic structures, determination of potential solutions, experimental and commercial testing of modified gear or mitigation technologies, and implementation of modified gear or mitigation technologies (Gilman 2009). Of these, experimental and commercial testing as well as implementation of modified gear or mitigation technologies may result in capture and handling of sea turtles. The Council will only fund projects that apply or implement previously tested gear or technology known to reduce sea turtle interactions, and any project implemented will be conducted in such a way that fishing effort and any resulting captures are less than currently occurs, ensuring that any interactions that may occur during field testing would not exceed what occurs using existing conventional gear and methods. The Council will actively engage the Pacific Islands Fisheries Science Center to ensure bycatch mitigation projects are implemented correctly and use standardized techniques.

Projects will also follow proper post-interaction handling protocols as developed and recommended by NMFS for any turtles captured during experimental and commercial trials. Fishing gear will be checked as often as feasible to reduce the potential for adverse impacts. Sea turtles that are entangled or hooked in fishing gear will be released immediately on site. If turtles are captured and encountered in a comatose state, resuscitation will be attempted as per NMFS handling protocol to resuscitate comatose turtles.

In the long-term, bycatch mitigation will reduce sea turtle injuries and mortality at sea, contributing to the further recovery of sea turtle populations.

4.4.2 Impacts of Alternative 4 to the Socioeconomic Environment

No adverse impacts are expected to the social and economic environment as a result of Alternative 4. Any project testing bycatch reduction methods will also include a component to compare target catch rates with conventional methods to ensure that the tested methods do not have adverse economic impacts to fishermen. In addition, fishermen participating in experimental and commercial trials will be compensated for their time and potential loss from the trials. Moreover, fishermen may experience economic loss from bycatch if sea turtles break fishing gear or consume bait as a result of interactions; in such cases, bycatch mitigation will reduce economic loss to fishermen, thereby providing a positive incentive to participate in bycatch reduction projects.

4.5 Cumulative Impacts

The Council's sea turtle conservation programs are implemented to contribute to the recovery of sea turtle populations that interact with longline fisheries of Hawaii and American Samoa, and are therefore designed to provide positive impacts to sea turtle populations. A number of other conservation programs funded through various national governments, international organizations, and NGOs are also available, and the Council's programs are part of a national and international effort to recover sea turtle populations in the Pacific. Since the start of the Council's program in

2003, they have focused primarily on conservation activities at nesting beaches to increase hatchling production.

It is difficult to quantify the amount of impact the Council's programs have had to date, and the programs' contribution to sea turtle populations may not become apparent for another 10-20 years due to the slow maturity rate of sea turtles. What is quantifiable, however, is the number of hatchlings produced or conserved at nesting beaches of Western Pacific leatherbacks and North Pacific loggerheads. To date, Council-funded projects have at minimum produced nearly 300,000 leatherback hatchlings, many of which would have been lost to predation, harvest, and erosion, and conserved at least 160,000 loggerhead hatchlings that would have otherwise been lost to erosion and inundation (those hatched *in situ* not included in the loggerhead hatchling numbers). Given that roughly one in 1,000 hatchlings is estimated to survive to adulthood, Council's projects may have resulted in 300 adult leatherbacks and 160 adult loggerheads (in addition to all adults produced as a result of *in situ* nests) to date.

The Council's programs have also contributed to improved conservation and research environments in its project locations. In Japan, Council-funded projects encouraging hatch success surveys have improved the general attitudes of researchers regarding such surveys (Yoshimasa Matsuzawa, personal communication). Hatch success surveys were typically not seen as an important research activity among loggerhead researchers in Japan. However, researchers have become stimulated to conduct hatch success surveys for not only relocated nests but also for *in situ* nests as one of the monitoring activities to determine incubation conditions of nests. In Huon Coast, PNG, Council management of the leatherback conservation program in the area has substantially improved the accountability and effectiveness of the program.

The activities implemented under the Council's sea turtle conservation program complement bycatch mitigation actions implemented in Hawaii-base longline fishery. The Council recognizes their responsibility to reduce protected species bycatch as much as possible, and have implemented a number of mitigation strategies especially to reduce sea turtle bycatch, such as the mandatory use of large circle hooks and mackerel bait. As a result, sea turtle bycatch in Hawaii-based swordfish fishery has been reduced by approximately 90% (Gillman et al. 2007), and the fishery now operates under strict regulations that include temporary closures if interaction limits are reached. The Council also recognizes that threats to sea turtle populations exist not only in domestic fisheries, but also in international fisheries as well as at nesting habitats. It is under this recognition that the Council supports various conservation programs across the Pacific. As such, the Council's sea turtle conservation projects proposed under the alternatives represent a portion of the Council's full efforts to conserve and recover sea turtle populations. All activities combined, including activities of other agencies and nations, are expected to have an overall cumulative positive effect on sea turtle populations in the Pacific.

4.6 Global Climate Change and Impacts to Sea Turtle Populations

As highly migratory, wide-ranging organisms that are biologically tied to temperature regimes, sea turtles are vulnerable to the effects of global climate change in various aspects of their physiology and behavior. These effects must be considered in addition to all other anthropogenic impacts on sea turtle populations. The major ways climate change may affect sea turtles are: 1) changes in hatchling sex ratios as a species that exhibits temperature-dependent sex determination; 2) loss of nesting beach habitat due to sea level rise; 3) changes in nesting behavior that correlate with fluctuations in sea surface temperature; and 4) alterations to foraging habitats and prey abundance resulting from global climate change.

Sex ratios

All species of sea turtle exhibit temperature-dependent sex determination (Standora and Spotila, 1985). Warmer temperatures within the nest chamber produce females while cooler ones produce males. As global temperatures continue to increase, so will sand temperatures, which in turn will alter the thermal regime of incubating nests and alter natural sex ratios within hatchling cohorts, presumably toward a heavier female bias. While sex ratios vary within and among seasons and nesting locations, several species already exhibit general trends of female bias throughout their major rookeries worldwide. Loggerheads nesting in the U.S. are already heavily skewed toward female (Mrosovsky and Provancha 1992, Hanson et al. 1998). Although some beaches at the northern limit of their nesting range in North Carolina may produce up to 55% males (Webster and Gouveia 1989), over 90% of loggerhead nesting in the U.S. occurs along the Atlantic coast of Florida, where warmer temperatures produce substantially more females than males. Nesting beaches in Cyprus, Brazil, and Turkey produce estimates of 89-99%, 82.5%, and 60-74% female loggerheads, respectively (Godley et al. 2001, Marcovaldi et al. 1997, Kaska et al. 2006, Oz et al. 2004). While less information is available on sex ratios for green, hawksbill, and leatherback sea turtles, the existing data also suggest that the nesting assemblages of these species that have been examined are slightly to severely female biased (Binckley et al. 1998, Godfrey et al. 1996, Chan and Liew 1995, Godfrey et al. 1999). In addition to altered sex ratios, the range of thermal tolerance for egg survival should be considered as nesting aggregations that already produce 100% females may be at the high end of their thermal range. Increases in temperature could reduce hatchling production altogether under such conditions (Matsuzawa et al. 2002). Rainfall has also been correlated with sex ratios in sea turtles as months with higher rainfall produce more males, lower rainfall more females (Godfrey et al. 1996). Climate change effects on rainfall are not well understood but could potentially have an indirect impact on the sex ratios of sea turtles.

Sea level rise

Sea level rose approximately 15 cm during the 20th century (Ruddiman 2001 *In* Baker et al. 2006) and further increases are expected. Resulting coastal inundation will have serious consequences for sea turtles in the form of loss of nesting beaches. For example, 23% and 52% of the total current sea turtle nesting beach area in Bonaire, Netherlands Antilles would be under threat of flooding with 0.5 m and 0.9 m rises in sea level respectively (Fish et al. 2005). While under natural conditions beaches can migrate landward or seaward with fluctuations in sea level, extensive coastal development has inhibited or eliminated this natural process. The North Pacific population of loggerhead turtles nests mainly on beaches along the Japanese coast. Sea walls and beach armoring are common along these beaches as precautions against tsunamis and sea level rise, severely limiting access for nesting females (Chaloupka et al. 2008). In some cases, nesting beaches occur on small, low-lying islands or atolls on which there is limited space for the beach to migrate landward. For example, Hawaiian green turtles nesting habitat at French Frigate Shoals (FFS), in the Northwestern Hawaiian Islands may lose from 40-57% of their current area by 2100 (Baker et al. 2006).

SST and nesting behavior
A change in phenology for Atlantic loggerheads has been correlated with rising sea surface temperatures (SST). Weishampel et al. (2004) found that as nearshore SST rose 0.8°C over thelast 15 years, the median nesting date became earlier by ten days. In North Carolina, earlier nesting and longer nesting seasons were correlated with warmer sea surface temperature (Hawkes et al. 2007). The implications/consequences of temporal shifts in nesting activity are speculative. The findings lead to numerous follow up questions (listed by Weishampel et al. 2004) including whether earlier nesting will affect overall fecundity, clutch size, incubation length, hatch success, hatchling, survivorship, food availability for hatchlings, mating synchrony, and sex ratio.

Ocean productivity/foraging resources
Global climate change may have varying effects on sea turtle foraging habitat/prey abundance. Seagrasses are a major food source for green turtles worldwide. Potential effects of climate change on seagrasses include decreased productivity in deeper water due to sea level rise and shifts in distribution as a result of increased temperature stress and changes in salinity in seagrass habitats (Short and Neckles 1999, Duarte, 2002). A substantial increase in gelatinous zooplankton (large medusae) in the Bering Sea from 1979 to 1997 is possibly linked to climate change (Brodeur et al. 1999). Leatherbacks, which prey mainly on large jellyfish, are thought to have extended their range in the Atlantic north by 330 km in the last 17 years as warming has caused the northerly migration of the 15° C SST isotherm, the lower limit of thermal tolerance for leatherbacks (McMahon and Hays, 2006). Loggerheads in the North Pacific demonstrated lower breeding capacity in years following higher sea surface temperatures (Chaloupka et al. 2008).

Studying loggerhead nesting beach trends in Australia and Japan, Chaloupka et al. (2008) found that during the last 50 years of increasing sea surface temperatures in foraging areas, there was an inverse relationship between nesting beach abundance and mean sea surface temperatures. Cooler foraging habitat is associated with increased ocean productivity resulting in higher loggerhead nesting abundance and warmer ocean temperatures could lead to long-term decreased food supply and nesting abundance unless loggerheads shift their foraging habitat to cooler waters. This effect of sea surface temperature in foraging areas on inter-season nesting beach abundance has also been found for Pacific green sea turtles (Limpus and Nicholls 2000, Chaloupka 2001) as well as for Pacific leatherback sea turtles (Saba et al. 2007). It is important to note that turtles appear to return to the same foraging areas, so if the rate of change to those habitats is rapid, turtles will have to adapt quickly to keep up with shifted distributions and will be displaced to new foraging areas.

4.7 Summary of Impacts by Alternative

Table 9 compares the potential impacts of all of the alternatives. Alternative 1 (no action) is expected to result in negative impacts to sea turtle populations and the socioeconomic environment due to the termination of existing programs in Japan, Indonesia, PNG, and Mexico. The loss of sea turtle projects funded by the Council will result in unmitigated threats at both nesting and in-water habitats of leatherback, loggerhead, and green turtle populations. Alternatives 2-4 progressively have positive impacts to sea turtles as a result of threat mitigation and to the socioeconomic environment as a result of possible employment of project staff in the local communities. Alternative 4 provides the greatest positive impact to sea turtle populations because existing major threats are addressed.

Table 9: Summary of impacts of the alternatives

	Alternatives*			
Resource	1	2	3	4
Sea Turtles	-	+	++	+++
Socioeconomic Environment	-	+	++	++

*0 (no impact); + (positive impact); - (negative impact)

4.8 Issues Eliminated from Detailed Study

NEPA specifies that an EA should only address resources that are potentially subject to adverse impacts, and that the level of analysis should be commensurate with the anticipated level of environmental impact. Therefore, the following impacts were eliminated from detailed analysis as these potential impacts were considered negligible or non-existent.

4.8.1 Impacts to Public Health and Safety

Implementation of the proposed action would have no effect on public health and safety. The community members conducting the conservation measures receive training by the relevant organizations to conduct their work in safe manner, and follow stringent handling protocols as defined in the IUCN (1999) comprehensive guide to turtle research and conservation: *Research and Management Techniques for the Conservation of Sea Turtles.* These handling protocols are designed to ensure the safety of both the sea turtle and the person(s) doing the tagging.

4.8.2 Impacts to Unique Geographic Areas

The proposed action is not expected to impact unique geographic areas, as no construction of physical structures or destruction of existing features are being proposed.

4.8.3 Impacts as Highly Controversial

The impacts of the proposed action on the human environment are not expected to be controversial because the sea turtle conservation measures are well recognized as being effective in the global effort to conserve sea turtles, and have been endorsed and supported by the Council's Sea Turtle Advisory Committee and other program partners, including the Sea Turtle Association of Japan, Marine Research Foundation, World Wildlife Fund-Indonesia, Proyecto Caguama, Secretariat of the Pacific Regional Environment Program, Secretariat of the Pacific Communities, and Everlasting Nature of Asia.

4.8.4 Impacts Resulting in Unknown or Uncertain Risks

The proposed action is not expected to result in highly uncertain or unknown risks because the work replicates sea turtle conservation programs that have proven to be successful by increasing hatchling production and obtaining valuable life history information from monitoring efforts.

4.8.5 Impacts to National Historic Places

The proposed action does not include any areas listed under the National Register of Historic Places.

4.8.6 Violation of Any Federal, State, or Local Laws

The proposed action does not violate any Federal, state, or local law. All projects will operate under appropriate permits as required by the country in which the project is taking place.

4.8.7 Impacts Associated with Spreading Non-Indigenous Species

The proposed action does not involve any non-indigenous species, and therefore will not contribute to the spreading of such species.

CHAPTER 5: REFERENCES

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National Marine Fisheries Service
FINDING OF NO SIGNIFICANT IMPACT
for Environmental Assessment of Financial Assistance for the
Sea Turtle Conservation Program of the
Western Pacific Regional Fishery Management Council

Introduction

Pursuant to National Environmental policy Act (NEPA) and NOAA policy as per NOAA Administrative Order 216-6, the Pacific Islands Regional Office, in conjunction with the Western Pacific Regional Fishery Management Council (Council) prepared an Environmental Assessment (EA) that contains an analysis of a range of alternatives and resulting impacts for providing financial assistance over a five-year grant period to the Council's Sea Turtle Conservation Program. One of the purposes of the EA is to provide the evidence and analysis necessary to decide whether an agency must prepare an environmental impact statement (EIS). This Finding of No Significant Impact (FONSI) is the decision maker's determination that the proposed action will not result in significant impacts to the human environment and therefore further analysis in an EIS is not needed. This EA and FONSI also integrate and cover the environmental review for E.O. 12114, Environmental Effects Abroad of Major Federal Actions.

Alternatives Considered

The alternatives considered in detail in the EA are:

Alternative 1: No Action – This alternative would not provide financial assistance to the Council to support sea turtle conservation programs at the locations described in Chapter 2 of the attached EA.

Alternative 2: Education, Outreach, and Census Patrols – This alternative consists of community education and outreach, and census patrols utilizing strict and well-defined protocols. This alternative does not include the touching of turtles or eggs (i.e., no tagging or measurements, and no nest management activities), but entails only the counting of females and nests to quantify simple baseline nesting dynamics (i.e., number of nesting turtles and number of nests laid per season). Nesting beach protection would be achieved by education and outreach initiatives provided to the local community, and by the presence of beach monitors conducting nightly census patrols.

Alternative 3: Education and Outreach, Census Patrols, Research Monitoring, and Nesting Beach Management (including Predator Mitigation) - This alternative consists of community education and outreach, census patrols, research monitoring, nesting beach management, and predator mitigation utilizing strict and well-defined protocols. Monitoring would include research efforts consistent with stringent protocols for tagging turtles and collecting biological information (e.g., measurements) at nesting and foraging sites, and quantifying hatching success rates at nesting beaches to obtain a measure of site productivity. Nest management would involve utilizing strict and well-defined protocols to identify and relocate nests laid in erosion prone areas to maximize hatchling production.

To alleviate impacts from predators at nesting sites (e.g. feral dogs/cats, pigs, raccoons, iguanas), management efforts would include the protection of hatchling and/or nest from predators by either *in-situ* management (i.e., construction of protective structures around, near or over non-relocated nests, fences, placement of grates/cages, etc.), or relocation of nests to hatcheries to maximize hatchling production (site specific methods to be identified by the implementing organization). Nesting beach protection would be achieved by education and outreach initiatives provided to the local community to reduce anthropogenic impacts, by the presence of beach monitors conducting nightly census/monitoring patrols, and by the relocation of nests destined for certain (100%) mortality due to beach erosion impacts.

Alternative 4: Education and Outreach, Census Patrols, Research Monitoring, Nesting Beach Management, and Bycatch Mitigation (Preferred Alternative) - This alternative consists of community education and outreach, census patrols, research monitoring, nesting beach management, predator mitigation, and bycatch mitigation utilizing strict and well-defined protocols. Monitoring would include research efforts consistent with stringent protocols for tagging turtles and collecting biological information (e.g., measurements) at nesting and foraging sites, and quantifying hatching success rates at nesting beaches to obtain a measure of site productivity. Nest management would involve utilizing strict and well-defined protocols to identify and relocate nests laid in erosion prone areas to maximize hatchling production. Predator mitigation would include protection of hatchlings and/or nests from predators by either *in-situ* management or relocation of nests to hatcheries to maximize hatchling production. Additional nesting beach protection would be achieved by education and outreach initiatives provided to local community to reduce anthropogenic impacts, by the presence of beach monitors conducting nightly census/monitoring patrols, and by the relocation of nests destined for certain (100%) mortality due to beach erosion impacts.

Bycatch mitigation would involve testing of alternative gear or fishing methods known to or predicted to reduce sea turtle bycatch, testing of other mitigation technology (e.g., deterrents such as illumination of gear and use of shark shapes), and education and outreach to fishers and local communities to gain support for bycatch reduction. Other projects directed at understanding sea turtle bycatch issues would involve necropsies of dead stranded sea turtles and monitoring of certain fisheries.

Content and Intensity as Required by NEPA

The Council on Environmental Quality (CEQ) Regulations state that the determination of significance using an analysis of effects requires examination of both context and intensity, and lists ten criteria for intensity (40 CFR 1508.27). In addition, the National Oceanic and Atmospheric Administration Administrative Order (NAO) 216-6 Section 6.01b. 1 - 11 provides eleven criteria, the same ten as the CEQ Regulations and one additional, for determining whether the impacts of a proposed action are significant. Each criterion is discussed below with respect to the proposed action and considered individually as well as in combination with the others.

1. Can the proposed action reasonably be expected to cause both beneficial and adverse impacts that overall may result in a significant effect, even if the effect will be beneficial?

The proposed action is designed to conserve and protect threatened and endangered sea turtles and to be beneficial to these species. Stringent handling protocols as defined in the IUCN comprehensive guide to turtle research and conservation: *Research and Management Techniques for the Conservation of Sea Turtles* (1999, as cited in the attached EA) will be followed to ensure no harm or injury to these species will occur as a result of the proposed action. These methods and protocols are accepted by sea turtle experts as not causing harm to sea turtles and to enhance hatchling productivity.

Although the sea turtle conservation projects will likely increase hatchling success and provide valuable information on sea turtles, there are numerous other nesting beaches that remain unprotected. In addition, there are many other threats to sea turtles including fishery interactions, loss of habitat, beach construction, and disease, which can adversely affect sea turtle populations. The conservation work described in Alternatives 2-4 will not single-handedly recover sea turtle populations and are just a small portion of the larger international effort needed to protect sea turtles. Therefore, while the impacts of these activities are beneficial, they are not considered to be significant on a global scale.

2. Can the proposed action reasonably be expected to significantly affect public health or safety?

Section 4.8.1 of the attached EA (pg. 62) states that implementation of the proposed action would have no effect on public health and safety. The community members conducting the conservation measures receive training by the relevant organizations to conduct their work in safe manner, and follow stringent handling protocols as defined in the IUCN (1999) comprehensive guide to turtle research and conservation: *Research and Management Techniques for the Conservation of Sea Turtles.* These handling protocols are designed to ensure the safety of both the sea turtle and the person(s) doing the tagging.

As described in Section 3.1.2.1 of the attached EA (pg. 38), sea turtle eggs are a traditional food item for people in Papua and Papua New Guinea. However, the amount of food derived from leatherback sea turtle eggs is thought to be minimal, as many areas have prohibited the harvest of sea turtles and eggs for several years. Additionally, there are other sources of protein available to communities, such as from fish, chicken, and pigs, and thus there are no expected impacts to public health as a result of implementing Alternatives 2-4 which promote the non-harvest of leatherback sea turtle eggs.

3. Can the proposed action reasonably be expected to result in significant impacts to unique characteristics of the geographic area, such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?

Under Alternatives 3 and 4, which involve nest relocation from erosion-prone areas, the nests dug for relocating sea turtle eggs would not involve large quantities of sand to be displaced and subsequently re-deposited into the marine environment. Nesting beach management programs promote activities which maintain the beaches in their natural state. Therefore, Alternatives 3 and 4 are not expected to have any significant impacts on unique geographic areas, as no construction of physical structures or destruction of existing features is being proposed.

4. Are the proposed action's effects on the quality of the human environment likely to be highly controversial?

The impacts of the alternatives on the human environment are not expected to be controversial because the sea turtle conservation measures described in Alternatives 2 through 4 are well recognized as being effective in the global effort to conserve sea turtles, and have been endorsed and supported by the Council's Turtle Advisory Committee (TAC) and other program partners, including the Sea Turtle Association of Japan, Marine Research Foundation, World Wildlife Fund-Indonesia, Proyecto Caguama, Secretariat of the Pacific Regional Environment Program, Secretariat of the Pacific Communities, and Everlasting Nature of Asia. The actions described in Alternatives 3 and 4 for relocating nests and handling turtles follow stringent handling protocols as defined in the IUCN comprehensive guide to turtle research and conservation: *Research and Management Techniques for the Conservation of Sea Turtles* (1999, as cited in the attached EA). These methods and protocols are accepted by sea turtle experts as not causing harm to sea turtles and to enhance hatchling productivity. See Chapter 2, Sections 2.1.5.3 through 2.1.5.4.1 for a detailed description of the handling and nest relocation procedures that would be used under Alternatives 3 and 4 (EA, pp. 20-24).

5. Are the proposed action's effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Section 4.8.4 of the attached EA (page 62) states that none of the alternatives are expected to result in highly uncertain or unknown risks because the work replicates sea turtle conservation programs that have proven to be successful by increasing hatchling production and obtaining valuable life history information from monitoring efforts. See Section 1.4.1 of the attached EA (pp. 10-17) for a detailed description of the history of the sea turtle conservation programs undertaken by the Council to date.

6. Can the proposed action reasonably be expected to establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration?

The activities outlined in the proposed action do not set a precedent. The sea turtle conservation measures described in Alternatives 2 through 4 are well recognized as being effective in the global effort to conserve sea turtles, and have been endorsed and supported by the Council's Turtle Advisory Committee (TAC) and other program partners, including the Sea Turtle Association of Japan, Marine Research Foundation, World Wildlife Fund-Indonesia, Proyecto Caguama, Secretariat of the Pacific Regional Environment Program, Secretariat of the Pacific Communities, and Everlasting Nature of Asia. The actions described in Alternatives 3 and 4 for relocating nests and handling turtles follow stringent handling protocols as defined in the IUCN comprehensive guide to turtle research and conservation: *Research and Management Techniques for the Conservation of Sea Turtles* (1999, as cited in the attached EA). These methods and protocols are accepted by sea turtle experts as not causing harm to sea turtles and to enhance hatchling productivity.

7. Is the proposed action related to other actions that when considered together will have individually insignificant but cumulatively significant impacts?

Section 4.5 of the attached EA describes the cumulative impacts of the proposed action in combination with other actions in the affected region (pp. 58-59). Although the sea turtle conservation projects will likely increase hatchling success and provide valuable information on sea turtles, there are numerous other nesting beaches that remain unprotected. In addition, there are many other threats to sea turtles including fishery interactions, loss of habitat, beach construction, and disease (to name a few) which can adversely affect sea turtle populations. The conservation work in Alternatives 2-4 will not single-handedly recover sea turtle populations. Collaborative international efforts addressing all phases of a turtle's life history are required to save sea turtle populations from extinction. The Council's sea turtle conservation efforts, although important, are just a small portion of the larger effort needed to protect sea turtles. All activities combined, including activities of other agencies and nations, are expected to have an overall cumulative positive effect on sea turtle populations in the Pacific.

8. Can the proposed action reasonably be expected to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources?

The conservation measures contained in the proposed action are international in scope and do not take place in any areas listed or eligible for listing under the National Registry of Historic Places.

9. Can the proposed action reasonably be expected to have a significant impact on endangered or threatened species, or their critical habitat as defined under the Endangered Species Act of 1973?

The proposed action is designed to conserve and protect threatened and endangered sea turtles and to be beneficial to these species. Stringent handling protocols as defined in the IUCN comprehensive guide to turtle research and conservation: *Research and Management Techniques for the Conservation of Sea Turtles* (1999, as cited in the attached EA) will be followed to ensure no harm or injury to these species will occur as a result of the proposed action. These methods and protocols are accepted by sea turtle experts as not causing harm to sea turtles and to enhance hatchling productivity.

On March 16, 2010, the NMFS and the USFWS published a 12-month finding in the Federal Register, responding to a petition to reclassify loggerhead sea turtles in the North Pacific Ocean and the Northwest Atlantic Ocean as Distinct Population Segments (DPSs), to change their listing status from threatened to endangered under the ESA, and to designate critical habitat (Federal Register Vol. 75, No. 50 pp.12598-12655). Comments are being solicited on the proposal to reclassify these turtle populations as DPS's with endangered status until June 14, 2010. If found to be prudent and determinable, a subsequent Federal Register notice would be published on the proposal to designate critical habitat for the two DPSs. There is currently no critical habitat designated for any ESA-listed sea turtle.

10. Can the proposed action reasonably be expected to threaten a violation of Federal, state, or local law or requirements imposed for environmental protection?

The proposed action does not violate any Federal, state, or local law. As stated in the attached EA in Section 4.8.6, all projects will operate under appropriate permits as required by the country in which the project is taking place (EA, page 63).

11. Can the proposed action reasonably be expected to result in the introduction or spread of a nonindigenous species?

The conservation measures in the proposed action do not involve the importation or handling of non-indigenous species. The work would strictly focus on education, outreach, monitoring, research, and protection of indigenous sea turtles.

DETERMINATION

In view of the information presented in this document and the analysis contained in the supporting Environmental Assessment prepared for Financial Assistance for the Sea Turtle Conservation Program of the Western Pacific Regional Fishery Management Council, it is hereby determined that the Sea Turtle Conservation Program of the Western Pacific Regional Fishery Management Council will not significantly impact the quality of the human environment as described above and in the supporting Environmental Assessment. In addition, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an environmental impact statement for this action is not necessary.

Michael D. Tosatto
Acting Regional Administrator
Pacific Islands Regional Office
National Marine Fisheries Service

04/22/2010
Date