

Assessment of Sea Turtle Status and Trends

Integrating Demography and Abundance

All six species of sea turtles found in U.S. waters are listed as endangered or threatened, but the exact population sizes of these species are unknown due to a lack of key information regarding birth and survival rates. The U.S. Endangered Species Act prohibits the hunting of sea turtles and reduces incidental losses from activities such as shrimp trawling and development on beaches used for nesting. However, current monitoring does not provide enough information on sea turtle populations to evaluate the effectiveness of these protective measures. This National Research Council report reviews current methods for assessing sea turtle populations and finds that although counts of sea turtles are essential, more detailed information on sea turtle biology, such as survival rates and breeding patterns, is needed to predict and understand changes in populations in order to develop successful management and conservation plans.

Sea turtles are vulnerable to the perils of ocean life. With long lifetimes and wide-ranging migration patterns, sea turtles are exposed to many sources of danger both in coastal locations and in the open sea, including environmental accidents like oil spills, incidental capture in fishing nets, and changes in the ocean environment. Furthermore, some societies prize sea turtles and their eggs for food and for their putative therapeutic value, making sea turtles a target for hunters. Because it takes many years for sea turtles to mature and reproduce, populations are slow to recover from losses.

To protect dwindling sea turtle populations, regulations are in place to prohibit or limit activities that can harm the animals. Additional information on sea turtle populations is needed to assess if these measures are effective—but current monitoring methods rely in large part on counts of the adult

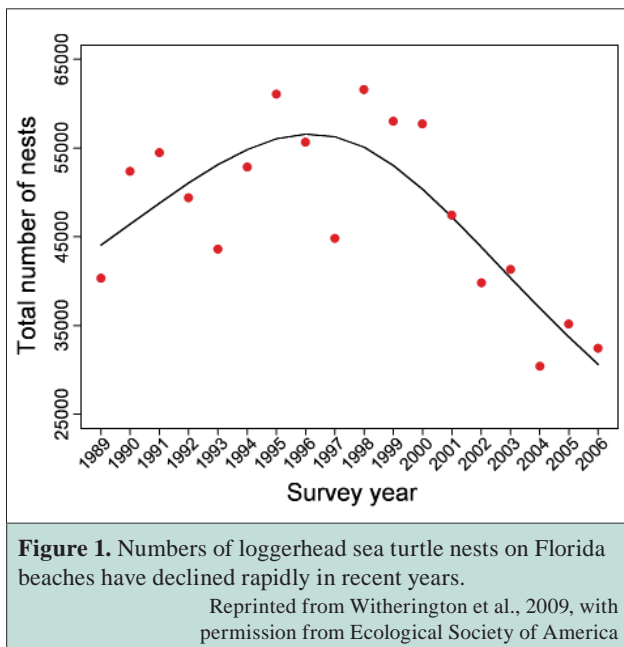


Hawaiian green sea turtle in the Hawaiian Islands Humpback Whale National Marine Sanctuary.
Credit: Claire Fackler, NOAA National Marine Sanctuaries

females that return to land each year to lay their eggs on nesting beaches, information that doesn't provide an accurate picture of the whole sea turtle population. Improved population assessments are important to develop and adjust management plans for sea turtle populations.

In response to these concerns, the National Marine Fisheries Service of

the National Oceanic and Atmospheric Administration requested that the National Research Council form a committee to investigate methods of improving assessments of sea turtle populations. The committee reviewed existing methods, identified gaps in information, and suggested improvements for monitoring and data collection. The committee's central finding was that, in addition to estimates of the numbers of sea turtles, more detailed information is needed on key stages of the sea turtle lifecycle, such as breeding,



survival, and dispersal of hatchlings from nesting beaches into the sea. These data would provide insight on the causes of declining sea turtle populations and could be used to develop management plans to limit and reverse these declines.

Gathering Information

To measure the impacts of environmental change or the success of conservation work, researchers monitor specific sea turtle populations, defined as groups of individuals of the same species whose members interbreed and experience similar conditions, resulting in common birth, mortality, and growth rates. However, keeping track of sea turtle populations is difficult. Their wide-ranging migration patterns make sea turtles virtually inaccessible to researchers for large periods of time. Furthermore, foraging activities can bring different sea turtle populations into the same area, where the intermingling of groups can prevent researchers from collecting data from just one population.

Adult female sea turtles return to the same beach to nest every two or three years, providing an opportunity to observe and collect data from a single population. Many U.S. nesting beaches have programs in place to count sea turtle nests, but the connection between the number of nests on the beach and the status of the population is weak. Counts of sea turtles at a single life-cycle stage can be misleading for diagnosing the status and trends of the whole population—adult females represent only a subset of the whole population, and not

every female in the population returns to nest every year. The report's authoring committee concluded that collecting and analyzing demographic information on sea turtle population biology, such as survival and reproductive rates, provides a more accurate picture of the whole population and could help researchers draw robust conclusions from their observations. In addition, efforts should be made to monitor sea turtles at locations other than nesting beaches in the hope of collecting data on all sectors of the population (see illustration).

Data on environmental factors such as resource availability, ocean temperature, and ocean currents can help researchers interpret demographic information. Processes such as breeding or mortality are sensitive to environmental conditions; for example, the availability of food affects the age at which sea turtles begin to breed, the frequency with which females lay eggs, and the number of years between breeding seasons. An understanding of the relationship between environmental conditions and demographic information is essential to predict the population changes that could occur in response to changes in habitat or climate. Models can be used to help link population counts, demographic rates, and information on environmental factors to allow managers of sea turtle populations to identify trends and make decisions to help prevent population declines.

Improving Data Management, Coordination, and Education

The report's authoring committee suggested that the National Marine Fisheries Service and US Fish and Wildlife Service develop management plans for sea turtles based on both counts of sea turtles and demographic information. Improved data management, coordination, and education are needed to allow researchers to collect and analyze this information.

- In general, not enough accurate information on sea turtle populations is collected, even though hundreds of projects have been established throughout the United States to monitor sea turtle populations and research sea turtle biology. All too often, data collected by one organization are not accessible to other researchers because the methods for collecting and analyzing data are not standardized, or because of issues with data ownership. This

The Lifecycle of Sea Turtles



Mature female sea turtles nest every two to three years, somehow returning to the same beaches where they themselves hatched.



On the beach, female sea turtles dig nests in the sand and enter a trance-like state as they lay clutches of about 100 eggs.



Some species, such as loggerhead, green, hawksbill, and Kemp's ridley turtles, roam between the open ocean and the nearshore as juveniles. Others, such as the leatherback and olive ridley, remain in the open ocean throughout their lives. All sea turtles undergo extensive migrations in response to changes in temperature and to forage for food. Mating occurs at sea.



After covering their eggs with sand, female sea turtles head back to the ocean.



The eggs incubate for about two months before hatching. Then, the baby sea turtles make their way into the sea. With the exception of basking green turtles in Hawaii and other areas, only adult female turtles will ever return to land.

DNA Testing

DNA testing can differentiate sea turtle populations by identifying the genetic markers unique to particular sea turtle groups. For this analysis to work, samples must be taken from sea turtles at both the breeding and nesting sites to establish the genetic characteristics of the population. Samples are then taken from sea turtles on foraging grounds or during migrations and used to distinguish among different populations in mixed groups or to trace the lineage of sea turtle populations in order to figure out how new populations are established.

species; however, most sea turtle researchers agree that the permitting process is a greater obstacle to research than is necessary to protect sea turtles and can delay or hamper innovative research projects. The report's authoring committee recommended

lack of coordination is a major impediment to the management and conservation of sea turtles. Plans should be developed for the collection and analysis of data to address data gaps, with the input of sea turtle biologists and other experts who collect, analyze, and use the data. An online database also should be established to store and allow easy access to the information.

- Partnerships between the National Marine Fisheries Service, which manages sea turtles in the water, the U.S. Fish and Wildlife Service, which is responsible for sea turtles when on land, and other government agencies, universities, research institutions are needed to improve coordination between researchers and encourage data sharing.
 - Because sea turtles are endangered, permits are required to carry out research on the
- Accurate assessments of sea turtle populations and statistical analyses of population dynamics require extensive knowledge of topics such as statistics, modeling, study design and data analysis. To provide this information to managers of sea turtle populations, one strategy would be to recruit statisticians and modeling specialists from fields outside of conservation biology. Longer-term solutions include launching interdisciplinary training of fisheries and conservation professionals. Training would include population and ecosystem ecology, statistics, modeling, and also economics, policy, and decision analysis to provide insight into how the conservation of natural resources can be achieved.

that methods be developed to expedite the permitting process while meeting legislative requirements and intent.

Committee on the Review of Sea Turtle Population Assessment Methods: **Karen A. Bjorndal**, (*Chair*), University of Florida; **Brian W. Bowen**, University of Hawaii; **Milani Chaloupka**, Ecological Modelling Services Pty Ltd, St. Lucia, Australia; **Larry B. Crowder**, Duke University; **Selina S. Heppell**, Oregon State University; **Cynthia M. Jones**, Old Dominion University; **Molly E. Lutcavage**, University of New Hampshire; **Andrew R. Solow**, Woods Hole Oceanographic Institution; **Blair E. Witherington**, Florida Fish and Wildlife Conservation Commission; **Jodi Bostrom** (*Associate Program Officer*); **Susan Park** (*Senior Program Officer*), until December 31, 2009; **David Policansky** (*Scholar*); **Jeremy Justice** (*Senior Program Assistant*), National Research Council.

The National Academies appointed the above committee of experts to address the specific task requested by the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.



For more information, contact the Ocean Studies Board at (202) 334-2714 or visit <http://nationalacademies.org/osb>. Copies of *Assessment of Sea Turtle Status and Trends: Integrating Demography and Abundance* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

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