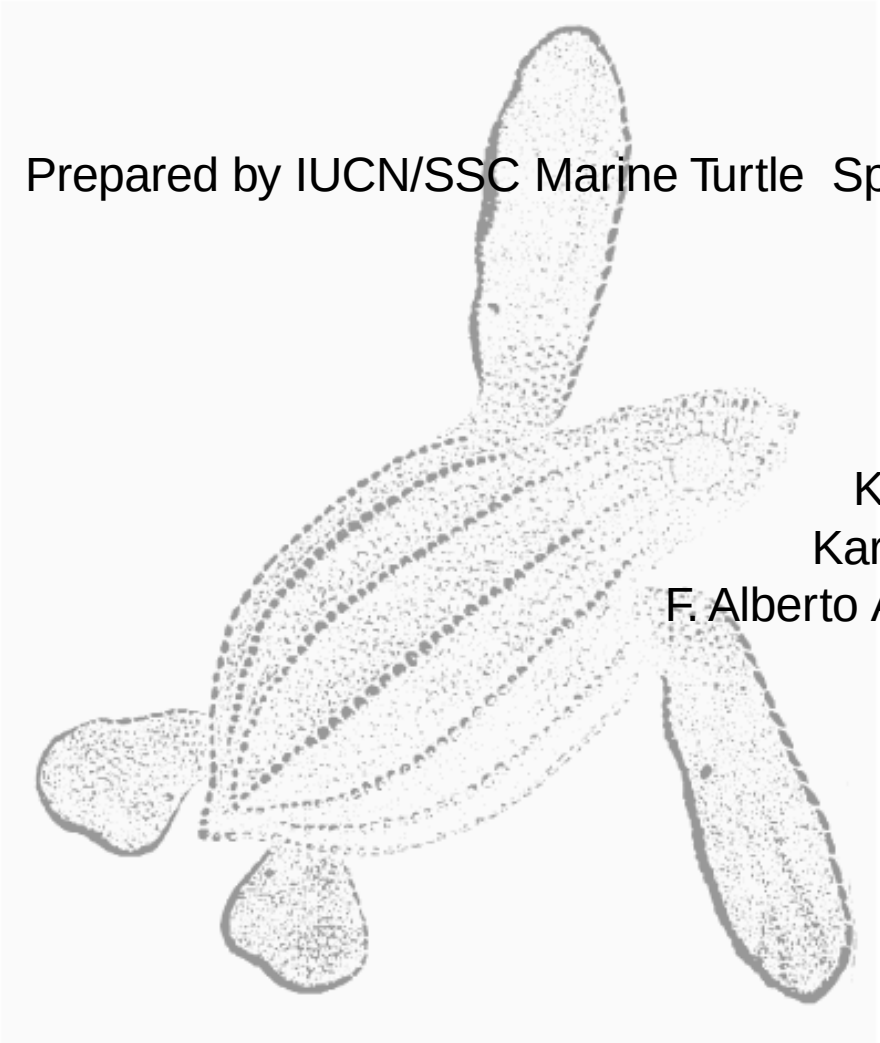
Research and Management Techniques for the Conservation of Sea Turtles

Prepared by IUCN/SSC Marine Turtle Specialist Group



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Preface

In 1995 the IUCN/SSC Marine Turtle Specialist Group (MTSG) published *A Global Strategy for the Conservation of Marine Turtles* to provide a blueprint for efforts to conserve and recover declining and depleted sea turtle populations around the world. As unique components of complex ecosystems, sea turtles serve important roles in coastal and marine habitats by contributing to the health and maintenance of coral reefs, seagrass meadows, estuaries, and sandy beaches. The *Strategy* supports integrated and focused programs to prevent the extinction of these species and promotes the restoration and survival of healthy sea turtle populations that fulfill their ecological roles.

Sea turtles and humans have been linked for as long as people have settled the coasts and plied the oceans. Coastal communities have depended upon sea turtles and their eggs for protein and other products for countless generations and, in many areas, continue to do so today. However, increased commercialization of sea turtle products over the course of the 20th century has decimated many populations. Because sea turtles have complex life cycles during which individuals move among many habitats and travel across ocean basins, conservation requires a cooperative, international approach to management planning that recognizes inter-connections among habitats, sea turtle populations, and human populations, while applying the best available scientific knowledge.

To date our success in achieving both of these tasks has been minimal. Sea turtle species are recognized as "Critically Endangered," "Endangered" or "Vulnerable" by the World Conservation Union (IUCN). Most populations are depleted as a result of unsustainable harvest for meat, shell, oil, skins, and eggs. Tens of thousands of turtles die every year after being accidentally captured in active or abandoned fishing gear. Oil spills, chemical waste, persistent plastic and other debris, high density coastal development, and an increase in ocean-based tourism have damaged or eliminated important nesting beaches and feeding areas.

To ensure the survival of sea turtles, it is important that standard and appropriate guidelines and criteria be employed by field workers in all range states. Standardized conservation and management techniques encourage the collection of comparable data and enable the sharing of results among nations and regions. This manual seeks to address the need for standard guidelines and criteria, while at the same time acknowledging a growing constituency of field workers and policy-makers seeking guidance with regard to when and why to invoke one management option over another, how to effectively implement the chosen option, and how to evaluate success.

The IUCN Marine Turtle Specialist Group believes that proper management cannot occur in the absence of supporting and high quality research, and that scientific research should focus, whenever possible, on critical conservation issues. We intend for this manual to serve a global audience involved in the protection and management of sea turtle resources. Recognizing that the most successful sea turtle protection and management programs combine traditional census techniques with computerized databases, genetic analyses and satellite-based telemetry techniques that practitioners a generation ago could only dream about, we dedicate this manual to the resource managers of the 21st century who will be facing increasingly complex resource management challenges, and for whom we hope this manual will provide both training and counsel.

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Priorities for Studies of Reproduction and Nest Biology

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An understanding of reproduction and nest biology is essential for recovery and management of sea turtle stocks. Without this knowledge, well intentioned but ignorant conservation efforts can be detrimental to sea turtles. A case in point: removing sea turtle eggs from the beach to incubation boxes placed within protective storage was an accepted management practice for many years until the effect of incubation temperature on sex was determined. As a result, an unnatural preponderance of male turtles may well have been produced by this "conservation" measure. Research on incubation temperatures at nesting beaches proved to be necessary for wise conservation guidelines involving the protection of sea turtle eggs.

The nesting beach provides a narrow but important window of opportunity for studying reproduction and nest biology. Essential information may be obtained with proper focus and commitment, particularly within the areas of demographics, hatchling recruitment, and nesting habitat quality. Until quite recently, the most dependable source of information on population numbers and the changes in these numbers over time was derived almost exclusively from beach studies of reproduction and nesting biology. This chapter will focus on research and management needs on the nesting beach, including studies of the adult females, eggs, and hatchlings.

Guiding Principles

Choose a project with importance for management and recovery of sea turtle populations. Will the proposed study improve the conservation picture for sea turtles, their reproductive success, or the quality of their nesting habitat? Will project results enhance local management capability, as well as regional cooperative efforts that are often international in perspective? Each study should be evaluated on a periodic basis for its benefit to the recovery of the species, in addition to satisfaction derived by the investigator. Periodic review of purpose should be adopted by every investigator studying reproduction and nest biology on beaches.

Think in terms of time. Sea turtles are long-lived organisms with delayed age of first reproduction and many years of potential reproductive activity. Hatchling production will not provide recruitment to the adult nesting population for decades following departure of the hatchlings from the nesting beach. Numbers of actively nesting females vary enormously from year to year for environmental reasons not well understood. Thus, a priority for certain reproductive studies is the capacity to design and support long term monitoring programs of a decade or more in duration. As this may require teams of field biologists extending over several human generations, there must be the capacity and technical knowledge for database management and computer analysis that does not live and die with the individual observer. Reproductive studies of long duration benefit from a team effort.

Be sensitive to the turtles' welfare. Balanced against the need for professional studies on nesting beaches is a strong moral and scientific imperative to minimize the negative impact of research on the sea turtles being investigated. Research frequently involves inevitable harassment of the animals, such as tagging, weighing, clutch relocation, and even hatchling release. Studies of threatened and endangered animals must always insure that the benefits of the research for management and recovery of the species outweigh the costs inflicted upon the research subjects. Furthermore, if the behavior of the turtle is affected adversely, this fact may invalidate the data

gathered and ruin the scientific credibility of the study.

Using tagging as an example, we know that marking nesting females with flipper tags and internal passive integrated transponder (PIT) tags is an important technique for life history studies. However, tagging, even when done correctly, can be disruptive to nesting females. As is true for any manipulation, tagging should not be done unless absolutely necessary. Tagging is a research tool, a means to an end, and not a priority unto itself. When appropriately applied (and especially if sample sizes are large), benefits may include sufficient tag returns to evaluate migration patterns, foraging locations, and the causes and intensity of mortality away from the nesting beach, with special reference to harvest levels. Faithful, intensive coverage of the nesting beach for many years provides an opportunity for measuring population recruitment and annual survival. In order to achieve credible results, rates of tag loss should be measured, tag records must be error free, and tagging databases should be accessible to any serious student of sea turtle behavior who may intercept a tagged animal and need to know the location of her nesting beach.

Eggs and hatchlings should be handled with caution and only where needed. Manipulation of eggs often reduces hatching success, and its effect on the viability of the hatchlings is largely unknown. Natural dispersal of hatchlings from nest site to offshore pelagic habitat represents a critical process involving a progression of behavioral responses obviously sensitive to disruption. Hatchlings should not be detained following their emergence without a very specific purpose.

Research Priorities

Inventory Nesting Beaches

Long term conservation of sea turtles will depend on the availability and condition of nesting beaches. Where is the suitable nesting habitat, and is there historic and/or current evidence of nesting? Nesting beaches should be inventoried by area, habitat type, ownership, and conservation status. Records should be maintained regarding the loss or degradation of nesting beaches due to natural or anthropogenic causes, and decisions made concerning which areas of greater nesting activity deserve regular, methodical monitoring.

Document Nesting Activity

Document when and where nesting activity is taking place, the species involved, and the intensity and trends of nesting. Surveys need not be strictly nocturnal. Excellent nesting surveys can be achieved with trained personnel on daytime patrols, if some nighttime measurements are available to calibrate daytime observations. Conduct surveys with methodical design, so that survey results are comparable between seasons, study sites, and observers. Design and commit to a program with the capacity for many years of replicate surveys. Train observers in standardized data gathering and archiving procedures. Positive evidence of *no* nesting is also important from a management standpoint.

Calculate Hatch Success

Small, seemingly marginal nesting beaches may provide optimum nesting opportunities, while some wilderness beaches may suffer near zero reproductive success. It should be a management priority to identify beaches with high nesting activity and estimate hatch success (including likely causes of low hatch rates) at those sites. Conservation efforts should be focused at sites where high levels of reproductive success can be realized.

Define Genotypic Variation

Genetic identification of nesting populations is a priority, both at nesting beaches and on the foraging grounds. Ultimately, successful global mapping of genotypic variation among nesting assemblages will depend on the cooperation of beach studies located throughout the world. Sampling one egg from each clutch, saving a dead, unhatched embryo, or collecting a small biopsy from the rear flipper of a nesting female represent disturbances that are justified by the knowledge gained in identifying the genetic signature of a nesting population. On the other hand, drawing blood samples from nesting females is a difficult procedure with severe harassment potential, and should be done only by trained personnel.

Measure Population Parameters

Population parameters measured with accuracy and precision are crucial for developing predictive models needed for management decisions. Beach studies for this purpose might include measuring annual mortality and recruitment to the nesting population, immigration and emigration to the nesting population, average fecundity (eggs laid) per female, sex ratio, and the proportion of population fecundity realized as hatchlings entering the water. Understanding annual variation in numbers of nesting females requires

comprehensive beach coverage for most of the nesting season (as many as 100-200 days/year) and surveys that extend over many years. Very little error in measurement of annual survival and recruitment of adults and age to reproductive maturity can be tolerated by population models, as opposed to clutch size and hatching success that can be measured with less accuracy. Presence or absence of each female on the nesting beach and her absolute number of clutches laid are specifics that need to be known with certainty. Population studies also require intensive tagging (with accurate estimates of tag loss) and careful maintenance of voluminous, error-free field records.

Investigate Relevant Conservation Issues

A broad range of important studies may be included here: people and pets and their effects on nesting behavior and the survival of eggs and hatchlings; perturbation or manipulation of the beach environment and its effect on nesting adults and hatchlings, including problems associated with beach lighting, sand mining, vehicle and foot traffic with resulting sand compaction, exotic vegetation, and coastal development; toxic materials and the chemical and physical quality of beach sand for embryonic development; effect of beach nourishment on hatching success; the effect(s) of feral animals and exotic pests. If hatcheries are essential, then research and improve on the methods. To ignore conservation issues or fail to measure adequately their importance to sea turtle reproductive success is management negligence.

Design Objectives

A successful project starts with clearly defined objectives, a knowledge of what needs to be measured to meet those objectives, and a research plan that, among other things, takes into account the number of seasons or decades of seasons required to achieve accurate estimates of the relevant parameters *(e.g.,* presence of nesting activity on a nesting beach, hatch success, number of reproductively active females, recruitment and mortality of adult females). Equally important is defining the portion of the nesting population being studied. Based on knowledge from genetic markers, a management unit or MU of nesting females can be defined and the geographic scope of its nesting activity can be defined. This may be distributed over many nesting beaches on many islands or along a mainland beach many kilometers in length. An investigator should know whether the chosen study of reproduction and nest biology needs to consider the MU. Studies of hatch success, for example, may be applied to a beach (narrowly) or an MU (broadly). Studies of population parameters at selected sites must consider the movement of animals between nesting sites within the MU, lest estimates of mortality and recruitment of the adults become meaningless.

As a profession, we are at a stage with beach studies where much has been learned, but obvious gaps remain in our understanding. Studies that improve the survival outlook for sea turtles are worthy efforts. Studies that minimize unnecessary disturbance of the animals are worthy efforts. Replication of facts without design is not a priority. Anecdotal observations on individual turtles is not a priority. Reinventing (or "rediscovering") what we already know is not a priority. Our collective focus should be to achieve comparable, replicative results with accuracy and precision. Studies of reproduction and nesting biology provide the greatest return for the conservation of sea turtles if they are comparable to other similar studies. This manual provides excellent guidance toward standardized "best practices." Finally, we should seek to invest in each other and in our collective capacity to conserve sea turtles by sharing our results and publishing our data in a timely fashion.