Sea Turtles

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24

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Photo above:
Green turtle feeding on sea grass.

INTRODUCTION

Sea turtles are highly migratory and widely distributed throughout the world's oceans. Of the seven species found worldwide, six are found in U.S. waters and include the loggerhead, Kemp's ridley, olive ridley, green, leatherback, and hawksbill turtles. In the Pacific Ocean, all of these species except the Kemp's ridley inhabit either the U.S. coastal and Exclusive Economic Zone (EEZ) or the high seas. Nesting populations of the green and hawksbill occur in the Hawaiian Archipelago, American Samoa, and other U.S. territories (e.g. Guam, Northern Marianas, Palau, Micronesia, Jarvis Island, and Palmyra Atoll). With rare exception, the loggerhead, leatherback, and olive ridley do not nest in U.S. Pacific states or territories. The loggerhead, Kemp's ridley, green, hawksbill, and leatherback are commonly found in U.S. Atlantic waters, while the olive ridley almost exclusively inhabits South Atlantic Ocean waters. Significant nesting assemblages of the loggerhead, leatherback, green, and hawksbill are found in the southeastern United States and the U.S. Caribbean. The current status of U.S. sea turtles, based on research conducted at major nesting beaches, is summarized in Table 24-1.

All six species of sea turtles found in the United States are currently listed either as endangered or threatened under the Endangered Species Act (ESA). The Kemp's ridley, hawksbill, and leatherback are listed as endangered throughout their ranges. The loggerhead is listed as threatened. The green turtle is also listed as threatened, except for breeding populations found in Florida and on the Pacific coast of Mexico, which are listed as endangered. The olive ridley is listed as threatened, except for nesting populations on the Pacific coast of Mexico, which are listed as endangered. The authority to protect and conserve sea turtles in the marine environment is vested in the National Marine Fisheries Service (NMFS), while the U.S.

Table 24-1
Status of principal sea turtle nesting populations in the Atlantic and Pacific regions.

Species	ESA status[1]	Location of principal nesting populations[2]
Atlantic region		
Loggerhead	Threatened	North Carolina, South Carolina, Georgia, Florida
Green[3]	Endangered, threatened	Florida, all other Atlantic populations
Kemp's ridley	Endangered	Mexico
Leatherback	Endangered	Florida, U.S. Virgin Islands, Puerto Rico, Suriname, French Guiana
Hawksbill	Endangered	U.S. Virgin Islands, Puerto Rico
Pacific region		
Loggerhead	Threatened	Japan, Australia
Green[3]	Threatened, endangered	Hawaii, Mexico
Olive ridley[3]	Threatened, endangered	Mexico, Costa Rica
Leatherback	Endangered	Mexico, Central America (including Costa Rica), Irian Jaya, Malaysia
Hawksbill	Endangered	Hawaii

[1]Status under the Endangered Species Act (ESA).
[2]Sea turtles in the U.S. Atlantic and Pacific regions originate from nesting populations in the U.S. and foreign countries.
[3]The ESA status for this species varies for different breeding populations.

Fish and Wildlife Service (USFWS) has jurisdiction for protection of sea turtles, their eggs, and hatchlings on land (nesting beaches).

SPECIES AND STATUS

Sea turtles have complex life histories, but historical data on population sizes are limited or nonexistent. This paucity of long-term abundance and trend data makes it difficult to fully understand current population dynamics. Standardized surveys of selected nesting beaches were implemented in the United States for green turtles (in Hawaii) in 1973 and for other sea turtles in the late 1980's. These surveys, which count the number of nests laid per year, provide an index of the annual adult female population and an indication of whether their relative abundance is declining, stable, or increasing.

Atlantic Region

Loggerhead

Genetic research has enhanced our knowledge of sea turtle biology by identifying unique breeding populations. Only two large loggerhead nesting assemblages (e.g. > 10,000 nesting females per year) exist in the world, and are restricted to the southeastern United States and Masirah Island in the Middle Eastern country of Oman. The U.S. and Oman nesting aggregations are similar in size and represent about 35 and 40% of the nests, respectively, for this species. Most nesting in the United States occurs along Florida's east coast, where the mean annual number of nests deposited in south Florida from 1998–2002 was 75,459 nests per year. This number of nests equates to approximately 18,405 females nesting per year (Florida Fish and Wildlife Conservation Commission, unpublished data[1]). The most current analyses show evidence of a declining trend from 1982–2007 in the Florida aggregation. After reaching a high of almost 86,000 nests in Florida during 1998, the number dropped to 45,084 nests in 2007 (Florida Fish and Wildlife Conservation Commission, unpublished data[1]). Four U.S. nesting subpopulations occur: central and southwest Florida; north of Cape Canaveral, Florida (about 7,500 nests in 1998; stable or declining); the Florida Panhandle (about 1,000 nests in 1998); and the islands of the Dry Tortugas near Key West, Florida (about 200 nests per year). Adult and immature turtles from these four subpopulations, as well as a fifth subpopulation that nests along the Yucatán coast of Mexico, mix with each other on


Gray's Reef NMS

Loggerhead turtle moving up the beach at night to make a nest and lay eggs.

[1]Florida Fish and Wildlife Conservation Commission, 620 S. Meridian St., Tallahassee, FL 32399.

the foraging grounds. Important developmental habitat for juvenile loggerheads consists of inshore bays, sounds, and lagoons along U.S. Gulf and Atlantic coasts from Cape Cod, Massachusetts, to southern Texas.

Kemp's Ridley

The Kemp's ridley inhabits coastal waters throughout the U.S. Atlantic coast and the Gulf of Mexico. The Kemp's ridley is unusual in that it nests almost exclusively along one stretch of beach in the State of Tamaulipas on the Caribbean coast of Mexico. This single population underwent a dramatic decline after 1947, when on a single day an estimated 40,000 Kemp's ridley females were filmed coming ashore to nest. This mass nesting emergence is a phenomenon commonly known as an arribada. The population plummeted to fewer than 1,000 females nesting annually through the early 1980's. Today, under strict protection, the population appears to be in the earliest stages of recovery (Figure 24-1). Nesting, although still rare, has also increased in the United States (primarily Texas), rising from 6 in 1996 to 128 in 2007 (U.S. National Park Service, unpublished data[2]). This increase can be attributed to two primary factors—full protection of nesting females and their nests in Mexico, and the requirement to use turtle excluder devices (TED's) in shrimp trawls both in the United States and Mexico. Significant progress has also been made through collaboration with Mexico and the USFWS to establish and maintain more comprehensive nesting beach surveys for Kemp's ridleys.

Green

Green turtles are found in southeastern U.S. waters around the U.S. Virgin Islands and Puerto Rico, and off the continental United States from Texas to Massachusetts. Important feeding grounds in Florida include the Indian River Lagoon, the southeast Florida coastline, the Florida Keys, Florida Bay, Homosassa, Crystal River, Cedar Key, and St. Joseph Bay. North of Florida, the Pamlico–Albemarle Sound estuarine complex in North Carolina provides important foraging habitat, and green turtles are not uncommon in Connecticut and New York in the Long Island Sound during warmer months. In Texas, Laguna Madre once supported a significant green turtle population that was heavily exploited in the late 19th and early 20th centuries. The primary nesting beaches in the United States are along the east and southwest coasts of Florida; limited nesting also occurs in the U.S. Virgin Islands and Puerto Rico. The nesting population in the southeastern United States appears to be increasing, but is not genetically distinct from other nesting populations. Based on genetic information, subpopulations throughout the North and South Atlantic mix while on the foraging grounds. The number of nests deposited annually in the southeast United States fluctuates greatly, alternating between years of high and low levels of nesting, with an overall dramatic increase in the number of nests in Florida. From 1990–2007, Florida green turtle nests have ranged from 435 to 12,752 (Florida Fish and Wildlife Conservation Commission, unpublished data[1]).

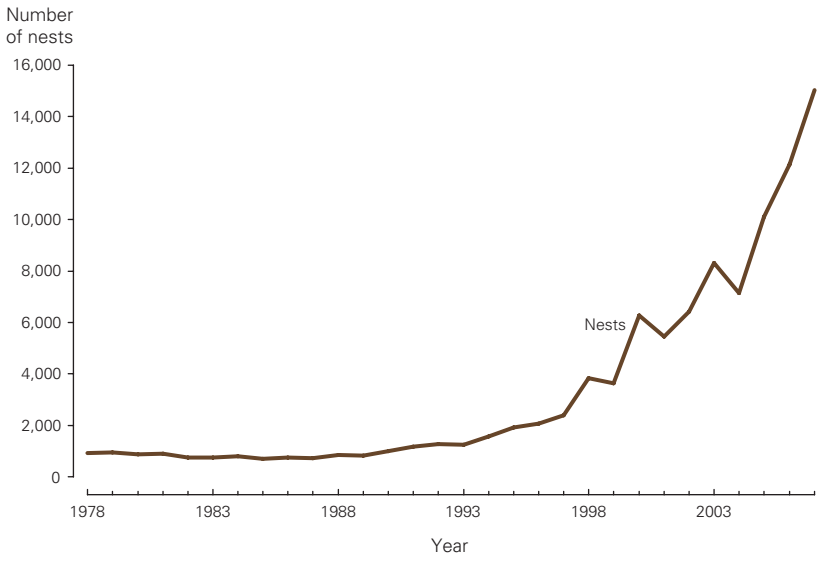

Figure 24-1
Number of Kemp's ridley nests observed annually at nesting sites of Tamaulipas and Veracruz, Mexico, 1978–2007 (Gladys Porter Zoo, 2001; R. Marquez M., unpublished data, SEMARNAP/INP, CRIP-Manzanillo, Program Nacional de Tortugas Marinas, P. Ventanas S/N, A.P. 591, Manzanillo, Colima, Mexico 28200).

Leatherback

Leatherbacks are capable of tolerating a wide range of water temperatures and are distributed along the entire U.S. East Coast from as far north as the Gulf of Maine, south to Puerto Rico and the

[2]U.S. National Park Service, 1849 C Street NW, Washington, DC 20240.

Scott R. Benson, SWFSC

Leatherback turtle surfacing to breathe.

U.S. Virgin Islands, and into the Gulf of Mexico. They occupy pelagic waters where they feed primarily on jellyfish and salps, but also commonly forage in coastal waters. In the western North Atlantic, waters shared with Canada (including the Gulf of Maine, Scotian Shelf, and Newfoundland) act as important seasonal foraging habitats for leatherbacks. To protect turtles while in these vital habitats, both countries collaborate on the development of an interactive and cooperative research program to address turtle conservation issues.

In the United States, the largest nesting assemblages of leatherbacks are found in the U.S. Virgin Islands, Puerto Rico, and Florida. Nesting in Puerto Rico between 1978–2005 has ranged from 469 to 882 nests, and the population has been growing since 1978 (TEWG, 2007). At the primary nesting beach on St. Croix, nesting has fluctuated from a few hundred nests to a high of 1,008 in 2001 (TEWG, 2007). The Florida nesting population is of growing importance, with between 800 and 900 total nests per year in the 2000's, following nesting totals of fewer than 100 nests per year in the 1980's (Florida Fish and Wildlife Conservation Commission, unpublished data[1]). However, U.S. nesting populations are very small in number compared to major Atlantic nesting grounds.

Hawksbill

The hawksbill is most commonly found in the Caribbean Sea, but also regularly occurs in southern Florida and southern Texas and has occasionally been recorded as far north as Massachusetts. Within the continental United States, a small amount of nesting occurs in Southeast Florida and the Florida Keys. The largest U.S. nesting assemblages of hawksbills are found at Mona Island in Puerto Rico, Buck Island in the U.S. Virgin Islands, and to a lesser extent at other sites in these areas. Approximately 500–1,000 nests are laid on Mona Island each year. The most significant nesting in the Caribbean Sea occurs in Mexico, where about 2,800 females nest in Campeche, Yucatán, and Quintana Roo each year. Hawksbill populations in the Atlantic were greatly depleted during the 20th century as a result of overharvest for trade in products made from their shells.

Pacific Region

Olive Ridley

Olive ridleys are well known for their synchronized mass nesting emergences, a phenomenon commonly known as arribadas. Although nonnesting individuals are occasionally seen in the waters of the southwestern United States, olive ridleys are rare in the Pacific Islands and do not have any nesting sites located on U.S. Pacific coasts. Significant nesting assemblages were once found along the Pacific coast of Mexico, but in recent years the Mexican arribadas have been largely restricted to one site, La Escobilla in the state of Oaxaca. In Costa Rica, a major nesting aggregation is found at Playa Ostional; smaller aggregations also occur in Nicaragua, Guatemala, and Panama. This species continues to be threatened by incidental capture in trawl and longline fisheries.

Loggerhead

Loggerheads originating from Japanese nesting beaches spend much of their early life stages in the central Pacific Ocean. A portion of this subpopulation regularly forages off the Pacific coast of Baja California, Mexico, and occasionally as far north

as the waters off southern California. Generally, the loggerheads found foraging off these coasts are immature. A few records exist of loggerheads as far north as Alaska and as far south as Chile; however, these extremes are likely not part of the normal range of the species. Loggerheads have been recorded in waters around the Northern Mariana Islands, American Samoa, and Hawaii, but are uncommon there. Loggerheads occupy both oceanic waters and coastal benthic habitats around continents during their life cycle. In the open ocean they are often associated with convergence zones, oceanic fronts, and boundary currents. Nesting occurs primarily in Japan and Australia. Currently, less than 1,000 female loggerheads nest annually in all of Japan and less than 500 nest annually in eastern Australia, where long-term data on nesting and foraging populations indicate a severe decline. Preliminary genetic analysis indicates that loggerheads inhabiting the eastern and North Pacific originate from the Japanese nesting stock, while animals foraging off of the coast of South America originate from nesting beaches in Australia (Dutton, unpublished data[3]).

Leatherback

The leatherback is a pelagic species that likely occurs near all U.S. Pacific islands and is widely distributed on the high seas. The leatherback is often sighted in coastal waters of the western United States, which provide critical foraging habitat. Principal leatherback nesting populations in the western Pacific occur in the Solomon Islands, Vanuatu, Papua (Indonesia), Papua New Guinea, and historically in peninsular Malaysia. In the eastern Pacific, principal leatherback nesting beaches occur in Mexico and Costa Rica. Leatherbacks are seriously declining at all major nesting beaches throughout the Pacific. The decline is dramatic along the Pacific coasts of Mexico and Costa Rica and coastal Malaysia. The Malaysian nesting population, once one of the largest in the Pacific (e.g. several thousand nesters annually), is essentially extinct, with only two or three females currently nesting each year. From 1984 to 1995, nesting at Mexiquillo, a major nesting beach on the Pacific coast of Mexico, declined at an annual rate of 22%. Similar declines have been reported for major nesting assemblages of leatherbacks in Costa Rica, with counts of nesting females declining from 1,367 in 1988–89 to 49 during the 2004–05 season. The collapse of these nesting populations has likely been caused by a tremendous overharvest of eggs, the direct harvest of adults, and incidental mortality from fishing. Satellite telemetry tracks from six post-nesting leatherbacks tagged at Jamursba-Medi, Papua, Indonesia, indicate that a portion of the western Pacific population utilizes the temperate waters off of North America (Benson et al., 2007). This information is consistent with genetic studies that are currently underway (Dutton et al., 2006).

Hawksbill

The hawksbill is typically more associated with islands than other sea turtle species and is often found foraging on coral reefs. Although not all U.S. flag islands in the western Central Pacific have been surveyed, the hawksbill likely occurs at most of them. The USFWS estimates that probably no more than 35 hawksbills nest in Hawaii each year, primarily along the east coast of the island of Hawaii. The number of hawksbills present in American Samoa and Guam is unknown, but nesting has been observed at Tutuila and the Manu'a Islands in American Samoa. The status of the hawksbill throughout the Pacific is unknown, but continued exploitation of hawksbills for their shells is a conservation concern. The most important conservation achievement for this species in recent years was the decision by Japan to end the import of hawksbill shell. Further declines are possible if this trade is renewed. Additionally, destruction and degradation of coral reefs that hawksbills rely on for food and habitat is a major threat to recovery.

Green

The green turtle is found throughout the North Pacific, occasionally ranging as far north as Eliza Harbor on Admiralty Island, Alaska, and Ucluelet, British Columbia. On the U.S. West Coast, a resident population of green turtles occurs in San

[3]P. H. Dutton, NMFS Southwest Fisheries Science Center, 8604 La Jolla Shores Dr., La Jolla, CA 92037.

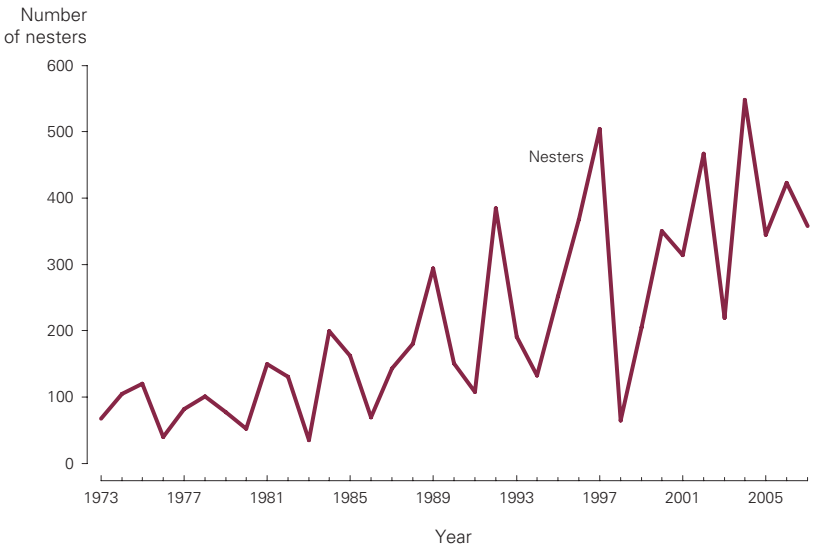

Figure 24-2
Population estimates for nesting green turtles on East Island, French Frigate Shoals, Northwest Hawaiian Islands, 1973–2007.

Diego Bay. In the Central Pacific, green turtles can be found at most tropical islands including the islands in the Hawaiian Archipelago. Ninety to 95% of all nesting and breeding activity occurs in the Northwestern Hawaiian Islands at French Frigate Shoals. At least 50% of these activities take place on East Island, which has been monitored by researchers since 1973 (Figure 24-2). Beach counts of nesting females have increased over the last three decades from a low of 35 individuals in 1983 to a high of 548 in 2004. This increase in Hawaiian green turtle counts is attributed to a reduction in human-caused mortality after the species was listed under the ESA in 1978. In American Samoa, the primary nesting beach is at Rose Atoll where an estimated 15 to 25 females return annually. The number of green turtles in Guam is unknown, and only low nesting activity has been recorded there. Based on limited data, green turtle populations in American Samoa, Guam, Palau, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Republic of the Marshall Islands, and the Unincorporated Islands (Wake, Johnston, Kingman, Palmyra, Jarvis, Howland, Baker, and Midway) have declined dramatically, due foremost to the harvest of eggs and adult turtles by humans. Genetic studies to determine the population structure and migratory patterns of green turtles in the Pacific are currently underway.

Significant progress is being made in the monitoring of Hawaiian green turtles by NMFS and USFWS. A 5-year series of saturation surveys completed in 1992 led to the development of rigorous quantitative methods to estimate the nesting population. Progress is also being made in monitoring juvenile and subadult Hawaiian green turtles in their nearshore habitat.

ISSUES

Fisheries Interactions

Sea turtles are threatened by multiple factors, most of which are human-related. A principal concern is their incidental capture in fisheries. Trawl, longline, and gillnet fisheries pose the greatest threats, although turtles are also taken and killed in fixed-gear fisheries, such as pound nets and traps/pots. Trawl fisheries pose a large threat to turtle survival, although much progress has been made towards reducing this source of mortality. Prior to the implementation of TED regulations, the National Academy of Sciences estimated that as many as 44,000 sea turtles, mostly loggerheads and Kemp's ridleys, were killed annually in the Gulf of Mexico and southeastern U.S. Atlantic shrimp trawl fisheries. Currently, TED use is mandated for the shrimp fishery and a portion of the summer flounder trawl fishery. In 2003, regulations were amended to increase the size of the TED escape opening, a change that benefits larger species such as leatherback and adult green and loggerhead turtles.

In the Pacific and Atlantic pelagic longline fisheries for highly migratory species (including tuna, swordfish, and some shark species), the incidental take of sea turtles is monitored through a logbook and observer program. Workshops have been held to formulate research techniques to assess the population-level effects of hooking and entanglement and to identify ways to reduce or mitigate incidental capture in longline fisheries.

NMFS supported a landmark experiment to evaluate the effects of hook and bait types on sea turtle bycatch in pelagic longline fisheries in the eastern Atlantic, known to capture significant numbers of sea turtles. NMFS also conducted fishery-dependent research on the Grand Banks in the North Atlantic to identify gear and fishing method modifications that would reduce or

eliminate the bycatch of sea turtles while preserving local longline fisheries. Researchers found that using larger offset circle hooks and substituting mackerel-style bait had the potential to significantly reduce the interaction rate and mortality rate of leatherbacks and loggerheads.

Implementation of U.S. gear modifications, such as those demonstrated in gear experiments in the Atlantic, may have broader implications for sea turtles around the world. If modifications in longline fishing practices demonstrate that target species (e.g. swordfish) can be caught sustainably and with similar catch-per-unit-effort as before, the international community will be more likely to accept the results of such studies and to adopt gear and fishing modifications.

In related research, satellite transmitters have been deployed on sea turtles captured on longline hooks to track post-release movements and better understand the long-term effects on individual animals. Linkages between individual movements and oceanographic processes are also being studied, and computer simulation models are under development to better assess the impacts of Pacific fisheries on these populations.

Significant progress has been made with coastal states to investigate fishery interactions in the Mid-Atlantic and to implement a management response to reduce annual spring mortality of loggerheads and Kemp's ridleys in Virginia and North Carolina waters. A comprehensive NMFS strategy for sea turtle conservation and recovery in Atlantic Ocean and Gulf of Mexico commercial and recreational fisheries addresses incidental capture through a consistent, gear-based approach.

Non-Fisheries Interactions

Propeller strikes and vessel collisions pose significant threats to sea turtles, especially in areas of high human population where recreational boat and commercial traffic is heavy and coastal ports are active. Sea turtles can become entrained and killed in the draghead of hopper dredges used in constructing and maintaining navigation channels. Coastal power plants that draw their cooling water from nearshore and estuarine waters can also entrain sea turtles and cause mortality.

SEFSC Pascagoula Laboratory

Children travel through a makeshift shrimp trawl equipped with a TED. Outreach and education events, such as this one sponsored by the NMFS Pascagoula Laboratory, help teach people about sea turtle conservation.

Habitat Concerns

Coastal development can interfere with or prevent nesting and affect reproductive success. Monitoring and protecting beaches of the southeastern United States and Hawaii is essential to the survival and recovery of sea turtles. Many nesting beaches have already been significantly degraded or destroyed. In particular, nesting habitat is threatened by coastal armoring structures (i.e. rigid shoreline protection) such as sea walls, rock revetments, and sandbag installations. Many miles of once productive nesting beach have been permanently lost to this type of shoreline protection. Additionally, nesting habitat can be negatively impacted by altered beach and sand characteristics resulting from beach nourishment projects. Artificial beachfront lighting, increased human activity in the coastal zone, and beach driving also seriously threaten species' recovery. In light of these issues, conservation and long-term protection of nesting habitats is an urgent and high priority need.

Development in the coastal zone can also degrade the foraging habitat of sea turtles. Important foraging grounds for several species of sea turtles exist along the U.S. East Coast and throughout the Gulf of Mexico near major areas of nearshore and

Ursula Keuper-Bennett/Peter Bennett

Hawaiian green turtle exhibiting the skin, eye, and oral tumors that result from fibropapillomatosis (FP).

offshore oil exploration and production. Offshore oil extraction may result in chronic low-level spills and occasional massive spills, which may imperil important foraging habitat.

Damage and destruction of coral reefs and nearshore hard-bottom habitat is also an important habitat issue facing sea turtles. Many sea turtles rely on coral reefs for food and habitat; degradation of these critical habitats can pose a major threat to turtle species' recovery.

Marine Debris

Ingestion of marine debris can be a serious threat when turtles mistake debris for natural food items. An examination of loggerhead hatchlings' feeding habits in offshore convergence zones revealed a high incidence of tar and plastic in their stomachs. Some types of marine debris, such as oil, may be directly or indirectly toxic through exposure or ingestion. Other hazards, such as discarded or derelict fishing gear, may also entangle and drown turtles.

Disease

A disease known as fibropapillomatosis (FP), originally identified in green turtles but now affecting other species as well, has emerged as a serious threat to the recovery of some populations. The disease is most notably present in green turtles of Hawaii, Australia, Florida, and the Caribbean. FP can be fatal and is commonly expressed as tumors that occur on the skin and eyes. Regional differences in symptoms exist between some affected populations; in Hawaii, green turtles have a high incidence of tumors in the oral cavity, whereas oral tumors have not been found in Florida or other areas. The cause of the disease remains unknown, although a fibropapilloma-associated turtle herpesvirus is consistently present in turtles with FP (Greenblatt et al., 2004).

Recently, FP has been systematically monitored in several locales in Hawaii. At a study site on southern Molokai where tumors were virtually unknown before 1988, the prevalence of tumored green turtles ranged from 42 to 56% during the 1995–97 surveys and declined to 9–15% during the 2005–07 surveys. In Florida, up to 50% of the immature green turtles captured in Indian River Lagoon are infected, and there are similar reports from other sites, including Florida Bay, as well as Puerto Rico and the U.S. Virgin Islands. The disease has also been found to affect loggerheads in Florida Bay.

A multidisciplinary research program is underway to study the cause and effects of FP. The possible etiologies of the disease, including viruses, parasites, and environmental pollutants are also under investigation. Recent studies demonstrated the involvement of both a retrovirus and a herpesvirus. In addition to field and laboratory research, statistical analyses and modeling are underway to link FP incidence and severity to key aspects of green turtle population dynamics and to assess impacts on population recovery.

Progress

In 1998, recovery plans were published for five species of Pacific sea turtles and one regionally distinct and important population (the East Pacific green turtle). U.S. Atlantic recovery plans were completed in the early 1990's; two plans, the loggerhead and Kemp's ridley, are currently under revision. These plans describe and prioritize the actions that are necessary to conserve and recover turtles throughout their ranges. In addition to addressing these issues, research priorities focus on understanding population structure, migratory movements, and life histories, as well as threats to sea turtle recovery.

In the last decade, considerable effort has been expended to elucidate sea turtle management units (stocks) through the use of genetic tools. For all species, scientists have found a high degree of genetic

Caroline Rogers, USGS

Hawksbill turtle.

structuring within ocean basins. It is believed that these genetically distinct stocks arose as a result of genetic isolation facilitated by the species' natal homing behavior. While the animals appear to segregate when nesting, they commingle on foraging grounds, sometimes thousands of miles away from natal beaches (where they hatched).

Additionally, the analyses of genetic material from turtles incidentally taken in various fisheries can tell us which populations are being impacted by fisheries interactions. For example, the Hawaii-based longline fishery interacts with loggerheads originating from Japan, green turtles originating from Hawaii and the eastern Pacific (Mexico or Ecuador), and leatherbacks originating primarily from the far western Pacific rookeries—Papua (Indonesia), Malaysia, and the Solomon Islands—and to a lesser extent from the eastern Pacific—Mexico and Costa Rica. The fishery also interacts with olive ridleys originating from both the eastern Pacific, and the Indian and western Pacific rookeries. Eastern Atlantic and Mediterranean longline fisheries interact with migrating loggerheads from the western Atlantic (primarily the United States).

Genetic analyses also can identify the natal areas of turtles mixing on foraging grounds. Loggerheads inhabiting foraging habitats along the East Coast of the United States originate from the United States, Mexico, and Brazil. Green turtles co-occur from Florida, the Caribbean, and the South Atlantic Ocean (east and west). Leatherbacks caught in the Northeastern Distant Fisheries in the Atlantic originate from the western Atlantic stock (e.g. Caribbean).

Complementing the genetic work, satellite telemetry studies are helping to identify routes of travel and resident foraging grounds of sea turtles. NMFS scientists have successfully used satellite telemetry to study the migratory movements of post-nesting Hawaiian and Florida green turtles; Florida loggerheads; foraging green turtles in San Diego Bay; post-nesting leatherbacks in the western Pacific and St. Croix, U.S. Virgin Islands; and foraging Pacific leatherbacks off central California.

NMFS has conducted considerable research on various kinds of tags to mark and identify sea turtles in order to collect important biological information on life history variables such as growth,


Michael Jensen

Olive ridley turtle.

survival rates, and age at maturity. A number of studies are also investigating habitat use to further our understanding of the life histories of Kemp's ridleys, loggerheads, and greens. Work at study sites in Florida, North Carolina, the northwestern Gulf of Mexico, and Hawaii will help determine the importance of inshore and nearshore habitats to the survival of these species. Based on this research, critical habitat for the green turtle has been designated for the nearshore foraging grounds off Culebra, Puerto Rico, and for the hawksbill on Mona and Monita Islands, Puerto Rico.

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