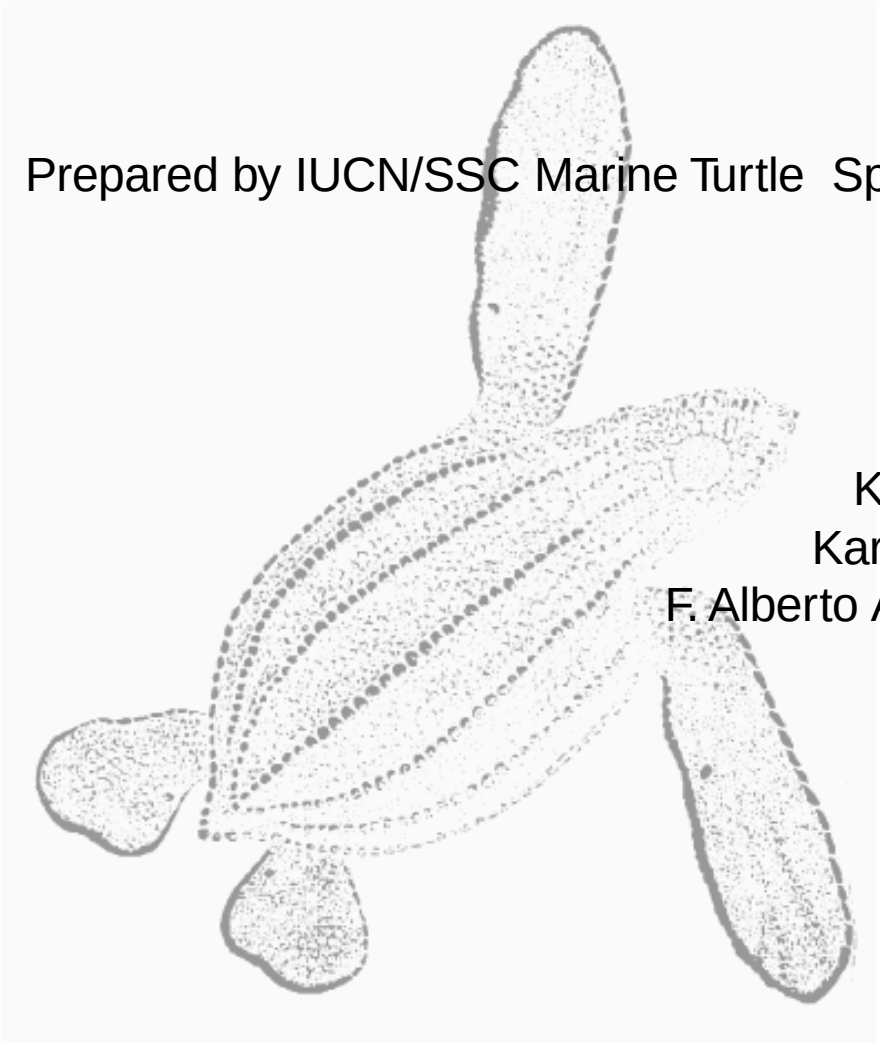
Research and Management Techniques for the Conservation of Sea Turtles

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

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

Introduction to the Evolution, Life History, and Biology of Sea Turtles

Anne B. Meylan
Florida Marine Research Institute, Department of Environmental Protection, 100 8th Avenue SE, St. Petersburg, Florida 33701-5095 USA; Tel: +1 (727) 896-8626; Fax: +1 (727) 893-9176; email: ameylan@mindspring.com

Peter A. Meylan
Collegium of Natural Sciences, Eckerd College, P.O. Box 12560, St. Petersburg, Florida 33733 USA; Tel: +1 (727) 864-8432; Fax: +1 (727) 864-8382

Seven species of sea turtles representing two families, Cheloniidae and Dermochelyidae, are the only living members of what has been a large and diverse marine radiation of cryptodiran turtles. These seven species include the loggerhead (*Caretta caretta)*, green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), olive ridley (*Lepidochelys olivacea)*, flatback (*Natator depressus*), and leatherback (*Dermochelys coriacea*) turtles. An eighth species, the black turtle or East Pacific green turtle (*Chelonia agassizii)*, is recognized by some biologists, but morphological, biochemical, and genetic data published to date are conflicting, and the black turtle is currently treated as belonging to *Chelonia mydas*. (See Pritchard and Mortimer, this volume).

Sea turtles inhabit every ocean basin, with representatives of some species found from the Arctic Circle to Tasmania. Hawksbills are perhaps the most confirmedly tropical of the sea turtles, whereas leatherbacks are known to make forays into colder, sometimes polar, waters. With the exception of Kemp's ridley and flatback turtles, sea turtles are cosmopolitan in distribution. Kemp's ridley is restricted principally to the Gulf of Mexico and the eastern seaboard of the United States, with some individuals occasionally found along the shores of the United Kingdom and western Europe. The flatback is endemic to the Australian continental shelf.

The living sea turtles are a monophyletic group (derived from a common ancestor that has not given rise to other living turtles) of the suborder Cryptodira. This suborder includes those turtles that close their jaws by contracting muscles over a cartilage on the otic chamber (Gaffney, 1975). In all living cryptodires, the head is retracted in a vertical plane and assumes an S-shape between the shoulder girdles (Gaffney and Meylan, 1988). Living sea turtles have a reduced ability to retract their heads compared to other living cryptodires, but thick, nearly complete skull roofing confers additional protection to the head. The oldest members of this sea turtle radiation date back 110 million years to the early Cretaceous (Hiryama, 1998). An earlier (late Jurassic) lineage of cryptodiran sea turtles, the family Plesiochelyidae, is considered to be independent of that which produced the living forms (Gaffney and Meylan, 1988).

Sea turtles are considered highly derived morphologically and have many adaptations for life in the sea. All species share features such as paddle-shaped limbs, in which all movable articulations between the distal bony elements are lost and three or four digits of the hand are markedly elongate. Lacrimal, or tear, glands are remarkedly enlarged and modified to remove excess salts from body fluids; the salts are derived mostly from drinking sea water. Sea turtle shells are characterized by a reduced amount of bone. Sea turtles are also streamlined to various degrees, which improves their hydrodynamic efficiency. An enlarged shoulder girdle with a markedly elongate coracoid serves as an attachment site for the well-developed pectoral muscles which are used for swimming.

A generalized life-history model (Hirth and Hollingworth, 1973; Carr *et al.,* 1978) developed with data from the green turtle, and elaborated upon by

numerous other authors, provides a framework for understanding and refining the life histories of all species of sea turtles. Although each species diverges from the model in significant ways, the phenomenon of seasonal and ontogenetic shifts in habitat occupation appears to explain much of the observed movements and migrations. Upon leaving the nesting beach as hatchlings, green turtles, loggerheads, and hawksbills begin a pelagic (open ocean) phase that is believed to last at least several years. They are often found at sea in association with weed lines or drift lines that exist near frontal boundaries near major currents. Passive drifting with currents has been demonstrated in the immediate post-hatching period. The flatback seems to be an exception to this pattern; hatchlings remain in coastal waters and apparently lack a pelagic phase (Walker and Parmenter, 1990). The habitats of post-hatchling leatherbacks and ridleys remain unknown.

This early pelagic phase, originally referred to as the "lost year" by Archie Carr, varies in duration among species and among populations. Western Atlantic loggerheads, for example, remain in the pelagic environment until they are well over 40 cm in straight carapace length, whereas Atlantic green turtles, hawksbills, and Kemp's ridleys 20-30 cm in carapace length are commonly found in shallow-water habitats.

Carr *et al.* (1978) discussed the concept of "developmental habitats" and defined them as places where immature sea turtles commonly occur but where adults of the same species are rarely, if at all, found. These may consist of one or a series of habitats (generally coastal feeding grounds) through which turtles pass as they grow to adult size. Entry into, and departure from, developmental habitats appear to occur at predictable sizes for some species. Individual turtles are often caught repeatedly in the same area over intervals of several years, implying residency in these developmental habitats. The amount of time the various species remain resident in any particular developmental habitat before moving on to the next is poorly known.

Estimates of growth rates in wild individuals indicate typically slow growth, with age-to-maturity ranging 15 to 50 years or more, depending on the species and geographic area (Balazs, 1982; Bjorndal and Zug, 1995). Adult turtles spend most of their lives in the adult foraging ground (with or without immatures), an area that is usually separate from the nesting beach. Adult foraging grounds may be fixed in space, such as seagrass beds, or transitory, such as areas in the ocean with seasonably predictable blooms of jellyfish or benthic invertebrates. During the reproductive season, adult turtles travel to the vicinity of the nesting beach, where they may remain for up to several months. Mating takes place along the migratory corridor, at courtship or breeding stations, and in the vicinity of the nesting beach. During the reproductive season, both males and females may be found in the longshore waters off the nesting beach, also called the internesting habitat.

Different species of sea turtles share many behaviors, especially those involved in reproduction. For this reason, methodologies for studying or managing sea turtles at the nesting beach are very similar for all the species. Female sea turtles typically nest more than once per reproductive season; most do not nest in consecutive years. Nesting behavior is highly stereotypic. Species-specific differences exist in parameters such as nesting habitat preference, nesting strategy (aggregated vs. solitary), size at first reproduction, average clutch size, and details of the nest size and construction. One highly divergent reproductive behavior is that of nesting in huge aggregations over a period of a few days. These mass arrivals, or *arribadas,* are formed only by Kemp's and olive ridleys.

All sea turtles appear to exhibit migratory behavior at different times in their lives. Reproductive migrations between feeding grounds and nesting beaches are the best documented because of the ease of tagging adult females on nesting beaches. Journeys spanning many thousands of kilometers are known to occur. The seasonal movements of sea turtles in search of food may also be considered as migrations. For example, leatherbacks nesting in the Wider Caribbean region return to jellyfish-rich waters in the northern and eastern Atlantic basin after breeding. Immature turtles travel between successive developmental habitats, which may be separated by hundreds or thousands of kilometers. What has been gleaned about migratory behavior of sea turtles from recaptures of tagged turtles has been greatly augmented in recent years by the use of molecular genetics (to identify the nesting beach origin of turtles captured at sea) and satellite telemetry. The latter yields information about the actual course of travel, rather than point-to-point capture data.

Because of their wide-ranging migratory nature, sea turtles require international cooperation to ensure their survival. All seven species of sea turtles are included on the IUCN Red List of Threatened

Animals (Baillie and Groombridge, 1996): Kemp's ridley and the hawksbill are considered Critically Endangered; loggerheads, green turtles, olive ridleys, and leatherbacks are listed as Endangered; and flatbacks are considered Vulnerable. These categories reflect the global status of whole taxa and are based on criteria such as population level, population trends, extent of occurrence, and probability of extinction in the wild.

Literature Cited

Baillie, J. and B. Groombridge. 1996. IUCN Red List of Threatened Animals. World Conservation Union (IUCN), Gland, Switzerland. 368 pp.

Balazs, G. 1982. Growth rates of immature green turtles in the Hawaiian Archipelago, p.117-125. *In:* K. A. Bjorndal (Editor), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D.C. 583 pp.

Bjorndal, K. A. and G. Zug. 1995. Growth and age of sea turtles, p.599-600. *In:* K. A. Bjorndal (Editor), Biology and Conservation of Sea Turtles, Revised Edition. Smithsonian Institution Press, Washington, D.C. 619 pp.

Carr, A., M. H. Carr and A. Meylan. 1978. The ecology and migrations of sea turtles, 7. The West Caribbean green turtle colony. Bulletin of the American Museum of Natural History 162:1-46.

Gaffney, E. S. 1975. A phylogeny and classification of the higher categories of turtles. Bulletin of the American Museum of Natural History 155:387-436.

Gaffney, E. S. and P. A. Meylan. 1988. A phylogeny of turtles, p.157-219. *In:* M. J. Benton (Editor), The Phylogeny and Classification of Tetrapods. Clarendon Press, Oxford.

Hirayama, R. 1998. Oldest known sea turtle. Nature 392:705-708.

Hirth, H. and S. L. Hollingworth. 1973. Report to the government of the People's Democratic Republic of Yemen on marine turtle management. Rep. FAO/UNDP(TA) 3178, 51 pp.

Walker, T. A. and C. J. Parmenter. 1990. Absence of a pelagic phase in the life cycle of the flatback turtle, *Natator depressa* (Garman). Journal of Biogeography 17:275-278.