Recovery Plan for U.S. Pacific Populations

of the

Olive Ridley Turtle

(Lepidochelys olivacea)

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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(*Lepidochelys olivacea*)

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

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Date: 12-23-97

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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:

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998. Recovery Plan for U.S. Pacific Populations of the Olive Ridley Turtle (*Lepidochelys olivacea*). National Marine Fisheries Service, Silver Spring, MD.

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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.

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ACKNOWLEDGMENTS

The team wishes to thank and acknowledge the following technical advisors and contributors to these recovery plans:

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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 olive ridley turtle is listed as Threatened in the Pacific, except for the Mexican nesting population, which is classified as Endangered. This latter classification was based on the extensive over-harvesting of olive ridleys in Mexico, which caused a severe population decline. Since the ban on the harvest of turtles in Mexico, the primary threat to the Mexican nesting population has been reduced and the population appears to be stabilizing. Downlisting to Threatened status may be feasible. The primary threats to the olive ridley appear to be incidental take in fisheries and boat collisions while in U.S. waters (or by U.S.-based fishing fleets), and the harvest of turtles and eggs on Mexican and Central American nesting beaches.

Goal: The recovery goal is to delist the species.

Recovery Criteria: To consider delisting all of the following recovery 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) Foraging populations are statistically significantly increasing at several key foraging grounds within each stock region.

3) All females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 10 years.

4) A management plan based on maintaining sustained populations for turtles is in effect.

5) International agreements are in place to protect shared stocks.

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

1) Minimize incidental mortalities of turtles by commercial fishing operations.

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

3) Identify stock home ranges using DNA analysis.

RECOVERY PLAN FOR U.S. PACIFIC POPULATIONS OF THE OLIVE RIDLEY TURTLE (*Lepidochelys olivacea*)

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 consists of 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 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.

By virtue of the highly migratory behavior of adult turtles, and the shifting habitat requirements of post-hatchlings and juveniles, populations of olive ridley turtles (*Lepidochelys olivacea*) in the Pacific Ocean cross international boundaries. The following discussions acknowledge the extended range of this species by incorporating relevant biological information from within and without U.S. jurisdiction.

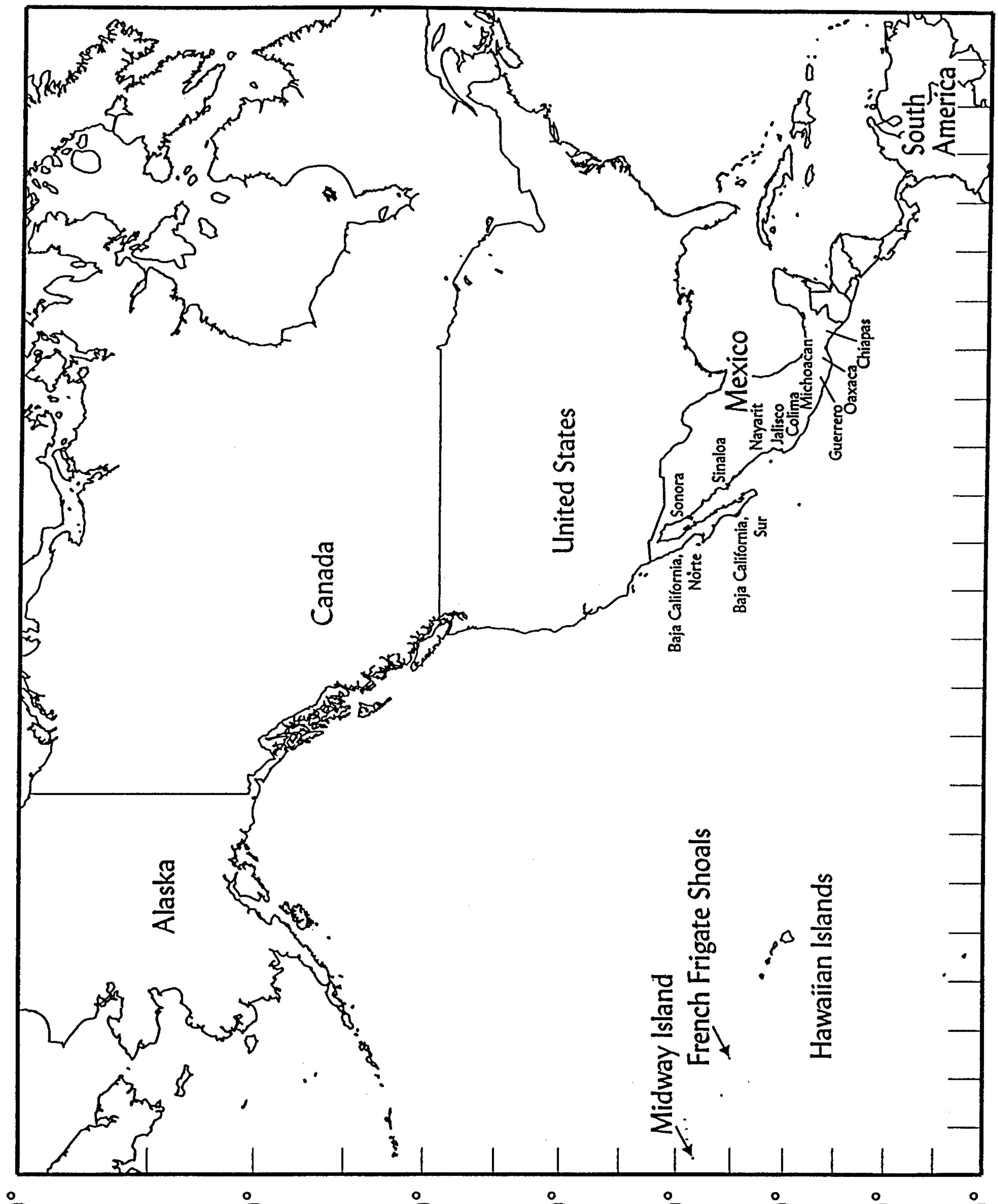

Figure 1a. Western coasts of the United States, Canada and Mexico (as well as Central and northern South America) constitute a shared habitat for Pacific sea turtles.

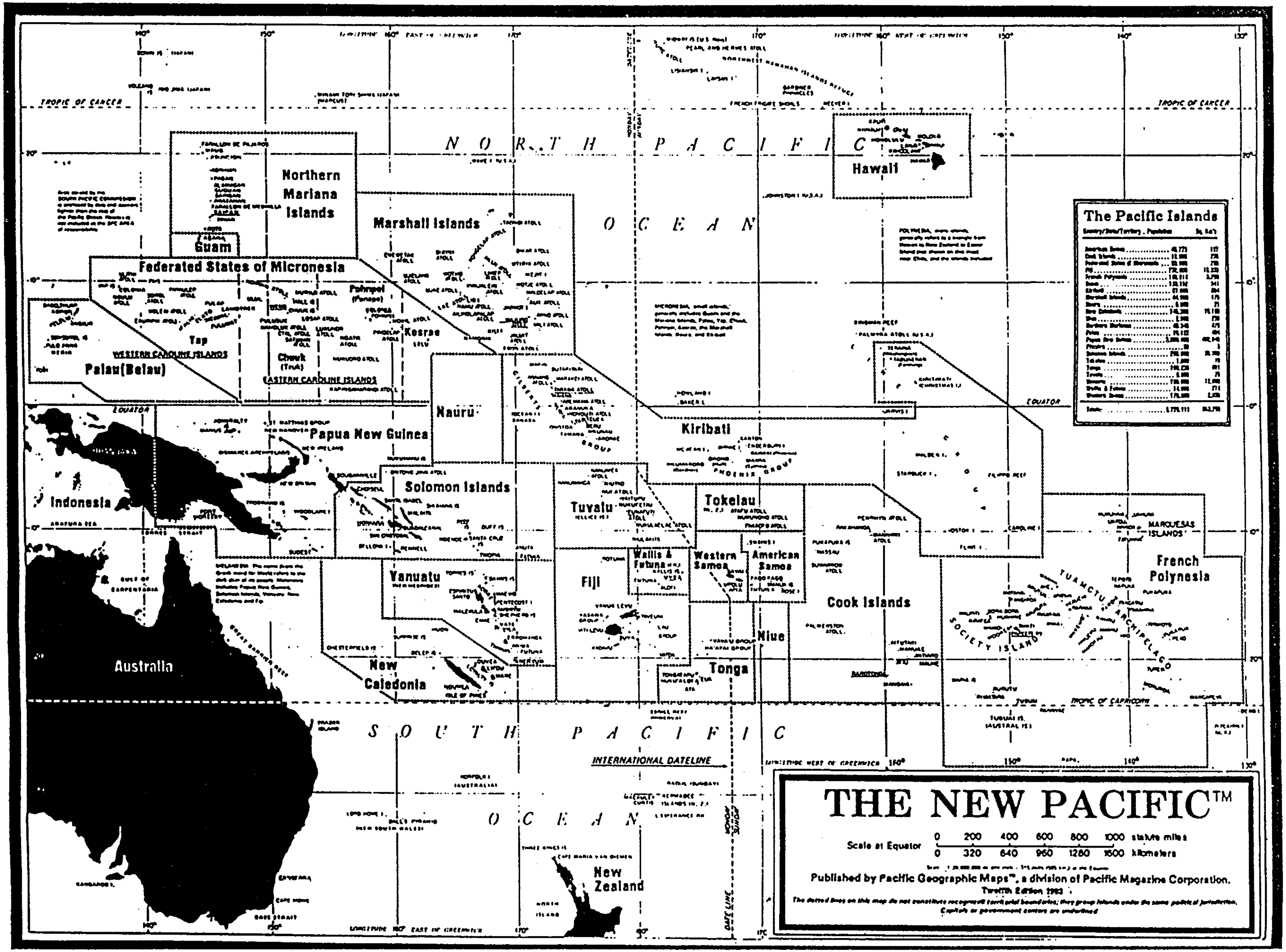

Figure 1b. The western Pacific constitutes a shared habitat for Pacific sea turtles.

B. Historical and Cultural Background

Throughout most of its range, especially where abundant, the olive ridley has been exploited for food and non-comestibles (e.g., bait, bone meal, fertilizer, oil, leather). Meat and eggs have probably been consumed by indigenous peoples along the Pacific coast of Mexico and Central America ever since the area was first inhabited by man. Although the meat is palatable, it is not considered a delicacy and usually not widely sought after (Carr 1952). Olive ridley eggs, however, are esteemed everywhere and, at least through 1979, millions were harvested annually throughout the eastern Pacific (Cliffton et al. 1982).

Egg harvest can be an important contribution to local economies (Woody 1986; Lagueux 1991). Egg poaching is illegal in most of the countries where olive ridleys nest in the eastern Pacific, but the laws are rarely enforced. At Ostional Beach, Costa Rica, managed egg harvests have been undertaken to take advantage of the tremendous waste of eggs that naturally occurs during olive ridley mass nesting (called *arribadas* or *arribazones*). Typically, nesting females dig up or disturb previously deposited eggs at Ostional (Cornelius et al. 1991). Thus eggs laid during the first day of each *arribada* are collected and sold within the local community (Arauz-Almengor et al. 1993). This practice shows unique promise of maintaining a balance between a traditional source of income for coastal communities and the long-term survival of a turtle population.

A discussion of the "historical and cultural" background of sea turtles in the eastern Pacific would not be complete without a discussion of the commercial fishing frenzy that decimated turtle populations in this region during the 1960s and 1970s. During the mid 1960s, Mexico established a turtle leather trade with Europe (mainly Italy) and Japan which vastly accelerated the harvest of adult turtles: several million were landed over the next 15 years. The combination of relentless egg poaching and harvesting unsustainably large numbers of adults as they amassed off major nesting beaches ultimately led to the collapse of all but one of the largest nesting populations in Mexico. The remaining colony, La Escobilla (Oaxaca State), was showing signs of a major decline (Cliffton et al. 1982; Groombridge 1982) when efforts were made by the Mexican government to protect the remaining vestiges of olive ridley nesting populations in Mexico (Aridjis 1990).

Finally, it should be noted that olive ridleys nesting throughout the eastern Pacific (as well as a mixture of juveniles) depend for food on rich zones of upwelling off South America and have historically been exploited there. For example, although few, if any, olive ridleys nest in Ecuador, large numbers immigrate there from Mexico and Central America to feed in offshore waters. Starting around 1970, an important fishery for olive ridleys was established in Ecuador, with several thousand turtles per year landed for a frozen meat market (Green and Ortiz-Crespo 1982). In 1973, Ecuador entered the turtle leather export trade and landings quickly elevated to over 100,000 turtles a year by the late 1970s (Green and Ortiz-Crespo 1982) before the industry was banned altogether (Hurtado 1982).

Olive ridley numbers are so small within U.S. territorial waters that there has probably never been a directed harvest there (see Stinson 1984). However, olive ridleys are incidentally captured and sometimes killed by U.S. tuna purse seine fishermen operating in the Eastern

Tropical Pacific (ETP) with an estimated annual mortality of less than 100 turtles (S. Eckert, Hubbs-Sea World Research Institute, pers. comm.).

C. Taxonomy

This species was originally described as *Testudo mydas minor* Suckow, 1798, later renamed *Chelonia olivacea* Eschscholtz, 1829, and eventually *Lepidochelys olivacea* Fitzinger, 1843. The genus name is derived from the Greek words *lepidos*, meaning scale, and *chelys*, meaning turtle, possibly in reference to the supernumerary costal scute counts characteristic of this species (cf. Smith and Smith 1979). The etymology of the English vernacular name "ridley" is unclear (Dundee 1992). *Lepidochelys* is the only sea turtle genus with more than one extant species: *L. olivacea* and the closely related Kemp's ridley *L. kempii* (Bowen et al. 1991). Although the name *L. o. remivaga* has been proposed for the eastern Pacific populations, there are no currently accepted named subspecies (Pritchard 1969a; Smith and Smith 1979). Detailed taxonomic reviews of this genus and species are provided by Smith and Smith (1979) and Pritchard and Trebbau (1984).

D. Description

Historically, field researchers and observers have had difficulty distinguishing olive ridleys from loggerhead turtles (*Caretta caretta*), which has led to erroneous distribution and breeding records that still persist today (Nishimura 1967; Frazier 1985). The genus *Lepidochelys* is characterized by its relatively small size; unusually broad carapace; four pairs of inframarginal scutes, each or most with a posterior inframarginal pore that opens to a musk gland (Rathke's Gland); and a medium-sized head that is triangular in planar view. The two species (*olivacea* and *kempii*) differ in the number of lateral carapace scutes; the Kemp's ridley has five pairs while the olive ridley can have up to nine. In fact, olive ridleys are unique among extant turtles in having a variable, often asymmetrical, lateral scute count, ranging from five to nine plates on each side, but with six to eight being the most common. While both of the two recognized species occur in the Atlantic Ocean, only *L. olivacea* is found in the Pacific Ocean.

The olive ridley is the smallest living sea turtle, with an adult carapace length usually between 60 and 70 cm. Schulz (1975) measured 500 females in Suriname and reported an average carapace length of 68.5 cm (range 63-75 cm). Pacific olive ridleys are slightly smaller. The modal length class of a sample of 99 nesting females from Pacific Honduras was 65-65.9 cm, with a range of 58-74 cm (Pritchard 1969a). Ridleys from Playa Nancite, Costa Rica, have a mean carapace length of 63.3 cm (range = 54.0-72.5 cm, n = 251; Hughes and Richard 1974). Márquez et al. (1976) listed carapace lengths for mature females from nesting beaches in different states in Pacific Mexico as follows: Oaxaca, mean = 62.9 cm (range = 52.5-73, n = 1,203); Guerrero, mean = 63.5 cm (range = 52-73.5, n = 253); Michoacan, mean = 63.1 cm (range = 60-67, n = 13); Colima, mean = 64.3 cm (range = 60-68, n = 19); Jalisco, mean = 63.2 cm (range = 54-70, n = 115); Sinaloa, mean = 62.2 cm (range = 55-69, n = 190). Hatchlings from Mexico measure from 34.7 to 44.6 mm (straight carapace length [SCL]) (Márquez 1990).

Olive ridleys rarely weigh over 50 kg (Schulz 1975). Adult females captured off Oaxaca, Mexico, weighed an average of 35.45 kg (n = 58); males weighed significantly less with an average of 33.00 kg (n =17). The entire sample ranged from 25 to 46 kg (Frazier 1983). Hatchlings weigh between 12.0 and 22.3 g (Márquez 1990).

Adults are olive or grayish green above, but sometimes appear reddish due to algae growing on the carapace. The underparts are greenish white, especially in younger specimens, becoming creamy yellow with age. Hatchlings are all black when wet (dark gray otherwise) with a pale yolk scar. Hatchlings and juveniles have serrated posterior marginals; these become smooth with age and the adult has a rounded carapace. Juveniles also have three longitudinal dorsal keels; the central keel gives younger animals a serrated profile and persists almost until maturity. Two keels on the plastron also disappear with age.

Adults are moderately sexually dimorphic. As in other cheloniids, mature males have substantially longer and thicker tails than females (used for copulation), and one of the claws on the front flippers is enlarged and strongly hooked (used to grasp the carapace of the female during copulation). The male has a longer, more tapered carapace than the more rounded female, while the female has a higher, more domed carapace (Frazier 1983). Males have a more concave plastron, presumably adaptive for mating (Wibbels et al. 1991). For detailed information on the description of this species see Pritchard and Trebbau (1984).

E. Population Distribution and Size

The olive ridley sea turtle is widely regarded as the most abundant sea turtle in the world (Carr 1972; Zwinenberg 1976). Until recent historical times and the advent of modern commercial exploitation of sea turtles, the olive ridley was superabundant in the eastern Pacific, undoubtedly outnumbering all other sea turtle species combined in the area. For example, Carr (1972) states that more than 1,000,000 olive ridleys were commercially harvested in Mexico during 1968 alone, and Cliffton et al. (1982) estimated that a minimum of 10,000,000 olive ridleys swam in the seas off Pacific Mexico before the recent era of exploitation.

Nesting Grounds

Preferred nesting areas occur along continental margins and, rarely, on oceanic islands. The largest nesting aggregation in the world occurs in the Indian Ocean along the northeast coast of India (Orissa), where in 1991 over 600,000 turtles nested in a single week (Mrosovsky 1993). The second most important nesting area occurs in the eastern Pacific, along the west coast of Mexico and Central America. Elsewhere, olive ridleys nest in much smaller numbers including along the Atlantic coast of South America and western Africa, as well as in the western Pacific and Indian oceans (Sternberg 1981; Groombridge 1982; Carr and Carr 1991).

In the eastern Pacific, the largest nesting concentrations occur in southern Mexico and northern Costa Rica, with stragglers nesting as far north as southern Baja California (Fritts et al. 1982) and as far south as Peru (Brown and Brown 1982). Hubbs (1977) reported a pair of olive ridleys mating off the La Jolla coast in southern California, but there is no known nesting there. Indeed, with the exception of a single nesting in September 1985 on the island of Maui, Hawaii (Balazs and Hau 1986), there is no nesting by this species anywhere in the United States or the territories under U.S. political jurisdiction (see Geographic Scope).

Although the olive ridley is renowned for its *arribadas*, most nesting areas support only small or moderate-sized aggregations (up to 1,000 nesting females) (Groombridge 1982). Although the spectacular nesting emergences at beaches such as Orissa in India, Playas Ostional and Nancite in Costa Rica, and La Escobilla in Mexico, have received a good deal of attention from biologists and conservationists, the overall contribution of smaller nesting beaches may be of considerable importance.

According to A. Abreu G. (pers. comm.), the number of females nesting in Mexico annually are: Baja California Norte - 3; Baja California Sur - 71; Sonora - status unknown; Sinaloa - 612; Nayarit - 100; Jalisco - 830; Colima - present; Michoacan - 500; Guerrero - 1,415; Oaxaca - 157,500; Chiapas - 430; total - 161,501. Márquez (1990) estimated over 200,000 nests per year at La Escobilla, Morro Ayuta, Chacahua, Piedra de Tlacoyunque, and Mismaloya-La Gloria nesting beaches. Sternberg (1981) erroneously lists Islas Revillagigedos (Mexico) as a nesting area.

Márquez (1990) cited an estimate of 3,000 nests per year in Guatemala, and Higginson (1989) stated that 21,067 olive ridleys nested there annually during 1981 and 1982. [Data on population size in the eastern Pacific are variously reported either as number of nests or number of nesting females. These data can be loosely compared by remembering that most females deposit two clutches of eggs per year (Plotkin et al. 1994).] Olive ridleys nest at least in small numbers in El Salvador, but no specific information is available (Cornelius 1982).

According to C. Lagueux (Univ. Florida, pers. comm.), olive ridleys nest on many islands in the Gulf of Fonseca (Honduras) and on the mainland from the border with Nicaragua to Punta Novillo, located on the west side of Isla Zacate Grande; over half of the nesting occurring at three mainland sites: Punta Raton, Cedeño, and El Carretal. Cornelius (1982) cited an estimate of 3,000 nesting females for all of Pacific Honduras and reported that the population was declining. In 1987, olive ridleys laid an estimated 2,000 clutches (= ca. 1,000 nesting females) (C. Lagueux pers. comm.).

There are two primary *arribada* beaches in Nicaragua, Playa Chacocente (or Chococente) and Playa La Flor, both located in the southern Department of Rivas. *Arribada* activity peaks in August- October. Cornelius (1982) stated that olive ridley populations had declined from former times but that the ridleys were still the most abundantly nesting sea turtle on the Pacific coast. Calculating from egg exports in 1975-1976, Cornelius (1982) estimated minimum numbers of nesting females at 2,800 and 3,200, respectively. In actual fact the population(s) are larger. Typically, 5,000-10,000 females participate in peak season *arribadas*. Higher numbers have been recorded; for example, 12,960 females nested from 13-18 October in Playa La Flor's largest 1994 *arribada* (MARENA, *in litt*. K. Eckert 14 July 1995). Egg collection quotas allow more than half million eggs (from the two beaches combined) to be harvested each year.

Costa Rica supports the largest nesting aggregations of *Lepidochelys olivacea* in the eastern Pacific and, with the exception of Orissa, India, the largest nesting aggregations for this species in the world. Two beaches are most important: Playa Nancite and Playa Ostional. Playa Nancite is 1.0 km in length and typically receives 25,000-50,000 turtles per year. Playa Ostional is three km in length and typically receives 450,000-600,000 turtles per year. At both sites *arribadas* peak in the months of September and October. As many as 30,000 females may nest in one *arribada* at Nancite, and as many as 100,000 females at Ostional. Both populations appear to have reached their carrying capacities, as shown by significant numbers of nests predictably exhumed by later nesting females. Average annual hatch success ranges from 3.0 to 22%. Census data initiated in 1980 and continuing to the present, indicates that population at Playa Nancite is declining. There are no long term data for Playa Ostional (Claudette Mo, Univ. Nacional de Costa Rica, pers. comm., 1995).

Isla Cañas has by far the largest population in Panama with an estimated 20,000 nesting females; approximately 10,000 females nest throughout the remainder of the country (R. Chang, Dirreción Nacional des Áreas Protegidas y Vida Silvestre, pers. comm.). Cornelius (1982) stated that the number of ridleys nesting in Panama appeared to be drastically reduced from former levels.

The olive ridley is the most commonly nesting sea turtle in Pacific Colombia (Amorocho et al. 1989), but no estimate of the size of the breeding population there is available. Although olive ridleys are not known to nest in Ecuador (Green and Ortiz-Crespo 1982), breeding occurs in countries to the north and south and it seems likely that at least a few must nest there. Brown and Brown (1982) reported a single nest from northern Peru and cited additional evidence that small numbers of olive ridleys may regularly nest in that country.

Insular and Pelagic Range

The olive ridley occurs worldwide in tropical and warm temperate ocean waters. It is by far the most common and widespread sea turtle in the waters of the eastern Pacific (Pitman 1990; Inter-American Tropical Tuna Commission [IATTC], unpubl. data); it is increasingly uncommon further offshore, and rare in the central Pacific, both at sea and around islands (Balazs 1982a). At sea occurrences in the United States and waters under U.S. jurisdiction are limited to the west coast of the continental United States (Stinson 1984) and Hawaii where the species is rare (Balazs 1982a), but sightings are reportedly increasing (Balazs 1983). A 57 cm (SCL) individual was hooked by a fisherman in Los Angeles Harbor and brought to Sea World of San Diego in 1983 (M. Shaw, Sea World, pers. comm.). There are no reported encounters with olive ridley turtles in U.S. Pacific territorial waters (see Geographic Scope).

Concentrations at sea have been noted mainly in tropical neritic waters, usually adjacent to known nesting areas. Unpublished data assembled by the IATTC show that olive ridleys are present from 30°N to 15°S and are most often seen within 1,200 nautical miles from shore (although they are seen as far as 140°W, and it is not uncommon to find large groups hundreds of miles from the nearest coast). Arenas and Hall (1992) report aggregations of over 100 animals as far offshore as 120°W. Although there is strong evidence for moderate seasonal movements of olive ridleys within the eastern Pacific (see Movements and Migration), regular transoceanic migrations are unknown.

Observations by the IATTC indicate seasonal distribution for the olive ridley. Values for the relative frequency of occurrence index were usually high near the coasts of central and south America, especially during July through December (the nesting season peak), and the index was always low off Mexico (despite seasonal high density nesting in Oaxaca). There was also seasonal distribution by sex and size; southeast of the Galapagos Islands, and in the area between the Revillagigedo Islands and Baja California, only females were observed. Over two-thirds of all small individuals were seen in the feeding area off Ecuador and Colombia during July through December. In the offshore region, both males and females were observed but only during May through June (IATTC, unpubl. data).

Data collected during tuna fishing cruises from Baja California to Ecuador and from the coast to almost 150°W indicated that the two most important areas in the Pacific for the olive ridley are the central American coast and the nursery/feeding area off Colombia and Ecuador, where both adults (mostly females) and juveniles are often seen (IATTC, unpubl. data). Large groups (again, mostly females) were also observed in the Humboldt Current area southeast of the Galapagos Islands. The largest group (at least 216 turtles) observed by Arenas was near the Gulf of Guayaqui, Ecuador.

F. Status

The olive ridley is classified as Endangered according to the World Conservation Union (IUCN) Red Data Book (Groombridge 1982), and is listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). According to the Code of Federal Regulations (50 CFR 17.11), under the U.S. Endangered Species Act of 1973 (ESA), as amended, nesting populations of olive ridleys along the Pacific coast of Mexico are listed as Endangered and all others are listed as Threatened. However, the National Marine Fisheries Service (NMFS) intends to propose upgrading the Atlantic population(s) of olive ridley to Endangered (P. Williams, NMFS, pers. comm.).

G. Biological Characteristics

Migration and Movements

Hatchlings leave the beach to begin what is presumed to be a pelagic phase, the so-called "lost year". No information is available on the movements or the kind of habitat these turtles use during their first year (or possibly years) of life. Information on the habitat of juvenile ridleys is almost nonexistent. During a three hour period on 14 September 1989, R. Pitman observed 75 turtles (only olive ridleys identified), 90 to 120 nautical miles due southwest of Acapulco, Mexico. Numerous individuals in the 20-30 cm size range were present. These turtles were noticeably more common in areas where flotsam and debris were also visible at the surface (R. Pitman, NMFS, unpubl. data). During tuna fishing cruises in the eastern Pacific, the only place turtles less than 60 cm were seen was in the feeding/nursery area in the Panama Bight, off Ecuador and Colombia (IATTC, unpubl. data). It is possible that young turtles move offshore and occupy areas of surface current convergences to find food and shelter among aggregated floating objects until they are large enough to recruit to the nearshore benthic feeding grounds of the adults. A similar scenario has been suggested for hatchling loggerheads that associate with *Sargassum* weed in the western Atlantic (Carr 1987).

Information on the movements of adult olive ridleys comes from recaptures of females previously tagged on nesting beaches and satellite telemetry studies. Cornelius and Robinson (1986) reported on 189 recaptured individuals from over 45,000 ridleys tagged in Costa Rica, and summarized results of smaller scale tagging efforts in Mexico and Nicaragua. Turtles nesting in Costa Rica were recovered as far south as Peru, as far north as Oaxaca, Mexico, and offshore to a distance of 2,000 km. The majority (37.6%) were recaptured in Costa Rican waters, 28.6% were recaptured in countries south of Costa Rica and 32.3% were recaptured north of Costa Rica. Cornelius and Robinson (op. cit.) reviewed data on surface current flow in the eastern Pacific but were not able to draw any conclusions about whether the movements of Costa Rican ridleys were the result of active migrations or passive drifting with these currents.

Regardless of the mode of transport, there is evidence to suggest that many ridleys undergo a regular migration within the eastern Pacific between breeding grounds in the north and feeding grounds to the south. Of the 54 ridleys recaptured south of Costa Rica in the Cornelius and Robinson (1986) study, 80% were from Ecuador, and turtles tagged in Mexico and Nicaragua have also been recaptured in Ecuador. From 1970-1979, turtle fishermen were taking up to 90,000 ridleys per year (Green and Ortiz-Crespo 1982) in Ecuador, a country where apparently very few ridleys actually nest (none according to Green and Ortiz-Crespo 1982). These and other data (e.g., Hurtado 1981; Meylan 1982) suggest that the huge numbers of ridleys that occur (or formerly occurred) off Ecuador and Colombia are comprised of seasonal migrants from nesting populations to the north.

Plotkin et al. (1994) provide further insight into olive ridley movements. Satellite monitoring of post-nesting movements (from Nancite Beach, Costa Rica) showed migration routes traversing thousands of kilometers over deep (>1,000 m) oceanic water, distributed over a very broad range from Mexico to Peru and over 3000 km west of Costa Rica. Their data further indicated that rather than migrating to one specific foraging area after nesting, olive ridleys are nomadic and exploit multiple feeding areas. Sightings of large aggregations of ridleys at sea (e.g., Oliver 1946) have led to unconfirmed speculation that turtles travel in large flotillas between nesting beaches and feeding areas (Márquez 1990).

<u>Foraging Biology and Diet</u>

Data on the food and foraging habits of olive ridleys are remarkably sparse with much of the information only anecdotal. An early suggestion that olive ridleys are primarily vegetarian (Deraniyagala 1939; Bustard 1972) has not been substantiated (Márquez et al. 1976). The general picture suggests a catholic diet with crustaceans playing a major role. Identified prey include a variety of mostly benthic, but also some pelagic, prey items. Benthic prey include bottom fish, crabs, oysters, sea urchins, snails, sessile tunicates, shrimp, and algae; pelagic prey include jellyfish medusae, salps, and pelagic red crabs (*Pleuroncodes planipes*) (Deraniyagala 1939; Carr 1961; Caldwell 1969; Fritts 1981; Cornelius and Robinson 1986; Mortimer 1982; Márquez 1990). Landis (1965) reported a sighting by the crew of a semi-submersible craft from Scripps Institution of Oceanography (University of California) of a "green turtle" feeding on crabs at a depth of 300 m in the Sea of Cortez. This turtle identification was later corrected as an olive ridley (Eckert et al. 1986). Olive ridleys have also been observed feeding on flotsam-associated epibiota, mostly acorn and gooseneck barnacles, molluscs, algae and crabs (IATTC, unpubl. data).

The most complete study of olive ridley diet in the eastern Pacific (Montenegro et al. 1986, cited in Márquez 1990) indicates the wide variety of prey taken by this species: adult males (n = 24) fed mainly on fishes (57%), salps (38%), crustaceans (2%), and molluscs (2%), while adult females (n = 115) fed on salps (58%), fishes (13%), molluscs (11%), algae (6%), crustaceans (6%), bryozoans (0.6%), sea squirts (0.1%), sipunculid worms (0.05%), and fish eggs (0.04%). Olive ridleys off western Baja California may feed almost entirely on pelagic red crabs (Márquez 1990), which are superabundant in that area (Pitman 1990).

There are several accounts of olive ridleys being caught on longline fishing gear (e.g., Pritchard 1977; Fritts 1981; Balazs 1982b; Cornelius and Robinson 1986). Bait used in these cases include fish (Fritts 1981), squid (R. Pitman, NMFS, pers. obs.), shrimp and turtle meat (Cornelius and Robinson 1986). These observations suggest that olive ridleys scavenge at times, which should be considered when evaluating food and feeding habits based on stomach contents alone. The only information on the natural diet of olive ridleys in offshore waters comes from Bailey and Bailey (1974) who butchered a specimen they collected several hundred miles west of Costa Rica. The turtle was full of shell fragments and they assumed it had been feeding on crabs that had taken up residence around their life raft. Olive ridleys in the open ocean of the eastern Pacific are often seen near floating objects, possibly to feed on associated fish and invertebrates (Pitman 1992; IATTC unpubl. data).

Growth

Nothing is known about the growth rates of wild olive ridleys. Three hatchlings sent to Sea World of California in December of 1988 and measured on 23 March 1989 averaged 90.3 mm SCL and 169.3 gm. After nearly 15 months, they had gained an average of 265.7 mm and 7,230.7 gm. After just over 18 months, two of the turtles had gained an average of 288.5 mm and 8,723.0 gm since their initial measurement (McDonald and Dutton, unpubl. data).

Reproduction

Most mating is generally assumed to occur in the vicinity of nesting beaches (Márquez et al. 1976), but copulating pairs have also been reported over 1,000 km from the nearest nesting beach (Hubbs 1977; Pitman 1990). From research conducted at Playa Nancite, Costa Rica, it appears that the number of copulating (or courting) pairs observed near the nesting beach cannot account for the fertilization of tens of thousands of gravid females, and some if not the majority of mating must occur away from the nesting grounds (O. Owens, Texas A & M University [TAMU], pers. comm.). Arenas and Hall (1992) observed that turtles start to aggregate near the nesting beach two months before the nesting season.

Olive ridleys nest throughout the year in the eastern Pacific with peak months, including major arribadas, occurring from September through December. Preferred nesting habitat is a relatively flat, middle beach zone, free of debris (Cornelius 1976). Beach fidelity is not absolute. Hughes and Richard (1974) reported individual ridleys nesting at both Playa Naranjo and Playa Nancite, Costa Rica, approximately 1.5 km apart, during the same season. Nesting is mostly nocturnal but some diurnal emergences are known, especially during large *arribadas* (Pritchard 1969a; Caldwell and Casebeer 1964; Cliffton et al. 1982). Age at sexual maturity is not known, but there are data on the minimum breeding size. For example, the average length of 251 turtles nesting at Playa Nancite, Costa Rica, was 63.3 cm, with the smallest being 54.0 cm (Hughes and Richard 1974).

Ten of 22 nesting females recaptured at Punta Raton, Honduras, had internesting intervals of 15 to 17 days (Minarik 1985). Similarly, Pritchard (1969b) and Schulz (1975) reported modal internesting intervals of 17 days and 16 days, respectively, for olive ridleys nesting in Suriname. These are typical internesting intervals for solitary nesters. Most olive ridleys, however, undertake to nest synchronously in *arribadas* which typically occur on 28-day, lunar-associated cycles. For example, Márquez et al. (1982) report that olive ridleys nesting in Mexico show "clear internesting cycles every 28 days."

Gravid females ascend the beach with an alternate gait, excavate a nest chamber with their rear flippers, deposit the clutch, and vigorously tamp down the nest site with their plastron after the eggs are covered. Most females lay two clutches of eggs per season, remaining nearshore for the approximately one month internesting period (Plotkin et al. 1994). Mean clutch size for Mexican populations is 105.3 eggs (n = 1,120 nests) (Márquez 1990). Mean clutch sizes for two nesting beaches in Costa Rica is 99.6 eggs (SD = 17.0, n = 115 nests) and 107.4 eggs (SD = 17.4, n = 66) (Cornelius et al. 1991). Eggs range from 32.1 to 44.7 mm in diameter and 30 to 38 g. Incubation usually takes from 50 to 60 days, but can vary depending on temperature, humidity, sand grain size and organic content. Hughes and Richard (1974) found that individuals from nests in shady, vegetated areas took up to 70 days or more to hatch.

Plotkin et al. (*in review*) satellite-tagged nesting females during an *arribada* at Playa Nancite, Costa Rica, and monitored internesting movements and cohort cohesiveness. They found that the turtles dispersed away from each other during the internesting period, returning to nest in successive *arribadas*. After their final nest, the turtles from each of the three cohorts studied dispersed independently of each other.

It is noteworthy that scientific opinions differ as to the extent to which arribadas, which are unique to *Lepidochelys,* contribute to overall population status. Some researchers feel that the tremendous reproductive output of arribadas is essential to the success of the species by subsidizing smaller colonies elsewhere. For example, Lagueaux 1991 mentions beaches in Nicaragua where 100% of the eggs have been harvested for many years. It seems logical that those beaches recruit breeding turtles from other populations. On the other hand, the excessive egg loss (up to 99.8% in some instances) and the subsequent decline in reproductive output suggests that traditional arribada beaches may fall far short of their reproductive potential and may not be primarily responsible for maintaining olive ridley populations in the ETP.

The greatest single cause of olive ridley egg loss comes from the nesting activity of conspecifics on arribada beaches where nesting turtles destroy eggs by inadvertently digging up previously laid nests or causing them to become contaminated by bacteria and other pathogens from rotting nests nearby. At Playa Nancite, Costa Rica, an estimated 0.2% of 11.5 million eggs laid during a single arribada produced hatchlings (Hughes and Richard 1974). Predators also contribute to egg loss and include coyotes, opossums, raccoons, coatimundies, feral dogs and pigs, and humans. At Playa Nancite during 1981-1984 an average of 14.2% nests per year was excavated by mammalian predators (range 3.4-25%), with coatimundies being the most numerous predator (Cornelius et al. 1991). Abiotic sources of egg loss include inundation by high tides and erosion.

The predators of hatchlings are legion: on the beach they include crabs, snakes, iguanas, frigatebirds, vultures, coyotes, and racoons; in the water they include predatory fish (Hughes and Richard 1974).

Offshore Behavior

In the eastern tropical Pacific the olive ridley occurs much more commonly in the open ocean than any other cheloniid (Pitman 1990), but this may only be a function of its being much more abundant than any of the other species and thus increasing the likelihood of their being wayward individuals. Alternatively, olive ridleys may have a truly pelagic habit. Further research is needed in this regard.

At sea in the eastern tropical Pacific, olive ridleys readily associate with objects floating in the water including anything from logs to plastic debris to dead whales (Pitman 1992; Arenas and Hall 1992), and appear strongly attracted to brightly colored objects (Arenas and Hall 1992). The reason for this association is unknown but shelter from predators seems likely, although turtles may also be feeding on fishes and other organisms that aggregate around floating objects. Observations by the IATTC (unpubl. data) indicated that only 17% of all positively identified olive ridleys were seen in open water, 44% were observed near floating objects.

Olive ridleys often bask at the surface in the eastern Pacific where they are frequently accompanied by seabirds (Oliver 1946; Márquez 1990; IATTC, unpubl. data). The birds, mainly boobies, roost on the exposed carapaces of the turtles and feed on fish that aggregate beneath them (Pitman 1993).

Health Status

Almost nothing is known about disease or natural mortality rates in olive ridley populations. Cornelius and Robinson (1983) reported that some nesting females in Costa Rica in 1982 had fleshy tumors on the head, neck and front flippers that had not been noticed during the 1970s. A. Chavez (pers. comm.) confirmed cases of fibropapillomas (tumor disease) on ridleys nesting in Costa Rica, but the occurrences were relatively rare and infestations usually minor.

As with all marine turtles, sharks are likely to be major predators of all age classes at sea (Hughes and Richard 1974; Stancyk 1982). Nesting females with missing flippers and damaged shells, presumably due to shark attacks, are common in both the Atlantic (Pritchard 1969b) and the eastern Pacific (Cornelius and Robinson 1983). G. Friedrichsen (pers. comm.) photographed a juvenile olive ridley (estimated carapace length: 30 cm) that had been swallowed whole by a pelagic white-tipped shark (*Carcharinus longimanus*) caught in the eastern Pacific.

During research cruises in the eastern Pacific in the fall of 1989 and 1990, 11 dead olive ridleys were found floating far offshore in widely scattered areas (R. Pitman, pers. obs.). One had been killed after being impaled by a sailfish (*Istiophorus platypterus*) (Frazier et al. 1994) and another had apparently been killed by fishermen after it got caught on a longline hook. The remaining turtles died of unknown but possibly natural causes because nearly all were emaciated and apparently starved to death with no outward signs of trauma. Cornelius (1975) reported on a late-year die-off of marine turtles (mostly greens [*Chelonia mydas*], but also olive ridleys) off Costa Rica and speculated that a toxin such as ciguatera or red tide may have been responsible. It is possible that similarly affected turtles could drift for weeks, possibly months, and be carried far offshore before succumbing.

In addition to the cases cited above, two moribund olive ridleys were captured far offshore that had cataracts in both eyes and may have been starving due to blindness (R. Pitman, pers. obs.), although blindness does not necessarily imply death for this species (Mora and Robinson 1982).

H. Threats

This section presents a brief overview of threats to olive ridley turtles in the Pacific basin, followed by summaries of major threats in each U.S.-affiliated area. A third section then presents more detailed information specific to each area where this species occurs.

"Threats" to sea turtles are broadly defined as any factor that jeopardizes the survival of turtles or impedes the recovery of their populations. Twenty-six threats have been identified, 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 area was evaluated separately based on information received from the Recovery Team and Technical Advisors. Table 1 lists the 15 threats in the marine environment and ranks their significance. Definitions of the threats are provided in subsequent text.

<u>Pacific Synopsis</u>

Lack of knowledge concerning the abundance and distribution of olive ridley turtles in the northeastern Pacific constitutes a threat, particularly since important foraging grounds have not been identified. Forage areas most likely exist along the coast of Baja California and southern California, however, these vital areas cannot be given adequate protection until they have been identified. The breeding population origins and migratory habits of the olive ridley turtles frequenting waters off the west coast of the United States are unknown. Threats to migrating turtles are therefore also unknown. This information is important to determining their status and necessary for effective management.

<u>Regional Summaries</u>

U.S. West Coast

Primary turtle threats: **incidental take in fisheries**
boat collisions

Olive ridleys have occasionally been killed by gillnets and boat impacts as well as cold-stunning in Oregon and Washington.

Hawaii

Primary turtle threats: incidental take in fisheries

While rare in Hawaii, olive ridleys have occasionally been killed by commercial fishing vessels. The entanglement of juveniles and adults in marine debris around the Hawaiian islands is reported from Kailua-Kona (Hawaii). Pukoo (Molokai), Hana (Maui), and Oahu (Balazs 1985).

American Samoa

Primary turtle threats: none

Guam

Primary turtle threats: none

Republic of Palau

Primary turtle threats: none

Commonwealth of the Northern Mariana Islands (CNMI)

Primary turtle threats: none

Republic of the Marshall Islands (RMI)

Primary turtle threats: none

Federated States of Micronesia (FSM)

Primary turtle threats: none

TABLE 1. Threat checklist for olive ridley sea turtles in the Eastern and central 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.
Marine Environment										
12	Directed take	-	-	-	-	-	-	-	-	-
13	Natural disasters	3	-	-	-	-	-	-	-	-
14	Disease/parasites	-	-	-	-	-	-	-	-	-
15	Algae/Seagrass/reef degradation	-	-	-	-	-	-	-	-	-
16	Environmental Contaminants	-	-	-	-	-	-	-	-	-
17	Debris (entangle/ingest)	3	3	-	-	-	-	-	-	-
18	Fisheries (incidental take)									
	-domestic waters	3	2	-	-	-	-	-	-	-
	-international	2	2	-	-	-	-	-	-	-
19	Predation	-	-	-	-	-	-	-	-	-
20	Boat collisions	2	-	-	-	-	-	-	-	-
21	Marina/dock development	-	-	-	-	-	-	-	-	-
22	Dredging	-	-	-	-	-	-	-	-	-
23	Dynamite “fishing”	-	-	-	-	-	-	-	-	-
24	Oil exploration/development	-	-	-	-	-	-	-	-	-
25	Power plant entrapment	-	-	-	-	-	-	-	-	-
26	Construction blasting	-	-	-	-	-	-	-	-	-

[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 (#12-26) are included in this table.

General Threat Information

This section provides the supportive information used to rank the turtle threats listed in Table 1. Each threat is defined and then evaluated separately for each of the eight U.S.-affiliated island groups. The first 11 threats pertain to the turtle's nesting environment, the latter 15 to the marine environment.

Nesting Environment

While no olive ridleys 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 1.1.1.1)

2. Increased Human Presence

Human populations are growing rapidly in many areas of the insular Pacific and this expansion is exerting increasing pressure on limited island resources. Threats to sea turtles include increased recreational and commercial use of nesting beaches, the loss of nesting habitat to human activities (e.g., pig pens on beaches), beach camping and fires, an increase in litter and other refuse, and the general harassment of turtles. 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 on most Pacific islands 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. (see Recovery - Section 1.1.5.2, 1.2.1)

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 - Section 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 - Sections 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. (see Recovery - Section 2.1)

There is no directed take of olive ridleys in U.S. waters.

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. Storms can alter current patterns and blow migrating turtles off course into cold water. Unseasonal warm water incursions from subtropical regions into the northeastern Pacific, known as "El Niño" events, may cause olive ridleys to migrate north where they "cold stun" once they encounter colder water. El Niño events can also cause reduced food production for some turtle species which can reduce growth and fecundity. (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. Contact with cold water currents in the northeastern Pacific may cause cold-stunning and make turtles more susceptible to disease. Stranded individuals have been found along the U.S. coast in an emaciated condition (Joe Cordaro, NMFS, pers. comm.)

15. Algae, Seagrass, and Reef Degradation

Most sea turtle species depend upon sea grass and/or coral reef habitats for food and refuge. The destruction or degradation of these habitats is a widespread and serious threat to the recovery of depleted sea turtle stocks. The general degradation of these habitats can be affected by eutrophication, sedimentation, chemical poisoning, collecting/gleaning, trampling (fishermen, skin and SCUBA divers), anchoring, etc. (see Recovery - Section 2.2)

16. 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 U.S., particularly near the populated coastal areas of southern California. Declining productivity of benthic communities can negatively impact the olive ridley turtles that depend on these communities for nutrition. (see Recovery - Section 2.2)

17. Debris (Entanglement and Ingestion)

The entanglement in and ingestion of persistent marine debris threatens the survival of olive ridley 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; they may lose a limb or attract predators with their struggling. Turtles will also ingest debris such as plastic bags, plastic sheets, plastic six-pack rings, tar balls, styrofoam, and other refuse. 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)

18. Fisheries (Incidental Take)

Turtles are accidentally taken in several commercial and recreational fisheries. These include bottom trawls commonly used by shrimp vessels in the Gulf of California, gillnets, traps, pound nets haul seines and beach seines commonly used in inshore and coastal waters of Baja California. In addition, trawls, purse seines, hook and line, driftnets, bottom and surface longlines may kill an as yet unknown number of turtles in different areas of the eastern Pacific. IATTC (unpublished data) reported turtles - mostly unidentified but probably olive ridleys or greens - feeding directly off bait (usually shark or dorado) used by tuna fishermen. Olive ridleys comprised 18% of the annual take of all species of sea turtles by the Hawaiian-based longline fishery observed from 1990-1994 (NMFS 1995). The predicted annual take of olive ridleys by this fishery is 152 turtles. Although most are released alive, the level of post-release mortality remains unknown. (see Recovery - Section 2.1.4)

19. Predation

Large coastal and pelagic sharks and killer whales are common in the northeastern Pacific and pose a potential threat to adults and juvenile turtles.

On two occasions in 1992, groups of killer whales were observed feeding on an olive ridley off the coast of Mexico (Esquivel et al. 1993).

20. 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 due to collisions and harassment. (see Recovery - Section 2.1.4, 2.1.5, 2.1.7)

21. Marina and Dock Development

The development of marinas and private or commercial docks in inshore waters can negatively impact turtles through destruction or degradation of foraging habitat. This type of development also leads to increased boat traffic resulting in collision-related injury and mortality of turtles. Fueling facilities at marinas can result in discharge of oil and gas into sensitive estuarine habitats. There is increasing demand to install marinas and docks and develop inland coastal areas where turtles are known or are likely to exist in Baja California and southern California. (see Recovery - Sections 1.2.1, 2.2)

22. Dredging

Active dredging machinery (especially hopper dredges) may injure or kill sea turtles, and channelization may alter natural current patterns and sediment transportation. Coral reef and sea grass ecosystems may be excavated and lost, and suspended materials may smother adjacent coral and seagrass communities. (see Recovery - Section 2.2)

23. Dynamite “Fishing”

The use of explosives to stun or kill fish destroys coral, degrading or eliminating foraging habitat and refugia for all sea turtle species (except the leatherback) as well as killing turtles directly. (see Recovery - Section 2.2)

24. 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. (see Recovery - Section 2.2)

25. Power Plant Entrapment

The entrainment and entrapment of juvenile and sub-adult turtles in the saltwater cooling intake systems of coastal power plants have been documented in southern California at San Diego Gas & Electric (SDG&E) plant at Carslbad, as well as the Southern California Edison Nuclear Generating Station at San Onofre (Kent Miles, SDG&E, pers. comm., Joe Cordaro, pers. comm.). Some of these turtles are released unharmed.

26. Construction Blasting

Blasting can injure or kill sea turtles in the immediate area. The use of dynamite to construct or maintain harbors, break up rock formations or improve nearshore access can decimate sea turtle habitat. Anchoring and related activities employed in support of the blasting can also degrade reefs and other benthic communities that support sea turtles. Some types of dynamiting have minimal impact to marine life, such as placing explosive in pre-drilled holes (drilling and shooting) prior to detonation. This is the standard practice to secure armor rock. (see Recovery - Section 2.2)

I. Conservation Accomplishments

The olive ridley is classified as Endangered according to the International Union for Conservation of Nature and Natural Resources (IUCN) Red Data Book (Groombridge 1982), and is listed in Appendix I of CITES. According to the Code of Federal Regulations (50 CFR 17.11), under the ESA nesting populations of olive ridleys along the Pacific coast of Mexico are protected as Endangered and all others are listed as Threatened.

Until 1959 the harvest of olive ridleys in Mexico was primarily for local consumption by local coast-dwelling peoples which included the Seris (from Sonora), the Huaves (from Sinaloa) and the Pomaros (from Michoacan). After 1959 a commercial market primarily for meat and leather was established and thus increased the need for regulatory control of the harvest. Up until this increase in commercial use, fisheries' regulations forbade the harvest of eggs (est. 1927) and established a legal season for the harvest of turtles (est. 1929). After 1960, protection programs and research camps were established on the nesting beaches, and by 1968 a franchise system was established to further regulate olive ridley harvests. The franchise system turned over responsibility for the harvest of turtles to fisheries' cooperatives, who were responsible for monitoring turtle harvest. Olive ridleys subsequently represented 90% of all turtles harvested and 5% of the entire fishery production for Mexico. By 1986, declines in olive ridley nesting populations, and the apparent lack of control by the cooperatives forced the government of Mexico to establish 17 reserve areas for the protection of sea turtles. These areas included the primary nesting beaches for the olive ridley including Ceuta and El Verde in Sinaloa, Mismaloya, Teopa and Cuitzmala in Jalisco; Maruata, Colola and Mexiquillo in Michoacan; Piedra de Tlacoyunque and Tierra Colorada in Guerrero; Chacahua and Escobilla in Oaxaca and Puerto Arista in Chiapas. Establishment of these reserves and the subsequent stationing of military guards at these beaches reduced the harvest of olive ridleys. Finally in 1990, a total prohibition on sea turtle harvest and the additional establishment of protection camps has further reduced the take of olive ridleys in Mexico.

II. RECOVERY

A. Recovery Objectives

Goal: The recovery goal is to delist the species.

Recovery Criteria: To consider delisting all of the following recovery 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) Foraging populations are statistically significantly increasing at several key foraging grounds within each stock region.

3) All females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 10 years.

4) A management plan based on maintaining sustained populations for turtles is in effect.

5) International agreements are in place to protect shared stocks.

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. 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 olive ridleys in the U.S. Pacific, we support the efforts of Mexico and Central American nations with nesting grounds to preserve their olive ridley nesting populations. The following tasks may be used as guidelines to enhance the reproductive ability of sea turtle populations at the 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. Where egg harvests are still important to the local culture, egg harvests may be managed on *arribadas*. (Also see Section 4)

1.1.1.2 Increase enforcement of 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 dogs 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. However, 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 for 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 olive ridley 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 analyses also have a forensic application that can 1) support law enforcement efforts to identify the source of illegal sea turtle products (eggs and meat) (see Section 2.1.1.2) and 2) identify originating stock of confiscated or stranded live animals for rehabilitation purposes (see Section 3.3).

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 olive ridley 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.

2.1.1 Eliminate directed take of turtles.

Direct take of turtles was identified as a severe 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. (Also see Section 4)

2.1.1.2 Increase the law-enforcement efforts to reduce illegal exploitation.

One of the major threats identified for turtle populations in the Pacific was the illegal harvest of turtles, primarily for turtle leather export, 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. Trade in sea turtle products and other curio must also be restricted.

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 olive ridley 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 olive ridley 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 olive ridley, even less is understood about distribution of foraging adult and juvenile populations. Quantitative surveys of foraging areas to determine olive ridley abundance, and to identify essential habitat is of significant importance for restoration of olive ridley populations.

2.1.2.2 Determine adult migration routes and internesting movements.

Like all species of sea turtle, with the possible exception of the Flatback turtle, *Natator depressus)*, olive ridleys migrate from foraging grounds to nesting beaches. Though we do have some data on their movements, indicating seasonal north south migrations or at sea migrations between a series of feeding areas, their movements need further clarification. 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 olive ridleys follow between nesting and foraging areas. Satellite telemetry studies of both males and females are needed.

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. 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 olive ridley 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 olive ridleys. 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 sea turtles ingest persistent debris.

Quantification of the extent to which sea turtles 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 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 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 with mitigating the problem.

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

For some areas, incidental take in fisheries has been identified as a severe threat. These mortalities are associated with international fleets operating on the high seas and U.S. tuna purse seine fisheries (minimal). 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 fishermen 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. Implementation of mortality reduction activities includes the use of Turtle Excluder Devices (TED) in shrimp trawler fisheries.

2.1.5 Eliminate the harassment of turtles at sea.

Activities such as “petting” turtles and chasing them while snorkeling and scuba diving, water skiing, jet skis, vessel traffic, and vessel anchoring may disturb or displace turtles. These factors should be regulated or controlled to eliminate negative impacts, especially in sensitive and high density foraging and resting areas.

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.

2.1.7 Maintain 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 an 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. 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.

Olive ridleys inhabit a variety of marine habitats, although we are most familiar with their coastal habitat. Increased human presence in this and other sea turtle habitats have contributed to degradation, primarily by coastal construction, increased recreational and fisheries use, and increased industrialization. Habitat loss and degradation must be prevented or slowed.

2.2.1 Identify important marine habitats.

These areas may include hatchling (pelagic algal mats), juvenile and adult foraging areas and migratory range for all age classes. (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 (*Sargassum* beds, coral reefs and sponge habitats) need to be protected to ensure long-term 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 Identify other threats to marine habitat and take appropriate actions.

Such threats to sea turtle habitats that do not fit in the previous sections or new threats must be considered and addressed. Such threats may include commercial and recreational illegal takes of coral and “live rock” for aquaria, as well as take of tropical fish for aquaria. Chemicals used to capture the fish may indirectly affect reefs.

3 ENSURE PROPER CARE IN CAPTIVITY.

Depending on the scale of such activities such captivity can be harmful to the wild population due to excess take from the wild, or from the potential introduction of exotic diseases or unfit genetic stocks to the wild population. Captive care should be carefully regulated to minimize such problems, and all release programs should rigorously monitor the status of released turtles to ensure their proper integration into the wild. It should be noted that to be deemed successful, captive-reared turtles that have been released to the wild should be shown not only to survive in the wild but should also successfully reproduce. If released turtles do not reproduce, such populations will never be self sustaining.

3.1 Develop standards for the care and maintenance of sea turtles, including diet, water quality, tank size, and treatment of injury and disease.

Standards should be developed by NMFS or other appropriate agencies. Once developed, these criteria should be published and set as requirements for any sea turtle holding facility. Facilities that comply with the criteria will receive permits to hold turtles and be inspected for compliance. A manual for diagnosis and treatment of sea turtle diseases should be compiled, published and distributed to holding facilities.

3.2 Establish a catalog of all captive sea turtles to enhance use for research and education.

The FWS and NMFS should establish a catalog of turtles at all known facilities and include basic biological data and genetic origin.

3.3 Designate rehabilitation facilities.

FWS, NMFS and other appropriate agencies should designate these facilities based on the above criteria. Designation should be based on availability of appropriate veterinary personnel, compliance with standards of care and annual inspections. Recommendations should be made on when and where hatchlings or adults should be released.

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 olive ridleys 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).

4.2 Encourage ratification of the 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 which support olive ridleys.

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 olive ridley 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
COE	=	U.S. Army Corp of Engineers
DOC	=	U.S. Department of Commerce
DOI	=	U.S. Department of Interior
DOS	=	U.S. Department 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
NA	=	Not applicable
NMFS	=	National Marine Fisheries Service
RMI	=	Republic of the Marshall Islands

IMPLEMENTATION SCHEDULE/U.S. PACIFIC Olive Ridley (*Lepidocheyls olivacea*)										
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	(2)	Continuing	FWS, NMFS, DOS (No documented nests under U.S. jurisdiction)						Provide support for international information exchange forum
	1.1.1.2 Law enforcement-prevent illegal exploitation & harassment	(2)	Continuing	FWS, US Customs, DOS, NMFS						Encourage Mexico and Central American countries to support this task
1.1 Protect & manage turtles on nesting beaches (*cont.*)	1.1.2 Ensure coastal construction activities do not disrupt nesting & hatching activities	(3)	Continuing	FWS, DOS, NMFS						Encourage Mexico and Central American countries to support this task
	1.1.3 Reduce nest predation by domestic & feral animals	(3)	Continuing	FWS, DOS						Encourage Mexico and Central American countries to support this task

[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 Olive Ridley (*Lepidocheyls olivacea*)										
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						Encourage Mexico and Central American countries to support this task
	1.1.4.2 Implement, enforce, evaluate lighting regulations or other lighting control measures	(3)	Continuing							Encourage Mexico and Central American countries to support this task
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	FWS, DOS, NMFS						Encourage Mexico and Central American countries to support this task
	1.1.5.2 Evaluate nest success, implement nest-protection measures	(1)	Continuing	FWS, DOS						Encourage Mexico and Central American countries to support this task

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IMPLEMENTATION SCHEDULE/U.S. PACIFIC Olive Ridley (*Lepidocheyls olivacea*)										
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 Define stock boundaries	1	3 years	NMFS, FWS		50	50	50		Includes Tasks 1.1.5.3.1-1.1.5.3.3
	1.1.5.3.1 Identify stock type for major nesting beach areas	(1)	3 years	NMFS, FWS, DOS						
	1.1.5.3.2 Determine nesting beach origins-juvenile & subadult populations	1	3 years	FWS, NMFS, DOS						
	1.1.5.3.3 Determine genetic relationship among populations	1	3 years	FWS, NMFS						
1.2 Protect & manage nesting habitat	1.2.1. Prevent degradation due to erosion-control measures, jetties & breakwaters	(3)	Continuing	FWS, DOS, NMFS						Encourage Mexico and Central American countries to support this task
	1.2.2 Eliminate sand, coral rubble removal & mining practices	(3)	Continuing							Encourage Mexico and Central American countries to support this task

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IMPLEMENTATION SCHEDULE/U.S. PACIFIC Olive Ridley (*Lepidocheyls olivacea*)										
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						Encourage Mexico and Central American countries to support this task
	1.2.4 Ensure replenishment projects maintain quality habitat	(3)	Continuing	.						Encourage Mexico and Central American countries to support this task
	1.2.5 Implement non-mechanical beach cleaning alternatives	NA	NA							
	1.2.6 Prevent vehicular driving on nesting beaches	(3)	Continuing							Encourage Mexico and Central American countries to support this task

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IMPLEMENTATION SCHEDULE/U.S. PACIFIC Olive Ridley (*Lepidocheyls olivacea*)										
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	5 years	NMFS, U.S. West Coast	15	15	15	15	15	
	2.1.1.2 Increase enforcement reduce exploitation	1	Continuing	NMFS, USCG, DOS						Encourage Mexico and Central American countries to support this task
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	50	50	50	50	Support and work with Mexico and Cenral American countries to implement this task
	2.1.2.2 Determine adult migration routes, internesting habitats	2	3 years							Support and work with Mexico and Cenral American countries to implement this task

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IMPLEMENTATION SCHEDULE/U.S. PACIFIC Olive Ridley (*Lepidocheyls olivacea*)										
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 *(cont.)* **2.1.2** Determine distribution, abundance, status (*cont.*)	2.1.2.3 Determine growth rates, survivorship, age sexual maturity	1	10 years	NMFS, FWS	50	50	50	50	50	Encourage and work with Mexico and Central American countries to implement this task
	2.1.2.4 Identify current threats adults, juveniles on foraging grounds	1	Continuing							Encourage and work with Mexico and Central American countries to implement this task
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	2	5 years	NMFS, EPA,	50	50	50	50	50	
	2.1.3.2 Evaluate effects ingestion persistent debris	2	3 years	NMFS, FWS			100	100	100	
	2.1.3.3 Reduce, eliminate persistent debris	2	Continuing	NMFS, EPA, USCG						Encourage Mexico and Central American countries to support this task

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IMPLEMENTATION SCHEDULE/U.S. PACIFIC Olive Ridley (*Lepidocheyls olivacea*)										
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 (*cont.*)	2.1.4 Monitor, reduce incidental mortality in commercial, recreational fisheries	1	Continuing	NMFS, U.S. West Coast, Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unincorp. Territories	20	20	20	20	20	
	2.1.5 Eliminate harassment of turtles at sea	2	NA							
	2.1.6 Study the impact of diseases on turtles	3	3 years	NMFS, U.S. West Coast, Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unincorp. Territories, FWS (as appropriate to beach habitat)		40	40	40		
	2.1.7 Maintain carcass stranding network	2	Continuing	NMFS, FWS	5	5	5	5	5	All sea turtle species

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IMPLEMENTATION SCHEDULE/U.S. PACIFIC Olive Ridley (*Lepidocheyls olivacea*)										
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 (*cont.*)	2.1.8 Centralize tagging program and tag-series records	2	Continuing	NMFS, FWS	60	60	60	60	60	Encourage Mexico & Central American countries to participate. All sea turtle species included.
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						Coordinate with Tasks 2.1.2.1. & 2.1.2.2
	2.2.2 Ensure long-term protection	1	Continuing							Encourage Mexico and Central American countries to participate.
	2.2.3 Identify other threats, take action	2	Continuing	NMFS, EPA, USCG						Encourage Mexico and Central American countries to participate. All sea turtle species
3 Ensure proper care in captivity	3.1 Develop captive standards	3	2 year	NMFS, FWS		35	15			

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IMPLEMENTATION SCHEDULE/U.S. PACIFIC Olive Ridley (*Lepidocheyls olivacea*)										
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 (*cont.*)	3.2 Catalog captive turtles for research, education	3	2 year	NMFS, FWS		10	10			
	3.3 Designate rehab facilities	3	1 year					25		
4 International cooperation	4.1 Support agreements, conventions, protect in foreign water	1	Continuing	FWS, NMFS, DOS, DOI, DOC	100	100	100	100	100	Includes all turtle species and tasks 5.2, 5.3. (1 FTE and travel)
	4.2 CITES membership, compliance	1	Continuing							
	4.3 Develop new agreements to protect in foreign waters	1	Continuing	NMFS, DOS, DOI, DOC						
	4.4 Display information at airports	2	5 years	NMFS, FWS, U.S.West Coast Hawaii, American Samoa, Guam, Palau, CNMI, RMI, FSM, Unincorp. Territories	15	15	15	15	15	Includes all sea turtle species

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