Research and Management Techniques for the Conservation of Sea Turtles
K. L. Eckert, K. A. Bjorndal, F. A. Abreu-Grobois, M. Donnelly (Editors)
IUCN/SSC Marine Turtle Specialist Group Publication No. 4, 1999

Priorities for Research in Foraging Habitats

Karen A. Bjorndal
Archie Carr Center for Sea Turtle Research, Department of Zoology, P. O. Box 118525, University of Florida, Gainesville, Florida 32611 USA; Tel: +1 (352) 392-5194; Fax: +1 (352) 392-9166; email: kab@zoo.ufl.edu

Research on sea turtles on their foraging grounds has lagged far behind research on nesting beaches. Although sea turtles spend at most 1% of their lives in or on nesting beaches—in the form of embryos, hatchlings, and adult females that emerge to deposit their eggs—approximately 90% of the literature on sea turtle biology is based on nesting beach studies. Clearly, the reproductive period is a critical one, but the uneven distribution of research effort is not due to this fact alone. Generally, research on nesting beaches is less expensive and has higher ratios of turtle encounters to human effort than does research on foraging grounds. Anyone who has spent days on rough seas searching for turtles and finding them at a rate of one per day cannot help but think wistfully of the colleague working on the nesting beach who, during a pleasant evening stroll, is certain to encounter many more turtles. The bias toward nesting beach research also reflects the fact that many biologists who work with sea turtles were trained in programs that stressed terrestrial, rather than marine, habitats. This terrestrial bias influences not only the choice of habitats, but also the way in which questions are asked. One can only wonder if the "lost year" stage of all but two sea turtle populations would still be lost if more marine-oriented scientists were involved in sea turtle biology.

Role in the Ecosystem

The role of sea turtles in the structure and function of ecosystems has been largely unstudied and should be addressed as a high priority. An understanding of their capacity to affect ecosystem structure and function can be viewed as the ultimate integration of our knowledge of sea turtle biology. In addition to this excellent goal of basic biology, such studies have important implications for the management and conservation of sea turtles and marine ecosystems. Under the pressure of increased demand, priority for access to conservation resources is shifting to those species that have critical roles in the functioning of ecosystems. Are sea turtle species central to and essential for healthy ecosystem processes or are they relict species whose passing would have little effect on ecosystem function? To answer this question, the roles of sea turtles as predators and prey, as competitors with other species, and as conduits for substantial energy and nutrient flows within and between ecosystems must be elucidated. Necessary analyses range from simple studies of feeding habits—tremendous gaps still exist in our knowledge of sea turtle diets—to evaluation of complex interspecific interactions, such as of hawksbills in a coral reef habitat.

Pelagic Studies

High priority must be given to the early pelagic stage that occurs in most sea turtle species. Undoubtedly the poorest known life-stage, the location of this stage is only known for two populations—the North Atlantic and North Pacific loggerhead populations. Thus, studies of these two pelagic populations are of prime interest, and efforts must be made to locate the early life-stages of other populations.

In addition to the early pelagic stage, increased emphasis is needed on the pelagic stage in those species—primarily the leatherback and olive ridley—that remain in pelagic habitats as sub-adults and adults. In general, these two species are the least studied, largely because of their pelagic distribution.

Population Identification, Migrations, and Abundance

Identification of sea turtle populations throughout their life cycle is another area of research that deserves high priority. Most sea turtles undertake complex developmental migrations that carry them through a number of habitat types and many different national jurisdictions. These complex migrations and variable residence times result in enigmatic distribution patterns with turtles from various nesting populations intermingling on foraging grounds. These characteristics significantly increase the difficulties of developing effective management plans for sea turtle populations. Three approaches are currently employed in these investigations: passive tags (both external and internal), satellite telemetry, and genetic markers. Each of these techniques has advantages and disadvantages, and the resolution of movement patterns and population identification undoubtedly will result from an integration of these three approaches as well as techniques not yet developed.

The lack of reliable methods to estimate population levels in foraging habitats hampers our ability to monitor population trends over time. Development of reliable techniques of population estimation, either relative or absolute, should be a high priority. Such techniques would allow us to monitor the effects of human activities on sea turtle populations and the success or failure of management policies.

Closely related to the elucidation of distribution and migratory patterns and population abundance is the identification of critical habitats—other than nesting beaches—that must be protected to ensure that minimum habitat requirements of sea turtle populations are met. These habitats will include pelagic and benthic foraging areas, mating and internesting habitats, and migratory corridors that are used by turtles when moving among these habitats.

Population Structure and Regulation of Productivity

Quantitative descriptions of population structure and measures of critical demographic parameters such as somatic growth rates, age at first reproduction, survivorship, recruitment, migration, and sex ratio are essential for the development of population models. Growth rates and residence times also provide invaluable bioassays for habitat quality and population health. Studies that address these priority parameters are underway, but many more are needed that represent the complete range of habitat types and species. Genetic structure of populations can be integrated with the more standard measures of population structure to give important new insights into this field.

Descriptive assessments of demographic parameters, however, cannot be the end point. Priority should be given to studies that go beyond the descriptive level and evaluate the regulatory mechanisms that control these demographic parameters. Such studies would examine the roles of nutrition, hormones, genetics, physiology, disease, and behavior in the regulation of productivity (growth and reproduction). Research in this area would address such questions as why green turtles grow at different rates in different foraging grounds and why intervals between breeding seasons appear to be consistently longer in some geographic regions than in others for the same species. Only by understanding the regulation of productivity can we gain the ability to predict how sea turtle populations will respond to perturbations in their environment from such factors as global climate change or various human activities.

Anthropogenic Effects

Knowledge of the effects of human activities on sea turtles in foraging habitats are clearly a high priority for the management and conservation of sea turtles. Current levels of directed take of sea turtles on foraging grounds and the effect of these harvests on population stability should be assessed. The opinion that sea turtle populations can sustain harvests on their foraging grounds as long as they are protected at their nesting beaches reflects a lack of understanding of just how unrelenting and efficient such harvests can be.

Also critical is the quantification of indirect effects on sea turtle populations such as incidental capture in fisheries, potential for competition between humans and sea turtles for food, and effects of pollution and debris. Degradation of foraging habitats through pollution, siltation, and destructive fishery practices is much more difficult to monitor than that of nesting habitats, but no less important. Degradation of habitat quality may have widespread effects by suppressing the immunological system of sea turtles and making them more susceptible to disease and other stressors.

Human activities must be assessed not only for lethal effects on sea turtles, but also for sub-lethal effects. The latter are often more difficult to discern, but their cumulative effect of lowering growth

rates and reproductive output can have a greater population effect than that of direct mortality. Measures of human impacts should be incorporated into sea turtle population models to evaluate their overall effect on sea turtle populations. Development of mitigation measures should be given high priority.

Conclusion

The research described in this section requires substantial investments of time, efforts, and funds. Resources are not available to support such studies on all populations of all sea turtle species. Thus, a high priority should be given to the development of predictive methods that employ more readily available data to address these research needs. Examples of such methods are the use of size-frequency data to estimate growth rates or the use of remote sensing to predict current-mediated movements of young, pelagic-stage sea turtles. Once validated, such techniques can have wide application. Also, representative populations should be selected for intensive studies and long-term monitoring. By focusing on such "index" populations, resources can be used most effectively.

Of course, the value of any of the above studies is only realized when the results are analyzed and published. Timely publication of research results should always be a high priority. Methods—such as regional databases—should be established so that data of regional significance can be shared, and interdisciplinary studies, which can focus broad areas of expertise on individual questions, should be encouraged.