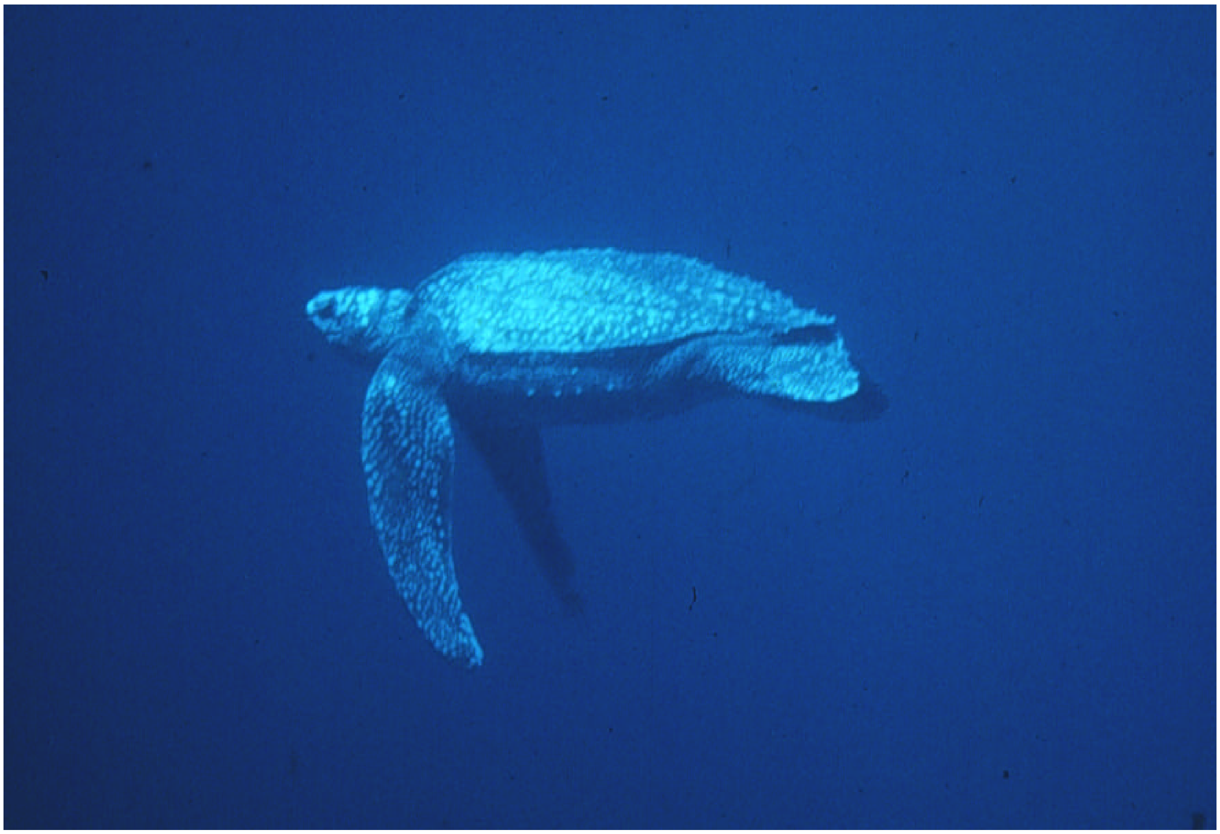
Recovery Plan for U.S. Pacific Populations

of the

Leatherback Turtle

(Dermochelys coriacea)



U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

U.S. Department of the Interior
U.S. Fish and Wildlife Service

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RECOVERY PLAN FOR U.S. PACIFIC POPULATIONS OF THE LEATHERBACK TURTLE

(*Dermochelys coriacea*)

Prepared by the

Pacific Sea Turtle Recovery Team

for

National Marine Fisheries Service

Silver Spring, Maryland

and

Pacific Region

U.S. Fish and Wildlife Service

Portland, Oregon

Approved: Sam D. Hamilton
Regional Director, U.S. Fish and Wildlife Service

Date: 12-23-97

Approved: David Evans
Assistant Administrator for Fisheries, National Marine Fisheries Service

Date: 1/12/98

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the species. Plans are prepared by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS), and sometimes with the assistance of recovery teams, contractors, State agencies and others. Objectives will only be attained and funds expended contingently upon appropriations, priorities and other budgetary constraints. Recovery plans do not necessarily represent the views nor the official positions or approvals of any individuals or agencies, other than those of NMFS and the FWS which were involved in the plan formulation. They represent the official positions of NMFS and the FWS only after they have been approved by the Assistant Administrator for Fisheries or the Regional Director. Approved recovery plans are subject to modification as dictated by new findings, changes in species status and the completion of recovery tasks.

Literature citations should read as follows:

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PREFACE

The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) share responsibilities at the Federal level for the research, management, and recovery of Pacific marine turtle populations under U.S. jurisdiction. To accomplish the drafting of this recovery plan, NMFS appointed a team of professional biologists experienced with marine turtles in the Pacific region. This document is one of six recovery plans (one for each of the five species plus one for the regionally important population of the East Pacific green turtle).

While similar in format to previously drafted sea turtle recovery plans for the Atlantic, Caribbean, and Hawaii, the unique nature of the wider Pacific region required some modification of the recovery plan format. The geographic scope of the present plan is much larger than any previously attempted and considers areas from the western coastal United States extending to Guam. Furthermore, the amount of jurisdictional overlap between nations, commonwealths, territories and compact-of-free-association-states and their various turtle populations required a broader management perspective than has been attempted previously. Finally, sea turtles have not been studied as comprehensively in the Pacific as in other U.S. areas, and thus there are many areas in the Pacific where basic biological and ecological information must be obtained for management purposes. Thus, these plans have more extensive text on the general biology of the turtles, so that they might act as a resource to managers seeking a handy reference to the species. The plans are also subdivided into U.S. jurisdictional areas (i.e., the various territories and the commonwealth), so that local managers can address issues within their respective regions more easily.

Because of the previously noted aspects of marine turtle distribution in the Pacific (e.g. wide geographic range, multiple jurisdictions), the Recovery Team relied on the input and involvement of a large number of advisers, as can be noted by the lengthy Acknowledgments section. It is hoped that the resulting document is one that acts as a pragmatic guide to recovering the threatened and endangered sea turtle populations in the Pacific Ocean.

The members of the Pacific Sea Turtle Recovery Team and the authors of this document are:

Scott A. Eckert, Ph.D. (Team Leader)
Hubbs-Sea World Research Institute

Javier Alvarado, Ph.D.
Universidad de Michoacan, Mexico

George Balazs
National Marine Fisheries Service

Richard Byles, Ph.D.
U.S. Fish and Wildlife Service

Peter Craig, Ph.D.
Office of Wildlife and Marine Resources, Government of American Samoa

Peter Dutton, Ph.D.
Texas A&M University

Karen Eckert, Ph.D.
Wider Caribbean Sea Turtle Conservation Network (WIDECAST)

John Engbring
U.S. Fish and Wildlife Service

James Maragos, Ph.D.
East-West Center

Robert Pitman
National Marine Fisheries Service

Susan Pultz
U.S. Fish and Wildlife Service

James I. Richardson. Ph.D.
University of Georgia

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David Aldan, Department of Natural Resources, Saipan, MP
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Donald David, FSM
Gerry Davis, Division of Aquatic and Wildlife Resources, Dept. Agriculture, Guam
Oscar DeBrum, former Chief Secretary, RMI
Adrienne Farago, SPREP/RMTCP, Western Samoa
Michael Guilbeaux,Georgia Sea Turtle Cooperative
Vincent Hachiglou, Marine Resources Management Division, Yap State Government
Heidi Hirsh, Andersen Air Force Base, Guam
Paul Holthus, IUCN Biodiversity Program
Luciana Honigman, The Nature Conservancy
Noah Idechong, Division of Marine Resources, Palau
John Iou, Marine Resources Management Division, Yap State Government
Bruce Jensen, Pacific Magazine
Harry Kami, Hilo, Hawaii
Angela Kay Kepler, Athens, Georgia
Steve Kolinski, Marine Resources Management Division, Yap State Government
Colin Limpus, Queensland National Parks and Wildlife Service, Australia
Becky Madraisau, Micronesian Mariculture Demonstration Center, Republic of Palau
B. Renè Màrquez-M., P.N.I.T.M./INP, Mexico
Donna McDonald, Ocean Planet Research
Ken McDermond, U.S. Fish and Wildlife Service, Honolulu
Jeffery Miller, Queensland Department of Environment & Heritage, Australia
Susan Miller, South Pacific Regional Environment Program (SPREP)
Karen Miller McClune, Hubbs-Sea World Research Institute
Moses Nelson, Marine Resources Division, FSM
Peter Oliver, RMI
Arnold Palacios, Division of Fish and Wildlife, Dept. of Natural Resources, CNMI
Peter Pritchard, Florida Audubon Society
Georgita Ruiz, Colonia Irrigacion, Mexico
Laura Sarti, Universidad Naçional Autonoma de Mexico, Mexico
Fumihiko Sato, Ogasawara Marine Center, Japan
Katsufumi Sato, Kyoto University, Japan
Asterio Takesy, Secretary of Resources and Development, FSM
Natasha Tuato'o-Bartley, Department of Marine and Wildife Resources, American Samoa
Itaru Uchida, Port of Nagoya Public Aquarium, Japan
Richard Wass, U.S. Fish and Wildlife Service
Phil Williams, National Marine Fisheries Service

LIST OF ABBREVIATIONS

CCL	curved carapace length
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNMI	Commonwealth of the Northern Mariana Islands
COE	U.S. Army Corps of Engineers
DAWR	Division of Aquatic and Wildlife Resources
EEZ	Exclusive Economic Zone
ENSO	El Niño - Southern Oscillation
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ETP	Eastern Tropical Pacific
FENA	females estimated to nest annually
FSM	Federated States of Micronesia
FWS	U.S. Fish and Wildlife Service
HSWRI	Hubbs-Sea World Research Institute
IATTC	Inter-American Tropical Tuna Commission
INP	Instituto Nacional de Pesca
IUCN	International Union for the Conservation of Nature
MHI	Main Hawaiian Islands
MIMRA	Marshall Islands Marine Resource Authority
MMDC	Micronesian Mariculture Demonstration Center
MRMD	Marine Resources Management Division, Yap State government
mtDNA	mitochondrial DNA
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service (Soil Conservation Service)
NWHI	Northwest Hawaiian Islands
PNG	Papua New Guinea
RMI	Republic of the Marshall Islands
SCL	straight carapace length
SDG&E	San Diego Gas & Electric
SPREP	South Pacific Regional Environment Program
TAMU	Texas A & M University
TED	Turtle Excluder Device
UNAM	Universidad Naçional Autonoma de Mexico
USCG	U.S. Coast Guard
USVI	U.S. Virgin Islands
WIDECAST	Wider Caribbean Sea Turtle Conservation Network

EXECUTIVE SUMMARY

Current Status: The leatherback turtle is listed as Endangered throughout its range. In the Pacific, leatherback populations are in severe decline and recovery actions must be given the highest priority. Primary threats to the species are incidental take in coastal and high seas fisheries, and the killing of nesting females and collecting of eggs at the nesting beaches. The United States does not have any nesting of leatherbacks in its jurisdiction in the Pacific, but has important foraging areas on the continental U.S. west coast and near the Hawaiian Islands. It is likely that stocks in U.S. waters originate in Mexico and Central America, though some may originate from Southeast Asia as well. While not directly classified as a threat, the lack of information on the movement patterns and habitat needs of this entirely pelagic species (leatherbacks are the only species which remains pelagic throughout its life) is severely hampering recovery efforts and must be addressed as a high priority.

Goal: The recovery goal is to delist the species.

Recovery Criteria: To consider de-listing, all of the following criteria must be met:

1) All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.

2) Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years.

3) Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period.

4) Existing foraging areas are maintained as healthy environments.

5) Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region.

6) All Priority #1 tasks have been implemented.

7) A management plan designed to maintain sustained populations of turtles is in place.

Actions Needed: Five major actions are needed to achieve recovery (not in order of priority):

1) Eliminate incidental take of leatherbacks in U.S. and international commercial fisheries.

2) Support the efforts of Mexico and the countries of Central America to census and protect nesting leatherbacks, their eggs, and nesting beaches.

3) Determine movement patterns, habitat needs and primary foraging areas for the species throughout its range.

4) Determine population size and status in U.S. waters through regular aerial or on-water surveys.

5) Identify stock home ranges using DNA analysis.

RECOVERY PLAN FOR U.S. PACIFIC POPULATIONS OF THE LEATHERBACK TURTLE (*Dermochelys coriacea*)

Prepared by the
U.S. Pacific Sea Turtle Recovery Team

I. INTRODUCTION

A. Geographic Scope

Defining the geographic range of a population of sea turtles in the Pacific Ocean is difficult. Sea turtles are highly migratory, and the life histories of all species exhibit complex movements and migrations through geographically disparate habitats. Because the U.S. Pacific Sea Turtle Recovery Team is required to focus on sea turtle populations that reside within U.S. jurisdiction, we must delineate what constitutes a population where individuals reside permanently or temporarily within U.S. jurisdiction and what actions must be taken to restore that population. This has proven to be quite challenging because sea turtles do not recognize arbitrary national boundaries and in most cases we have only limited data on stock ranges and movements of the various populations. In this recovery plan we have tried to make these judgements with the best information available, and to suggest means by which the United States can promote population recovery.

Geographic scope (from a U.S. jurisdictional perspective) for all six of the U.S. Pacific sea turtle recovery plans (written for five species and one regionally important population) is defined as follows: in the eastern Pacific, the west coast of the continental United States (Figure 1a); in the central Pacific, the state of Hawaii and the unincorporated U.S. territories of Howland, Baker, Wake, Jarvis, and Midway Islands, Johnston Atoll, Palmyra Atoll, and Kingman Reef; in Oceania, Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and American Samoa (see Figure 1b). The U.S.-affiliated but independent nations of the Republic of the Marshall Islands (RMI), Federated States of Micronesia (FSM), and the Republic of Palau are also included. The FSM includes the states of Yap, Pohnpei, Chuuk, and Kosrae. While independent, all retain clearly defined administrative links to the United States in the areas of defense, natural resource management, and some regulatory issues. Thus, we include them here in an advisory capacity. Finally, where eastern Pacific sea turtles are held in common with Mexico, discussion of the status and recovery of these stocks will also include discussion of the resource under Mexican jurisdiction. In all cases where U.S. sea turtle stocks are held in common with other sovereign states, we have tried to suggest means by which the United States can support efforts at management of those stocks by those states. We recognize that other nations may have different priorities than the United States and we have sincerely attempted to avoid establishing policy for those nations.

Because of the highly migratory behavior of the adult turtles, and the likelihood of shifting habitat requirements for post-hatchlings and juveniles, the populations of leatherback turtles (*Dermochelys coriacea*) in the Pacific Ocean cross international boundaries. The offshore

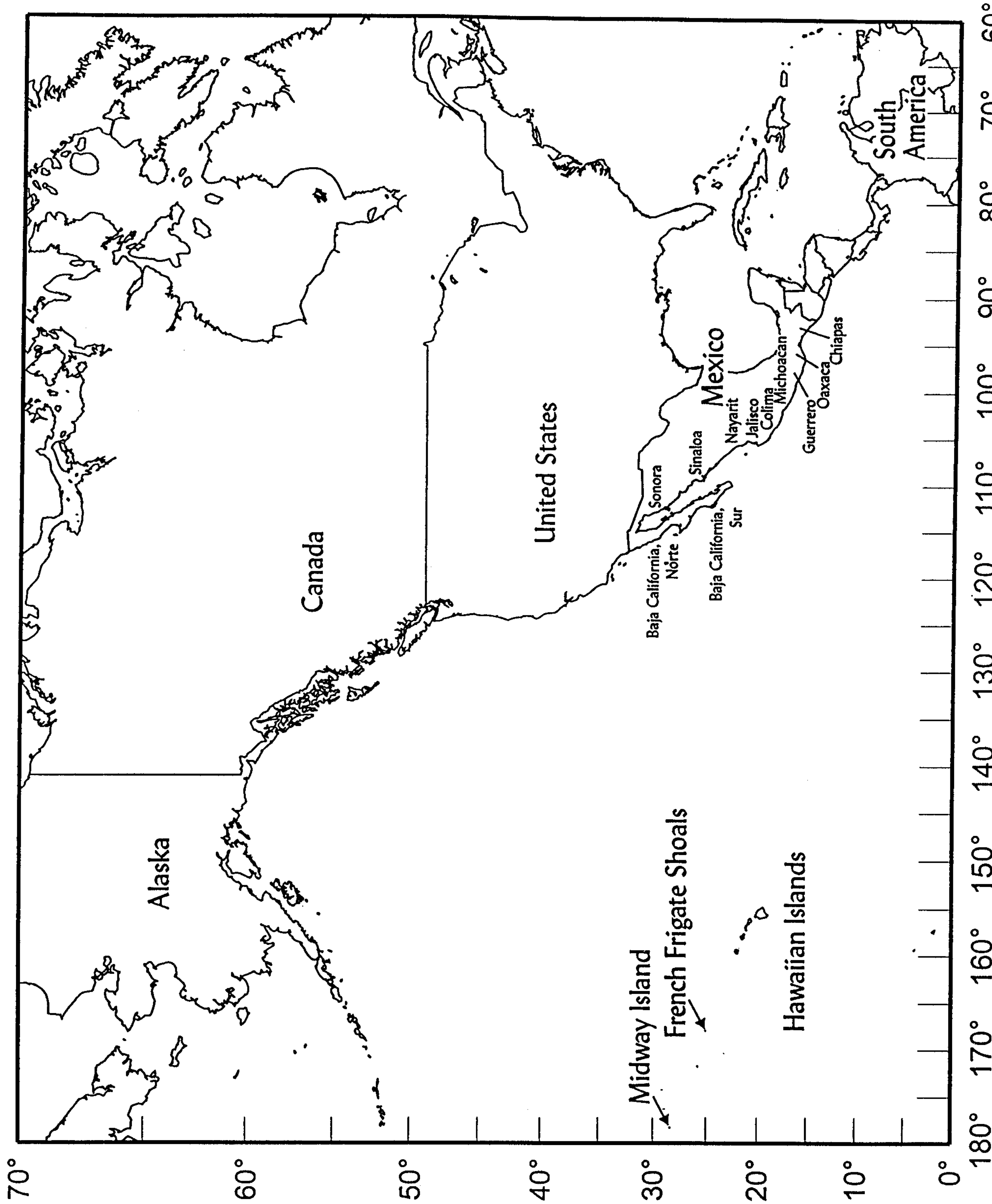

Figure 1a. Western coasts of the United States, Canada and Mexico (as well as Central and northern South America) constitute a shared habitat for Pacific sea turtles.

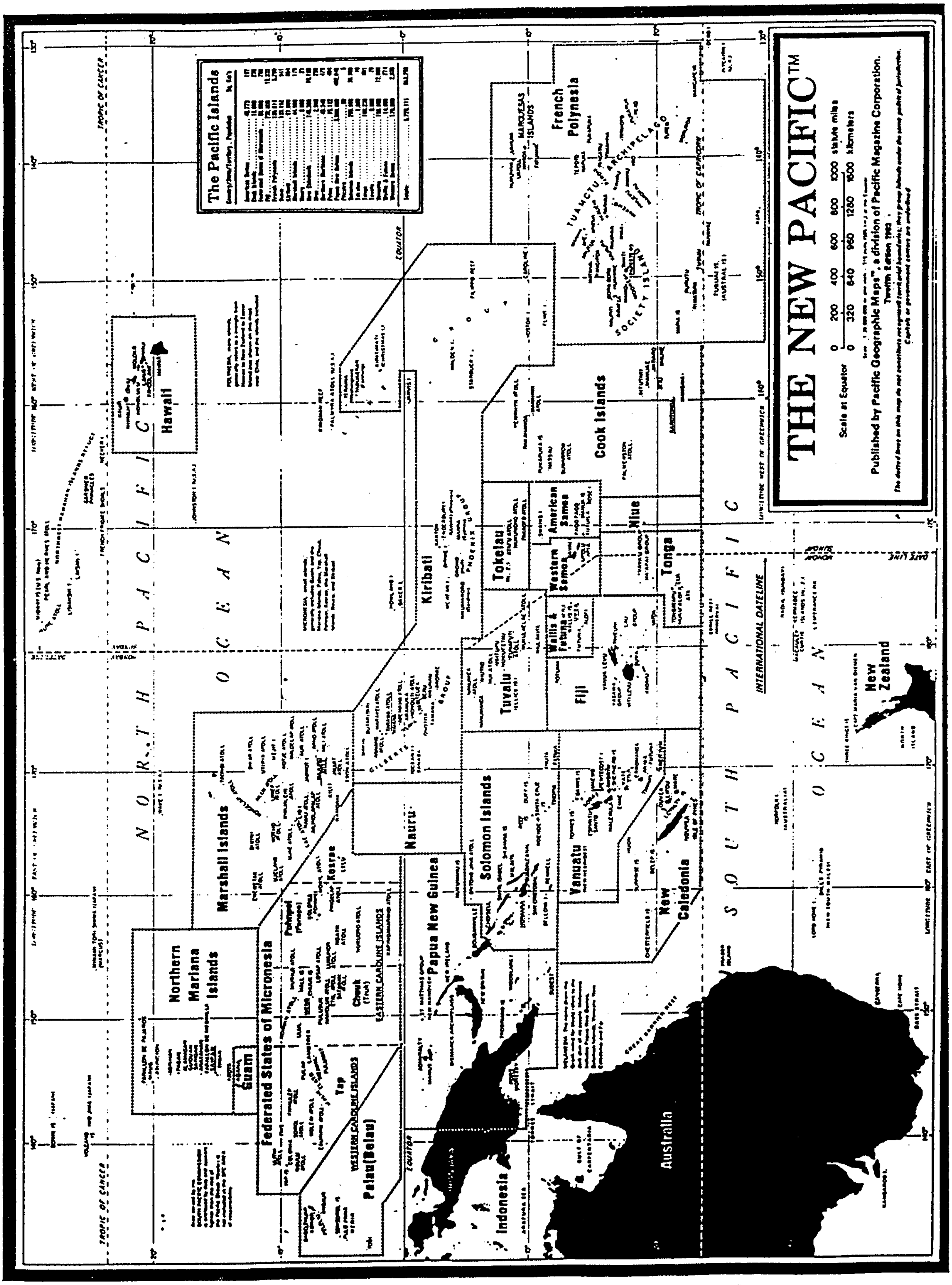

Figure 1b. The western Pacific constitutes a shared habitat for Pacific sea turtles.

waters of Indochina, China, Japan, and the east coast of the former Soviet Union in the western north Pacific, and the west coasts of Central America, Mexico and the United States in the eastern north Pacific probably constitute shared habitats for leatherback sea turtles. The species is also encountered in the international waters of the central north Pacific. The extent to which east and west Pacific populations mingle is not known. The extended range of leatherback sea turtles is acknowledged in the following discussions.

B. Historical and Cultural Background

In contrast to the rich legacy of cultural tradition and economic value which characterizes some other sea turtle species, there is no evidence of important subsistence or cultural usage in the United States involving the comparatively rare leatherback turtle. There is no nesting by leatherbacks on beaches under present or former U.S. Pacific jurisdiction. At-sea sightings in the U.S. Pacific are largely confined to the continental west coast.

C. Taxonomy

The generic name *Dermochelys* was introduced by Blainville (1816). The specific name *coriacea* was first used by Vandelli (1761) and adopted by Linnaeus (1766) (Rhodin and Smith 1982). The binomial refers to the distinctive leathery, scaleless skin of the adult turtle. This species is the sole member of the taxonomic family Dermochelyidae. All other extant sea turtles are in the family Cheloniidae. A degree of relationship between *Dermochelys* and other living sea turtles has been deduced from behavioral (Carr and Ogren 1959), morphological (Nick 1912; Zug 1966) and biochemical (Frair 1979, 1982; Chen et al. 1980; Chen and Mao 1981) and genetic (Bowen et al. 1993; Dutton 1995; Dutton et al. 1996) studies. However, *Dermochelys* possesses a skeletal morphology unique among turtles (Rhodin et al. 1981), and recent karyological studies (Medrano et al. 1987) support taxonomic classifications which segregate extant sea turtle species into two distinct families (Gaffney 1975, 1984; Bickham and Carr 1983). For the most recent detailed discussion of taxonomy and synonymy, see Pritchard and Trebbau (1984).

D. Description

Whereas other sea turtles have a carapace containing bony plates covered by horny scutes, the slightly flexible carapace of the leatherback is distinguished by a rubber-like texture. In adults, the carapace (ca. 4 cm thick) is constituted mainly of tough, oil-saturated connective tissue raised into seven prominent ridges and tapered to a blunt point posteriorly. A nearly continuous layer of small dermal bones lies just below the leathery outer skin of the carapace. The narrow ribs lack pleural flanges and remain widely separated throughout life. No sharp angle is formed between the carapace and the plastron, resulting in the animal being somewhat barrel-shaped. The scaleless skin and carapace are black with varying degrees of pale spotting. The underside is mottled, pinkish-white and black; the proportion of light to dark pigment is variable. The front flippers are proportionally longer than in other sea turtles and may span 270 cm in an adult. Hatchlings are likewise predominately black, with mottled undersides, but differ in being covered with tiny polygonal or bead-like scales. The flippers are margined in white, and rows of white scales appear as stripes along the length of the back. Front and rear flippers lack claws. In both adults and hatchlings, the upper jaw bears two tooth-shaped projections, each flanked by deep cusps, at the premaxillary-maxillary sutures. For a detailed discussion of anatomy, including embryonic development, see Deraniyagala (1932, 1936a), Dunlap (1955), Pritchard (1971), and Pritchard and Trebbau (1984).

Curved carapace length (CCL) in adult females nesting in Michoacán, Mexico, during 1980-1988 averaged 144.9 cm CCL (range 119-176, n=2591) (Laura Sarti M., Universidad Naçional Autonoma de Mexico [UNAM], unpubl. data). In contrast, adult females nesting in eastern Australia average 162.4 cm CCL (Limpus et al. 1984). Despite the size dichotomy between mature turtles from eastern and western Pacific nesting colonies, conclusions of evolutionary distinctness may be unwarranted. Genetic differentiation in this species, at least in terms of maternally inherited mitochondrial DNA (mtDNA) lineages, is extremely low relative to other species of sea turtle (Dutton et al. 1996). A recent survey of five Atlantic rookeries did not reveal any genetic population structure based on mtDNA, and found similarities between Pacific and Atlantic haplotypes. These data suggest gene flow between rookeries within ocean basins and imply that western Atlantic and eastern Pacific leatherbacks shared a common ancestor in recent evolutionary history (Dutton et al. 1994).

Adults exhibit broad thermal tolerances and are reported in the Pacific as far north as Alaska and the Bering Sea and as far south as Chile and New Zealand (see Insular and Pelagic Range). The core body temperature for adults in cold water has been shown to be several degrees C above ambient (Frair et al. 1972). This may be due to several features, including the thermal inertia of a large body mass, an insulating layer of subepidermal fat, countercurrent heat exchangers in the flippers, potentially heat-generating brown adipose tissue, and a relatively low freezing point for lipids (Mrosovsky and Pritchard 1971; Frair et al. 1972; Greer et al. 1973; Neill and Stevens 1974; Goff and Stenson 1988; Davenport et al. 1990). The skeleton remains highly cartilaginous, even in adult animals, and the species is unique among turtles in showing an extensive cartilage canal vascular system in the long bones (Rhodin et al. 1981).

E. Population Distribution and Size

Nesting Grounds

Some of the largest nesting populations of leatherback turtles in the world border the Pacific Ocean, but no nesting occurs on beaches under U.S. jurisdiction. Until very recently, the largest known population, comprising perhaps nearly half the known number of adult females, nested on the Pacific coast of Mexico, notably in the states of Michoacán, Guerrero and Oaxaca. Today this population has noticeably declined. Leatherbacks do not generally nest in the insular Central and South Pacific (exceptions include the Solomon Islands, Vanuatu, and Fiji). Nesting is widely reported from the western Pacific, including China, Southeast Asia, Indonesia and Australia.

U.S. West Coast

No known nesting.

Hawaii

No known nesting.

American Samoa

No known nesting.

Guam

No known nesting.

Republic of Palau

No known nesting.

Commonwealth of the Northern Mariana Islands (CNMI)

No known nesting.

Republic of the Marshall Islands (RMI)

No known nesting.

Federated States of Micronesia (FSM)

No known nesting.

Unincorporated U.S. Island Territories

There is no known nesting in the unincorporated U.S. island territories of Howland, Baker, Wake, Jarvis, Midway, Johnston, Palmyra, or Kingman Reef.

Other Areas of the Pacific

Eastern Pacific:

The Pacific coast of Mexico is generally regarded as the most important leatherback breeding ground in the world. Based on a single aerial survey in 1980 (31 October - 1 November) of Michoacán, Guerrero, and Oaxaca, as well as on published and anecdotal data, Pritchard (1982a) estimated that 30,000 females nested annually in these three Mexican states. Lower density nesting was (and still is) reported further north in Jalisco (Pritchard 1971; Márquez 1976) and in Baja California, where the northernmost eastern Pacific nesting sites are found (e.g., Fritts et al. 1982). Today the nesting population is vastly reduced (Table 1, Sarti et al. 1996). The reason for the decline is not clear, but contributing factors surely include the persistent collection of eggs and incidental catch in national and international waters.

Table 1. A decade of declining leatherback nesting activity at Mexiquillo, Michoacán, based on annual all-night beach patrols throughout the peak November-February nesting season (Cruz et al. 1987; Sarti et al. 1986; Sarti et al. 1987; Sarti et al. 1988; Sarti et al. 1989a; Lopez et al. 1990; Lopez et al. 1991; Lopez et al. 1992.; Sarti et al. 1993; Diaz 1994; Sarti et al. 1996)

Nesting Season	Number of crawls	Beach km covered
1984-1985	4681	4.5
1985-1986	3414	4.5
1986-1987	5667	4.5
1987-1988	3747	4.5
1988-1989	2211	4.5
1989-1990	1752	4.5
1990-1991	1634	7
1991-1992	1496	7
1992-1993	1363	7
1993-1994	93	7
1994-1995	-	-
1995-1996	709	7

Low density nesting is reported from Pacific Central America and peaks in November-December (Pritchard 1971; Cornelius 1982, 1986). Playa Langosta-Playa Grande, Costa Rica, is a particularly important site, with 1,500 females nesting there in 1990 (J. Spotila, Drexel Univ., pers. comm., 1993). While these areas are not specifically within U.S. jurisdiction, it is likely that females nesting on these beaches forage in or migrate through U.S. waters.

Northwest Pacific:

Nesting is reported from China and Thailand, but quantitative data are lacking. In China, Chu-Chien (1982) reports leatherback turtles in Guangdong (Kwangtung), Guangxi (Kwangsi), Fujian (Fukien), Zhejiang (Chekiang), Jiangxi (Kiangsi), Shandong (Shantung), and Liaoning, but does not specify nesting sites, nest density or population sizes. Field surveys were conducted during June-August 1985 in Fujian and Guangdong Provinces, but no evidence of nesting was found (Frazier et al. 1988). Mao (1971) reported that "eggs are eaten wherever available" in Taiwan and the weight of an adult female "photographed at Nanfangao" was 252 kg; nesting sites, if any, were not specified. Nesting apparently does not occur in Korea (Groombridge 1982) or Japan (Uchida and Nishiwaki 1982; Kamezaki 1989).

Terengganu, Malaysia, once considered a major nesting area, has declined dramatically from over 2,000 nesting females per year in the 1960's and early 1970's to fewer than 20 females in 1993 (Limpus 1995), largely as a result of intensive egg collection (see Status). Nesting does not occur in Sabah (de Silva 1982) or Sarawak (Leh 1985).

Southwest Pacific:

In Indonesia, at least 13,000 leatherback nests were reported in 1984 on 17.8 km at Irian Jaya (Bhaskar 1985). More recently, about 2,600 leatherbacks were reported nesting at three main sites along 18 km of beach in the northern part of Kepala Burung, Sorong, Irian Jaya (Sutanto Suwelo et al. 1994). In contrast, nesting in eastern Australia is uncommon (1-2 turtles per year) and is restricted to about 160 km of coast northward from Bundaberg (Limpus 1982) near Wreck Rock
(Limpus et al. 1984).

Low density nesting occurs widely along the north coast and on some of the larger islands of Papua New Guinea. "Regular nesting sites" include Tulu and Timonai villages on Manus Island, Garu, Kimbe Bay and Ganoi villages in New Britain, along the southeast coast of New Ireland, on Long Island and parts of the mainland of the Madang Province, on Normanby Island in Milne Bay Province, along the coast from Boiken to Turubu in the East Sepik Province, and around Aitape in the West Sepik Province. "Occasional nestings" are reported from Kiriwina and Simsim Islands in the Trobriands, in the Wooklark Islands, on Lou Islands and Tingos village in the Manus Province, and at Pilapila Beach near Rabaul (Spring 1982). Lockhart (1989) confirmed localized nesting on the north coast and offshore islands, peaking around Christmas; adults and eggs are eaten and some rookeries have been exterminated (e.g., Aua and Wuvulu islands).

In the Solomon Islands, the leatherback nests on "numerous isolated beaches" during November-January, preferring those situated near river mouths, having a reefless approach, and being composed of black sand (Pritchard 1982b). According to Pritchard (1982b), the leatherback is known from the islands of Vanuatu, but no nesting beaches were given. A "very low level of nesting" takes place on the southeastern coast of Vanua Levu, Fiji, the most easterly record of nesting by leatherbacks in the insular Pacific (Pritchard 1982b). Nesting is not reported from the Philippines (Pejabat and Siow 1977), New Caledonia, Tonga, or French Polynesia (Pritchard 1982b), Micronesia (Pritchard 1977, 1982c; Thomas 1989), the Phoenix Islands, Western Samoa, Tokelau, Tuvalu, or the Cook Islands (Balazs 1975, 1982b).

Insular and Pelagic Range

The leatherback is typically associated with continental shelf habitats and pelagic environments. It is uncommon in the insular Pacific, but individuals are sometimes encountered in deep water near prominent archipelagoes. To a large extent, the oceanic distribution of leatherbacks may reflect the distribution and abundance of macroplanktonic prey. Analyses of stomach samples have shown that adults feed primarily on medusae, siphonophores, and salpae in temperate and boreal latitudes (see Foraging Biology and Diet). Reports of foraging in north Pacific waters include that of Eisenberg and Frazier (1983), who observed an adult feeding on the jellyfish *Aurelia* off the coast of Washington state. Little information is available on the diet of leatherbacks in northern waters, and on the spatial and temporal distribution of preferred prey species.

Oceanic temperature and bathymetric contours may also be important. The data suggest that leatherbacks occur north of central California during the summer and fall when sea surface temperatures are highest (Dohl et al. 1983; Brueggeman 1991). There is some evidence that leatherbacks follow the 16°C isotherm into Monterey Bay, although the length of their stay "seems more dependent on prey availability than on temperature regimes" (Starbird et al. 1993). Recorded sea surface temperatures at the Oregon and Washington sightings ranged between 13-18.5°C, with the majority in the 15-16°C range (Brueggeman 1991). Some aerial surveys of California, Oregon, and Washington waters suggest that most leatherbacks occur in continental slope waters, while fewer occur over the continental shelf.

U.S. West Coast

After analyzing some 363 records of sea turtles sighted along the Pacific coast of North America (from 29°45'N northward), Stinson (1984) concluded that the leatherback was the most common sea turtle in U.S. waters north of Mexico. Sightings and incidental capture data indicate that leatherbacks are found in Alaska as far north as 60.34°N, 145.38°W and as far west as the Aleutian Islands (Hodge 1979; Stinson 1984). Documented encounters extend southward through the waters of British Columbia (Logier and Toner 1961; MacAskie and Forrester 1962), Washington and Oregon (Brueggeman 1991; Washington Dept. Game, unpubl. data; Craig Webster, Northwest Marine Mammal Stranding Network, *in litt*., 29 October 1990), and California (Lowe and Norris 1955; Dohl et al. 1983; Stinson 1984). There were 96 sightings of leatherbacks within 50 km of Monterey Bay, California, from 1986-1991, mostly by recreational boaters (Starbird et al. 1993). Of 104 records of sea turtle strandings on the U.S. west coast between 1982 and 1991, 50 were leatherbacks (J. Cordaro, National Marine Fisheries Service [NMFS], pers. comm., 1994).

Further insight into coastal and pelagic range may be gained from reports of incidental catch. In the eastern north Pacific these include entanglement in gillnets off the coast of Washington, Oregon, and California (Stick and Hreha 1989; S. Eckert, Hubbs-Sea World Research Institute, pers. comm.). Fishermen "regularly" catch leatherbacks in drift/gill nets off Monterey Bay, central California (C. Starbird, San José State Univ., pers. comm., 1991). A leatherback was killed in October 1990 in a gillnet set in the Bay area (36°55'N, 122°40'W) (S. Eckert, pers. comm.). See also Threats, Fisheries (Incidental take).

Hawaii

Leatherbacks encountered in Hawaii, including those caught incidental to fishing operations, may represent individuals in transit from one part of the Pacific to another (Balazs 1973). Leatherbacks are "regularly sighted" in offshore waters at the southeastern end of the Hawaiian archipelago. In August 1979 at least ten individuals, including juveniles, were sighted in pelagic waters northwest of Hawaii (40-42°N, 175-179°W) (Balazs 1982a).

American Samoa

The only leatherback turtle record is that of a juvenile (42.7 cm CCL) caught by longline about 5.6 km south of Swains Island. Water depth at the capture location was about 1,400 m (Grant 1994). mtDNA analysis suggests that this juvenile probably originated in the western Pacific (P. Dutton, Texas A&M Univ. [TAMU], pers. comm., 1995).

Guam

During recent aerial surveys of Guam (October 1989-April 1991), 2.6% of the turtles recorded were leatherbacks (G. Davis, Guam, Division of Aquatic and Wildlife Resources [DAWR], *in litt*., 22 August 1991).

Republic of Palau

Few quantitative data are available concerning the abundance or distribution of leatherbacks in the insular Central Pacific, although fishermen in some areas, such as Palau, readily recognize the species (J. Engbring, U.S. Fish and Wildlife Service [FWS], pers. comm., 1992). Engbring et al. (1992) reported on the aggressive interactions between a grey reef shark and a leatherback in the lagoon near Koror.

Commonwealth of the Northern Mariana Islands (CNMI)

Leatherbacks are occasionally encountered in the pelagic waters of this archipelago.

Republic of the Marshall Islands (RMI)

No documented sightings.

Federated States of Micronesia (FSM)

Leatherbacks are infrequently sighted and rarely captured in the FSM states of Truk (=Chuuk), Yap and Pohnpei (McCoy 1974; Pritchard 1977). A leatherback caught near Woleai (Yap) in 1971 was eaten (McCoy 1974). An adult (444 kg, 2.17 m total length) was caught off Parem Reef, Ponape Island (Pritchard 1982c), and a small juvenile (69.4 cm carapace length) captured near Satawal (Yap) was tagged and released (McCoy 1974). More recent data are unavailable.

Unincorporated U.S. Island Territories

There are no documented sightings in the unincorporated U.S. island territories, although the species may be more common in the Central Pacific than the literature suggests. The territory is vast and poorly surveyed, especially for deep water species.

Other areas in the Pacific

Eastern Pacific:

Adults are seasonally abundant off Mexican breeding grounds at Michoacán, Guerrero, and Oaxaca (Márquez 1976; Pritchard 1982a; Sarti et al. 1987, 1989b). The species is also reported from Baja California, Mexico (Smith and Smith 1980; Cliffton et al. 1982). Eleven leatherbacks were captured in gillnets by a single fishermen from Bahia de la Paz, Baja California, from 1985-May 1987 (Alvarado and Figueroa 1990). In the Eastern Tropical Pacific (ETP), juvenile and adult leatherbacks are occasionally caught in tuna purse-seines (S. Eckert, pers. comm.). A small individual (about 15 cm carapace length) was captured in a purse-seine in April 1976 about 180 nautical miles west of San José, Guatemala (11°03'N, 92°20'W) (Robert Pitman, NMFS, pers. comm., 1991). Leatherbacks are found as far south as Chile (Chiloé Island, ca. 42°S: Philippi 1899 *in* Pritchard 1980; 89 km west of Isla Mocha, 38°22'S, 176°06'W: Frazier and Brito Montero 1990). They are captured in large numbers incidental to the Chilean swordfish fishery (Frazier and Brito Montero 1990).

Northwest Pacific:

In the western Pacific the species is found as far north as the Bering Sea (Mys Navarin, USSR, ca. 62°N) (Bannikov et al. 1971) and as far south as Tasmania and New Zealand (Graham 1964; McCann 1969; Eggleston 1971). In China, Zhou (1983) documented 10 adult and subadult leatherbacks (112- 135 cm carapace length, n=7) caught by the local fisheries from the coastal waters of Jiangsu Province, 1980-1982. Several were captured in coastal waters near Lüsi, one near Lianyungang Port (a city near the border with Shandong Province to the north), and another one near Haimen, a delta city of the Yangtze River. Further to the south, Frazier et al. (1988) examined nine adult and subadult specimens (mean=131.8 cm CCL, range 115.5-152.5, n=7) captured in the waters of Fujian and Guangdong Provinces during May-October; the largest and smallest specimens were both males.

In the waters of Korea, leatherbacks have been found near Mokp'o, Cholla Namdo Province, South Korea (Doi 1936 *in* Shannon 1956) and off Pyongwon county, South Pyongan Province, North Korea (Tong and Yon 1961 *in* Szyndlar 1991). Mao (1971) quotes fishermen who say that the species is "frequently captured from October to March, and occasionally in other months" in Taiwan; during the "prosperous season" two to five individuals (most >150 kg) could be seen on the wharf in a single day. Multiple sightings have been documented in the waters of Japan (Pritchard 1980; Uchida and Nishiwaki 1982), including a subadult (120 cm straight carapace length [SCL]) that died after becoming entangled in a gill net off Hyogo Prefecture (Balazs 1985).

Adults are present at least seasonally in the waters of the South China Sea, as nesting occurs in Malaysia and Indonesia (see Nesting Areas and Habits) and incidental catch in this region has been documented (Aikanathan and Kavanagh 1988; Chan et al. 1988). Hundreds of leatherbacks are accidentally caught each year in drift/gill nets set in the South China Sea and north Pacific (Wetherall et al. 1993).

Southwest Pacific:

The leatherback is known to occur in Indonesia (very few data are available, see Polunin and Nuitja 1982), Papua New Guinea (PNG), Australia, and New Zealand. After extensive interviewing, Lockhart (1989) concluded that the leatherback is found in deep water off PNG, particularly off the north coast, and was more abundant in the past than it is today. Limpus and McLachlan (1979) report concentrations of non-nesting leatherbacks in inshore waters off central eastern Australia, judging by incidental catch records from the shark netting industry; sightings are infrequent inshore of the Great Barrier Reef and across northern Australia. Leatherbacks are also caught in shark nets in southeastern Australia, primarily during the summer (December peak) (Limpus and McLachlan 1979). A number of immature specimens have been seen in the Gulf of Carpentaria; "some are being caught in set nets (only a few in trawls) but the magnitude is not known at this time" (J. Miller, *in litt*., 27 July 1992). Eggleston (1971) summarized sightings from New Zealand and concluded that the species "may be a regular visitor ... it is certainly the most frequently recorded New Zealand turtle."

South Central Pacific:

Few quantitative data are available concerning the abundance or distribution of leatherbacks in the insular Pacific. The leatherback is not typically associated with insular habitats, particularly those characterized by coral reefs or other potentially injurious surroundings, but individuals are occasionally encountered in deep water near prominent archipelagoes, such as the Philippines (de Celis 1982). The species has been documented in deep water near the Cook Islands (Brandon 1977 *in* Balazs 1982b) and two captures are reported from French Polynesia (Fretey and Lebeau 1985; Fretey 1987).

F. Status

The leatherback sea turtle is listed as Endangered throughout its entire range under the U.S. Endangered Species Act (ESA) of 1973, as amended. Similarly, the species is classified as Endangered in the International Union for Conservation of Nature and Natural Resources' (IUCN) *Red Data Book*, where taxa so classified are considered to be "in danger of extinction and whose survival is unlikely if the causal factors continue operating" (Groombridge 1982). Leatherbacks are included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), a designation which effectively bans trade in specimens or products except by special permit. Such permit must show that the trade is not detrimental to the survival of the species and is not for primarily commercial purposes (Lyster 1985). There is no commercial trade in leatherback sea turtles or their parts or products at the present time (Milliken and Tokunaga 1987; Mack et al. 1982). Neither Critical Habitat (under the aegis of the ESA) nor any protected areas have been established for this species in the U.S. Pacific, largely because nesting is not known to occur and important foraging areas have not been identified.

Leatherbacks are seriously declining at all major Pacific basin rookeries, including Irian Jaya (Indonesia), Terengganu (Malaysia), and Michoacán (Mexico). At least 13,000 leatherback nests were reported in 1984 on 17.8 km of coast extending eastward from Tanjung Jamursba on the Bird's Head Peninsula, Irian Jaya (Bhaskar 1985). In 1991, Betz and Welch (1992) visited the site and reported that nesting levels had declined to a mere 25% of those reported by Bhaskar; the near total collection of eggs has most certainly contributed to the population's demise. Similarly, the beach at Rantau Abang, Terengganu, has experienced a dramatic decline as a result of intensive egg collection. The data show a steady drop in nesting activity from nearly 11,000 landings in 1956 to 6,721 landings in 1968 to 280 in 1990 (Hendrikson and Alfred 1961; Chua 1988; Mortimer, WWF-Malaysia, *in litt*., 29 August 1991). Almost 2,000 females were tagged at Terengganu in 1970, while fewer than 20 females nested in 1993 (Limpus, 1995), largely as a result of intensive egg collection (see Status). Nesting does not occur in Sabah (de Silva 1982) or Sarawak (Leh 1985). In the case of Mexiquillo, Michoacán, an estimated 4,796 nests were laid on 4.5 km of beach in 1986-1987 and approximately 1,074 nests were laid in 1989-1990 (L. Sarti M., UNAM, unpubl. data). It is not yet clear whether the Mexican decline reflects natural fluctuation, but based on aerial survey data of Sarti et al. 1996 a geographic shift in nesting is unlikely. This decline represents a warning that the population is in serious jeopardy. Nevertheless, it is the contention of those close to the situation that the population is in very serious danger of collapse. Population declines have also been reported in India, Sri Lanka, and Thailand (see Ross and Barwani 1982).

No attempt has yet been made to assess the status of foraging populations. Despite occasional reports of leatherbacks sighted at sea, and a growing database documenting their incidental catch in coastal and pelagic fisheries, there are very few areas where the species is routinely encountered. Exceptions include Monterey Bay, California (Starbird et al. 1993) and southern Queensland and central New South Wales, Australia (Limpus and McLachan 1979).

G. Biological Characteristics

<u>Migration and Movements</u>

A suite of physiological adaptations allow adult leatherback sea turtles the most extensive range of any extant reptile (71°N to 47°S; Pritchard and Trebbau 1984) (see Species Description). In the western Atlantic, adults routinely migrate between boreal, temperate and tropical waters, presumably to optimize both foraging and nesting opportunities (Bleakney 1965; Lazell 1980; Eckert and Eckert 1988). Similarly, the seasonal presence of adult females at major eastern and western Pacific rookeries suggests that migration between nesting and non-nesting areas may also be characteristic of Pacific stocks. The timing and routing of reproductive migrations are unknown; however, eastern Pacific migratory corridors most likely exist along the western seaboards of the United States and Mexico and, in the western Pacific, along the eastern seaboards of the former Soviet Union and Asia, as well as the eastern seaboard of Australia. Bustard (1972) reports "an important migration route ... down the east coast of Australia judging by personal sightings and reports of capture in shark nets." Sightings along the coast of California peak in August, perhaps a reflection of adults moving southward for winter breeding in Mexico.

Post-nesting transoceanic travel (South America to Africa, minimum 5,900 km) is documented by Pritchard (1973). The extent to which leatherbacks undertake transpacific migrations is not known. Morreale et al. (1994) used satellite telemetry to monitor the movements of six post-nesting leatherbacks in the Caribbean Sea and in the Pacific Ocean and reported that nesting cohorts appear to share identical post-nesting migrational pathways. Similarly, recent studies suggest that females departing nesting beaches in Michoacán, Mexico, follow specific oceanic corridors into pelagic habitats (S. Eckert, HSWRI and L. Sarti M., UNAM, unpubl. data). The movements of males have not been studied.

Foraging Biology and Diet

Food habits are known primarily from the stomach samples of slaughtered animals and consist largely of cnidarians (medusae, siphonophores) and tunicates (salps, pyrosomas) found in temperate and boreal latitudes (Bleakney 1965; Brongersma 1969; Hartog and Nierop 1984; Davenport and Balazs 1991). Surface jellyfish feeding is reported in waters under U.S. jurisdiction, especially off the western coast of the continental United States (e.g., Eisenberg and Frazier 1983). Foraging may also occur at depth. Based on offshore studies of diving by adult females nesting on St. Croix, Eckert et al. (1989) proposed that the observed internesting dive behavior reflected nocturnal feeding within the deep scattering layer (strata comprised primarily of vertically migrating zooplankton, chiefly siphonophore and salp colonies in the Caribbean; Michel and Foyo 1976). Hartog (1980) speculated that foraging may occur at depth after finding nematocysts from deep water siphonophores in leatherback stomach samples.

No systematic study of foraging grounds has been initiated. There are clearly areas under U.S. jurisdiction that are predictably frequented by leatherback turtles (such as Monterey Bay, California), but specifically delineated resident feeding areas have not been identified. It has been suggested that roughly one-half the global population of adult females nests on the west coast of Mexico (Pritchard 1982a); if so, the waters off the west coast of the United States may represent some of the most important foraging habitat in the entire world for the leatherback turtle. It is certainly unfortunate that our present knowledge of foraging geography is based solely on infrequent and often isolated reports of foraging animals (see Foraging Biology and Diet). Nothing is known of the relative importance of various foraging habitats or the distribution (or size) of "foraging populations" of any age class.

Growth

No data on the growth rate of juvenile leatherback turtles in the wild are available. The distribution of juveniles is unknown, and thus specimens are not available for capture-recapture methodologies designed to measure growth. Research is further complicated by poor survivability in captivity. With few exceptions, notably Bels et al. (1988), captive individuals have not survived beyond two years. Captive growth data (e.g., Deraniyagala 1936b; Witham 1977) are widely disparate, but very rapid growth reported by some investigators, coupled with evidence of chondro-osseous development conducive to rapid growth, has led to speculations that leatherbacks may reach sexual maturity in two to three years (Rhodin 1985). Bels et al. (1988) challenge this hypothesis in their report of a healthy captive leatherback 1,200 days [3.28 yr] of age weighing only 28.5 kg, with a carapace 82 cm in length. While leatherbacks may well grow to sexual maturity at an earlier age than other sea turtles, it is clear that additional data, and especially studies of wild specimens, are needed before growth rates can be estimated and age at maturity can be predicted.

Reproduction

Reproduction is seasonal and gravid females are believed to migrate long distances between foraging and breeding grounds (see Migration and Movements), at intervals of typically two or three years. In Mexico, the nesting season extends from November to February, although some females arrive as early as August (Sarti et al. 1989b). In the western Pacific, nesting peaks in May and June in China (Chu-Chien 1982), June and July in peninsular Malaysia (Chan and Liew 1989), and December and January in Queensland (Limpus et al. 1984). In the Caribbean Sea there is some evidence that mating takes place in temperate latitudes prior to or during the reproductive migration (Eckert and Eckert 1988). Nesting is generally nocturnal. Preferred nesting beaches are typically on continental (as opposed to island) shores and have unobstructed, often deep offshore access (Hirth 1980; Mrosovsky 1983; Eckert 1987). The egg-laying sequence is composed of a beach landing, an overland traverse to and selection of a suitable nest site, excavation of a body pit and nest chamber, oviposition, filling the nest, covering and concealing the nest site, and returning to the sea (Deraniyagala 1936b; Carr and Ogren 1959; Pritchard 1971). The sequence, from landing to surf reentry, requires about 80-140 minutes.

In Mexico, females lay 1-11 clutches per season (mean = 5.7) at 9-10 day intervals, and clutch size averages 64 yolked eggs (Sarti et al. 1987; Laura Sarti M., UNAM, unpubl. data.). Clutch size is somewhat larger in the western Pacific. In Terengganu, Malaysia, clutches are composed, on average, of 85-95 yolked eggs (Chua and Furtado 1988). Similarly, clutch size averages 83 yolked eggs in Pacific Australia (Limpus et al. 1984). In China, nesting peaks in May and June, and 90-150 eggs are laid per clutch (Chu-Chien 1982). In addition to yolked eggs, each clutch contains a complement of yolkless eggs. These sometimes comprise 50% or more of total clutch size, a phenomenon which is unique among sea turtles. Yolkless eggs, typically smaller than yolked eggs and in many cases misshapen, are generally deposited last; their significance is unknown. In Mexico (Mexiquillo, Michoacán) and Australia (south Queensland) yolked eggs average 5.3 cm in diameter (López and Sarti 1989; Limpus et al. 1984). Incubation lasts 55-75 days, depending on ambient temperature. Nest temperature during incubation influences the sex of hatchlings. The "pivotal temperature" (ca. 1:1 sex ratio, Mrosovsky and Yntema 1980) has been estimated to be 29.25°- 29.50°C in Suriname and French Guiana (Mrosovsky et al. 1984; Dutton et al. 1985; Rimblot-Baly et al. 1986-1987). Pivotal temperatures have not been defined for Pacific nesting sites.

Hatchlings tunnel out of the nest in a cooperative activity which takes place over several days. Emergence is typically at early evening. As with other sea turtle species, sea-finding orientation is based largely on light, specifically the brightness differential between the open ocean horizon and the darker vegetation to the landward side (Mrosovsky 1972, 1977). Nesting results vary widely, with the proportion of turtles hatching and the proportion of those successfully emerging from the nest averaging 62.8% and 58.1%, respectively, in Mexiquillo (Mexico) during the 1988-1989 season (Sarti et al. 1989b). In Mexiquillo, hatchlings measure 5.0-6.3 cm SCL (mean= 5.64 cm, n=2,800) and weigh 32.4-50.0 g (mean=41.2 g, n=2937) (Laura Sarti M., UNAM, unpubl. data). Similarly, Queensland hatchlings measure 5.1-6.5 cm SCL (mean=5.88 cm, n=39) and weigh 38.3- 54.2 g (mean= 46.86 g, n=39) (Limpus et al. 1984).

Offshore Behavior

Adults are highly migratory and difficult to study. Aside from the predictable arrival of gravid females at nesting beaches, a few observations of foraging turtles, and a growing database on incidental catch, offshore behavior in the Pacific remains undefined. Based largely on evidence from the western Atlantic, we can assume that adults are primarily open water in their distribution, that they feed on medusae, salps, siphonophores and related prey in the water column and at the surface, and that at least the adult females engage in reproductive migrations at two or three (or more) year intervals for the purpose of egg-laying in tropical latitudes. Recent satellite-tracking studies at nesting beaches in Costa Rica and Mexico indicate that females journey into pelagic waters after the nesting season ends (see Migration and Movements). Leatherbacks were regularly captured in mid-Pacific waters by pelagic driftnet fisheries (Wetherall et al. 1993). Mortality and survival statistics are unavailable, and age at maturity and longevity have not been determined.

Nothing is known of the dispersal pattern of leatherback hatchlings from Pacific nesting beaches. Comprehensive discussions of the early pelagic stage of sea turtle development (the "lost year"), which include sightings of post-hatchling stage loggerhead, green, and hawksbill turtles associated with *Sargassum* weed and convergence debris, do not mention sightings of young *Dermochelys* (e.g., Carr 1987). Few immature leatherbacks are seen anywhere in the world. A very young individual (about 15 cm carapace) was accidentally captured in a tuna purse-seine some 180 nautical miles west of San José, Guatemala, in 1976 (Robert Pitman, pers. comm., 1991). Another juvenile (69.4 cm carapace length) was captured near Satawal (Yap District, FSM) on 2 September 1972 and tagged and released (McCoy 1974). Larger juvenile size classes are reported from China's coastal waters (Zhou 1983; Frazier et al. 1988) and Australia's Gulf of Carpentaria (see Insular and Pelagic Range). A juvenile (42.7 cm CCL) was recently caught on a long-line off Swain's Atoll in American Samoa (Grant 1994). With the exception of these isolated encounters, there are no data regarding the abundance or distribution of juvenile leatherbacks in the Pacific. Mortality and survivorship statistics are lacking, as is basic information on diet, growth rate, behavior, and movement of juveniles.

<u>Health Status</u>

The extent to which disease contributes to disability or mortality among wild leatherbacks in the Pacific Ocean has not been studied. As far as is known, the health status of this species is good throughout its range.

H. Threats

This section presents a brief overview of threats to leatherbacks in the Pacific basin, followed by summaries of major threats in each U.S.-affiliated island group. A third section then presents more detailed information specific to each island group.

"Threats" to sea turtles are broadly defined as any factor that jeopardizes the survival of turtles or impedes the recovery of their populations. Twenty-two kinds of threats have been identified in this Recovery Plan, but it is readily apparent that all are not equally important and that threats in one Pacific area may not be relevant in another area. Consequently, each island group was evaluated separately based on information received from the Recovery Team and Technical Advisors. Table 2 lists the 11 threats in the marine environment and ranks their significance. Definitions of the threats are provided in subsequent text.

When viewing Table 2, it should be recognized that there are limitations inherent in this tabulation. First, generalizations are made. Some island groups, such as the Republic of Palau, consist of over 500 islands; consequently, the data presented in Table 2 are limited to a general statement about conditions for the group as a whole. Similarly, most of the island groups possess both sparsely inhabited remote islands and heavily inhabited main islands. The distribution of turtles and the kinds of threats they face would obviously differ in these two types of islands. Specific information about individual islands, if available, is presented in 'Area-specific Threat Information'. Second, there are data limitations. For most islands, information about turtle threats is sparse (see 'Pacific Synopsis'). Third, the categorization in Table 2 of the extent of each threat, represents the seriousness of the threat within that geopolitical area. Unfortunately it does not necessarily represent the seriousness of the overall threat to the turtle stock.

Pacific Synopsis

Lack of knowledge concerning the abundance and distribution of leatherbacks under U.S. jurisdiction (particularly the northeastern Pacific) constitutes a threat, particularly since important foraging areas have not been identified. Forage areas most likely exist in nearshore and oceanic areas throughout the northeastern Pacific; however, these vital areas cannot be given adequate protection until they have been identified. Despite recent legal protection of animals at nesting beaches in Mexico, these populations continue to decline. The breeding population origins and migratory habits of the leatherback turtles frequenting the waters of this region are unknown. Threats to migrating turtles are therefore also unknown. This information is important to determining their status and necessary for effective management.

Regional Summaries

U.S. West Coast

Primary turtle threats: incidental take in fisheries

Incidental catch poses a threat in pelagic foraging and transit areas and the coastal feeding grounds and migratory corridors that probably exist along the west coast of the United States and south into Mexico. Entanglement and ingestion of marine debris, including old abandoned nets, may continue to pose a threat to leatherbacks, which seem to have a talent for seeking out and getting tangled in floating lines.

Hawaii

Primary turtle threats: incidental take in fisheries

The Hawaiian longline fishery poses the most important threat to leatherbacks, particularly as fishing effort increases. Research must be undertaken to identify ways of reducing hooking mortality and modifying techniques to avoid capture.

American Samoa

Primary turtle threats: N/A

The reported presence of leatherbacks on American Samoa is very rare. One turtle was killed by an experimental longline fishing boat (Grant 1994), but probably only represents a random event.

Guam

Primary turtle threats: N/A

There are no records of nesting by or at-sea sightings of leatherback turtles.

Republic of Palau

Primary turtle threats: N/A

There are no records of nesting by or at-sea sightings of leatherback turtles.

Commonwealth of the Northern Marianas (CNMI)

Primary turtle threats: N/A

There are no records of nesting by or at-sea sightings of leatherback turtles.

Republic of the Marshall Islands (RMI)

Primary turtle threats: N/A

There are no records of nesting by or at-sea sightings of leatherback turtles.

Federated States of Micronesia (FSM)

Primary turtle threats: N/A

There are no records of nesting by or at-sea sightings of leatherback turtles.

Unincorporated Islands (Wake, Johnston, Kingman, Palmyra, Jarvis, Howland, Baker, Midway)

Primary turtle threats: incidental take in fisheries

There are known problems with incidental take in fisheries, but the extent of the problem is unknown.

TABLE 2. Threat checklist for leatherback sea turtles in the U.S. Pacific Ocean.[a]

Codes 1 = major problem; 2 = moderate problem; 3 = minor problem; - = not current problem; ? = unknown; P = known problem but extent unknown

	Threat	U.S. West Coast	Hawaii	Amer. Samoa	Guam	Palau	CNMI	RMI	FSM	Uninc.[b]
Marine Environment										
12	Directed take	-	-	-	-	-	-	-	-	-
13	Natural disasters	-	-	-	-	-	-	-	-	-
14	Disease/parasites	?	-	-	-	-	-	-	-	-
15	Environmental Contaminants	?	?	-	?	?	?	?	?	?
16	Debris (entangle/ingest)	P	P	-	-	-	-	-	-	-
17	Fisheries (incidental take)									
	-domestic waters	1	1	-	-	-	-	-	-	P
	-international	1	1	-	-	?	-	?	?	P
18	Predation	?	?	?	?	?	?	?	?	?
19	Boat collisions	-	-	-	-	-	-	-	-	-
20	Marina/dock development	-	-	-	-	-	-	-	-	-
21	Oil exploration/development	?	-	-	-	-	-	-	-	-
22	Power plant entrapment	-	-	-	-	-	-	-	-	-

[a] There is no known nesting by this species in the United States or in any territory under U.S. jurisdiction. Therefore, only threats in the marine environment (#12-22) are included in this table.

[b]Wake, Johnston, Kingman, Palmyra, Howland, Baker, and Jarvis islands

General Threat Information

This section provides the supportive information used to rank the turtle threats listed in Table 2. The first 11 threats pertain to the turtle's nesting environment, the latter 11 to the marine environment.

Nesting Environment

While no leatherbacks nest in U.S. jurisdiction it is important that the United States participate in restoration efforts of U.S. sea turtle stocks at their nesting beaches. Thus, we have chosen to add a general description of nesting beach threats, so that U.S. resource managers can make informed decisions on policies to support turtles in other political jurisdictions.

1. Directed Take

The harvest of sea turtles and/or their eggs for food or any other domestic or commercial use constitutes a widespread threat to these species. Removing breeding adults from a population can accelerate the extinction of local stocks, and the persistent collection of eggs guarantees that future population recruitment will be reduced. This category includes only the harvest of sea turtles (typically nesting females) and their eggs on land. Harvest at sea is discussed in a later section. (see Recovery - Section 1.1.1)

2. Increased Human Presence

Human populations are growing rapidly in many areas of the coastal Pacific and this expansion is exerting increasing pressure on limited resources. Threats to sea turtles include increased recreational and commercial use of nesting beaches, the loss of nesting habitat to human activities, beach camping and fires, an increase in litter and other refuse, and the general harassment of turtles. Increasing human population densities also tend to increase direct harvest of turtles and their eggs, further exacerbating population declines. Related threats, such as coastal construction, associated with increasing human populations are discussed separately. (see Recovery - Sections 1.1, 1.2)

3. Coastal Construction

The most valuable land is often located along the coastline, particularly when it is associated with a sandy beach. Construction is occurring at a rapid rate and is resulting in a loss of sea turtle nesting areas. This section discusses construction-related threats to the region's sea turtle nesting beaches, including the construction of buildings (hotels, houses, restaurants), recreational facilities (tennis courts, swimming pools), or roads on the beach; the construction of sea walls, jetties, or other armoring activities that can result in the erosion of adjacent sandy beaches; clearing stabilizing beach vegetation (which accelerates erosion); and the use of heavy construction equipment on the beach, which can cause sand compaction or beach erosion. (see Recovery - Sections 1.1.2, 1.2)

4. Nest Predation

The loss of eggs to non-human predators is a severe problem in some areas. These predators include domestic animals, such as cats, dogs and pigs, as well as wild species such as rats, mongoose, birds, monitor lizards, snakes, and crabs, ants and other invertebrates. (see Recovery - Section 1.1.3)

5. Beach Erosion

Weather events, such as storms, and seasonal changes in current patterns can reduce or eliminate sandy beaches, degrade turtle nesting habitat, and cause barriers to adult and hatchling turtle movements on affected beaches. Many of these problems can be exacerbated by human development (ie. beach armoring, groins, jetties). (see Recovery - Section 1.2.1, 1.1.5.2)

6. Artificial Lighting

Hatchling sea turtles orient to the sea using a sophisticated suite of cues primarily associated with ambient light levels. Hatchlings become disoriented and misdirected in the presence of artificial lights behind (landward of) their hatching site. These lights cause the hatchlings to orient inland, whereupon they fall prey to predators, are crushed by passing cars, or die of exhaustion or exposure in the morning sun. Nesting adults are also sensitive to light and can become disoriented after nesting, heading inland and then dying in the heat of the next morning, far from the sea. Security and street lights, restaurant, hotel and other commercial lights, recreational lights (e.g., sports arenas), and village lights, especially mercury vapor, misdirect hatchlings by the thousands throughout the Pacific every year. (see Recovery - Sections 1.1.2,1.1.4)

7. Beach Mining

Sand and coral rubble are removed from beaches for construction or landscaping purposes. The extraction of sand from beaches destabilizes the coastline (e.g., reduces protection from storms), removes beach vegetation through extraction or flooding and, in severe cases, eliminates the beach completely. When mining occurs on or behind a nesting beach, the result can be the degradation or complete loss of the rookery. In addition, females can become confused when they emerge from the sea only to find themselves heading down slope into a depression formed by mining activities; too often the outcome is that the female returns to the sea without laying her eggs. Even when eggs are successfully deposited, reduced hatch success results if nests are flooded or excavated during mining. (see Recovery - Section 1.2.2)

8. Vehicular Driving on Beaches

Driving on the beach causes sand compaction and rutting, and can accelerate erosion. Driving on beaches used by turtles for egg-laying can crush incubating eggs, crush hatchlings in the nest, and trap hatchlings after they emerge from the nest cavity and begin their trek to the sea. In the latter case, hatchlings are exposed to exhaustion and predators when they fall into and cannot climb out of tire ruts that are typically oriented parallel to the sea. (see Recovery - Section 1.2.6)

9. Exotic Vegetation

Introduced species can displace native dune and beach vegetation through shading and/or chemical inhibition. Dense new vegetation shades nests, potentially altering natural hatchling sex ratios. Thick root masses can also entangle eggs and hatchlings. (see Recovery - Section 1.2.3)

10. Beach Cleaning

Removal of accumulated seaweeds and other debris from a nesting beach should be accomplished by hand-raking only. The use of heavy equipment can crush turtle eggs and hatchlings and can remove sand vital to incubating eggs. (see Recovery - Section 1.2.5)

11. Beach Replenishment

The nourishment or replacement of beaches diminished by seawalls, storms, or coastal development can reduce sea turtle hatching success by deeply burying incubating eggs, depositing substrate (generally from offshore deposits) that is not conducive to the incubation of sea turtle eggs, and/or obstructing females coming ashore to nest by machinery, pipelines, etc. (see Recovery - Section 1.2.4)

Marine Environment

12. Directed Take

The harvest of juvenile and adult sea turtles for food or any other domestic or commercial use constitutes a widespread threat to these species. In particular, the exploitation of large juveniles and adults can accelerate the extinction of both local and regional stocks. This category includes only the harvest of sea turtles at sea. Harvest on the nesting beach was discussed in a previous section.

No information exists on the intentional take of this species in U.S. waters, although in the past leatherbacks were occasionally killed as "sea monsters" (Stinson 1984). Off the coast of Chile, Peru and Mexico leatherbacks are occasionally caught and their meat sold in local markets. A subsistence fishery exists for leatherbacks in Indonesian waters (Starbird and Suarez, 1994). (see Recovery - Section 2.1)

13. Natural Disasters

Natural phenomena, such as cyclones, can contribute to the mortality of turtles at sea, particularly in shallow waters. Disease epidemics and other debilitating conditions that affect prey items (sea grass, coral, sponges, reef invertebrates) can also harm sea turtle populations. (see Recovery - Sections 2.1.6, 2.1.7, 2.2.1, 2.2.2)

14. Disease and Parasites

There are few data to assess the extent to which disease or parasitism affects the survivability of sea turtles in the wild. Stranded individuals have been found along the U.S. coast, and the cause of death in many cases cannot be determined (Joe Cordaro, NMFS, pers. comm.). (see Recovery - Section 2.1.6)

15. Environmental Contaminants

Chemical contamination of the marine environment due to sewage, agricultural runoff, pesticides, solvents and industrial discharges is widespread along the coastal waters of the western United States although the impact of these contaminants on leatherbacks is unknown. (see Recovery - Section 2.2.3)

16. Debris (Entanglement and Ingestion)

The entanglement in and ingestion of persistent marine debris potentially threatens the survival of leatherback turtles in the eastern Pacific. Turtles become entangled in abandoned fishing gear, lines, ropes and nets, and cannot submerge to feed or surface to breathe. For instance, in December 1982, a large (682 kg) female became entangled at night two miles offshore Kailua-Kona, Hawaii, in a "parachute anchor", dragging the boat for several hours before being killed (Balazs 1985). They may also lose a limb or attract predators with their struggling. Leatherback turtles will commonly ingest debris such as plastic bags, plastic sheets, balloons, latex products and other refuse which they mistake for jellyfish, their preferred food. Necropsies of stranded turtles have revealed mortalities due to ingested garbage resulting in poisoning or obstruction of the esophagus. (see Recovery - Section 2.1.3)

17. Fisheries (Incidental Take)

It is clear that incidental catch poses a very great threat in pelagic foraging and transit areas and the coastal feeding grounds and migratory corridors that probably exist along the west coast of the United States and south into Mexico. Reports of incidental catch in the eastern north Pacific include entaglement in gillnets off the coast of Washington, Oregon, and California (Stick and Hreha 1989). Fishermen "regularly" catch leatherbacks in drift/gill nets off Monterey Bay, central California (C. Starbird, pers. comm., 1991). A leatherback was killed in October 1990 in a gillnet set in the Monterey Bay area (36° 55'N, 122° 40'W) (S.Eckert, pers. comm.)

Leatherback turtles are accidentally taken in several commercial fisheries. Longlines and active and abandoned driftnets (Anonymous 1935, 1958, 1967; Pritchard 1977; Balazs 1982a) have a long history of ensnaring and killing leatherbacks in the central north Pacific. Data collected by observers aboard pelagic squid driftnet vessels in 1989 identified nine of 22 turtles caught as leatherbacks; only three survived their capture (Gjernes et al. 1990). Leatherbacks are the most common species reported caught in longline fisheries between 1935-1982 (Balazs 1982a). Thirty two percent of the turtles reported captured by the Hawaiian longline fisheries during the 1990-1994 observer program were leatherbacks (NMFS 1995). Skillman and Balazs (1992) report that leatherbacks eat the squid baited on swordfish longline gear, and suggest that the light sticks attached to longline gear to attract the fish may also attract leatherbacks, that probably rely on bioluminescence to locate their prey (Davenport 1988). Most reports of leatherback turtle interactions with longline gear involve entanglement, most likely due to their large flippers (Witzell 1984). Recently a juvenile leatherback was reported to have been hooked by its front flipper and killed near American Samoa (Grant 1994). In the southeastern Pacific leatherbacks are commonly caught by the swordfish fishery in Chilean waters (Frazier and Brito Montero 1990). Leatherbacks tagged on nesting beaches in Mexico and Costa Rica have also been drowned by purse seine and gillnets as far south as Chile (Chandler 1991; Montero 1995). The predicted take based on current fishing effort by the Hawaiian longline fisheries is 271 leatherbacks, of which 41 are expected to die (NMFS 1995). While this number seems relatively low, in the context of the dramatic decline in nesting populations in Mexico and Malaysia, there is cause for serious concern. Hooking mortality for sea turtles is not well understood (Balazs and Pooley, 1994), and the effects will undoubtedly be greater as fishing effort increases. In addition, there are indications that an increasing number of Asian longline tuna vessels are operating in the Pacific. Estimated annual incidental take of turtles by the Japanese longline fleet in 1978 in the western Pacific and South China Sea was very high (Nishemura and Nakahigashi, 1990). If these estimates are accurate and it is assumed that a significant proportion of the turtles caught are leatherbacks, the cumulative effect of longline fisheries in the Pacific may be devastating to this species. (see Recovery - Section 2.1.4)

18. Predation

Large coastal and pelagic sharks and killer whales are common in the northeastern Pacific and pose an unknown, though potential threat to adults and juvenile turtles. Killer whales are known to kill adults in Mexican waters (Sarti et al. 1991). Predation on hatchlings is believed to be relatively high and the species most often implicated are coastal and pelagic sharks.

19. Boat Collisions

Sea turtles can be injured or killed when struck by a boat, especially if struck by an engaged propeller. Recreational equipment, such as jet skis, also pose a danger. (see Recovery - Sections 2.1.4, 2.1.5, 2.1.7)

20. Marina and Dock Development

The development of marina and docking facilities pose direct and indirect threats to sea turtles. Direct consequences can be seen when foraging grounds and nesting beaches are dredged or otherwise permanently altered in the process of construction and maintenance. Altered current patterns and increased levels of ship traffic, pollution, and general activity which displace or injure local sea turtles constitute indirect consequences that should also be considered. (see Recovery - Sections 1.2.1, 2.2)

21. Oil Exploration and Development

Oil exploration and development pose direct and indirect threats to sea turtles. A rise in transport traffic increases the amount of oil in the water from bilge pumping and disastrous oil spills. Oil spills resulting from blow-outs, ruptured pipelines, or tanker accidents, can result in death to sea turtles. Indirect consequences include destruction of foraging habitat by drilling, anchoring, and pollution. While oil exploration is currently limited by regulation in U.S. waters, recent proposals to allow drilling on the California coast are cause for concern. Any such exploration should be carefully evaluated for impact to leatherback populations before such explorations are undertaken.

22. Power Plant Entrapment

Entrapment in the water intake mechanisms of power generating facilities can result in death to sea turtles of all size classes. There are no known incidences of power plant entrapment of leatherbacks.

I. Conservation Accomplishments

The Pacific coast of Mexico is a critical area for the reproduction of the leatherback turtle (*Dermochelys coriacea*), which is listed as an endangered species in Mexico's official government publication (Diario Oficial de la Federación, 1994). The first report of leatherback nesting in the Mexican Pacific (Marquez 1976) reported that San Juan Chacahua, Oaxaca, was an important reproductive area for this species. In 1981, the same author reported Tierra Colorada, Guerrero and Playon de Mexiquillo, Michoacan as major rookeries. Pritchard (1982a) concluded that the stretch of coast from Maruata, Mich. to the Tehuantepec Isthmus in Oaxaca, supported the largest leatherback nesting population in the world. Information on the rest of the Pacific coast of Mexico is scarce, with a few isolated reports of leatherbacks nesting in Baja California (Marquez et al. 1981; Fritz et al. 1982; Marquez and Carrasco, 1993). Today four major nesting beaches are recognized in the Mexican Pacific coast: Mexiquillo, Michoacan; Tierra Colorada, Guerrero; Chacahua and Barra de la Cruz, Oaxaca. The first three were established as Sea Turtle Reserve Areas in 1986.

Since the early reports, the need for the establishment of conservation programs intended to protect the leatherback was clearly recognized, as egg poaching was common practice in the nesting areas. Female turtles were not killed for meat, but occasionally fishermen would kill an adult leatherback to use it as shark bait. Also, adults were entangled in trammel nets placed in front of the beaches.

Mexiquillo and Chacahua beaches received the first conservation efforts, prior to 1983, and later Barra de la Cruz, Oaxaca in 1990. For Tierra Colorada, in spite of being reported as one of the most important nesting areas, conservation efforts have been irregular. The main tasks of these programs have been the relocation of eggs to protected areas and protection and tagging of nesting females. The number of protected nests has reached 90% at each beach per season.

Some of the projects have research programs designed to yield information on biological aspects of the leatherback and they involve conservation groups supported by government institutions, universities and non-government organizations.

Although information on the number of nestings per season doesn't exist for all the leatherback nesting beaches and for all the years, the groups working for different institutions in each beach, have recently established a regular information exchange to enable a comprehensive view of nesting along the entire coast.

Mexiquillo is the only rookery in the Mexican Pacific which has maintained continuous monitoring of the nesting and number of females for over 12 years. The project (managed by Facultad de Ciencias, UNAM) has recorded fluctuations in the number of nestings each season, however the data indicates a declining trend. The most drastic decline in the nesting at Mexiquillo occurred in the 1993-94 season, in which 78 nests were estimated (Sarti et al. 1994). A similar phenomenon was observed also in Chacahua (43 nestings, Alvarado-Padilla et al. 1994) and Barra de la Cruz (C. Peñaflores, pers. comm.). The causes of this decline are not known, but Sarti et al. in 1994 attributed the decline to:

a) Natural fluctuations in the reproductive biology of this species.
b) Displacement of the females to unknown nesting areas.
c) Poor recruitment to population caused by egg poaching in previous years.
d) Unsuitable environmental conditions affecting the reproductive capability of the females.
e) A real decrease in the nesting population, caused by incidental capture or poaching of adult females.

During the 1994-95 season a slight rebound in nesting activity occurred with over 400 nestings estimated in Mexiquillo (Sarti et al. 1996), 341 in Barra de la Cruz (Sandoval and Vazquez 1995) and 196 in Chacahua (Alvarado-Padilla et al. 1995).

Continuing research into effective population size, age to sexual maturity, sex ratio in natural populations, phylopatry, etc. are underway and are fundamental for the proper establishment of conservation programs. The group from Facultad de Ciencias, UNAM, has conducted several research projects on this species, obtaining basic data on the females size, general conditions of the females, clutch size, hatching success and number of nests. Additionally, research on nesting frequency, fertility, tag lost rate, effects of incubation temperature on hatching success and sex ratio, diving behavior and internesting movements has been accomplished. Other projects include research of efficiency of nest relocation techniques, effects of physicochemical characteristics of sand on the development and the presence of pollutants in sand, sea water and eggshells.

II. RECOVERY

A. Recovery Objectives

Goal: The recovery goal is to delist the species.

Recovery Criteria: To consider de-listing, all of the following criteria must be met:

1) All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.

2) Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) FENA over six years.

3) Nesting populations at "source beaches" are either stable or increasing over a 25 year monitoring period.

4) Existing foraging areas are maintained as healthy environments.

5) Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region.

6) All Priority #1 tasks have been implemented.

7) A management plan designed to maintain sustained populations of turtles is in place.

Rationale: Determining quantifiable values that can be used to determine when a sea turtle stock is recovered is quite difficult. The recovery team has tried to make such recommendations as listed above based on best available information with the following conceptual guidelines:

1) The minimum nesting stock must equal a size that could not easily be eliminated by a single catastrophic event ("natural" or "man induced").

2) Nesting population trends should be long enough to minimize the effects of natural fluctuations in numbers that are characteristic of sea turtle populations. Generally this time period is equal to the estimated one generation time for each species.

3) Habitats are adequate to support population growth once threats have been reduced or eliminated.

4) If a species is to be considered for delisting, a plan must already be in force for maintaining the population in stable or increasing condition. The team was concerned that if a species was delisted, and no management plan was already in force, that the species may be driven back toward extinction too rapidly for resource management agencies to implement such plans.

B. Step Down Outline and Narrative for Recovery

1 NESTING ENVIRONMENT

While it is recognized that there is no nesting by this species in U.S. Pacific jurisdiction, we felt that a description of recovery actions should be provided so that U.S. agencies could take them into account when providing support to those nations in which U.S. stocks may nest.

1.1 Protect and manage turtles on nesting beaches.

It is prudent to preserve the capacity of a population to recover from a depleted state by protecting nesting females, their nests and hatchlings and to preserve the quality of the nesting area. The killing of gravid females, poaching of nests, predation (native and feral), destruction of the habitat through mining, destruction of vegetation, artificial lighting, development, and increased human use all degrade the ability of depleted populations to recover. Although there are no known nesting grounds for leatherbacks in the U.S. Pacific, we strongly advocate that the United States financially and logistically support the efforts of Mexico, Malaysia, Indonesia, PNG and other Pacific nations with nesting grounds to preserve their leatherback populations. The following tasks may be used as guidelines to enhance the reproductive success of sea turtle populations at their nesting grounds.

1.1.1 Eliminate directed take of turtles and their eggs.

Direct take of nesting turtles and their eggs has been identified as a primary threat to Pacific sea turtle populations. Eliminating this threat is required if populations are to recover.

1.1.1.1 Reduce directed take of turtles through public education and information.

While increased law enforcement will be effective in the short term, without support of the local populace, regulations will become ineffective. Education of the public as to the value of conserving sea turtles, is a very effective way of sustaining recovery efforts and providing support for enforcement of management regulations.

1.1.1.2 Increase enforcement of protective laws protecting turtles by law enforcement and the courts.

Lack of adequate support for law-enforcement activities which protect sea turtle populations is common, yet it must be understood that enforcement is as important as any other resource management activities. Enforcement, judicial, and prosecutorial personnel must receive adequate resources as well as instruction about sea turtles and the importance of protecting turtle populations.

1.1.2 Ensure that coastal construction activities avoid disruption of nesting and hatching activities.

Coastal construction must be monitored to minimize impact on turtle beaches, both during construction, particularly during the nesting and hatching season and in the long-term. Construction equipment must not be allowed to operate on the beach, remove sand from the beach, or in any way degrade nesting habitat. Nighttime lighting of construction areas should be prohibited during nesting and hatching seasons. In the long-term, structures should not block the turtle's access to the beach, change beach dynamics, or encourage human activities that might interfere with the nesting process.

1.1.3 Reduce nest predation by domestic and feral animals.

Feral animals such as the Polynesian Rat (*Rattus exulans*), dogs and mongooses pose a severe threat to turtle nests and hatchlings. It is important that feral predators be controlled or eliminated from nesting areas. Domestic animals such as pigs or dogs can also threaten turtle nests and hatchlings, and should be controlled near nesting areas. In particular, domestic dogs should not be allowed to roam turtle nesting beaches unsupervised.

1.1.4 Reduce effects of artificial lighting on hatchlings and nesting females.

Because sea turtles (especially hatchlings) are strongly attracted to artificial lighting, lighting near nesting beaches should be placed in such a manner that light does not shine on the beach. If not, turtles may become disoriented and stray from their course.

1.1.4.1 Quantify effects of artificial lighting on hatchlings and nesting females.

It is important to quantify the impact of existing lighting in terms of nesting success and hatchling survival so that pragmatic mitigation can be applied. Also such study can be used to guide the development of effective lighting ordinances.

1.1.4.2 Implement, enforce, evaluate lighting regulations or other lighting control measures where appropriate.

Shielding of the light source, screening with vegetation, placing lights at lowered elevations and in some cases the use of limited spectrum low wavelength lighting (e.g. low pressure sodium vapor lights) are possible solutions to beach lighting problems. Such measures should be required by law and enforced.

1.1.5 Collect biological information on nesting turtle populations.

The collection of basic biological information on nesting is critical for making intelligent management decisions. Monitoring nesting success can help to identify problems at the nesting beach or elucidate important areas for protection. Analyzing population recruitment can help in understanding population status.

1.1.5.1 Monitor nesting activity to identify important nesting beaches, determine number of nesting females, and determine population trends.

Important nesting beaches (based on actual number of nests) must be identified for special protection. Nesting beaches need to be identified by standardized surveys during the nesting season. Informational surveys with local residents and officials should be conducted to determine current or historical nesting beaches.

One of the most crucial techniques for determining the status of sea turtle populations and for evaluating the success of management or restoration programs is long-term monitoring of annual nesting on key beaches. The surveys must be done in a standardized and consistent manner with experienced personnel. Because of long maturity times for turtles, quantifying trends in population sizes and effectiveness of any restoration program may take a generation time (20+ years) to be reflected in the annual numbers of nesters. Monitoring should thus be recognized as a long-term undertaking.

1.1.5.2 Evaluate nest success and implement appropriate nest-protection measures on important nesting beaches.

One of the simplest means to enhance populations is by increasing hatchling production at the nesting beach. The first step to such an enhancement program is to determine the nesting / hatching success and to characterize factors which may limit that success. Once those limiting factors are determined, protection or mitigation measures can be implemented. If nests must be moved to prevent loss from erosion or other threats, natural rather than artificial incubation should be employed.

1.1.5.3 Define stock boundaries for Pacific sea turtles.

Because sea turtles exhibit a unique genetic signature for each major nesting assemblage, and because nesting assemblages provide an easily censused means of monitoring population status, it is useful to use genetic analysis methods to determine stock boundaries for sea turtle populations. It also enables managers to determine which stocks are being impacted by activities far removed from the nesting beaches, and thus prioritize mitigation efforts.

1.1.5.3.1 Identify genetic stock type major nesting beach areas.

A “genetic survey” to establish the genetic signature of each nesting population must be established, before stock ranges can be determined. Such surveys are relatively simple as they require only a small blood sample from a statistically viable number of females within each nesting population.

1.1.5.3.2 Determine nesting beach origins for juvenile and subadult populations.

Because nesting populations can form the basis for stock management, it is important to be able to pair juvenile and subadult turtles with their stock units by genetic identification. DNA analyses have begun to provide scientists and managers with this sort of data.

1.1.5.3.3 Determine the genetic relationship among Pacific leatherback populations.

The need for such study is critical to successful management of a sea turtle population as it enables resource managers to identify the entire (and often overlapping) range of each population. This type of population study can also detail the genetic diversity and viability of the populations. Genetic studies can also contribute to forensics and law enforcement. (see Section 2.1.1)

1.2 Protect and manage nesting habitat.

The nesting habitat must be protected to ensure future generations of the species. Increased human presence and coastal construction can damage nesting habitat resulting in reduced nest success or reduced hatchling survival.

Once key nesting beaches are identified, they may be secured on a long-term basis in an assortment of ways. These may include conservation easements or agreements, lease of beaches, and in some cases, fee acquisition. Certain beaches may be designated as natural preserves. In some cases education of local residents may serve to adequately secure nesting beaches.

1.2.1 Prevent the degradation of nesting habitats caused by sea walls, revetments, sand bags, other erosion-control measures, jetties and breakwaters.

Beach armoring techniques that beach residents use to protect their beachfront properties from wave action may actually degrade nesting habitats by eroding beaches and preventing nesting by preventing access to nesting sites or preventing digging of the nest on the site. Guidelines on the proper placement of stonewalls must be proposed. Jetties and breakwaters impede the natural movement of sand and add to erosion problems in neighboring beaches. Regulations regarding beach construction and beach armoring should be reviewed to ensure that such measures are restricted or prohibited if adverse impacts to nesting are anticipated.

1.2.2 Eliminate sand and coral rubble removal and mining practices on nesting beaches.

Beach mining severely affects a nesting beach by reducing protection from storms, destroying native vegetation directly or indirectly and may completely destroy a nesting beach. Protective legislation and public education must be used to protect the substrate of the beaches.

1.2.3 Develop beach-landscaping guidelines which recommend planting of only native vegetation, not clearing stabilizing beach vegetation and evaluating the effects as appropriate.

Non-native vegetation may prevent access to nesting sites, prevent adequate nest digging, exacerbate erosion or affect hatchling sex ratios by altering incubation temperatures. Native vegetation, however, plays an important role in stabilizing the beach and creating the proper microclimate for nests. Guidelines for residents concerning the most appropriate plant species and the importance of a native plant base should be encouraged.

1.2.4 Ensure that beach replenishment projects are compatible with maintaining good quality nesting habitat.

Sand on sea turtle beaches has particular properties which affect hatching success (ie. compaction, gas diffusion, temperature). Any addition or replacement of sand may change these properties and make it more difficult for females to nest or reduce hatchling success. As such, beach replenishment projects should be carefully considered, use materials similar to the native sands and be carried out outside the nesting season.

1.2.5 Implement non-mechanical beach cleaning alternatives.

Hand raking of beach debris, rather than using heavy machinery, should be encouraged on nesting beaches where cleaning is done for aesthetic reasons. The use of heavy machinery can adversely affect hatchlings directly and their nesting habitat.

1.2.6 Prevent vehicular driving on nesting beaches.

Driving on active nesting beaches should be forbidden. Vehicles cause destabilization of beaches, threaten incubating nests and leave tire ruts that hatchlings have difficulty crossing.

2 MARINE ENVIRONMENT

2.1 Protect and manage leatherback populations in the marine habitat.

Protection of turtles in the marine environment is a priority that is often overlooked as enforcement is difficult and quantification of the problem problematic. However, 99% of a turtle's life is spent at sea; thus, recovery must include significant efforts to protect turtles at that time. This is particularly significant for the leatherback in U.S. jurisdiction.

2.1.1 Eliminate directed take of turtles.

There is no known directed take in U.S. waters however there are still Chilean, Peruvian and Mexican meat harvests. Direct take of turtles is identified as a threat to population recovery in the Pacific Ocean and must be eliminated if sea turtles are to recover.

2.1.1.1 Reduce directed take of turtles through public education and information.

While increased law enforcement will be effective in the short term, without support of the local populace, regulations will become ineffective. Education of the public as to the value of conserving sea turtles, is a very effective way of sustaining recovery efforts and providing support for enforcement of management regulations.

2.1.1.2 Maintain the enforcement of protective laws on the part of law enforcement and the courts.

One of the major threats identified for turtle populations in the Pacific is the illegal harvest of turtles both on the nesting beach and in the water. Rigorous efforts in law enforcement should be undertaken immediately to reduce this source of mortality. Such efforts need to include training of enforcement personnel in the importance of protecting turtles, as well as supplying such personnel with adequate logistical support (boats, communication and surveillance equipment etc.). Judges and prosecutors must also be educated in the importance of these matters.

2.1.2 Determine distribution, abundance, and status in the marine environment.

In its review of information on sea turtle populations in the Pacific, the Recovery Team found that lack of accurate information on distribution and abundance was one of the greatest threats to sea turtle populations. Most existing information is anecdotal or obsolete and where new information is available, it uniformly indicates that leatherback populations are vastly smaller than commonly believed. We consider that gathering of basic information on distribution and abundance should take a very high priority in the recovery of Pacific leatherback populations.

2.1.2.1 Determine the distribution and abundance of post-hatchlings, juveniles and adults.

While little is known about the distribution of nesting beaches for the leatherback, even less is understood about distribution of foraging adult and juvenile populations. Quantitative surveys of foraging areas to determine leatherback abundance, and to identify essential habitat are of significant importance for restoration of leatherback populations.

2.1.2.2 Determine adult (male and female) migration routes and internesting movements.

Like all species of sea turtle (with the possible exception of the Flatback turtle, *Natator depressus*), leatherbacks migrate from foraging grounds to nesting beaches. These migrations often mean that the turtles move through a variety of political jurisdictions where regulations regarding the stewardship of the species may vary. To preclude the problem of contradictory management strategies by these various jurisdictions, it is important to determine the migration routes leatherbacks follow between nesting and foraging areas. Satellite telemetry studies of both males and females are needed. For U.S.

recovery efforts, determination of migratory movements and foraging areas represent highest priority.

2.1.2.3 Determine growth rates and survivorship of hatchlings, juveniles, and adults, and age at sexual maturity.

Understanding the rates of growth and survivorship of turtle populations is crucial to the development of appropriate population models. This is especially true for leatherbacks for which the least information on growth is available. Such models are important in understanding population status and how best to efficiently apply management efforts, in restoring depleted populations. For example, the application of stage based modeling (Crouse et al. 1987) indicated that not enough effort was being expended on protecting juvenile sized loggerhead sea turtles in the southeastern United States and that without such protection, extensive nesting beach protection was having less positive benefit. A similar approach to understanding leatherback populations should be undertaken, and used to guide restoration policy.

2.1.2.4 Identify current or potential threats to adults and juveniles on foraging grounds.

Little is known about threats to foraging populations of leatherbacks. Studies on such threats should be undertaken immediately.

2.1.3 Reduce the effects of entanglement and ingestion of marine debris.

Entanglement due to abandoned or unmonitored fishing gear, as well as the ingestion of man-made debris is a significant problem in the marine environment.

2.1.3.1 Evaluate the extent to which leatherbacks ingest persistent debris and become entangled.

Quantification of the extent to which leatherbacks are impacted by marine debris should be undertaken as a first step to mitigating or preventing such impacts. The benefits of such work are that it allows the prioritization of recovery activities and it allows the activities to be efficiently targeted at the problem.

2.1.3.2 Evaluate the effects of entanglement and ingestion of persistent debris on health and viability of sea turtles.

Because of the remote nature of turtle/debris interactions, the acute and chronic effects of such interaction are not often understood. Turtles may not die immediately after ingesting certain materials, but may become debilitated. Studies to further understand the impacts of such interactions, and what age classes are affected most severely, should be undertaken immediately. As with quantifying the extent to which sea turtles ingest debris, such a program allows recovery efforts to be more efficient.

2.1.3.3 Formulate and implement measures to reduce or eliminate persistent debris and sources of entanglement in the marine environment.

Once the problem of marine debris has been identified and quantified, it is important to implement (and enforce) a program to reduce the amount of debris in the marine environment, ie. removing the problem entirely, as contrasted to mitigating the problem.

2.1.4 Monitor and reduce incidental mortality in the commercial and recreational fisheries.

2.1.4.1 Monitor incidental mortality in the commercial and recreational fisheries.

Incidental take in fisheries has been identified as a severe threat. These mortalities are associated with international fleets operating on the high seas and fisheries in coastal waters. Monitoring of turtle take by fisheries is extremely important for two reasons. First, it allows resource managers a means to quantify the extent of the problem, and by the very act of monitoring, tends to cause commercial fisherman to be more aware of the concern over incidental take, and thereby encourage reduced take. The choice method for monitoring take is through the use of an unbiased observer program. Voluntary logbooks have not proven a reliable technique for quantifying incidental catch in commercial fisheries. Genetic studies are a valuable tool to identify the nesting stocks being impacted by fisheries in forage areas or migratory corridors.

2.1.4.2 Reduce incidental mortality in the commercial and recreational fisheries.

Efforts to reduce mortality induced by fisheries include gear modifications or enhancement, and area and seasonal closures. Often a better understanding of the interaction between turtles and fishing gear, and between turtles and their preferred environments can be useful in developing methods to reduce mortality. For example, understanding the influence of bait type or attractors to turtles can help develop less turtle attractive gear. Technological improvements to fishing gear, such as the development of Turtle Excluder Devices (TED's) is also very important. Finally, closing areas or seasons when fisheries and turtle interactions are highest can limit impacts to turtle populations.

2.1.5 Eliminate the harassment of turtles at sea through education and enforcement.

Not applicable to leatherbacks.

2.1.6 Study the impact of diseases on turtles.

Little is known about diseases in sea turtles, but there has been recent evidence that it may be a limiting factor in certain populations. Disease origin and transmission may not be limited to the marine environment.

2.1.6.1 Investigate parasites and other infectious agents.

A variety of other diseases and parasites may be affecting leatherbacks. The prevalence of such infections, their impact on sea turtles, and modes of transmissions need to be studied. Parasites include internal parasites such as blood flukes, external parasites such as leeches (*Ozobranchus*) and burrowing barnacles (*Stephanolepas*), and certain bacterial infections such as *Vibrios*.

2.1.7 Develop carcass stranding network.

Stranding networks are operated generally by volunteers who monitor beaches for stranded animals. Such networks can be useful for alerting managers to incidents causing high mortality, such as increased fishery take or disease problems, as well as providing some basic biological data.

2.1.8 Centralize administration and coordination of tagging programs.

In general, government resource management agencies can provide the continuity required to coordinate tagging programs. The responsibility of any such agency is that they act as a central distribution point for tags, tagging training and database management. It is critically important that the coordinating agency: 1) provides adequate staff to keep the program organized and respond to tag returns immediately, and 2) remain in existence for many years (20+). Without such a commitment, tagging programs have very limited usefulness, and before initiation of such a program it should be considered carefully on its scientific merits. It must be remembered that sea turtles are long-lived animals, and the most valuable information yielded by any tagging program comes from turtles which have carried identification tags for many years. Conventional flipper tags generally only last 2 or 3 years in leatherbacks, and other forms of identification, such as Passive Integrated Transponders (PITs) and photoidentification are more appropriate for long-term projects (McDonald and Dutton, *In Press*). Short-term tagging projects are at best very limited in the information they yield and at worst are nothing more than a form of undue harassment to the turtles.

Centralization of tag records is useful as it makes the most efficient use of limited personnel resources, allows standardization of techniques, and can act as a screening mechanism to ensure that tagging is done for valid scientific reasons.

2.2 Protect and manage marine habitat, including foraging habitats.

Leatherbacks are primarily pelagic, although they often enter nearshore waters. Human activities which degrade important leatherback habitat must be limited.

2.2.1 Identify important marine habitats.

These areas are virtually unknown for this species and represent a high priority research need. (Many of these areas will first need to be identified through actions in Section 2.1.2.1 and 2.1.2.2.)

2.2.2 Ensure the long-term protection of marine habitat.

Once marine habitats are identified, sea turtle range, refugia and foraging habitats need to be protected to ensure longterm survival for the species. Habitats identified as important or critical should be designated as marine sanctuaries or preserves, while others may require close monitoring. The public needs to be educated on the importance of preserving these habitats.

2.2.3 Prevent the degradation of marine habitat caused by environmental contaminants such as sewage and other pollutants.

The effect of such pollution on leatherbacks has not been evaluated. However, leatherbacks are likely prone to concentrating such contaminants within their tissues because of their position in the food web.

2.2.4 Prevent the degradation or destruction of important habitats caused by upland and coastal erosion and siltation.

These processes, often made worse by coastal construction, disrupt vital trophic processes, reducing productivity and reducing species diversity. Minimum water standards upstream must be maintained. Land-use decisions must take this into account and associated projects where erosion and siltation occur must be monitored.

3 ENSURE PROPER CARE IN CAPTIVITY.

Not an issue for leatherback turtles which have proven to be impossible to rear in captivity.

4 INTERNATIONAL COOPERATION

4.1 Support existing international agreements and conventions to ensure that turtles in all life-stages are protected in foreign waters.

Considering that leatherbacks migrate outside of U.S. territorial waters during at least part of their life cycle, an effective recovery plan must include supporting existing cooperative agreements with other nations to protect the species. Existing agreements include CITES (see next section, adopted 1973), the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere (adopted 1940), the ASEAN Agreement on the Convention of Nature and Natural Resources (adopted 1985), the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP convention, adopted 1986), as well as a number of conventions concerning marine pollution (Eckert, 1993). Out of the SPREP convention, the South Pacific Regional Marine Turtle Conservation Programme was created to specifically implement a regional approach to the species protection. Agreements and conventions that are effective must continue to be supported.

4.2 Encourage ratification of CITES for all non-member Pacific countries, compliance with CITES requirements, and removal of sea turtle trade reservations held by member nations.

CITES is a comprehensive wildlife treaty signed by many countries that regulates and prohibits commercial import and export of wild plant and animal species that are threatened by trade. In the north Pacific signatories include 18 countries (Eckert, 1993). It is one of the most powerful international agreements concerning threatened species. The U.S. State Department, Department of Commerce and Department of Interior should work with Pacific nations to encourage non-member countries to become signatories, and demand compliance with CITES requirements on sea turtles from all signatories.

4.3 Develop new international agreements to ensure that turtles in all life-stages are protected in foreign waters.

New agreements must be outlined by the FWS and NMFS, and pursued by the State Department and Department of the Interior. Eastern Pacific nations should be encouraged to ratify the Regional Agreement for Investigation and Management of Marine Turtles of the American Pacific which was not put into place after being drafted in 1986.

4.4 Develop or continue to support informational displays in airports which provide connecting legs for travelers to the areas where leatherbacks occur.

Airports are particularly good avenues for information about illegal trade in tortoise and tortoiseshell paraphernalia, as well as general information on sea turtle conservation. If travelers don't purchase the items, the market for them may decrease. Agencies such as NMFS, FWS and the U.S. Customs Service should collaborate on display content and placement.

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IV. IMPLEMENTATION SCHEDULE

The Implementation Schedule outlines management and research actions and estimated costs for the U.S. Pacific leatherback turtle recovery program, as set forth in this recovery plan. It is a guide for meeting the objectives discussed in Part II of this plan. This schedule indicates wherever possible, task priority, task numbers, task descriptions, duration of tasks, the agencies responsible for committing funds, and lastly, estimated costs. The agencies responsible for committing funds are not, necessarily, the entities that will actually carry out the tasks. The actions identified in the implementation schedule, when accomplished, should protect habitat for the species, stabilize the existing populations, and increase the population sizes and numbers. Monetary needs for all parties involved are identified to reach this point, whenever feasible.

Priorities in column 3 of the following Implementation Schedule are assigned as follows:

Priority 1 -

An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 -

An action that must be taken to prevent significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 -

All other actions necessary to provide for full recovery of the species.

Key to Implementation Table Abbreviations:

CNMI	=	Commonwealth of the Northern Mariana Islands
DOC	=	U.S. Department of Commerce
DOI	=	U.S. Department of Interior
DOS	=	U.S. Deptartment of State (primarily as a conduit for negotiations and support for tasks in other political jurisdictions)
EPA	=	U.S. Environmental Protection Agency
FSM	=	Federated States of Micronesia
FWS	=	U.S. Fish & Wildlife Service
RMI	=	Republic of the Marshall Islands
NA	=	Not applicable
NMFS	=	National Marine Fisheries Service
NRCS	=	Natural Resources Conservation Service (Soil Conservation Service)

IMPLEMENTATION SCHEDULE/U.S. PACIFIC Leatherback (*Dermochelys coriacea*)										
General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
1.1 Protect & manage turtles on nesting beaches **1.1.1** Eliminate directed take of turtles and their eggs	1.1.1.1 Reduce directed take through public education & information	(1)	Continuing	FWS, NMFS, DOS, (No nests documented under U.S. jurisdiction)	15	25	20	20	20	Provide support for international information exchange forum
	1.1.1.2 Law enforcement-prevent illegal exploitation & harassment	(1)	Continuing	FWS, US Customs, DOS, NMFS	5	5	5	5	5	Provide support for in-country law enforcement efforts
1.1 Protect & manage turtles on nesting beaches (*cont.*)	1.1.2 Ensure coastal construction activities do not disrupt nesting & hatching activities	(1)	Continuing	FWS, DOS, NMFS						
	1.1.3 Reduce nest predation by domestic & feral animals	(1)	4 years		25	10	10	10		

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.

[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC Leatherback (*Dermochelys coriacea*)										
General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
1.1 Protect & manage turtles on nesting beaches (*cont.*) **1.1.4** Reduce effects of artificial lighting on hatchlings & nesting females	1.1.4.1 Quantify effects of artificial lighting	(3)	Continuing	FWS, DOS, NMFS						No additional costs. Information gathered as part of nest surveys
	1.1.4.2 Implement, enforce, evaluate lighting regulations or other lighting control measures	(3)	Continuing							No specific additional costs. Carried out by in-country regulatory agencies
1.1 Protect & manage turtles on nesting beaches (*cont.*) **1.1.5** Collect biological information on nesting populations	1.1.5.1 Monitor nesting activity, identify important nesting beaches, determine population trends	(1)	Continuing		80	80	80	80	80	Includes Mexico, Central America, Indonesia
	1.1.5.2 Evaluate nest success, implement nest-protection measures	(1)	10 years		100	100	100	100	100	Includes Mexico, Central America, Indonesia. Re-evaluate after 10 years.
	1.1.5.3 Define stock boundaries	1	10 years	NMFS, FWS	80	50	50	50	10	

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.
[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC Leatherback (*Dermochelys coriacea*)										
General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
1.1 Protect & manage turtles on nesting beaches (*cont.*) **1.1.5** Collect biological information on nesting populations (*cont.*)	1.1.5.3.1 Identify stock type for major nesting beach areas	(1)	10 years	FWS, NMFS						Costs covered by Task 1.1.5.3
	1.1.5.3.2 Determine nesting beach origins-juvenile & subadult populations	1	10 years							Costs covered by Task 1.1.5.3
	1.1.5.3.3 Determine genetic relationship among populations	1	10 years							Costs covered by Task 1.1.5.3
1.2 Protect & manage nesting habitat	1.2.1. Prevent degradation due to erosion-control measures, jetties & breakwaters	(3)	Continuing	FWS, DOS, NMFS						No costs. Carried out by in-country resource & regulatory agencies
	1.2.2 Eliminate sand, coral rubble removal & mining practices	(3)	Continuing							No costs. Carried out by in-country resource & regulatory agencies

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.
[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC Leatherback (*Dermochelys coriacea*)										
General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
1.2 Protect & manage nesting habitat (*cont.*)	1.2.3 Develop, evaluate natural beach-landscaping guidelines	(3)	Continuing	FWS, DOS,						No costs. Carried out by in-country resource & regulatory agencies
	1.2.4 Ensure replenishment projects maintain quality habitat	(3)	Continuing							No costs. Carried out by in-country resource & regulatory agencies
	1.2.5 Implement non-mechanical beach cleaning alternatives	NA	NA							
	1.2.6 Prevent vehicular driving on nesting beaches	(3)	Continuing							No costs. Carried out by in-country resource & regulatory agencies

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.

[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC Leatherback (*Dermochelys coriacea*)										
General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
2.1 Protect & manage populations in marine habitat **2.1.1** Eliminate directed take of turtles	2.1.1.1 Reduce directed take through education, information	1	Continuing	NMFS, U.S. West Coast, Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unincorp. Territories, DOS, FWS	30	30	30	30	30	
	2.1.1.2 Maintain enforcement reduce exploitation	1	Continuing	NMFS, USCG, DOS						No additional costs - part of ongoing leatherback program
2.1 Protect & manage populations in marine habitat (*cont.*) **2.1.2** Determine distribution, abundance, status	2.1.2.1 Determine distribution, abundance posthatchlings, juveniles, adults	1	10 years	NMFS, FWS			50	20	20	Combine 2.1.2.1 and 2.1.2.3 under single study,

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.
[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC
Leatherback (*Dermochelys coriacea*)

General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K Current	FY2	FY3	FY4	FY5	Comments/ Notes
2.1 Protect & manage populations in marine habitat (*cont.*) **2.1.2** Determine distribution, abundance, status (*cont.*)	2.1.2.2 Determine adult migration (males and females) routes, internesting habitats	1	10 years	NMFS, FWS	150	150	150	150	150	
	2.1.2.3 Determine growth rates, survivorship, age sexual maturity	1	30 years				100	50	50	
	2.1.2.4 Identify current threats adults, juveniles on foraging grounds	1	10 years				40	40	40	
2.1 Protect & manage populations in marine habitat (*cont.*) **2.1.3** Reduce effects of entanglement & ingestion marine debris	2.1.3.1 Evaluate extent ingestion of persistent debris & entanglement	1	Continuing	NMFS, EPA	25	25	25	25	25	
	2.1.3.2 Evaluate effects ingestion persistent debris & entanglement	1	Continuing			30	30	30	30	

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.
[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC
Leatherback (*Dermochelys coriacea*)

General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
	2.1.3.3 Reduce, eliminate persistent debris and sources of entanglement	1	Continuing	NMFS, EPA, USCG		10	10	10	10	
2.1 Protect & manage populations in marine habitat (*cont.*) **2.1.4** Monitor, reduce incidental mortality in commercial, recreational fisheries	2.1.4.1 Monitor incidental mortality in commercial, recreational fisheries	1	Continuing	NMFS, U.S.West Coast , Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unincorp. Territories	200	500	500	500	500	Duplicative of Task 2.1.4.1 in loggerhead plan
	2.1.4.2 Reduce incidental mortality in commercial, recreational fisheries	1	Continuing		250	250	250	250	250	Duplicative of Task 2.1.4.1 in loggerhead plan
2.1 Protect & manage populations in marine habitat (*cont.*)	2.1.5 Eliminate harassment of turtles at sea	2	NA	NMFS, U.S.West Coast , Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unincorp. Territories						NA

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.

[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC Leatherback (*Dermochelys coriacea*)										
General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
	2.1.6 Study the impact of diseases on turtles	3	NA	NMFS, U.S.West Coast , Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unincorp. Territories, FWS (as appropriate to beach habitat)						NA
	2.1.6.1 Investigate parasites and other infectious agents	3	1 year							Review literature. Determine need
2.1 Protect & manage populations in marine habitat (*cont.*)	2.1.7 Develop carcass stranding network	2	Continuing	NMFS, FWS	5	5	5	5	5	Coordinate with existing marine mammal network; includes all species
	2.1.8 Centralize tagging program and tag-series records	2	Continuing		60	60	60	60	60	Total funds for all species

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.
[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC
Leatherback (*Dermochelys coriacea*)

General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
2.2 Protect & manage marine habitat	2.2.1 Identify important habitat	1	10 years	NMFS, U.S.West Coast , Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unincorp. Territories						Should be coordinated with Tasks 2.1.2.2. Funds are covered with these tasks.
	2.2.2 Ensure long-term protection	1	Continuing							Part of ongoing program activities
	2.2.3 Prevent degradation of marine habitat by pollution	(2)	Continuing	NMFS, EPA, USCG, DOS						Part of ongoing program activities
	2.2.4 Prevent degradation or destruction by upland, coastal erosion, siltation	(2)	NA	FWS, EPA, NRCS, DOS, NMFS, COE						
2.2 Protect & manage marine habitat (*cont.*)	2.2.5 Prevent degradation of pelagic habitat by oil transshipment	2	Continuing	USCG, NMFS, EPA						Part of ongoing program activities
	2.2.6 Identify other threats, take action	2	Continuing	NMFS, EPA, USCG						Part of ongoing program activities

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.
[B] The lead agency is listed first.

IMPLEMENTATION SCHEDULE/U.S. PACIFIC Leatherback (*Dermochelys coriacea*)										
General Task Categories	Plan Task	Priority[A]	Task Duration	Agencies Responsible[B]	Estimated Fiscal Year Costs $K					Comments/ Notes
					Current	FY2	FY3	FY4	FY5	
3 Ensure proper care in captivity		NA	NA							
4 International cooperation	4.1 Support agreements, con-ventions, protect in foreign water	1	Continuing	FWS, NMFS, DOS, DOI, DOC		100	100	100	100	This includes all sea turtle species and Tasks 4.2, 4.3 (1 FTE plus travel)
	4.2 CITES membership, compliance	1	Continuing							
	4.3 Develop new agreements to protect in foreign waters	1	Continuing	NMFS, DOS, DOI, DOC						
4 International cooperation (*cont.*)	4.4 Display information at airports	2	5 years	NMFS, U.S. West Coast, Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unicorp. Territories, FWS	15	15	15	15	15	Includes all sea turtle species

[A] ( ) parentheses denote that this task does not necessarily apply to U.S. jurisdiction, but that the task must be addressed if the U.S. populations are to be restored. Such tasks may require U.S. resource agencies to support recovery tasks in other political jurisdictions.

[B] The lead agency is listed first.