OLIVE RIDLEY SEA TURTLE
(*LEPIDOCHELYS OLIVACEA*)

5-YEAR REVIEW:
SUMMARY AND EVALUATION

NATIONAL MARINE FISHERIES SERVICE
OFFICE OF PROTECTED RESOURCES
SILVER SPRING, MARYLAND
AND
U.S. FISH AND WILDLIFE SERVICE
SOUTHEAST REGION
JACKSONVILLE ECOLOGICAL SERVICES FIELD OFFICE
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U.S. FISH AND WILDLIFE SERVICE

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1.0 GENERAL INFORMATION

1.1 Reviewers

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1.2. Methodology Used to Complete the Review

Dr. Pamela Plotkin was contracted by the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) (collectively referred to as the Services) to gather and synthesize information regarding the status of the olive ridley sea turtle. This review was subsequently compiled by a team of biologists from NMFS' Headquarters Office and the FWS' Southeast Regional Office and the Jacksonville Ecological Services Field Office. Our sources include the final rule listing this species under the Act; the recovery plan; peer reviewed scientific publications; unpublished field observations by the Service, State, and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists. The draft 5-year review was sent out for peer review to six academic professionals with expertise on the species and its habitats. Peer reviewers were provided guidance to follow during the review process. Comments received from peer reviewers were incorporated into the 5-year review document (see Appendix). The public notice for this review was published on April 21, 2005, with a 90 day comment period (70 FR 20734). A few comments were received and incorporated as appropriate into the 5-year review.

1.3 Background

1.3.1 FR notice citation announcing initiation of this review

April 21, 2005 (70 FR 20734)

1.3.2 Listing history

Original Listing
FR notice: 43 FR 32800
Date listed: July 28, 1978
Entity listed: 2 populations or groups of populations
Endangered Population - breeding colony populations on Pacific coast of Mexico
Threatened Populations - wherever found except where listed as Endangered
Classification: Endangered and Threatened

1.3.3 Associated rulemakings

Regulations Consolidation Final Rule: 64 FR 14052, March 23, 1999. The purpose of this rule was to make the regulations regarding implementation of the Endangered Species Act of 1973 (ESA) by NMFS for marine species more concise, better organized, and therefore easier for the public to use.

1.3.4 Review history

Plotkin, P.T. (Editor). 1995. National Marine Fisheries Service and U.S. Fish and Wildlife Service Status Reviews for Sea Turtles Listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland. 139 pages.
Conclusion: Retain the listing as Endangered for the Mexico breeding population and the Threatened listing wherever they occur. [Note: the status review concluded that the olive ridley in the western Atlantic should be listed as Endangered. However, populations in the western Atlantic were not listed separately from the global listing. A Distinct Population Segment (DPS) analysis for the western Atlantic was not conducted as a result of the 1995 status review.]

Mager, A.M., Jr. 1985. Five-year status reviews of sea turtles listed under the Endangered Species Act of 1973. U.S. Department of Commerce, NOAA, National Marine Fisheries Service, St. Petersburg, Florida. 90 pages.
Conclusion: Inadequate information available to assess whether the status had changed since the initial listing as Threatened wherever it occurs (1978).

FWS also conducted 5-year reviews for the olive ridley in 1983 (48 FR 55100) and in 1991 (56 FR 56882). In these reviews, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertain to the individual species. The notices stated that FWS was seeking any new or additional information reflecting the necessity of a change in the status of the species under review. The notices indicated that if significant data were available warranting a change in a species' classification, the Service would propose a rule to modify the species' status. No change in the olive ridley's listing classification was recommended from these 5-year reviews.

1.3.5 Species' recovery priority number at start of review

National Marine Fisheries Service = 5 (this represents a moderate magnitude of threat, a high recovery potential, and the presence of conflict with economic activities).
U.S. Fish and Wildlife Service (48 FR 43098) = 8C (this represents a full species with a moderate degree of threat, a high recovery potential, and the potential for conflict with construction or other development projects or other forms of economic activity).

1.3.6 Recovery plan

Name of plan: Recovery Plan for U.S. Pacific Populations of the Olive Ridley Turtle (*Lepidochelys olivacea*)
Date issued: January 12, 1998
Dates of previous plans: Original plan date - September 19, 1984

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) Policy

2.1.1 Is the species under review a vertebrate?

Yes.

2.1.2 Is the species under review listed as a DPS?

No, it is listed as two populations (pre-1978 when DPS language was added to ESA).

2.1.3 Is there relevant new information for this species regarding the application of the DPS policy?

Yes. Although the Services believe the current population listing is valid based on the best available information, we have preliminary information that indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the olive ridley. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The Services have not yet fully assembled or analyzed this new information; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins. To determine the application of the DPS policy to the olive ridley, the Services intend to fully assemble and analyze this new information in accordance with the DPS policy. See Section 2.3 for new information since the last 5-year review and Section 4.0 for additional information.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

No. The "Recovery Plan for U.S. Pacific Populations of the Olive Ridley Turtle (*Lepidochelys olivacea*)" was signed in 1998, and while not all of the recovery criteria strictly adhere to all elements of the 2004 NMFS Interim Recovery Planning Guidance, they are still a viable measure of the species status in the Pacific. See Section 4.0 for additional information.

The recovery criteria are identified below, along with several key accomplishments:

To consider delisting, all of the following criteria must be met:

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
   - Home ranges have been identified and population identification of turtles caught as fisheries bycatch have been conducted using DNA analysis.

2. Foraging populations are statistically significantly increasing at several key foraging grounds within each stock region.
   - At-sea estimates of density and abundance of the olive ridley were determined by shipboard line-transects conducted along the Mexico and Central American coasts in 1992, 1998, 1999, 2000, 2003, and 2006. A weighted average of the yearly estimates was 1.39 million, which is consistent with the increases seen on the eastern Pacific nesting beaches over the last decade.
   - Population abundance has been surveyed and data on size, diet, and distribution of olive ridleys has been collected in the eastern tropical Pacific during NOAA research cruises.
   - Efforts to attain this goal are ongoing.

3. All females estimated to nest annually (FENA) at "source beaches" are either stable or increasing over 10 years.
   - Based on the number of olive ridleys nesting on the Pacific coast of Mexico, the Endangered population appears to be stable at some locations (e.g., Mismaloya and Moro Ayuta) and increasing at one location (La Escobilla). A comparison of the current abundance of the Mexico nesting assemblages with the former abundance at each of the large arribada beaches indicates that the populations experienced steep declines that have not yet been overcome. Nesting trends in Mexico at non-arribada beaches are stable or increasing in recent years.

4. A management plan based on maintaining sustained populations for turtles is in effect.
   - Not yet completed.

5. International agreements are in place to protect shared stocks.
   - The U.S. is a party to the Inter-American Convention for the Protection and Conservation of Sea Turtles.

2.3 Updated Information and Current Species Status

The following section is not meant to be an exhaustive review of what is known about the olive ridley sea turtle. Rather, the section presents new information since the last 5-year review that may indicate a change in species status or change in the magnitude or imminence of threats. The section is divided into two subsections (A and B) based on the current listings -- Subsection A refers to the 'Endangered' breeding colony populations on the Pacific coast of Mexico and Subsection B refers to the 'Threatened' populations. As such, there is some repetition of information in the two subsections because the information either pertains to both listings or the origin of the affected individual turtles cannot be identified to a listed population due to in-water mixing of populations.

SUBSECTION A: ENDANGERED POPULATION

A.2.3.1 Biology and Habitat

A.2.3.1.1 New information on the species' biology and life history:

This 5-year review provides a summary of our current knowledge of the two mating systems: (1) solitary nesting and (2) synchronized nesting, known as the arribada. Recent studies provide support for taking such an approach when reviewing the status of the olive ridley. First, there are significant life history differences between solitary nesters and arribada nesters (Kalb 1999, Plotkin and Bernardo 2003, Bernardo and Plotkin 2007; see section on demography for details) that can impact population growth. Second, Lopez-Castro and Rocha-Olivares (2005) demonstrated genetic differences between the solitary and arribada nesting populations. Jensen *et al*. (2006) found a significant increase in multiple paternity (i.e., more than one male fertilizing eggs in a clutch) in nests from arribada beaches and attributed population size and the associated increase in male encounter rates as the major factor. These studies demonstrate that solitary and arribada mating systems are distinct from each other. The available life history data, coupled with the genetic data, underscore the need to examine the status of solitary nesting populations independently from arribada nesting populations.

A third mating system may exist. Interestingly, some olive ridleys exhibit a mixed strategy; that is, some females switch between solitary nesting and arribada nesting within a nesting season (Kalb 1999, Bernardo and Plotkin

2007). Unfortunately the underlying basis of the mixed strategy is not understood and its prevalence has not been quantified.

Olive ridleys are best known for their arribada behavior (Carr 1967, Hughes and Richard 1974). Hundreds to tens of thousands of ridleys may emerge synchronously from the ocean in just a few days to nest in close proximity. This remarkable phenomenon has been filmed in many natural history documentaries and is well known among non-scientists, yet our understanding of this behavior remains largely obscure.

Arribadas of the endangered olive ridley population occur at only a few beaches in the eastern Pacific. However the nesting range for the olive ridley extends far beyond these select beaches. Many endangered ridleys nest solitarily on tropical beaches of the Pacific. In the eastern Pacific, arribadas occur annually at several beaches in Mexico, Nicaragua, Costa Rica, and Panama from June through December. During the same time, solitary olive ridleys emerge individually to nest along nearly the entire coastline from Mexico (Table 1) to Colombia (Carr 1967; Pritchard 1969, 1979; R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica Mazatlan, personal communication, 2006).

Table 1. Locations of *Endangered* olive ridley arribada and solitary nesting beaches in the East Pacific and estimates of the arribada size at each site.

Country	**Beach**	**Estimates of Arribada Size**	**References**
Arribada			
Mexico	Mismaloya*	1,000-5,000 nests	R. Briseño, BITMAR, and A. Abreu, Unidad Academica Mazatlan, pers. comms., 2006
Mexico	Tlacoyunque*	500-1,000 nests	R. Briseño, BITMAR, and A. Abreu, Unidad Academica Mazatlan, pers. comms., 2006
Mexico	Chacahua*	10,000-100,000 nests	R. Briseño, BITMAR, and A. Abreu, Unidad Academica Mazatlan, pers. comms., 2006
Mexico	La Escobilla	1,000,000+ nests	Márquez-M. *et al*., 2005
Mexico	Moro Ayuta*	10,000-100,000 nests	R. Briseño, BITMAR, and A. Abreu, Unidad Academica Mazatlan, pers. comms., 2006
Solitary			
Mexico	Entire Pacific coast		R. Briseño, BITMAR, and A. Abreu, Unidad Academica Mazatlan, pers. comms., 2006

* Large arribadas once occurred at these beaches but no longer do (Cliffton *et al*. 1979, Hoeckert *et al*. 1996).

Very little is known about the underlying causes of the different mating systems of olive ridleys. The study of the arribada phenomenon has dominated most aspects of research on this species and comparatively little attention has been given to the solitary nesting strategy. This is reflected in the literature wherein solitary nesting is not mentioned in most review papers (Ehrhart 1982, Reichart 1993, Van Buskirk and Crowder 1994, Miller 1997) despite the fact that its extent was well known and described many years ago by Carr (1967). In contrast, substantial effort has been directed at studying arribada nesters and their offspring (Pritchard 1969; Richard and Hughes 1972; Hughes and Richard 1974; Acuña-M. 1983; Acuña-M. and Castillo 1985; Acuña-Mesén 1988; Cornelius and Robinson 1985, 1986; Cornelius *et al*. 1991; Arauz-Almengor and Mo 1994; Plotkin *et al*. 1995, 1997; and many others).

Recognizing these different mating strategies (solitary, arribada, mixed), and acquiring data on the abundance, status, biology, and ecology of each is critical to managing and recovering the species. Nearly all of the research, population monitoring, and conservation effort has been directed toward the relatively larger arribada nesting populations. Focusing attention on just a few nesting populations is a risky strategy and sea turtle conservation programs need to study and protect both large and small nesting populations within a region (McClenachan *et al*. 2006).

A.2.3.1.2 Abundance, population trends, and demographic features:

<u>(1) Abundance and Population Trends</u>

The olive ridley is the most abundant sea turtle in the world (Pritchard 1997a) and population trends vary among geographic regions as well as within regions.

At-sea estimates of density and abundance of the olive ridley were determined by shipboard line-transects conducted along the Mexico and Central American coasts in 1992, 1998, 1999, 2000, 2003, and 2006 (Eguchi *et al*. in preparation). A weighted average of the yearly estimates was 1.39 million, which is consistent with the increases seen on the eastern Pacific nesting beaches over the last decade (Eguchi *et al*. in preparation).

Population abundance has been assessed and monitored, on the nesting beaches, using the standard survey method for sea turtles (Schroeder and Murphy 1999) where the number of female turtles observed nesting on the beach and/or their tracks left in the sand are counted during some pre-determined time interval and over a standard length of beach. Most olive ridley nesting beach surveys have taken place at arribada beaches where mass emergences in a spatially limited area present challenges to counting turtles directly or counting individual tracks left in the sand. Several methods have been used to estimate the number of turtles nesting during an arribada (Márquez-M. and Van Dissel 1982, Cornelius and Robinson 1985, Gates *et al*. 1996, Valverde and Gates 1999). Clusella *et al*. (2000) compared three of the commonly used methods and found significant differences among the estimates derived. The olive ridley abundance estimates presented herein were derived from multiple methods at the different arribada beaches and in some cases the method used at a specific arribada beach has changed over the years (i.e., Ostional, Costa Rica). This renders comparisons among arribada beaches problematic and discerning population trends over time complicated.

A further complication is the fact that many nesting population estimates from arribada beaches have been calculated as the sum total of all the turtles nesting during arribadas within a given nesting season. An individual olive ridley may nest on the same beach multiple times during a nesting season and thus the sum total of all the turtles or tracks counted during surveys is not directly equivalent to the number of turtles present in any given nesting population.

Olive ridleys commonly nest in successive years (Pritchard 1969, Cornelius 1986, Plotkin 1994), and the behavior may well be the norm for the species. The erratic nesting population trend lines often shown by loggerhead turtle (*Caretta caretta*) or green turtle (*Chelonia mydas*) populations, which rarely nest in successive years, are not shown by olive ridley populations. Overall, olive ridley population trends are easier to detect from a few years of comprehensive nesting beach surveys than for those species with multi-year nesting cycles.

ARRIBADA BEACHES

Historically there were several large arribada nesting populations in Mexico (Table 1). These arribadas occurred at: Mismaloya, Tlacoyunque, Chacahua, La Escobilla, and Moro Ayuta. Many recent published accounts have indicated that some of these nesting populations are now extirpated but this characterization is an overstatement. Although significant population declines have been observed at many of the arribada beaches in Mexico (Cliffton *et al*. 1982), olive ridleys still nest at these beaches and the arribada behavior is still present (i.e., ridleys emerge synchronously) (R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica Mazatlan, personal communication, 2006).

Based on the current number of olive ridleys nesting in Mexico (Table 1), populations appear to be stable, and in one location increasing, but they have not returned to their pre-1970s abundance (R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica Mazatlan, personal communication, 2006). The current abundance of olive ridleys compared with former abundance at each of the large arribada beaches indicates the populations experienced steep declines (Cliffton *et al*. 1982). Based on qualitative information, Cliffton *et al*. (1982) derived a conservative estimate of 10 million adults prior to 1950. By 1969, after years of adult harvest, the estimate was just over one million (Cliffton *et al.* 1982). Abundance estimates in recent years indicate that the Mismaloya and Moro Ayuta nesting populations appear to be stable and the nesting population at La Escobilla is increasing (R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica

Mazatlan, personal communication, 2006). Olive ridley nesting at La Escobilla rebounded from approximately 50,000 nests in 1988 to over 700,000 nests in 1994 (Márquez-M. *et al*. 1996) and more than a million nests by 2000 (Márquez-M. *et al*. 2005).

NON-ARRIBADA BEACHES

In Mexico, olive ridleys nest more or less along the entire coastline, but the most concentrated area of nesting lies between the states of Sinaloa in the north to Chiapas in the south (R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica Mazatlan, personal communication, 2006). Elsewhere nesting is considered sporadic with the exception of Baja California Sur, where a small, solitary nesting population has been reported (Lopez-Castro and Rocha-Olivares 2005). Nest density varies along Mexico's coast: density is highest adjacent to arribada beaches and declines with increasing distance from arribada beaches (R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica Mazatlan, personal communication, 2006). Nesting population trends for most beaches indicate they are stable or increasing. Stable beaches include: El Verde, Sinaloa, and Moro Ayuta, Oaxaca. Increasing trends are reported for La Gloria, Jalisco; Colola, Michoacan; Mexiquillo, Michoacan; and Maruata, Michoacan (R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica Mazatlan, personal communication, 2006).

(2) Demographic Features

Little is known of the demography of this species. This includes all of the classical components of an organism's demography: age and sex distribution, growth, birth rates, death rates, immigration, and emigration. Spatial distribution, another demographic component, is reviewed below in section 2.3.1.5.

Maternal size, clutch size, egg size, and offspring size vary among and within olive ridley populations (Carr 1952, Pritchard 1969, Frazier 1982, Reichart 1993, VanBuskirk and Crowder 1994); however, these studies do not differentiate between solitary nesters and arribada nesters and their offspring. Differences between solitary nesters and arribada nesters do exist and these differences have the potential to impact population dynamics (Bernardo and Plotkin 2007). In general, individual olive ridleys may nest one, two, or three times per season but on average two clutches are produced annually, with approximately 100-110 eggs per clutch (Pritchard and Plotkin 1995). Solitary nesters oviposit on 14-day cycles whereas arribada nesters oviposit approximately every 28 days (Pritchard 1969, Kalb and Owens 1994, Kalb 1999). Kalb (1999) also found that within a nesting season solitary nesters use multiple beaches for oviposition but arribada nesters display nest site fidelity. However, Shanker *et al*. (2003b) indicates some arribada nesters nest at different arribada beaches.

Plotkin and Bernardo (2003) examined life history characteristics of olive ridleys nesting at Nancite Beach, Costa Rica, during an arribada, as well as females nesting solitarily outside of the arribada to ascertain whether there were any significant differences between them. There were no differences between these two groups in female size, egg size, or within-clutch variability in egg size, but arribada nesters did produce significantly larger clutches (i.e., more eggs). Plotkin and Bernardo (2003) suggested that the smaller clutch sizes observed for solitary nesters might be due to energetic costs associated with undertaking internesting movements among multiple beaches, a behavior that is not characteristic of arribada nesters.

Nest success varies in time and space. At some beaches olive ridley egg survivorship is quite high, while at others it is low. It is widely recognized that survivorship is low on high density arribada nesting beaches because of density-dependent mortality (Cornelius *et al*. 1991). The sheer number of turtles (1,000-500,000 turtles) nesting in spatially limited areas results in density-dependent egg mortality during a single arribada. Moreover, turtles return approximately every month during a discrete nesting season (3-6 months) and nests that remained intact during the previous month are again at risk when new waves of turtles crawl ashore. In addition to nest disturbance, the existence of high nest densities over time apparently alters the nutrient composition of sand, as well as the concentration of ammonia in the sand (McPherson and Kibler in press). High ammonia concentrations, and/or high concentrations of fungal and bacterial pathogens, at beaches with high nest densities might also contribute to density-dependent nest loss, but these issues have not been empirically explored. On solitary nesting beaches, where density-dependent mortality is not a factor, hatching rates are significantly higher (Castro 1986, Gaos *et al*. 2006). Predation and/or human egg collection occurs at most olive ridley nesting beaches (solitary and arribada) and these also impact hatching rates.

Post-hatching survivorship is unknown and there is no information available on recruitment rates. Presumably, like other sea turtles, olive ridleys experience high mortality in their early life stages. Juveniles are believed to occur in similar habitats as the adults (i.e., pelagic waters) where they forage on gelatinous prey such as jellyfish, salps, and tunicates (Kopitsky *et al*. 2005).

Female olive ridleys attain sexual maturity at an age similar to its congener, the Kemp's ridley (*Lepidochelys kempii*). Based on samples collected in the north-central Pacific Ocean, Zug *et al*. (2006) recently confirmed this and estimated the median age of sexual maturity for the olive ridley is 13 years with a range of 10 to 18 years.

A.2.3.1.3 Genetics and genetic variation:

Genetic studies have revealed much about the evolution of the olive ridley and have helped clarify the contemporary "genetic landscape" where populations or current unique haplotypes occur (Kichler Holder and Holder 2007). More sophisticated techniques are available now and new questions are being asked to further elucidate genetic patterns among olive ridleys.

Intra-specific phylogeographic differentiation occurs among, as well as within, ocean basins (Bowen *et al*. 1998, Shanker *et al*. 2004, Lopez-Castro and Rocha-Olivares 2005). There have been four main lineages identified: east India (believed to be the ancestral lineage), the Indo-Western Pacific lineage, the Atlantic lineage, and the eastern Pacific lineage (Bowen *et al*. 1998, Shanker *et al*. 2004).

Within these lineages, few in-depth genetic surveys have assessed fine-scale population structure. In the Indian Ocean, Shanker *et al*.'s (2004) thorough sampling detected no population subdivision along 2,000 km of east India coastline. Lopez-Castro and Rocha-Olivares (2005) found genetic differences between the Baja population and nesting populations in Guerrero, Mexico, and Costa Rica, but no significant differences were found between Baja and Oaxaca, Mexico. However, they found genetic diversity in solitary nesting assemblages from the Baja California Peninsula to be significantly lower than arribada nesting populations along the east Pacific coast of Mexico and Costa Rica. They concluded that the genetic composition of the Baja population indicates reproductive isolation and genetic differentiation. They felt that the loss of genetic diversity and the differences in mating strategies distinguish the Baja population from the arribada beaches on the main continent, and recommended that the peninsular population be considered a distinct management unit (Lopez-Castro and Rocha-Olivares 2005).

A recent study (Jensen *et al*. 2006) compared rates of multiple paternity (i.e., more than one male fertilizing a clutch) between the clutches laid by arribada nesters with those laid by solitary nesters in Costa Rica. This study revealed a significantly higher incidence of multiple paternity in the clutches of the arribada nesters, suggesting that the mating systems of arribada and solitary nesters differ. Although more data are needed to fully comprehend the conservation implications of such a finding, these data further underscore the differences between solitary and arribada olive ridleys and the need to distinguish between these two mating systems, particularly in conservation planning exercises.

A.2.3.1.4 Taxonomic classification:

Kingdom: Animalia
Phylum: Chordata
Class: Reptilia
Order: Testudines
Family: Cheloniidae
Genus: *Lepidochelys*
Species: *olivacea*
Common names: Olive ridley sea turtle, Pacific ridley sea turtle

A.2.3.1.5 Spatial distribution:

The nesting distribution of olive ridleys has been presented already in the section on abundance and trends and will not be reiterated in this section. The aquatic distribution of olive ridleys is the focus of this section, with some reference made to nesting beaches when appropriate. Spatial distribution is generally discerned from data collected from mark-recapture studies, incidental capture of turtles in fisheries, and/or satellite tracking studies.

The olive ridley has a circumtropical distribution in the Pacific (Pritchard 1969). They are not known to move between or among ocean basins. Within a region, olive ridleys may move between the oceanic zone (the vast open ocean environment from the surface to the sea floor where water depths are greater than 200 meters) and the neritic zone (the inshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters) (Plotkin *et al*. 1995, Shanker *et al*. 2003a) or just occupy neritic waters (Pritchard 1976, Reichart 1993). However, it is important to note that some data are derived from tag returns of turtles recaptured in coastal fisheries and may present a biased impression of the true distribution of these populations. Recent telemetric data indicate offshore movements well beyond the continental shelf (Georges *et al.* 2007).

In the eastern Pacific, the olive ridley typically occurs in tropical and subtropical waters, as far south as Peru and as far north as California, but occasionally have been documented as far north as Alaska (Hodge and Wing 2000). In this region, olive ridleys are highly migratory and may spend most of their non-breeding life cycle in the oceanic zone (Cornelius and Robinson 1986; Pitman 1991, 1993; Arenas and Hall 1991; Plotkin 1994; Plotkin *et al*. 1994, 1995; Beavers and Cassano 1996). Olive ridleys occupy the neritic zone during the breeding season. Reproductively active males and females migrate toward the coast and aggregate at nearshore breeding grounds located near nesting beaches (Pritchard 1969; Hughes and Richard 1974; Cornelius 1986; Plotkin *et al*. 1991, 1996, 1997; Kalb *et al*. 1995). A significant proportion of the breeding also takes place far from shore (Pitman 1991, Kopitsky *et al*. 2000), and it is possible that some males and females may not migrate to nearshore breeding aggregations at all. Some males appear to remain in oceanic waters, are non-aggregated, and mate opportunistically as they intercept females *en route* to near shore breeding grounds and nesting beaches (Plotkin 1994; Plotkin, *et al*. 1994, 1996; Kopitsky *et al*. 2000).

The post-reproductive migrations of olive ridleys in the eastern Pacific are unique and complex. Their migratory pathways vary annually (Plotkin 1994), there is no spatial and temporal overlap in migratory pathways among groups or cohorts of turtles (Plotkin *et al*. 1994, 1995), and no apparent migration corridors exist. Unlike other marine turtles that migrate from a breeding ground to a single feeding area, where they reside until the next breeding season, olive ridleys are nomadic migrants that swim hundreds to thousands of kilometers over vast oceanic areas (Plotkin 1994; Plotkin *et al*. 1994, 1995; Parker *et al.* 2003).

A.2.3.1.6 Habitat or ecosystem conditions:

There is little information about the condition of habitats and/or ecosystems and their impact on olive ridley populations. Olive ridleys occupy large marine ecosystems and an El Niño, a large natural atmospheric-marine phenomenon in the eastern Pacific Ocean, is probably the most significant ecosystem condition that may impact the survival status of olive ridleys in this region. El Niños alter water temperatures, particularly in the eastern Pacific. The cool, nutrient rich and biologically productive waters characteristic of this region become warmer and less productive during an El Niño. This warming impacts lower trophic levels in the ocean (i.e., planktonic communities) and eventually, the upper trophic levels as well (i.e., nekton). Hill (1995) reported that warming trends in the Pacific, caused by the frequent occurrence of El Niños since 1976, may be responsible for the decline in zooplankton in the California Current and the corresponding decline in higher trophic level vertebrates of this marine ecosystem. The direct impact of El Niños on sea turtles is unknown but they have been associated with low numbers of turtles nesting on Pacific beaches (Limpus and Nicholls 1988, Valverde *et al*. 1998), and they influence migration pathways and habitats used by pelagic olive ridleys (Plotkin 1994). Because olive ridleys in the eastern Pacific are highly vagile, and seemingly adaptable to fluctuating environmental conditions, they possess the ability to shift from an unproductive habitat to one where the waters are biologically productive (Plotkin 1994).

Global warming also has the potential to impact the habitats and ecosystems of olive ridley populations worldwide (Hays *et al*. 2003, Weishampel *et al.* 2004), but specific impacts are difficult to predict. Most accounts have focused on the impact of global warming on incubation temperatures of eggs, which influence the sex ratio of the embryos (Hays *et al*. 2003).

A.2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

The determination to list a species under the ESA is based on the best scientific and commercial data regarding five listing factors (see below). Subsequent 5-year reviews must also make determinations about the listing status based, in part, on these same factors.

A.2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

There are increasing impacts to the nesting and marine environment that affect olive ridley turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Lutcavage *et al*. 1997, Bouchard *et al*. 1998). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to nesting females, and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997; Witherington *et al*. 2003, 2007). These activities have increased in many parts of the olive ridley's range and pose threats to major nesting sites in Central America (Cornelius *et al*. 2007). In addition, coastal development is usually accompanied by artificial lighting. The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1991). In many countries, coastal development and artificial lighting are responsible for substantial hatchling mortality. Although legislation controlling these impacts does exist (Lutcavage *et al*. 1997), a majority of countries do not have regulations in place.

At sea there are numerous potential threats including marine pollution, oil and gas exploration, lost and discarded fishing gear, changes in prey abundance and distribution due to commercial fishing, habitat alteration and destruction caused by fishing gear and practices, agricultural run off, and sewage discharge (Lutcavage *et al*. 1997, Frazier *et al*. 2007). There are no empirical data to determine the impacts of these activities on olive ridley populations.

Although empirical data on the impacts of destruction, modification, and curtailment of the olive ridley's habitat or range are lacking from many areas, habitat loss is highly likely given current human encroachment on coastal habitats. Coastal construction, pollution, and other human-related impacts to the olive ridley's habitat will likely increase as Mexico's population expands and tourism increases, which has the potential to negatively affect the availability of nesting habitat, as well as nesting success.

A.2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

ADULT NESTERS AND EGG HARVEST

Olive ridleys and their eggs have been overutilized worldwide. The history of use and detailed accounts of this use are reviewed by Cornelius *et al*. (2007), Frazier *et al*. (2007), and Campbell (2007a). Use is summarized below by region, with information provided on historical use and/or contemporary use. There are many "scales" of use and the following summary distinguishes commercial use (of all sizes) from personal use. "Personal use" in this report is meant to imply non-commercial use by individuals or families and includes subsistence use as well as non-subsistence use.

The current impact of human use of olive ridley turtles and their eggs on populations is difficult to evaluate because there are many factors that contribute to a population's growth and decline (e.g., incidental take in commercial fisheries); however, Cornelius *et al*. (2007) identify several solitary nesting beaches and arribada beaches where current egg use is causing declines. Recreational, scientific, or educational overutilization has not been reported for olive ridleys.

Large-scale egg use historically occurred at arribada beaches in Mexico, concurrent with the use of adult turtles at these beaches (Cliffton *et al*. 1982). The high level of adult mortality is believed to be the reason why rapid and large nesting population declines occurred in Mexico (Cornelius *et al*. 2007; R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica Mazatlan, personal communication, 2006).

The nationwide ban on harvest of nesting females and eggs has decreased the threat to the Endangered population. The nesting population at La Escobilla, Oaxaca, Mexico, has increased from 50,000 nests in 1988 to more than a million nests in 2000 as a result of the harvest prohibitions and the closure of a nearshore turtle fishery (Cornelius *et al*. 2007). However, illegal egg use is still believed to be widespread. Approximately 300,000-600,000 eggs were seized each year from 1995-1998 (Trinidad and Wilson 2000).

IN-WATER HARVEST

Olive ridleys were overutilized for commercial purposes in two legal turtle fisheries that operated in the eastern Pacific Ocean (Cliffton *et al*. 1982, Green and Ortiz-Crespo 1982, Campbell 2007a). The Mexican turtle fishery caused rapid, large declines at olive ridley arribada beaches in Mexico (Cliffton *et al*. 1982) that were so dramatic they have been widely referred to in the literature as population collapses, crashes, or extinctions. An estimated 75,000 turtles were taken each year over two decades until 1990 when the fishery closed (Aridjis 1990). The fishery closure is generally believed to have resulted in an increase in the population (Márquez-M. *et al*. 1996, Godfrey 1997, Pritchard 1997b), while others caution the interpretation of the data (Ross 1996).

An Ecuadorian turtle fishery also existed during the 1970s and fished several hundreds of thousands of olive ridleys during this time (Green and Ortiz-Crespo 1982). This fishery is also believed to have contributed to the decline in the number of olive ridleys nesting on Mexican arribada beaches. A direct link between Mexico nesting beaches and Ecuadorian waters was established when olive ridleys, tagged while nesting in Mexico, were later captured in the Ecuadorian turtle fishery (Green and Ortiz-Crespo 1982).

The closure of the olive ridley turtle fishery has decreased the threat to the population. However, illegal take of adult turtles still occurs in the region and the impact of this take is unknown. There is evidence that thousands of olive ridleys are still taken each year along the Pacific coast of Mexico (Frazier *et al*. 2007). The Mexican enforcement agency, Procuraduria Federal de Protección al Ambiente (PROFEPA), seized approximately 1.7 million turtle eggs, 1,900 units of turtle leather, and several hundred dead and live whole turtles from 1995-1998 in the State of Oaxaca (species not specified) (Trinidad and Wilson 2000).

A.2.3.2.3 Disease or predation:

Very little is known about disease in olive ridleys and in wild sea turtles in general (George 1997). Nothing is known about the impact of disease on olive ridley abundance. The only disease identified in the literature thus far for olive ridleys is fibropapillomatosis, sometimes associated with a herpes-virus found in sea turtles nearly worldwide (Herbst 1994). The incidence of fibropapillomatosis is not believed to be high in olive ridleys. However, the disease has been observed in olive ridleys nesting in Mexico (Vasconcelos *et al*. 2000), Costa Rica (Herbst 1994, Aguirre *et al.* 1999), and India (Kartik Shanker, Indian Institute of Science, personal communication).

Over 1,000 turtles, of which 99% were olive ridleys, stranded dead within a two-month period on the coast of Ecuador in 1999 (Alava *et al.* 2005). The causes of the strandings are unknown; however, Alava *et al.* (2005) cite epizootic outbreaks as one possibility.

Predation on olive ridleys, their eggs, and offspring occurs on land and in the ocean throughout their range and the relative impacts of this mortality on nesting populations is unknown. On land, adult females fall prey to crocodiles (Ortiz *et al*. 1997), coyotes (Cornelius and Robinson 1982; P. Plotkin, Cornell University, personal observation), and jaguars (Cornelius and Robinson 1982, Kelle *et al.* 2004). In the ocean, sharks, billfish, and whales may prey on adult turtles (Frazier *et al*. 1994, 1995; Pitman and Dutton 2004). Eggs and hatchlings fall prey to numerous mammalian, avian, reptilian, invertebrate, and fungal organisms while on land (Cornelius and Robinson 1982, Eckrich and Owens 1995). In the ocean, fish, sharks, and birds may prey on olive ridley hatchlings.

In summary, disease and predation are believed to be relatively minor threats to the population.

A.2.3.2.4 Inadequacy of existing regulatory mechanisms:

The ESA is the only domestic law that provides direct and holistic protections for the olive ridley. Without the ESA, current domestic legislation is inadequate. Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), NMFS has implemented mandatory measures to reduce incidental take and minimize injury to olive ridleys in domestic longline fisheries operating in the Pacific. These regulations were implemented as a result of ESA section 7 consultations requiring such measures. Section 301 by itself does not require specific measures. However, mandatory bycatch reduction measures can be incorporated into management plans for specific fisheries, as has happened with the U.S. pelagic longline fisheries in the Atlantic and Pacific oceans. Section 316 requires the establishment of a bycatch reduction engineering program to develop "technological devices and other conservation engineering changes designed to minimize bycatch, seabird interactions, bycatch mortality, and post-release mortality in Federally managed fisheries."

Olive ridleys are highly migratory, and largely pelagic. They do not nest on U.S. beaches and many of the factors affecting them occur outside of U.S. jurisdiction. Many foreign countries lack regulations or have inadequate regulations in place to address the wide range of anthropogenic activities that directly injure and kill olive ridleys, disrupt necessary behaviors, and alter terrestrial and marine habitats used by the species. In particular, improved regulations of fisheries that incidentally capture olive ridleys are needed to reduce mortality. Improved fishery observer coverage is also needed to provide more basic information on olive ridley bycatch. Government regulations and community programs need to be initiated or strengthened to address the impacts of turtle hunting and egg poaching. Enforcement efforts are needed to ensure that requirements are adhered to in all sectors. Overall, increased efforts are needed to assist many foreign countries with the enactment and enforcement of national regulations to protect olive ridleys.

The conservation and recovery of the olive ridley also requires multi-lateral cooperation and agreements to ensure their survival. The U.S., Mexico, Costa Rica, Nicaragua, Ecuador, and Peru have entered into the Inter-American Convention for the Protection and Conservation of Sea Turtles (http://www.iacseaturtle.org/iacseaturtle/English/home.asp), the primary agreement affecting the Endangered olive ridley populations. The Convention focuses on the protection of sea turtles and their habitats. It also places importance on the reduction of bycatch in fisheries. It is the only binding multi-national agreement for sea turtles and is open to all countries in North, Central, and South America, and the Caribbean. It currently has 12 signatory countries, including the United States, a signatory party since 1999.

Two other key international agreements provide some level of protection for olive ridleys, generally affecting directed harvest and/or trade. However, not all parties that provide nesting, foraging, and/or migratory habitat are signatories. These agreements are the Convention on the Conservation of Migratory Species of Wild Animals - focusing on the conservation of migratory species and their habitats, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora - designed to regulate international trade in a wide range of wild animals and plants.

The Convention on the Conservation of Migratory Species of Wild Animals, also known as the Bonn Convention or CMS, is an international treaty that focuses on the conservation of migratory species and their habitats. As of January 2007, the Convention had 101 member states, including parties from Africa, Central and South America, Asia, Europe, and Oceania. While the Convention has successfully brought together about half the countries of the world with a direct interest in sea turtles, it has yet to realize its full potential (Hykle 2002). Its membership does not include a number of key countries, including Brazil, Canada, China, Indonesia, Japan, Mexico, and the United States.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as CITES, was designed to regulate international trade in a wide range of wild animals and plants. CITES was implemented in 1975 and currently includes 169 Parties. Although CITES has been effective at minimizing the international trade of sea turtle products, it does not limit legal and illegal harvest within countries, nor does it regulate intra-country commerce of sea turtle products (Hykle 2002).

Without the protection of the ESA, existing regulatory mechanisms are inadequate to ensure protection of the olive ridley. Although the nationwide ban on the harvest of nesting females and eggs in Mexico, as well as the closure of the olive ridley turtle fishery, has decreased the threat to the Endangered population, enforcement is inadequate and illegal take is believed to be widespread. In addition, current domestic laws lack adequate conservation requirements to provide protection to ensure the olive ridley population does not decline.

A.2.3.2.5 Other natural or manmade factors affecting its continued existence:

The incidental capture of olive ridleys occurs in trawl fisheries, longline fisheries, purse seines, gillnet and other net fisheries, and hook and line fisheries (Frazier *et al*. 2007). The impact of the incidental capture of olive ridleys in fisheries has been well documented for some regions, but not for others.

Incidental capture in fisheries remains a serious threat in the eastern Pacific (Frazier *et al.* 2007) where olive ridleys aggregate in large numbers off nesting beaches (Kalb *et al*. 1995, Kalb 1999), but the information available is incomplete (Pritchard and Plotkin 1995, NMFS and FWS 1998). Incidental capture of olive ridleys in this region has been documented in shrimp trawl fisheries, longline fisheries, purse seine fisheries, and gillnet fisheries (Frazier *et al*. 2007). Incidental capture of sea turtles in shrimp trawls is a serious threat along the coast of Central America, with an estimated annual capture for all species of marine turtles exceeding 60,000 turtles, most of which are olive ridleys (Arauz 1996). Recent growth in the longline fisheries of this region is also a serious and growing threat to olive ridleys and has the potential to capture hundreds of thousands of ridleys annually (Frazier *et al*. 2007).

SUBSECTION B: THREATENED POPULATION

B.2.3.1 Biology and Habitat

B.2.3.1.1 New information on the species' biology and life history:

This five-year review provides a summary of our current knowledge of the two mating systems: (1) solitary nesting and (2) synchronized nesting, known as the arribada. See Subsection A.2.3.1.1 for the discussion.

Arribadas occur at only a few beaches worldwide in the eastern Pacific, western Atlantic, and northern Indian Oceans (Table 2). However the nesting range for the olive ridley extends far beyond these select beaches. Many ridleys nest solitarily on tropical beaches of the Atlantic, Pacific, and Indian Oceans (Table 3). For example, in the eastern Pacific, arribadas occur annually at several beaches in Mexico, Nicaragua, Costa Rica, and Panama from June through December. During the same time, solitary olive ridleys emerge individually to nest along nearly the entire coastline from Mexico to Colombia (Carr 1967; Pritchard 1969, 1979; R. Briseño, BITMAR, personal communication, 2006; A. Abreu, Unidad Academica Mazatlan, personal communication, 2006).

Table 2. Locations of *Threatened* olive ridley arribada nesting beaches and estimates of arribada size at each site.

Country	Beach	Estimates of Arribada Size	References
Western Atlantic Ocean			
Suriname	Galibi Nature Reserve*	335 nests	Hoeckert *et al*. 1996
French Guiana	Cayenne Peninsula	1,000-2,000 nests (2002-06)**	L. Kelle, WWF, pers..comm., 2007
East Pacific Ocean			
Nicaragua	Chacocente	42,541 nests	López Carcache *et al*. in press
Nicaragua	La Flor	1,300-9,000 turtles per arribada	Ruiz 1994
Nicaragua	Masachapa	No estimate available	Cornelius 1982, Margaritoulis and Demetropoulous 2003
Nicaragua	Pochomil	No estimate available	Cornelius 1982, Margaritoulis and Demetropoulous 2003
Nicaragua	Boquita	No estimate available	Cornelius 1982***
Costa Rica	Nancite	2,000-12,000 turtles per arribada	S. Honarvar, Drexel University, pers. comm., 2006
Costa Rica	Ostional	Average 50,000-200,000 turtles per arribada	Chaves *et al*. 2005
Panama	Isla Cañas	5,000-12,000 turtles per arribada	Evans and Vargas 1998
Northern Indian Ocean			
India	Gahirmatha	1,000-100,000+ turtles per arribada	Shanker *et al*. 2003b
India	Devi River	No estimate available	Shanker *et al*. 2003b
India	Rushikulya	10,000-200,000 turtles per arribada	Shanker *et al*. 2003b

* Large arribadas once occurred at these beaches but no longer do (Cliffton *et al*. 1979, Hoeckert *et al*. 1996).
** These data represent total nests for season.
*** Masachapa, Pochomil, and Boquita were extant at the time of the Cornelius (1982) article. The status for Boquita is unknown.

Table 3. Locations of *Threatened* olive ridley solitary nesting beaches.

Country	Beach	References
Western Atlantic Ocean		
Suriname		Kelle *et al.* 2004, Godfrey and Chevalier 2004
Guyana		Kelle *et al.* 2004, Godfrey and Chevalier 2004
French Guiana		Kelle *et al.* 2004, Godfrey and Chevalier 2004
Brazil	Sergipe, Bahia, Ceará	da Silva *et al*. 2003
Eastern Atlantic Ocean		
The Gambia		Barnett *et al*. 2004
Guinea Bissau		Barbosa *et al.* 1998
Sierra Leone		Siaffa *et al*. 2003
Ivory Coast		Gomez *et al*. 2003
Ghana		Beber 2002
Togo		Hoinsoude *et al*. 2003
Benin		Doussou Bodjrenou *et al*. 2005
Boiko, Säo Tome, Corisco, Mbanye, Hoco Islands		Fretey *et al*. 2005
Cameroon		Fretey *et al*. 2005
Equatorial Guinea		Fretey *et al*. 2005
Gabon		Fretey *et al*. 2005
Congo		Fretey *et al*. 2005
Angola		Fretey *et al*. 2005
Liberia		E. Possardt, FWS, pers. comm., 2007
Western Pacific Ocean		
Australia	Northern & northeast beaches	Limpus 1975, Whiting 1997
Brunei		Shanker and Pilcher 2003
Malaysia	Sarawak	Tisen and Bali 2002
Indonesia	Java	Suwelo 1999
	Jamursba-Medi	Teguh 2000; P. Dutton and M. Tiwari, NMFS, pers. comms. 2007
Vietnam		Shanker and Pilcher 2003
East Pacific Ocean		
Guatemala	Hawaii Beach & others	Juarez and Muccio 1997
Honduras	Punta Raton and others	Lagueux 1991
El Salvador	Toluca, San Diego & others	Hasbún and Vasqúez 1999
Nicaragua	Entire Pacific coast	Pritchard 1979
Costa Rica	Entire Pacific coast	Pritchard 1979
Panama		Pritchard 1979
Colombia	La Cuevita	Martinez and Paez 2000
Western Indian Ocean		
Mozambique		Pritchard 1979
Madagascar		Pritchard 1979
Kenya		Church 2005
Tanzania		Frazier 1976
Northern Indian Ocean		
India	Entire east & west coasts	Tripathy *et al*. 2003, Krishna 2005
Pakistan		Asrar 1999
Sri Lanka	Northwest, west & southern coasts	Amarasooriya and Jayathilaka 2002
Andaman & Nicobar Is.		Andrews 2000
Bangladesh		Sarker 2005
Myanmar (Burma)		Shanker and Pilcher 2003
Thailand		Aureggi *et al*. 2005

B.2.3.1.2 Abundance, population trends, and demographic features:

(1) Abundance and Population Trends

See Subsection A.2.3.1.2 for the introductory discussion.

ARRIBADA BEACHES

East Pacific Ocean:
In the east Pacific Ocean, Threatened populations of the olive ridley nest south of Mexico to Colombia. Within this range lie several beaches where arribadas reportedly occurred in the past but no longer do, as well as beaches were they do still occur: five in Nicaragua, two in Costa Rica, and one in Panama (Table 2). Current estimates for some of the beaches are either unavailable or are based on sporadic nesting beach surveys.

Nicaragua
There are two arribada beaches known to still exist in Nicaragua (Ruiz 1994): Playa Chacocente (located in the Chococente Wildlife Refuge) and Playa La Flor (located in a private wildlife refuge). Most recent abundance estimates for Playa Chacocente indicate 42,541 nests were laid in 2002-2003 (López Carcache *et al*. in press). Hope (2002) combined data from Playa Chacocente and Playa La Flor for a mean arribada size of 66,885 and a frequency of 5 to 7 arribadas per year for the period 1993-1999. There are no published data from which to discern long-term trends. Estimates for Playa La Flor indicate this population is increasing. In 1993, an estimated 27,427 olive ridley nests were laid during six arribadas (Ruiz 1994). Most recently, Honarvar and van den Berghe (in press) estimated there were 69,765 olive ridley nests laid at Playa La Flor in 2003 and 68,753 olive ridley nests in 2004.

Costa Rica
There are two arribada beaches in Costa Rica: Nancite Beach (located in the Santa Rosa National Park, Guanacaste Conservation Area) and 90 km to the south, Ostional Beach/Wildlife Refuge (located within the Tempisque Conservation Area on the Nicoya Peninsula).

There is currently a small and declining nesting population at Nancite Beach. In the early 1980s, large arribadas occurred at Nancite nearly monthly (Cornelius and Robinson 1982). In 1981, Cornelius and Robinson (1982) estimated that over 400,000 olive ridleys nested at Nancite during 11 arribadas that took place between April and November. A significant decline in the population size occurred during the 1980s and 1990s and the frequency of arribadas also decreased (Valverde *et al*. 1998; P. Plotkin, Cornell University, personal observation). No nesting surveys were conducted from 1998-2004. A 2005 nesting survey conducted at Nancite indicates there has been a 50% population decline since the early 1990s [1990: 37,123 turtles (Zanella and Mo 1990);

1991: 34,189 turtles (Calvo and Mo 1991); 1992: 31,029 turtles (Maziarz and Mo 1992)]. S. Honarvar (Drexel University, personal communication, 2006) estimated that only 15,895 olive ridleys nested at Nancite during three arribadas in 2005 (2,000-12,000 turtles per arribada).

In contrast to Nancite Beach, the other arribada beach in Costa Rica (Ostional) hosts a comparatively large nesting population that is stable and possibly increasing (Chaves *et al*. 2005, in press). Within the Ostional Wildlife Refuge, olive ridleys gather *en masse* on Ostional Beach and to the immediate south onto Nosara Beach. Arribadas occur there throughout the year, with the largest number of olive ridleys nesting between July and January. Monitoring in the Refuge began in the 1970s. At least four different census methods have been used since then to estimate the number of turtles nesting during an arribada: (1) visual counts of all turtles, (2) Cornelius and Robinson method (quadrat method), (3) Valverde and Gates method (strip transect in time method that counts only nesting turtles), and, more recently, (4) Chaves and Morera method (a modified strip transect in time method that counts all turtles on the beach, not just nesting turtles). Since 1980, the frequency of arribadas has increased, the area of the beach used during arribadas has increased, and the number of turtles nesting per arribada has increased (Chaves *et al*. 2005). The average arribada size in the main nesting beach increased from 75,000 turtles in 1980 to 125,000 turtles in 2003 (Chaves *et al*. 2005). The number of arribadas per year ranged from 7 to 16 and averaged 11.17 ± 2.29 (Chaves *et al*. 2005).

The "Chaves and Morera method" was used most recently, from 1999-2003, to estimate the number of turtles nesting in the Refuge. Use of this new method corresponds in time with a documented increase in the estimated number of turtles nesting at the Refuge (Chaves *et al*. 2005) and there is a probability that the observed increase, in part, is an artifact of this new census method, rather than a real increase in the number of turtles nesting there. One shortcoming of the Chaves and Morera method is that it counts all turtles in the transect – not just confirmed nesters. This presents a problem because olive ridleys frequently emerge during an arribada, but do not lay eggs (Shanker *et al*. 2003b; Pamela Plotkin, Cornell University, personal communication). Interference competition among female ridleys can be very intense when turtle density on the nesting beach is high and generally there are three outcomes that result from this interaction: (1) turtle returns to sea without nesting, (2) turtle excavates a nest, fails to oviposit, covers the nest, and then returns to sea, or (3) turtle nests successfully (P. Plotkin, Cornell University, personal observation). While this behavior has not been quantified in the Refuge, it was prevalent at Nancite Beach (P. Plotkin, Cornell University, personal observation) and has been reported in India as well (Shanker *et al*. 2003b). Consequently, use of the Chaves and Morera method likely leads to an overestimation of the number of ridleys nesting during an arribada.

Although Chaves *et al*. (2005) do not provide estimates of the total number of nests during any given year, if you take the number of arribadas recorded during 2003 (N = 10 arribadas) and multiply this by the average number of turtles nesting per arribada during that year (N = ~110,000 turtles), more than 1 million olive ridley nests were laid in the Refuge during 2003.

Panama

Olive ridley arribadas occur at Isla Cañas, part of the Panama National Wildlife Refuge system. Historical empirical data for this region are unavailable and the population trend is unknown. The most current data available indicate that 3-5 arribadas occur annually from August through December and that an estimated 5,000 to 12,000 olive ridleys nest during each arribada (Evans and Vargas 1998). The method used to quantify turtles there is undocumented. Based on the arribada frequency and the estimated numbers of turtles nesting per arribada, the estimated total number of nests was between 15,000 and 60,000 in 1997. R. Chang (cited personal communication in NMFS and FWS 1998) reported there were an estimated 20,000 olive ridleys nesting annually at Isla Cañas.

West Atlantic Ocean:

There are two distinct olive ridley nesting populations currently recognized in the western Atlantic: Suriname/French Guiana and Brazil. Survey effort has fluctuated over the years and it is difficult to estimate recent abundance because of incomplete surveys during many years. Moreover, because the coastline of Suriname and French Guiana is dynamic, long-term surveys are difficult because the turtles change nesting locations frequently. We do know with certainty however that the Suriname olive ridley population is currently very small and has declined by more than 90% (Hoekert *et al*. 1996, Marcovaldi 2001). Schulz (1975) reported 3,290 olive ridley nests in 1968. By 1980, there were 1,080 olive ridley nests recorded in Suriname (Reichart and Fretey 1993) and between 2002 and 2006 nesting varied between 1,600 and 3000 nests annually in French Guiana (L. Kelle, World Wildlife Fund (WWF), personal communication). Most recent estimates based on surveys in Suriname indicate there were 150-300 nests annually between 2002 and 2006.

There are some recent abundance estimates for olive ridleys in French Guiana. Olive ridleys were known to nest on the western beaches and were recently discovered nesting in eastern French Guiana (Kelle *et al*. 2004). It is unknown if the recently discovered turtles that relocated there from Suriname represent a true population increase, or if they always existed but were undetected because monitoring did not occur regularly in this region (Marcovaldi 2001). The mean annual number of olive ridley nests laid during 2001-2002 in all of French Guiana was estimated to be between 1,444 and 1,844 nests (Godfrey and Chevalier 2004).

The olive ridley nesting beach in the state of Sergipe, Brazil, has been monitored since 1990. This population is small (Marcovaldi 2001), but increasing (Godfrey and Chevalier 2004, de Castilhos and Tiwari 2006). The number of nests has increased from 100 nests in 1989/1990 to an estimated 2,000 nests in 2000/2001(Godfrey and Chevalier 2004). Unfortunately the latter estimate of 2,000 nests was based on the total number of sea turtle nests observed in Sergipe; over 50% of them were not confirmed olive ridley nests.

Indian Ocean:
In the Indian Ocean/Bay of Bengal, three arribada beaches have been reported in the Indian State of Orissa (Pandav *et al*. 1998): Gahirmatha, Devi River mouth, and Rushikulya. Nesting beach surveys at Gahirmatha have been conducted since the mid-1970s. Long-term data for the two other arribada beaches are unavailable. Survey effort on India beaches has fluctuated over the years and the methods used to census the nesting populations have also changed. As a result, for many years there have been some highly speculative numbers released regarding its size, with estimates exceeding 700,000 turtles nesting in one arribada.

There is good evidence to suggest that olive ridleys in this region have recently changed their nesting behavior. Since recordkeeping began at Gahirmatha in the 1970s until the mid-1990s, there have been two arribadas recorded there during each nesting season. On rare occasions, there was only one arribada or no arribada recorded during a nesting season. Since the mid-1990s, there has been only one arribada at Gahirmatha annually (Shanker *et al*. 2003b). There is speculation that this change in nesting behavior, as well as decreases in size of adults over a 5-year period, is an indicator that a problem exists or is imminent (Shanker *et al*. 2003b). However, because exchange among the arribada beaches in India has been noted (Shanker *et al*. 2003b), the change in nesting behavior at Gahirmatha might be attributed to a shift in preferred nesting beaches. More detailed, concurrent censuses of all arribada beaches in India are needed before conclusions can be drawn from these observations.

Shanker *et al*. (2003b) recently compiled all of the available census data from the arribada beaches in India, derived a consensus estimate for each arribada, and then determined nesting population trends at Gahirmatha. From 1974 to 2001, at least one arribada in excess of 100,000 turtles occurred in most years at Gahirmatha, as well as smaller arribadas less than 1,000. In their revised estimates, Shanker *et al*. (2003b) took into account the fact that the same turtles nest in successive arribadas and that the same turtles nest at different arribada beaches, an important fact that had been overlooked in previous estimates of nesting population size. The most recent reliable abundance estimate for Gahirmatha during the 1999 arribada is approximately 180,000 nesting females. Long-term data for Gahirmatha indicate that the olive ridley nesting population increased during the 1980s, followed by a decrease during the 1990s (Shanker *et al*. 2003b). However, the decline was not significant, but Shanker *et al*. (2003b) concluded that the olive ridley nesting population may be declining or on the verge of decline. Estimates of arribada size at Devi River mouth and

Rushikulya are quite large and considered unreliable (Shanker *et al*. 2003b). An estimated 200,000 olive ridleys nested during the 1994 arribada at Rushikulya (Pandav *et al*. 1994), followed by considerable fluctuations in the number of nesting females from 60,000 in 1995 to 8,000 in 1998 (Pandav *et al.* 1998).

NON-ARRIBADA BEACHES

East Pacific Ocean:
<u>Guatemala</u>
In Guatemala, there is widespread, low-density olive ridley nesting. The most current estimate available indicates there were over 2 million olive ridley eggs laid on the coast of Guatemala in the late 1990s (Muccio 2000). If we assume that the average clutch size is 100 eggs, then this represents approximately 20,000 nests. Higginson (1989) provided estimates from data collected by Ramboux (1982) and Rosales Loessener (1987) and stated that 21,067 olive ridleys nested during 1981-1982. It is unknown if this estimate refers to the number of nests laid or if it refers to nesting females. Empirical population trend data are unavailable for Guatemala, but olive ridleys are reported to be declining (Juarez and Muccio 1997). Muccio (1999) reported that solitary nesting ridleys are estimated to have declined 34% between 1981 and 1997.

<u>El Salvador</u>
In El Salvador, there is low-density olive ridley nesting. There is no current estimate available of the number of olive ridleys nesting along the coast of El Salvador. Population trend data are unavailable; however, the olive ridley nesting population was considered to be declining in 1989 (Formia *et al*. 2000). In addition, coastal residents in El Salvador are convinced that sea turtle populations are steadily declining (Arauz 2000).

<u>Honduras</u>
In Honduras, there is widespread, low-density olive ridley nesting on the shores of the Gulf of Fonseca. Lagueux (1989) reported nesting occurs on 46 different Honduran beaches. In Punta Raton, Lagueux (1989) reported 742 nests laid from July through December 1987. There is no current estimate of the number of olive ridleys nesting along the coast of Honduras, and population trend data are unavailable.

<u>Nicaragua</u>
In Nicaragua, there is widespread, low-density olive ridley nesting. There is no current estimate of the number of olive ridleys nesting on non-arribada beaches along the coast of Nicaragua, and population trend data are unavailable.

<u>Costa Rica</u>
In Costa Rica, there is widespread, low-density olive ridley nesting. There is no current estimate of the number of olive ridleys nesting on non-arribada beaches along the coast of Costa Rica, and population trend data are unavailable.

However, there are a few non-arribada beaches where data have been collected. These beaches include: San Miguel, Playa Caletas, Punta Banco, and Osa Peninsula. From 1998 through 2004, on average, 180 nests were documented in San Miguel. For Play Caletas, 71 olive ridley nests were documented during the 2002-2003 nesting season; however, there were 226 unconfirmed events, most of which were believed to be olive ridleys. From 1996-2005, over 1,000 olive ridley nests were located to hatcheries and protected from predation and poaching. Punta Banco has been monitored since 1996 (Gaos *et al*. 2006). A declining trend in the number of nests (*note:* the trend includes *Eretmochelys imbricata* and *Chelonia mydas*, but these species only laid a few nests each year) laid there has been reported (Gaos *et al*. 2006). During the 1993-1994 nesting season on the Osa Peninsula, 3,155 olive ridley nests were recorded (Drake 1996).

Panama

Cornelius (1982) reported that sea turtle nesting in Panama was widespread and that large nesting aggregations once occurred on at least 30 beaches. By the early 1980s, turtles had declined and were nesting in smaller aggregations on only 12 beaches (Cornelius 1982). The sea turtle species nesting in these aggregations were not reported and may represent other species as well as olive ridleys. Widespread, low-density olive ridley nesting still occurs in Panama. There is no current reliable estimate of the number of olive ridleys nesting on non-arribada beaches along the coast of Panama, and population trend data are unavailable. Cornelius (1982) reported that by the late 1970s and early 1980s, olive ridley abundance in Panama was lower compared to former abundance levels. R. Chang (cited personal communication in NMFS and FWS 1998) estimated 10,000 solitary ridleys nested annually throughout Panama (exclusive of Isla Cañas).

Colombia

There is low-density olive ridley nesting in Colombia, principally in the Playon de El Valle (Choco Region) and Parque Snaguianga in the south (Narino Department) (Amorocho *et al*. 1992; D. Amorocho, MONASH University personal communication 2007). Since 2003, 25 olive ridleys nests have been documented on Parque Gorona, a small 1.2 km island in the south (D. Amorocho, MONASH University, personal communication 2007). Amorocho (1994) reported olive ridley nesting on Playa Larga but did not provide the numbers of turtles or nests. On another beach, La Cuevita, Martinez and Paez (2000) reported 112 olive ridley nests in 1998.

West Pacific Ocean:

Indonesia

Indonesia also provides habitat for olive ridleys, and there are some recently documented nesting sites. The main nesting areas are located in Sumatra, Alas Purwo in East Java, Paloh-West Kalimantan, and Nusa Tenggara. On Jamursba-Medi beach, on the northern coast of Papua, 77 olive ridley nests were documented from May to October 1999 (Teguh 2000). Extensive hunting and egg collection, in addition to rapid rural and urban development, have reduced nesting activities in this area. On Hamadi beach, Jayapura Bay, in June 1999, an estimated several hundred ridleys were observed nesting. At Alas Purwo National Park, located at the eastern-most tip of East Java, olive ridley nesting was documented from 1992-1996. Recorded nests were as follows: from September 1993 to August 1993, 101 nests; between March and October 1995, 162 nests; and between April and June 1996, 169 nests. From these limited data, no conclusions could be reached regarding population trends (Suwelo 1999); however, Dermawan (2002) reports that there were up to 250 females nesting at this site in 1996, with an increasing trend.

Malaysia

Olive ridleys nest on the eastern and western coasts of peninsular Malaysia; however, nesting has declined rapidly in the past decade. The highest density of nesting was reported to be in Terrenganu, Malaysia, and at one time yielded 240,000 *eggs* (2,400 nests, with approximately100 eggs per nest) (Siow and Moll 1982 as cited in Eckert 1993), while only 187 nests were reported from the area in 1990 (Eckert 1993). In eastern Malaysia, olive ridleys nest very rarely in Sabah and in low numbers (Basintal 2002), and only a few records are available from Sarak (Eckert 1993).

West Atlantic Ocean:

There is low-density olive ridley nesting in Guyana, Suriname, and French Guiana (Reichart 1993, Godfrey and Chevalier 2004, Kelle *et al.* 2004; see data discussed above in the arribada section). Whether these turtles are true arribada nesters (i.e., emerge synchronously) or solitary nesters is undocumented and thus it is difficult to differentiate between them. Numbers presented in the above West Atlantic Ocean section for Arribada beaches therefore reflect the combined numbers of olive ridleys nesting on arribada beaches and non-arribada beaches along this coastline with the exception of Guyana where there are fewer than five nests recorded annually during this same 5-year time period in Guyana (L. Kelle, WWF, personal communication from Guyana Marine Turtle Conservation Society).

East Atlantic Ocean:

There is widespread, low density olive ridley nesting along many West African beaches from Gambia south to Angola (Barnett *et al*. 2004, Barbosa *et al*. 1998, Beyer 2002, Doussou Bodjrenou *et al*. 2005, Fretey *et al*. 2005, Hoinsoude *et al*. 2003, Gomez *et al*. 2003).

Indian Ocean:

There is widespread, low-density olive ridley nesting in the western and northern Indian Ocean. The species has been recorded nesting in low numbers in Mozambique (Pritchard 1979), Tanzania (Frazier, 1976), Kenya (Church 2005), Madagascar (Pritchard 1979), and along the southwest coast of India (Krishna 2005) (Table 3). Olive ridley nesting is most concentrated in the northern Indian Ocean, particularly along the shores of the Bay of Bengal on the East Indian coast and Sri Lanka (Amarasooriya and Jayathilaka 2002, Tripathy *et al*. 2003). Abundance estimates and population trends are generally unavailable for most of this region. Declines of olive ridleys have been recorded in Bangladesh (Islam 2002), Myanmar (Thorbjarnarson *et al*. 2000), Malaysia (Limpus 1995), Pakistan (Asrar 1999), and southwest India (Krishna 2005).

(2) Demographic Features

See Subsection A.2.3.1.2 for the discussion.

B.2.3.1.3 Genetics and genetic variation:

See Subsection A.2.3.1.3 for the discussion.

B.2.3.1.4 Taxonomic classification:

Kingdom: Animalia
Phylum: Chordata
Class: Reptilia
Order: Testudines
Family: Cheloniidae
Genus: *Lepidochelys*
Species: *olivacea*
Common names: Olive ridley sea turtle, Pacific ridley sea turtle

B.2.3.1.5 Spatial distribution:

The nesting distribution of olive ridleys has been presented already in the section on abundance and trends and will not be reiterated in this section. The aquatic distribution of olive ridleys is the focus of this section, with some reference made to nesting beaches when appropriate. Spatial distribution is generally discerned from data collected from mark-recapture studies, incidental capture of turtles in fisheries, and/or satellite tracking studies.

The olive ridley has a circumtropical distribution, occurring in the Atlantic, Pacific, and Indian Oceans (Pritchard 1969). They are not known to move between or among ocean basins. Within a region, olive ridleys may move between the oceanic zone and the neritic zone (Plotkin *et al*. 1995, Shanker *et al*. 2003a) or just occupy neritic waters (Pritchard 1976, Reichart 1993). However, it is important to note that some available data are derived from tag returns of turtles recaptured in coastal fisheries and may present a biased impression of the true distribution of these populations. Recent telemetric data indicate offshore movements well beyond the continental shelf (Georges *et al*. 2007).

East Pacific Ocean:
In the eastern Pacific, the olive ridley typically occurs in tropical and subtropical waters, as far south as Peru and as far north as California, but occasionally have been documented as far north as Alaska (Hodge and Wing 2000). In this region, olive ridleys are highly migratory and may spend most of their non-breeding life cycle in the oceanic zone (Cornelius and Robinson 1986; Pitman 1991; Arenas and Hall 1991; Pitman 1993; Plotkin 1994; Plotkin *et al*. 1994, 1995; Beavers and Cassano 1996). Olive ridleys occupy the neritic zone during the breeding season. Reproductively active males and females migrate toward the coast and aggregate at nearshore breeding grounds located near arribada beaches (Pritchard 1969; Hughes and Richard 1974; Cornelius 1986; Plotkin *et al*. 1991, 1996, 1997; Kalb *et al*. 1995). A significant proportion of breeding also takes place far from shore (Pitman 1991, Kopitsky *et al*. 2000), and it is possible that some males and females may not migrate to nearshore breeding aggregations at all. Some males appear to remain in oceanic waters, are non-aggregated, and mate opportunistically as they intercept females *en route* to near shore breeding grounds and nesting beaches (Plotkin 1994; Plotkin *et al*. 1994, 1996; Kopitsky *et al*. 2000; Parker *et al.* 2003).

The post-reproductive migrations of olive ridleys in the eastern Pacific are unique and complex. Their migratory pathways vary annually (Plotkin 1994), there is no spatial and temporal overlap in migratory pathways among groups or cohorts of turtles (Plotkin *et al*. 1994, 1995), and no apparent migration corridors exist. Polovina *et al.* (2003, 2004) tracked 10 olive ridleys caught in the Hawaii-based pelagic longline fishery. Three of the turtles were identified from genetics to be of western Pacific origin. These turtles associated with major currents in the central North Pacific-southern edge of the Kuroshio Extension Current, North Equatorial Current, and Equatorial Counter Current. Whereas, the olive ridleys from the eastern Pacific populations stayed south of these currents in the region of 8 to 31°N, suggesting that olive ridleys from different populations may occupy different oceanic habitats (Polovina *et al.* 2003, 2004).

Unlike other marine turtles that migrate from a breeding ground to a single feeding area, where they reside until the next breeding season, olive ridleys are nomadic migrants that swim hundreds to thousands of kilometers over vast oceanic areas (Plotkin 1994; Plotkin *et al*. 1994, 1995).

West Atlantic Ocean:
In the western Atlantic, olive ridleys have been reported at sea as far north as the Grand Banks Region and as far south as Uruguay, encompassing a range between 43°N and 34°S (Fretey 1999, Foley *et al*. 2003, Stokes and Epperly 2006). However, they are most common in the waters of Guyana, Suriname, French Guiana, and Brazil: elsewhere they are uncommon. Western Atlantic olive ridleys appear to remain in neritic waters after breeding (Pritchard 1976,

Reichart 1993). There appears to be little geographic overlap between the olive ridleys nesting in French Guiana/Suriname and those from Brazil (Godfrey and Chevalier 2004). Tag returns from females that nested in French Guiana/Suriname indicate that turtles migrate either south from eastern Guyana to Amapa (Brazil), or north, from the mouth of the Orinoco River to the islands of Tobago, Trinidad, and Margarita (Pritchard 1973, Schulz 1975). Tag returns from females that nested in Sergipe have been recovered in Sergipe or farther south in Brazil (Marcovaldi *et al*. 2000).

East Atlantic Ocean:
Information on marine turtles in the eastern Atlantic is limited, but it is clear that olive ridleys are common throughout this region (Fretey *et al*. 2005). The species has been confirmed, or is thought to occur, along the coast between Mauritania and South Africa. The highest densities have been recorded in the Gulf of Guinea between the Ivory Coast and Gabon. Similar to the western Atlantic, there are few pelagic records of olive ridleys from the eastern Atlantic.

Indian Ocean:
In the Indian Ocean, olive ridleys occur in the western ranges, but are seemingly uncommon. The species has been recorded in Mozambique, Tanzania, Kenya, Madagascar, and along the west coast of India (Table 3). Olive ridleys are most abundant in the northern Indian Ocean, particularly in the Bay of Bengal along the Indian coast. Very little is known about the habitats that olive ridleys occupy in this part of their range. Large numbers aggregate near shore during the breeding season, but their habitat use beyond the reproductive area is not well documented. Shanker *et al*. (2003a) tracked the migrations of a few post-nesting olive ridleys from India and found that the turtles moved almost randomly offshore in large circles before one turtle began a directed movement southwards. Such behavior was similar to the non-directed movements of female olive ridleys in the east Pacific (Plotkin *et al*. 1995).

B.2.3.1.6 Habitat or ecosystem conditions:

See Subsection A.2.3.1.6 for the discussion.

B.2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

The determination to list a species under the ESA is based on the best scientific and commercial data regarding five listing factors (see below). Subsequent 5-year reviews must also make determinations about the listing status based on these same factors.

B.2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

There are increasing impacts to the nesting and marine environment that affect olive ridley turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Lutcavage *et al*. 1997, Bouchard *et al*. 1998). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to nesting females, and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997; Witherington *et al*. 2003, 2007). These activities have increased in many parts of the olive ridley's range and pose threats to major nesting sites in India and Central America (Cornelius *et al*. 2007). In addition, coastal development is usually accompanied by artificial lighting. The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1991). In many countries, coastal development and artificial lighting are responsible for substantial hatchling mortality. Although legislation controlling these impacts does exist (Lutcavage *et al*. 1997), a majority of countries do not have regulations in place.

At sea there are numerous potential threats including marine pollution, oil and gas exploration, lost and discarded fishing gear, changes in prey abundance and distribution due to commercial fishing, habitat alteration and destruction caused by fishing gear and practices, agricultural run off, and sewage discharge (Lutcavage *et al*. 1997, Frazier *et al*. 2007). There are no empirical data to determine the impacts of these activities to olive ridley populations.

Although empirical data on the impacts of destruction, modification and curtailment of the olive ridley's habitat or range are lacking from many areas, habitat loss is highly likely given current human encroachment on coastal habitats. Coastal construction, pollution, and other human-related impacts to the olive ridley's habitat will likely increase as coastal human populations expand.

B.2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

ADULT NESTERS AND EGG HARVEST

Olive ridleys and their eggs have been overutilized worldwide. The history of use and detailed accounts of this use is reviewed by Cornelius *et al*. (2007), Frazier *et al*. (2007), and Campbell (2007a). Use is summarized below by region, with information provided on historical use and contemporary use. There are many "scales" of use and the following summary distinguishes commercial use (of all sizes) from personal use. "Personal use" in this report is meant to imply non-commercial use by individuals or families and includes subsistence use as well as non-subsistence use.

The current impact of human use of olive ridley turtles and their eggs on populations is difficult to evaluate because there are many factors that contribute to a population's growth and decline (e.g., incidental take in commercial fisheries); however, Cornelius *et al*. (2007) identify several solitary nesting beaches and arribada beaches where current egg use is causing declines. Recreational, scientific, or educational overutilization has not been reported for olive ridleys.

East Pacific Ocean:

In Central and South America, olive ridley eggs have been and still are used for personal and commercial use (Lagueux 1989, Arauz 2000, Campbell 2007a, Cornelius *et al*. 2007). Laws regulating turtle egg use vary among the countries and even where laws prohibit egg use, illegal use of olive ridley eggs is believed to be widespread because enforcement is either non-existent or insufficient.

Personal use of turtle eggs is prevalent throughout the region and is viewed as overutilization in some areas, while in other areas it is not viewed as such (Campbell 2007a). The current impact of personal use of eggs on olive ridley abundance and trends in this region is largely unknown; however, on unprotected solitary nesting beaches (most are unprotected), where use often approaches 100%, declines are expected if such use continues.

Nicaragua

Commercial egg use occurred in Nicaragua and reportedly led to the disappearance of arribadas at Masachapa and Pochomil back in the 1970s (Nietschmann 1975). Egg use still occurs in Nicaragua. Egg collection is prohibited from October 1 to January 31 and year round in protected areas (Valle 1997). Enforcement of this closed period is reportedly poor and very few eggs are left to incubate anywhere in the country (Camacho and Cáceres 1995). Residents collected over 600,000 eggs annually between 1993 and 1999. Egg collection quotas appear to be based on demands of surrounding coastal communities rather than conservation needs of the turtles, and results in chaotic illegal egg commerce (Hope 2002).

Panama

Commercial egg use reportedly also occurs in Panama (Cornelius *et al*. 2007); however, the extent of the use and its impact on the nesting population is undocumented.

Costa Rica

The largest commercial egg use occurs in Ostional, Costa Rica, where a legal controlled collection of olive ridley turtle eggs supplies a national market. This use was largely unregulated 30 years ago but has been legal and regulated to varying degrees for the past 20 years (Campbell 2007b). During the dry season arribadas (January - May), the percentage of eggs harvested for the national commercial market ranged from 6.7% to 38.6% annually (1990-1997), during the rainy season arribadas (June - December) egg harvest ranged from 5.4% to 20% annually (1988-1997) (Ballestero *et al*. 2000). There are no data available to indicate that this use has adversely impacted the nesting population at Ostional or any other beach (Cornelius *et al*. 1991, 2007).

West Atlantic Ocean:
Olive ridleys were also overutilized in the western Atlantic (Cliffton *et al*. 1982, Green and Ortiz-Crespo 1982, Campbell 2007a). Both casual and organized take of adults and eggs of all nesting sea turtle species historically were widespread in the Guianas and northeast Brazil.

According to Geijskes (1945 as cited in Reichart and Fretey 1993), about 1,500 nesting olive ridleys were killed annually during most of the 1930s. The direct take of adults apparently diminished over time, but egg collection was intense and reached nearly 100% in the late 1960s (Schulz 1975). Despite a Suriname law that banned egg use in 1970, uncontrolled egg collection occurred from the late 1980s to the early 1990s at Eilanti Beach and elsewhere (Reichart 1993, Reichart and Fretey 1993). Illegal use is still believed to be widespread. Hoekert *et al*. (1996) reported that more than 40% of olive ridley nests were collected during the peak season in 1995.

In Brazil, initial surveys of sea turtle nesting activity in the early 1980s revealed unorganized but widespread use of adults and eggs of all species nesting along the Sergipe coast (Marcovaldi and Marcovaldi 1999).

East Atlantic Ocean:
Olive ridleys and their eggs are used along the entire coast of West Africa and sold in local and regional markets. A survey of 27 West African countries (including Macronesia) indicated that nesting females were killed in 14 of them (Fretey 2001). The extent of use and its impact on populations in the region is undocumented.

Indian Ocean:
Use of adult olive ridleys and their eggs for personal use and commercial use has been widespread in the Indian Ocean (Frazier 1982, Frazier *et al*. 2007). Use of turtle eggs for human consumption and domestic animal consumption historically was widespread in the Indian Ocean and continues today largely wherever ridleys nest (Cornelius *et al*. 2007). Commercial use of olive ridley eggs once occurred at the arribada beach in Gahirmatha, India, and in Myanmar and resulted in the collection of hundreds of thousands of eggs annually (Cornelius *et al*. 2007).

Egg use has been reported in India, Bangladesh, Myanmar, Sri Lanka, Andaman Islands, Pakistan, and Malaysia and is believed to have caused the decline of olive ridleys in these countries (Cornelius *et al*. 2007). Personal subsistence use of adult olive ridley turtles is also fairly widespread (Cornelius *et al*. 2007, Frazier *et al*. 2007).

In summary, the harvest of nesting turtles and eggs continues to be widespread and poses a significant threat to the Threatened population.

IN-WATER HARVEST
East Pacific Ocean:
Olive ridleys were overutilized for commercial purposes in two legal turtle fisheries that operated in the eastern Pacific Ocean (Cliffton *et al*. 1982, Green and Ortiz-Crespo 1982, Campbell 2007a). The Mexican turtle fishery caused rapid, large declines at olive ridley arribada beaches in Mexico (Cliffton *et al*. 1982) that were so dramatic they have been widely referred to in the literature as population collapses, crashes, or extinctions. An estimated 2 million turtles were taken for their meat and leather until 1990 when the fishery closed (Aridjis 1990). The impact of this use on olive ridley abundance, and population response since the fishery was closed has been discussed (Márquez-M. *et al*. 1996, Ross 1996, Godfrey 1997, Pritchard 1997b).

An Ecuadorian turtle fishery also existed during the 1970s and fished several hundreds of thousands of olive ridleys during this time (Green and Ortiz-Crespo 1982). This fishery is also believed to have contributed to the decline in the number of olive ridleys nesting on Mexican arribada beaches. A direct link between Mexico nesting beaches and Ecuadorian waters was established when olive ridleys, tagged while nesting in Mexico, were later captured in the Ecuadorian turtle fishery (Green and Ortiz-Crespo 1982).

The closure of the olive ridley turtle fishery has decreased the threat to the population. However, illegal take of adult turtles still occurs in the region and the impact of this take is unknown. There is evidence that thousands of olive ridleys are still taken each year along the Pacific coast of Mexico (Frazier *et al*. 2007). The Mexican enforcement agency, Procuraduria Federal de Protección al Ambiente (PROFEPA), seized approximately 1,000-8,000 kg of turtle meat, 100-1,800 units of turtle leather, and several hundred dead and live whole turtles each year in the State of Oaxaca (species not specified) (Trinidad and Wilson 2000).

B.2.3.2.3 Disease or predation:

See Subsection A.2.3.2.3 for the discussion.

Disease and predation are believed to be relatively minor threats to the population.

B.2.3.2.4 Inadequacy of existing regulatory mechanisms:

The ESA is the only domestic law that provides direct and holistic protections for the olive ridley. Without the ESA, current domestic legislation is inadequate. Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), NMFS has implemented mandatory measures to reduce incidental take and minimize injury to olive ridleys in domestic longline fisheries operating in the Pacific. These regulations were implemented as a result of ESA section 7 consultations requiring such measures. The MSA is a limited conservation tool for sea turtles; the Section 301 National Standards mandates are not prescriptive and only require that 'Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.'

Olive ridleys are highly migratory, and largely pelagic. They do not nest on U.S. beaches, and many of the factors affecting them occur outside of U.S. jurisdiction. Many foreign countries lack regulations or have inadequate regulations in place to address the wide range of anthropogenic activities that directly injure and kill olive ridleys, disrupt necessary behaviors, and alter terrestrial and marine habitats used by the species. In particular, improved regulations of fisheries that incidentally capture olive ridleys are needed to reduce mortality. Improved fishery observer coverage is also needed to provide more basic information on olive ridley bycatch. Government regulations and community programs need to be initiated or strengthened to address the impacts of turtle hunting and egg poaching. Enforcement efforts are needed to ensure that requirements are adhered to in all sectors. Overall, increased efforts are needed to assist many foreign countries with the enactment and enforcement of national regulations to protect olive ridleys.

The conservation and recovery of the olive ridley also requires multi-lateral cooperation and agreements to ensure their survival. The U.S. has entered into several international instruments directly focused on protecting and conserving sea turtles, including olive ridleys. The two primary agreements are the Indian Ocean–South-East Asian Marine Turtle Memorandum of Understanding (IOSEA) (http://www.ioseaturtles.org) and the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) (http://www.iacseaturtle.org/iacseaturtle/English/home.asp). The IOSEA provides a framework for countries of the Indian Ocean and South-East region, as well as other concerned countries, to share information and collaborate on recovery efforts. The IAC focuses on protection of sea turtles and their habitat, and reducing bycatch.

In addition to these two agreements, two other key international agreements provide some level of protection for olive ridleys, generally affecting directed harvest and/or trade. However, not all parties that provide nesting, foraging, and/or migratory habitat are signatories. These agreements are the Convention on the Conservation of Migratory Species of Wild Animals - focusing on conservation of migratory species and their habitats - and the Convention on International Trade in Endangered Species of Wild Fauna and Flora - designed to regulate international trade in a wide range of wild animals and plants.

Without the protection of the ESA, existing regulatory mechanisms are inadequate to ensure protection of the olive ridley. Current domestic laws lack adequate conservation requirements to provide protection and ensure the olive ridley population does not decline.

B.2.3.2.5 Other natural or manmade factors affecting its continued existence:

The incidental capture of olive ridleys occurs worldwide in trawl fisheries, longline fisheries, purse seines, gillnet and other net fisheries, and hook and line fisheries (Frazier *et al*. 2007). The impact of the incidental capture of olive ridleys in fisheries has been well documented for some regions but not for others. In some locations where bycatch statistics are unavailable from fisheries, cause and effect has been used to implicate a fishery in the decline of olive ridleys.

East Pacific Ocean:
Incidental capture in fisheries remains a serious threat in the eastern Pacific (Frazier *et al*. 2007) where olive ridleys aggregate in large numbers off nesting beaches (Kalb *et al*. 1995, Kalb 1999), but the information available is incomplete (Pritchard and Plotkin 1995, NMFS and FWS 1998). Incidental capture of olive ridleys in this region has been documented in shrimp trawl fisheries, longline fisheries, purse seine fisheries, and gillnet fisheries (Frazier *et al*. 2007). Incidental capture of sea turtles in shrimp trawls is a serious threat along the coast of Central America, with an estimated annual capture for all species of marine turtles exceeding 60,000 turtles, most of which are olive ridleys (Arauz 1996). Recent growth in the longline fisheries of this region is also a serious and growing threat to olive ridleys and has the potential to capture hundreds of thousands of ridleys annually (Frazier *et al*. 2007).

West Pacific Ocean:
Japanese tuna longliners are known to interact with sea turtles. Preliminary data from 2000 indicate approximately 6,000 turtles are caught annually (K. Hanafusa, Fisheries Agency of Japan, personal communication, 2004). Species composition is unknown, but interactions with olive ridleys are likely. Coastal gillnets in Taiwan are documented to interact with sea turtles. According to interviews with fishermen, 14 olive ridleys were taken in the fishery from 1991-1995 (Cheng and Chen 1997).

West Atlantic Ocean:
The incidental capture of olive ridleys in the shrimp trawl fisheries of the western Atlantic, specifically along the Guianas and Suriname coasts, is believed to be the main cause of the significant population decline observed there since the 1970s. The number of olive ridleys captured incidentally in trawl fisheries off the coasts of Suriname and French Guiana is believed to be approximately several thousand turtles annually (Godfrey and Chevalier 2004, Tambiah 1994, Frazier *et al*. 2007). Continued mortality from shrimp trawling appears to be the major threat to the recovery of these nesting populations (Godfrey and Chevalier 2004, Frazier *et al*. 2007). Gillnets and other fishing methods in this region also capture olive ridleys incidentally but to a lesser extent than shrimp trawl fisheries (Frazier *et al*. 2007).

East Atlantic Ocean:
In the eastern Atlantic, the incidental capture of olive ridleys by commercial fisheries is thought to be a significant threat; however, there is very little systematic data on incidental capture of marine turtles in West Africa (Frazier *et al*. 2007).

Indian Ocean:
Incidental capture of olive ridleys is extremely high along the coast of Orissa, India, where the densest concentrations of olive ridleys gather to nest and fishing effort is high. During the 1983-1984 nesting season, it was estimated that more than 600 olive ridleys stranded near Gahirmatha beach and another 500 in Hukitola Islands (Dash and Kar 1990). From 1978-1985, a total of 4,682 adult olive ridleys of both sexes were found dead on a 10-km stretch of beach between Habalikhati and Ekakulanasi (Dash and Kar 1990). There would have been more strandings than this each year since only a relatively small portion of the coast was covered and surveys were carried out for only a part of the season. In the 1990s, recorded carcasses increased from 5,000 in 1994 to 15,000 in 1999 (Pandav and Choudhury 1999), and since then, 10 to 20 thousand dead turtles have been counted on the Orissa coast each year (Wright and Mohanty in press). A gillnet fishery also operates in the region and contributes to the ridley mortality observed along this coastline. In 2001, a gillnet washed ashore near Gahirmatha with over 200 dead turtles entangled in it (Wright and Mohanty in press), indicating a serious threat from this fishery.

Incidental capture in commercial and subsistence fisheries remain a serious threat to the recovery of the Threatened population.

2.4 Synthesis

Endangered Population (Mexico breeding population)

Based on the number of olive ridleys nesting on the Pacific coast of Mexico, the Endangered population appears to be stable at some locations (e.g., Mismaloya and Moro

Ayuta) and increasing at one location (La Escobilla). A comparison of the current abundance of the Mexico nesting assemblages with the former abundance at each of the large arribada beaches indicates that the populations experienced steep declines that have not yet been overcome. Nesting trends in Mexico at non-arribada beaches are stable or increasing in recent years. However, current threats, particularly with regard to commercial fisheries, remain a serious concern for the future of this population. Incidental capture of olive ridleys in shrimp trawl fisheries has been and remains a significant threat to nesting populations. Also of concern is the growing threat posed by expansion of the longline fisheries in this region. The nationwide ban on harvest of nesting females and eggs has decreased the threat to the Endangered population. The nesting population at La Escobilla, Oaxaca, Mexico, has increased from 50,000 nests in 1988 to more than a million nests in 2000 as a result of the harvest prohibitions and the closure of a nearshore turtle fishery. However, illegal harvest of eggs and turtles is believed to still be widespread in Mexico.

Threatened Population (globally except Mexico breeding population)

In the eastern Pacific, the large arribada nesting populations have declined since the 1970s. Nesting at some arribada beaches continues to decline (e.g., Nancite in Costa Rica) and is stable or increasing at others (e.g., Ostional in Costa Rica). There are too few empirical data available from solitary nesting beaches to confirm the declining trend that has been described for numerous countries throughout the region including El Salvador, Guatemala, Costa Rica, and Panama.

Western Atlantic arribada nesting populations are currently very small. Recent data indicate the Suriname/French Guiana nesting population may still be threatened by incidental capture in the shrimp trawl fishery. Nesting data from French Guiana/Suriname during the 2002-2006 nesting seasons indicate that while nesting in Suriname continues at very low levels, nesting in French Guiana and overall nesting appears comparable to levels recorded for both countries about two decades ago. This may indicate a shift from nesting beaches in Suriname to French Guiana and reflect the dynamic aspects of beach erosion and accretion in the region. The other nesting population in Brazil, for which no long term data are available, is small, but increasing. In the eastern Atlantic, long-term empirical data are not available and thus the abundance and trends of this population cannot be assessed at this time. However, the threats associated with growing commercial and artisanal (i.e., generally smaller scale local, non-commercial) fisheries in the region are serious and warrant close attention.

In the northern Indian Ocean, arribada nesting populations are still large but are characterized as stressed and either in decline or on the verge of decline due primarily to the incidental capture of large numbers of turtles in shrimp trawl and gillnet fisheries. Declines of solitary nesting olive ridleys have been reported in Bangladesh, Myanmar, Malaysia, Pakistan, and southwest India.

3.0 RESULTS

3.1 Recommended Classification:

3.1.1 Endangered population

Based on the best available information, we do not believe the breeding colony populations on the Pacific coast of Mexico should be delisted or reclassified. However, for the current population listings for the olive ridley (both Endangered and Threatened), we have information that indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the olive ridley. See Section 4.0 for additional information.

3.1.2 Threatened population

Based on the best available information, we do not believe the threatened olive ridley populations should be delisted or reclassified. However, for the current population listings for the olive ridley (both Endangered and Threatened), we have information that indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the olive ridley. See Section 4.0, for additional information.

3.2 New Recovery Priority Number: No change.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

We have preliminary information that indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the olive ridley. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The Services have not yet fully assembled or analyzed this new information; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins. To determine the application of the DPS policy to the olive ridley, the Services intend to fully assemble and analyze this new information in accordance with the DPS policy. See Section 2.3 for new information since the last 5-year review.

The current Recovery Plan for U.S. Pacific Populations of the Olive Ridley was completed in 1998. The recovery criteria contained in the Plan, while not strictly adhering to all elements of the 2004 NMFS Interim Recovery Planning Guidance, are a viable measure of the species status. The species biology and population status information can be updated; however, the recovery actions identified in the Plan are appropriate and properly prioritized. While some additional recovery actions can no doubt be identified, the Services believe that the current Plan remains a valid conservation planning tool. The Recovery Plan should be re-examined over the next 5-10 year horizon, particularly if the DPS analysis results in restructuring of the current listing, to update the plan to conform to the 2004 NMFS Interim Recovery Planning Guidance. In the near-term, additional information and data are particularly needed on genetic relationships among nesting populations, impacts of fisheries (particularly trawl and longline fisheries) on population status, foraging areas and identification of threats at foraging areas, and long-term population trends.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Olive Ridley Sea Turtle*

Current Classification: Endangered and Threatened

Endangered Population - breeding colony populations on Pacific coast of Mexico
Threatened Populations - wherever found except where listed as Endangered

Recommendation resulting from the 5-Year Review: No change

Review Conducted By:

Therese Conant, Barbara Schroeder (National Marine Fisheries Service)
Sandy MacPherson, Earl Possardt, Kelly Bibb (U.S. Fish and Wildlife Service)

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve ______________________ Date 8/7/07
David L. Hankla

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve ______________________ Date 8/21/2007
ACTING Assistant Regional Director

NATIONAL MARINE FISHERIES SERVICE
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Review Conducted By:

Therese Conant, Barbara Schroeder (National Marine Fisheries Service)
Sandy MacPherson, Earl Possardt, Kelly Bibb (U.S. Fish and Wildlife Service)

REGIONAL OFFICE APPROVAL: The draft document was reviewed by the appropriate Regional Offices and Science Centers.

HEADQUARTERS APPROVAL:
Director, Office of Protected Resources, NOAA Fisheries

Approve: ______________________ Date: JUL 30 2007
James H. Lecky

Assistant Administrator, NOAA Fisheries

__✓__ Concur _____ Do Not Concur

Signature______________________ Date 8/6/07
Samuel D. Rauch, III
Deputy Assistant Administrator
for Regulatory Programs

APPENDIX

Summary of peer review for the 5-year review of
***Olive Ridley Sea Turtle* (*Lepidochelys olivacea*)**

A. Peer Review Method: See B. below.

B. Peer Review Charge: On February 13, 2007, the following letter and Guidance for Peer Reviewers of Five-Year Status Reviews were sent via e-mail to potential reviewers requesting comments on the 5-year review. Requests were sent to Dr. Kartik Shanker (Indian Institute of Science), Dr. Alberto Abreu Grobois (Unidad Academica Mazatlan, Mexico), Dr. Roldán Valverde (Southeastern Louisiana University), Dr. Laurent Kelle (World Wildlife Fund, French Guiana), Dr. Peter Pritchard (Chelonian Research Institute), and Dr. Matthew Godfrey (North Carolina Wildlife Resources Commission).

We request your assistance in serving as a peer reviewer of the U.S. Fish and Wildlife Service and National Marine Fisheries Service's (Services) 5-year status review of the olive ridley sea turtle (Lepidochelys olivacea). The 5-year review is required by section 4(c)(2) of the United States Endangered Species Act of 1973, as amended (Act). A 5-year review is a periodic process conducted to ensure the listing classification of a species as Threatened or Endangered on the Federal List of Endangered and Threatened Wildlife and Plants is accurate. The initiation of the 5-year review for the olive ridley turtle was announced in the Federal Register on April 21, 2005, and the public comment period closed on July 20, 2005. Public comments have been incorporated into the status review.

The enclosed draft of the status review has been prepared by the Services pursuant to the Act. In keeping with directives for maintaining a high level of scientific integrity in the official documents our agencies produce, we are seeking your assistance as a peer reviewer for this draft. Guidance for peer reviewers is enclosed with this letter. If you are able to assist us, we request your comments be received on or before March 14, 2007. Please send your comments to Sandy MacPherson at the address on this letter. You may fax your comments to Sandy MacPherson at 904-232-2404 or send comments by e-mail to Sandy_MacPherson@fws.gov.

We appreciate your assistance in helping to ensure our decisions continue to be based on the best available science. If you have any questions or need additional information, please contact Sandy MacPherson at 904-232-2580, extension 110. Thank you for your assistance.

Sincerely yours,

David L. Hankla
Field Supervisor
North Florida Ecological Services Office

Enclosures

Guidance for Peer Reviewers of Five-Year Status Reviews

U.S. Fish and Wildlife Service, North Florida Ecological Services Office

February 7, 2007

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with Service policy.

Peer reviewers should:

1. Review all materials provided by the Service.

2. Identify, review, and provide other relevant data that appears not to have been used by the Service.

3. Not provide recommendations on the Endangered Species Act classification (e.g., Endangered, Threatened) of the species.

4. Provide written comments on:
- *Validity of any models, data, or analyses used or relied on in the review.*
- *Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.*
- *Oversights, omissions, and inconsistencies.*
- *Reasonableness of judgments made from the scientific evidence.*
- *Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.*
- *Strengths and limitation of the overall product.*

5. Keep in mind the requirement that we must use the best available scientific data in determining the species' status. This does not mean we must have statistically significant data on population trends or data from all known populations.

All peer reviews and comments will be public documents, and portions may be incorporated verbatim into our final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to Sandy MacPherson, National Sea Turtle Coordinator, U.S. Fish and Wildlife Service, at 904-232-2580, extension 110, email: Sandy_MacPherson@fws.gov.

C. Summary of Peer Review Comments/Report

A summary of peer review comments from the four respondents is provided below. The complete set of comments is available at the Jacksonville Ecological Services Field Office, U.S. Fish and Wildlife Service, 6620 Southpoint Drive South, Suite 310, Jacksonville, Florida, 32216.

The Services accepted all minor edits from peer reviewers. The only exception was for requests for updated citations within the document, and the Services were unable to obtain the cited material for review. Overall reviewers felt the draft document adequately characterizes the known information on the status and threats of the listed populations. The following discussion is limited to where there was disagreement.

Dr. Kartik Shanker, Indian Institute of Science, Bangalore, Karnataka, India: Dr. Shanker noted there were sufficient data to recommend reclassifying the Endangered breeding colony as threatened. Dr. Plotkin (contractor for the sections on 'New information on the Species Biology and Life History') described the studies as demonstrating genetic differences between solitary and arribada phenotypes; one of these studies links a genetic difference to behavioral polymorphism. Dr. Plotkin stated that Lopez-Castro and Rocha-Olivares (2005) found genetic differences between a solitary nesting population located on the Baja Peninsula of Mexico and arribada nesting populations located further south on continental beaches in Mexico and Costa Rica. Dr. Shanker noted there were insufficient data to support a genetic link to solitary and arribada mating strategies. Dr. Shanker disagreed with the interpretation of the Lopez-Castro and Rocha-Olivares (2005) and Jensen *et al*. (2006) papers. He believed neither study showed different genotypes between individuals that nest in arribadas or that nest solitarily.

Dr. Roldán Valverde, Southeastern Louisiana University, Hammond, LA, USA: Dr. Valverde also disagreed with the conclusion that solitary and arribada nesting behavior may be due to genetic differences. Dr. Valverde noted that data are lacking to conclude there may be subpopulation structure in the East Pacific. He noted that Lopez-Castro and Rocha-Olivares (2005) found no genetic differences between arribada turtles on the Baja California Peninsula and the main nesting beach of Oaxaca, Mexico. Dr. Valverde believes there a significant lack of data to appropriately evaluate the demographic status of the various olive ridley populations around the world, which hinders the adequate ranking of threats and the design of appropriate and responsive conservation measures.

Dr. Matthew Godfrey, North Carolina Wildlife Resources Commission, Beaufort, NC, USA: Dr. Godfrey believed the major shortcoming of the document was the prevalence of personal communications and the difficulty of critically assessing these citations. He also had concerns, similar to the other reviewers, about the interpretation of the Lopez-Castro and Rocha-Olivares (2005) and Jensen *et al*. (2006) papers. He pointed out that Jensen *et al*. (2006) attributed the differences in the level of multiple paternity between solitary and arribada nests to increased encounters with males. Dr. Godfrey disagreed that a change in census methods would fully account for the increase in nest numbers at Ostional, Costa Rica.

Dr. Laurent Kelle, World Wildlife Fund, French Guiana: No disagreements.

D. Response to Peer Review

Dr. Kartik Shanker, Indian Institute of Science, Bangalore, Karnataka, India: The Services do not believe the breeding colony populations on the Pacific coast of Mexico should be delisted or reclassified. However, we have information that indicates an analysis and review should be conducted in the future to determine the application of the DPS policy to the olive ridley. The Services requested that Dr. Plotkin address concerns raised by the peer reviewers regarding the interpretation of the Lopez-Castro and Rocha-Olivares (2005) and Jensen *et al*. (2006) papers. Dr. Plotkin responded that the genetic differences refer to the level of genetic diversity due to multiple paternity, not to a genetic difference in arribada and solitary nesters. She reiterated that genetic differences were clearly found in the solitary nesting population on the Baja California Peninsula. She offered that there are insufficient data to fully interpret the meaning of the differences in the level of multiple paternity between arribada and solitary nesters. The Services clarified the text by eliminating references to genetic differences in arribada and solitary nesters. Where discussed in the document, we provided additional results and conclusions from the relevant studies.

Dr. Roldán Valverde, Southeastern Louisiana University, Hammond, LA, USA: We agree with Dr. Valverde's concerns regarding the genetic link to mating strategies and possible population substructure in the East Pacific. The Services clarified the text by eliminating references to genetic differences in arribada and solitary nesters, and adding discussion on the population substructure in the East Pacific. Where discussed in the document, we provided additional results and conclusions from the relevant studies. We agree with Dr. Valverde about the need for more reliable and comprehensive data and have acknowledged the lack of data in several places in the 5-year review; however, we must proceed using the best available data.

Dr. Matthew Godfrey, North Carolina Wildlife Resources Commission, Beaufort, NC, USA: We agree that personal communications can sometimes be difficult to assess. We requested that Dr. Plotkin provide alternate citations, if possible; however, we were unable to obtain additional information. The Services believe personal communications from experts are appropriate when these communications provide the best data available. We agree with Dr. Godfrey's concerns regarding a genetic link to mating strategies. The Services clarified the text by eliminating references to genetic differences in arribada and solitary nesters. Where discussed in the document, we provided additional results and conclusions from the relevant studies. We agree that a change in census methods (primarily the "Chaves and Morera method" - see section 3.2.3.1.2) would not fully account for the increase in numbers of nests. The frequency of arribadas and area of the beach used during arribadas has increased, indicating an increase in nests not completely attributable to a change in census method. We described the census method as a partial contributor to the increase in nests.

Dr. Laurent Kelle, World Wildlife Fund, French Guiana: No disagreements.