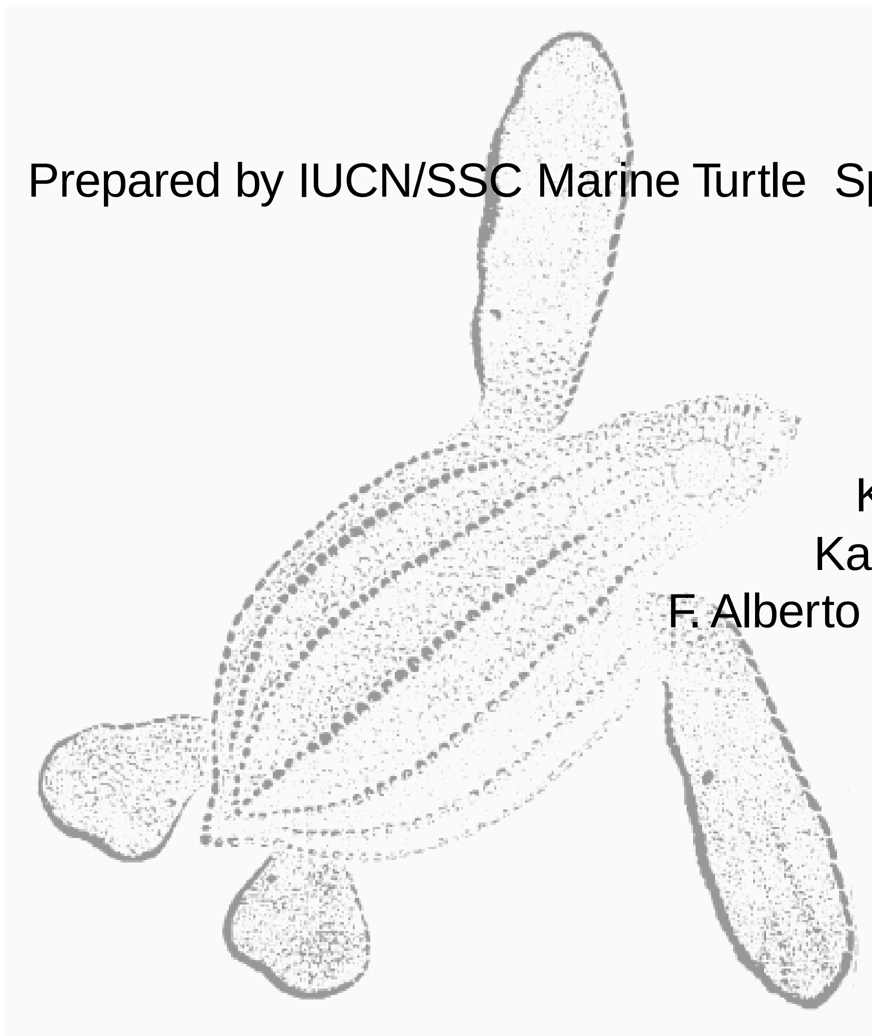
Research and Management Techniques for the Conservation of Sea Turtles



Prepared by IUCN/SSC Marine Turtle Specialist Group

Edited by
Karen L. Eckert
Karen A. Bjorndal
F. Alberto Abreu-Grobois
M. Donnelly

WWF CMS SSC NOAA MTSG CMC

Development and publication of *Research and Management Techniques for the Conservation of Sea Turtles* was made possible through the generous support of the Center for Marine Conservation, Convention on Migratory Species, U.S. National Marine Fisheries Service, and the Worldwide Fund for Nature.

ISBN 2-8317-0364-6

Printed by Consolidated Graphic Communications, Blanchard, Pennsylvania USA

Cover art: leatherback hatchling, *Dermochelys coriacea,* by Tom McFarland

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

To order copies of this publication, please contact:

Marydele Donnelly, MTSG Program Officer
IUCN/SSC Marine Turtle Specialist Group
1725 De Sales Street NW #600
Washington, DC 20036 USA
Tel: +1 (202) 857-1684
Fax: +1 (202) 872-0619
email: mdonnelly@dccmc.org

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.

Karen L. Eckert
Karen A. Bjorndal
F. Alberto Abreu Grobois
Marydele Donnelly
Editors

Table of Contents

1. Overview

2. Taxonomy and Species Identification

3. Population and Habitat Assessment

4. Data Collection and Methods

5. Reducing Threats

6. Husbandry, Veterinary Care, and Necropsy

7. Legislation and Enforcement

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

Nesting Periodicity and Internesting Behavior

Javier Alvarado
Laboratorio de Tortugas Marinas, Facultad de Biología, Instituto de Investigaciones sobre los Recursos Naturales, Universidad Michoacana de San Nicolás de Hidalgo, A.P. 35A, Morelia, Michoacán 58000 México; email: jadiaz@zeus.ccu.umich.mx

Thomas M. Murphy
South Carolina Department of Natural Resources, 585 Donnelley Drive, Suite 2, Green Pond, South Carolina 29446 USA; Tel: +1 (843) 844-2473; Fax: +1 (843) 846-6929; email: murphyt@pop.scdnr.state.sc.us

Nesting Periodicity

Females of all sea turtle species deposit multiple clutches of eggs over the course of a reproductive lifetime (one or more reproductive years). An “inter-nesting interval” is the period, in days, between a successful nesting and the first attempt at a subsequent nesting by an individual turtle during a single nesting season (=reproductive year). “Remigration interval” is the period, in years, between nesting seasons for an individual female. Estimating the size of an annual nesting population (the number of individual turtles nesting each year) is critical for any conservation or management strategy. In the absence of a saturation tagging project (which reveals precisely how many turtles nest each year), one key element in obtaining a reliable estimation is accurate information about the population’s nesting periodicity.

Internesting intervals range from 12-15 days for *Caretta, Chelonia, Eretmochelys* and for *Lepidochelys* solitary nestings; 13-18 days for *Natator;* and 9-10 days for *Dermochelys*. In *Lepidochelys, “arribada”* (mass nesting) intervals are longer and more variable because their occurrence is apparently also influenced by environmental factors such as wind and tide. Calculating the internesting interval requires a representative sampling of turtles nesting at least twice during the reproductive season (N of 100 or more is recommended). The closer the size of the sample is to the total number of nests laid, the more reliable the estimate will be. Turtles must be tagged (that is, known as individuals) and, in the case of each individual, the number of days between a successful nesting and subsequent nesting attempt must be counted. (Note that the internesting interval is *not* defined as the number of days between nests, but rather from one successful nesting to the first landing of the next nesting cycle.) From this sampling, a population average can be calculated. It is useful to report the average, as well as range (minimum and maximum) and standard error.

To aid in visualizing the internesting interval, it is helpful to represent the data graphically in histogram form, partitioning the x-axis in 2-day intervals (5-7 days, 7-9 days, 9-11 days, and so on). Data derived from nightly beach coverage and a comprehensive tagging program will illustrate a primary peak within a broadly defined species average *(e.g.,* 9-10 days for *Dermochelys),* with secondary peaks representing multiples of the average interval; in the case of *Dermochelys,* 20 days, 30 days, 40 days, and so on. In studies of *Caretta*, *Chelonia* and *Eretmochelys*, observed internesting intervals exceeding 25 days should be discarded in any calculation of the internesting interval, as should observed intervals exceeding 18 days for *Dermochelys.* In these cases, intervening nests are likely to have been laid unobserved, and data should be treated as described in the following paragraph.

At a monitored site where nesting females are tagged and the average internesting interval is, say 12 days, **clutch frequency** (average number of clutches laid by individual turtles during a single nesting season) should be estimated not from observed nests alone, but rather based on the assumption that all nesting occurs at regular 12 day intervals. A nest chart with nesting dates for (tagged) turtles enables an investigator to visualize gaps in the records for each individual's nesting sequence. These gaps will manifest themselves as internesting intervals of multiples of the regular period (24, 36, or more days), most likely reflecting the occurrence of nestings unobserved by the monitoring staff and should be taken into account for more precise calculations. Tallying observed and unobserved (missed) nests from this procedure, and dividing the total by the number of tagged turtles provides a more reliable estimation of clutch frequency than would be the case if the number of observed nests alone were divided by the number of tagged turtles. The result should be considered an underestimate, however, since gaps in the nesting record do not, by definition, appear when the missed nest was either the first or last nest laid by a particular female.

An indirect method of estimating the number of nesting females per year is derived from the total number of nests (defined as the successful deposition of eggs) recorded during the same time period. The total number of nests is divided by clutch frequency, defined as the average number of nests laid per female per year (ranging from 2-3 for *Lepidochelys* to as many as seven or more for *Dermochelys)*. Clutch frequency varies somewhat from year to year, as well as geographically. Once the value is known for a particular species and area (based on data collected at a monitored study site where nocturnal coverage includes a comprehensive tagging program), then estimates of population size can be obtained at sites where only crawl counts are available. For this, additional knowledge of **nesting success** must also be available. If, for example, 200 crawls are counted during a nesting season, yet only 160 of them are judged to be nests (that is, to contain eggs), and the average clutch frequency is known to be four, then the number of nesting females can be estimated at 40 (160/4).

Having an estimate of internesting intervals, clutch frequency and nesting success at a monitored study site allows calculations of population size at unmonitored sites where only crawl counts are available. In the absence of 100% beach coverage, which is difficult to achieve even in the most comprehensive monitoring programs (the case for most nations which cannot afford to comprehensively monitor all nesting beaches on a nightly basis) this information is fundamental to management. However, at least one comprehensively (nocturnally) monitored site is a requisite to obtain the basic data.

Since only a proportion of the adult population reproduces each year, it is necessary from a management standpoint to look beyond annual estimates of nesting females to estimates of the adult population at large. Information on the **remigratory interval** (inter-seasonal nesting periodicity) is essential to estimating the total number of mature females in the population at large. Assuming strict site fidelity among years and assuming that each female in a population nests every year, then the total number of nesting females observed per year would be equivalent to the total number of sexually mature females in the population at large. However, with the possible exception of *Lepidochelys,* no sea turtle population studied so far is characterized by all, or even a majority, of its mature females nesting every year. Generally, when a turtle completes a reproductive season, two, three, four or more years will pass before she is seen on the nesting grounds again.

To convert the number of nesting females per annual season to the total number of reproductively active females in the population at large, the average remigration interval must be known. With the exception of *Lepidochelys,* remigration intervals are not well known. It is possible for turtles to skip many years (perhaps a decade or more in some cases) between reproductively active seasons; thus, there are few databases with the longevity to measure this parameter accurately. Literature values for remigration intervals range from 2-3 years for most species, but these should be used with caution as they are constructed, for the most part, from as yet short-term (less than a decade) tagging studies and most have not taken into account the variable of tag loss.

To determine the remigratory interval, nocturnal beach coverage must include the tagging of nesting females for periods exceeding one decade, must maintain accurate tagging records, and must take into account calculations of tag loss. When a tagged female is encountered, her period of absence from the nesting beach can be calculated from tagging records documenting her last recorded nesting. At the end of each nesting season, a range of remigratory intervals will be evident in the database. These will be constrained by the number of years in which tagging has been conducted; that is, it is not possible to document a remigration interval which exceeds the number of years tagging has taken place. Over time, primary and secondary intervals can be documented for the study population. It is essential to obtain data over many reproductive seasons to obtain robust estimates of remigratory behavior.

Encountering Turtles and Collecting Data

Biological data essential for determinations of reproductive periodicity are obtained from nightly (or daily in some *Lepidochelys* populations) nesting beach patrols during the reproductive season. Crews inspect each turtle encountered and, typically after egg-laying, proceed with evaluations of injury, ectobiota and other items of interest, as well as measurements (see Bolten, this volume) and tags (see Balazs, this volume). If the turtle is tagged, tag numbers are registered. The presence of potential tag scars should be noted regardless of whether the turtle is to be tagged or not. If no tag is present, single or multiple tags are applied, depending on the standard practice. Whether or not eggs were deposited should be noted. If eggs are laid, the nest should be given a reference number and its location registered. Nest location can be estimated from reference points or stakes set up at predetermined spots along the length of the beach and separated by no more than 0.5 km.

Turtle behavior from her emergence onto the beach until her return to the sea can be documented in discrete phases, such as: a) emerging from the sea, b) crawling from the point of emergence to the nesting zone, c) selecting a specific nesting site, d) creating a body pit, e) excavating an incubation chamber, f) depositing eggs, g) covering eggs, h) camouflaging the nest, and i) returning to the sea.

Typically a track is observed before the turtle is seen. Species identification should be ascertained from the track, and a determination made as to whether or not the track is "fresh." Fresh tracks are detectable in the wettest portion of the beach, below the tidal line or immediately above it. They are very dark in the wet portion of the beach, and very pale in the dry zone. Fresh tracks are generally clear; that is, they are not marred by footprints, crab tracks, etc. Older tracks, on the other hand, are found exclusively above the high water mark, and are generally overlaid by animal tracks *(e.g.,* crabs, sea birds, domestic or feral animals). Older tracks are comparatively faint and appear the color of the surrounding beach.

Ascertaining whether the track is an "up" (ascending) or "down" (descending) track will facilitate locating the turtle and/or nest (see also Schroeder and Murphy, this volume). Once the turtle is found, the phase of the nesting cycle should be determined (see above) and recorded. Meanwhile, precautions must be taken when approaching a nesting turtle to avoid the use of any artificial light. Females, especially during the early phases of the nesting cycle (prior to laying eggs), are typically cautious and can be easily frightened by disturbance, particularly artificial light or extraneous noises. These can cause an abandonment of the nesting process. Turtles should be approached from behind and only after the body pitting process has begun. This stage can be detected by the presence of wet (darker) sand surrounding the turtle, and by the motion of all four flippers (as opposed to nest excavation which involves only the rear flippers).

Initially, contact with the turtle should occur only after the female has finished camouflaging the nest. Once a general level of tolerance on the part of females utilizing a particular study site is well known by patrol crews, certain aspects of data collection, such as measuring and egg counting, might be carried out safely once the egg chamber is complete (that is, prior to covering the egg chamber and camouflaging the nest). The general consensus is that tagging should not be done until the eggs have been laid (see Balazs, this volume). Prior to departure, the turtle should be examined with a soft light to confirm species (see Pritchard, this volume), identify potentially obscure tags (such as in the groin area), and document injury. Lastly, pertinent information is registered, such as nest location and distance from the sea, number of eggs, date, time and name of observer.

Looking for tags and potential tag scars is important even if the local project does not carry on a tagging program because nesting females may have been encountered in other regions and tagged by other researchers. If tags are found, the date and locality where the turtle was found, together with the names and institutions participating, should be sent to the return address engraved on the tag or to a central tagging database depending on the procedure operating in the region.

Internesting Behavior

While the focus of research and management on gravid females has been on terrestrial activities, there is a need to understand the at-sea activities of these females as it relates to interpretation of beach data and protection of nesting turtles in the marine environment during the nesting season. Documentation of internesting movements (the at-sea movements of females between nesting emergences within the same season) aids in identifying the areas and habitats used most frequently by gravid females. These should be key areas for protection from threats such as trawling, gill nets, dredging, and oil and mineral exploration during the nesting season.

Monitoring turtles in the marine environment usually requires the use of remote sensing techniques. This can involve balloons or floats for daytime monitoring, the use of "chem-lights" or battery powered light sources for nighttime monitoring, or the use of electronic telemetry techniques (see S. Eckert, this volume). The activities of gravid sea turtles which are monitored using remote sensing techniques may be used to 1) document habitat protection needs; 2) better understand behaviors associated with nesting; and 3) validate data collected on the nesting beach. The specific management needs of a rookery, combined with the personnel and funding available and local characteristics of the study area, will dictate the methods employed.

With the exception of leatherback turtles, which typically venture into deep offshore waters between nestings, the most direct approach to *short-term* monitoring of gravid females is the use of floats attached to the turtle by a leader or lanyard. The length of the lanyard used will depend on the water depths around the study area. In most cases the lanyard should be longer than the normal maximum depth. In addition to the tracking float at the end, there should also be floats placed at intervals (3 m) along the lanyard to prevent entanglement when the turtle is in shallow water. A length of PVC tubing may also be mounted at the point of attachment to the turtle to deflect the lanyard away from the turtle's flippers. The tensile strength of the lanyard or the point of attachment should be such that if the float or lanyard becomes snagged, the turtle could easily break free. In addition, the point of attachment should have a corrodible link which will detach all equipment through the action of salt water.

The float should be large enough to be visible at a distance of at least 1 km, under the conditions of a particular study area. The use of a mast to elevate a flag above the float will enhance visibility. A mast will usually require a counter weight to keep it vertical. The float can be attached during oviposition or after the female has completed the nesting process. The use of elevated observation areas, such as rocky headlands or towers, can enhance tracking. The position of the tracked turtle can be determined by recording two simultaneous compass bearings of the floats. The main limitation in the utilization of floats is that the tracking distance is restricted to the limits of visual observation. Also, the size and colors of the float can attract predators and people not involved in the project.

Monitoring the nocturnal activities of turtles will generally require the addition of lights to the float package. These lights should facilitate tracking but should not influence the turtle's activities. While chemical light sticks must be replaced daily, they do provide a highly visible but diffuse light source. Battery powered lights should be sealed from salt water to avoid the corrosive effects of the sea.

The use of electronic tags such as sonic or radio transmitters enhances the distance from which a turtle may be located. This advantage comes with the associated costs of transmitters and receiving equipment. Adult hard-shelled sea turtles are well suited to electronic monitoring because they can carry relatively large transmitters and have a convenient point of attachment in the form of a bony shell. Typically, sonic transmitters have a more limited range than radio transmitters but have the advantage of transmitting precise signals while the turtle is submerged. Shell-mounted sonic and radio transmitters are frequently used in combination, with the radio used to locate the general vicinity of the turtle during brief surface activity and the sonic to acquire continuous data once contact is established.

Radios are either attached directly to the carapace or incorporated into a float at the end of a lanyard. Direct attachment by gluing or fiberglassing to the dome of the shell provides a signal only when the turtle is at the surface. For most species this is only a small fraction of time while at sea and during terrestrial nesting emergences. The use of a float package enables continuous contact in shallow water but has the disadvantage of frequent detachment, especially in rocky or coral habitats. Float transmitters can be used in combination with carapace mounted transmitters. This double configuration allows continuous contact as long as the float remains attached but has the added advantage of reestablishing contact during terrestrial emergences if the float becomes detached. The float transmitter can usually be recovered and reused if it breaks free from the turtle. The float/lanyard configuration can also be used to recapture the turtle by "fishing" the turtle to the surface using the lanyard.

The use of satellite telemetry has the advantage of nearly unlimited range. Satellite transmitters (PTT's) also have the greatest initial cost as well as significant costs associated with monitoring and access. The accuracy and frequency of locations will vary with latitude, duty cycle, surface time of the turtle, sea state, attachment method, pass duration and satellite position. While internesting movements can be monitored via satellite or ground based VHF telemetry, it is the extensive post-nesting movements that can only be monitored with satellite technology (see S. Eckert, this volume).