

# 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.

©1999 SSC/IUCN Marine Turtle Specialist Group

Reproduction of this publication for educational and other non-commercial purposes is authorized without permission of the copyright holder, provided the source is cited and the copyright holder receives a copy of the reproduced material.

Reproduction for commercial purposes is prohibited without prior written permission of the copyright holder.

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](mailto: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 20<sup>th</sup> 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 21<sup>st</sup> 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

An Introduction to the Evolution, Life History, and Biology of Sea Turtles .....	3
<i>A. B. Meylan and P. A. Meylan</i>	
Designing a Conservation Program .....	6
<i>K. L. Eckert</i>	
Priorities for Studies of Reproduction and Nest Biology .....	9
<i>J. I. Richardson</i>	
Priorities for Research in Foraging Habitats .....	12
<i>K. A. Bjorndal</i>	
Community-Based Conservation .....	15
<i>J. G. Frazier</i>	

## 2 . Taxonomy and Species Identification

Taxonomy, External Morphology, and Species Identification .....	21
<i>P. C. H. Pritchard and J.A. Mortimer</i>	

## 3 . Population and Habitat Assessment

Habitat Surveys .....	41
<i>C. E. Diez and J. A. Ottenwalder</i>	
Population Surveys (Ground and Aerial) on Nesting Beaches .....	45
<i>B. Schroeder and S. Murphy</i>	
Population Surveys on Mass Nesting Beaches .....	56
<i>R. A. Valverde and C. E. Gates</i>	
Studies in Foraging Habitats: Capturing and Handling Turtles .....	61
<i>L. M. Ehrhart and L. H. Ogren</i>	
Aerial Surveys in Foraging Habitats .....	65
<i>T. A. Henwood and S. P. Epperly</i>	
Estimating Population Size .....	67
<i>T. Gerrodette and B. L. Taylor</i>	
Population Identification .....	72
<i>N. FitzSimmons, C. Moritz and B. W. Bowen</i>	

## 4 . Data Collection and Methods

Defining the Beginning: the Importance of Research Design .....	83
<i>J. D. Congdon and A. E. Dunham</i>	
Data Acquisition Systems for Monitoring Sea Turtle Behavior and Physiology .....	88
<i>S. A. Eckert</i>	
Databases .....	94
<i>R. Briseño-Dueñas and F. A. Abreu-Grobois</i>	
Factors to Consider in the Tagging of Sea Turtles .....	101
<i>G. H. Balazs</i>	
Techniques for Measuring Sea Turtles .....	110
<i>A. B. Bolten</i>	
Nesting Periodicity and Interesting Behavior .....	115
<i>J. Alvarado and T. M. Murphy</i>	
Reproductive Cycles and Endocrinology .....	119
<i>D. Wm. Owens</i>	
Determining Clutch Size and Hatching Success .....	124
<i>J. D. Miller</i>	
Determining Hatchling Sex .....	130
<i>H. Merchant Larios</i>	
Estimating Hatchling Sex Ratios .....	136
<i>M. Godfrey and N. Mrosovsky</i>	
Diagnosing the Sex of Sea Turtles in Foraging Habitats .....	139
<i>T. Wibbels</i>	
Diet Sampling and Diet Component Analysis .....	144
<i>G. A. Forbes</i>	
Measuring Sea Turtle Growth .....	149
<i>R. P. van Dam</i>	
Stranding and Salvage Networks .....	152
<i>D. J. Shaver and W. G. Teas</i>	
Interviews and Market Surveys .....	156
<i>C. Tambiah</i>	

## 5 . Reducing Threats

Reducing Threats to Turtles .....	165
<i>M. A. G. Marcovaldi and C. A. Thomé</i>	
Reducing Threats to Eggs and Hatchlings: <i>In Situ</i> Protection .....	169
<i>R. H. Boulon, Jr.</i>	
Reducing Threats to Eggs and Hatchlings: Hatcheries .....	175
<i>J. A. Mortimer</i>	
Reducing Threats to Nesting Habitat .....	179
<i>B. E. Witherington</i>	
Reducing Threats to Foraging Habitats .....	184
<i>J. Gibson and G. Smith</i>	
Reducing Incidental Catch in Fisheries .....	189
<i>C. A. Oravetz</i>	

## 6 . Husbandry, Veterinary Care, and Necropsy

Ranching and Captive Breeding Sea Turtles: Evaluation as a Conservation Strategy .....	197
<i>J. P. Ross</i>	
Rehabilitation of Sea Turtles .....	202
<i>M. Walsh</i>	
Infectious Diseases of Marine Turtles .....	208
<i>L. H. Herbst</i>	
Tissue Sampling and Necropsy Techniques .....	214
<i>E. R. Jacobson</i>	

## 7 . Legislation and Enforcement

Grassroots Stakeholders and National Legislation .....	221
<i>H. A. Reichart</i>	
Regional Collaboration .....	224
<i>R. B. Trono and R. V. Salm</i>	
International Conservation Treaties .....	228
<i>D. Hykle</i>	
Forensic Aspects .....	232
<i>A. A. Colbert, C. M. Woodley, G. T. Seaborn, M. K. Moore and S. B. Galloway</i>	

## Stranding and Salvage Networks

### **Donna J. Shaver**

*U.S. Geological Survey, Padre Island National Seashore, P.O. Box 181300, Corpus Christi, Texas 78480-1300 USA; Tel: +1 (361) 949-8173, ext. 226; Fax: +1 (361) 949-8023;*

*email: donna\_shaver@nps.gov*

### **Wendy G. Teas**

*Sea Turtle Stranding and Salvage Network, NOAA National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149 USA; Tel: +1 (305) 361-4595; Fax: +1 (305) 361-4478; email: wendy.teas@noaa.gov*

## **Overview: The Importance of a Network**

Stranded sea turtles are defined as those that wash ashore dead or alive or are found floating dead or alive (generally in a weakened condition). Sea turtles strand in the vicinity of migratory routes, foraging habitats, developmental habitats, and nesting beaches. The numbers that strand are typically influenced by a variety of factors and vary at different geographical locations and during different years and seasons.

Systematic data gathering for stranded sea turtles can provide resource managers and scientists with biological information useful in improving the conservation and management of these species. Data gathering is best accomplished through a formal stranding and salvage network that can document stranded sea turtles, salvage dead individuals for necropsy, and transport live individuals to rehabilitation facilities. Data collected through the network can be used to identify sources of mortality, document locations of negative human/sea turtle interactions, evaluate the effectiveness of various regulations, and serve as a basis for management decisions. Documenting stranded sea turtles and associated tag returns can enhance an understanding of species composition, distribution, seasonality, sizes, migratory patterns, and habitat use. Through salvage, necropsy, and specimen collection from dead stranded turtles, information is obtained on sex ratios, diseases, foraging ecology, and other topics. Live stranded sea turtles that are located and taken to appropriate rehabilitation facilities can

often be successfully rehabilitated and released back into the wild.

A national Sea Turtle Stranding and Salvage Network (STSSN) has operated in the USA since 1980. It serves as a basis for many of the protocols and recommendations offered in this chapter.

## **Network Components**

### ***Network Participants and Coordinators***

Funding is typically limited; thus, it is recommended that most participants and coordinators volunteer to provide data without compensation. Whenever possible, these volunteers should be trained biologists who understand the importance of accurate data collection, and who will be able to participate in the network for several years. Among those that should be considered to participate are employees of natural resource agencies, zoos and aquaria, as well as park managers, educators and dedicated local residents. Once informed about the importance of the stranding network, employers may allow participation in network activities during normal work hours. In order to facilitate timely data collection, participants should be distributed throughout the geographical area where the network will operate, and they should receive training in standardized data collection protocols.

A Network Coordinator, as well as several Regional Coordinators, should be designated. Each Regional Coordinator should be located within a specific geographical area and oversee network activi-

ties conducted there. The Network Coordinator should be an employee of the agency willing to commit to the long-term maintenance of a central computerized database that will contain all stranding records.

### ***Detection of Stranded Turtles***

Network participants document turtles stranded within their geographical area. Stranded turtles are detected either by network participants or by other individuals who report the turtles. Participants should immediately attempt to find turtles reported alive, so that they do not succumb prior to transfer to rehabilitation facilities, and promptly attempt to locate those reported dead, so that they do not deteriorate appreciably before data collection.

Turtles may be detected opportunistically, or during surveys designed specifically to identify stranded turtles. Depending on funding and time availability, surveys can be undertaken intermittently or systematically. If systematic monitoring is undertaken, surveys should be made from 1-3 times per week so that turtles can be located before they deteriorate or are taken by people or predators. "Index areas" for systematic monitoring can be established if those areas are surveyed consistently and effort expended is recorded. Regardless of the method used to detect stranded turtles, the numbers documented should be considered minimum stranding figures since they represent only reported strandings and not all stranding events.

### ***Documentation of Stranded Turtles***

Each stranded turtle located should be documented by a network participant on a standardized form. The form used by the STSSN is included as an example (Figure 1). Managers and researchers establishing networks in other areas will likely need to modify the STSSN form to meet their specific needs. Only one standardized form should be developed and used for a particular network. The form should include the data parameters and notation codes listed below, but contain only those species occurring within the geographical area covered by the network. It should be as short, concise, self-contained, and easy to complete as possible. The data to be collected for each stranded turtle should be printed on the front; a species guide and the Regional Coordinator's address should be printed on the back.

All data parameters listed on the standardized form should be recorded for each turtle. Straight and

curved carapace length and width should be measured using standard methodology (see Bolten, this volume). Straight line measurements made with calipers are more accurate than curved measurements made with a flexible tape. Attempts to determine sex using blood serum testosterone assays, laparoscopy, and examination of gonads during necropsy should be noted. It is not recommended to use tail length to identify sex since this method is unreliable for decomposed carcasses and immature turtles.

If possible, each stranded turtle should be photographed at the stranding site, necropsy location, or rehabilitation facility. Photographs provide additional documentation of the stranding authenticity and characteristics. Network participants should immediately submit each completed original stranding form to the appropriate Regional Coordinator, who should immediately review it for accuracy and submit it to the Network Coordinator. Both the network participant and Regional Coordinator should retain a copy of each form for archival and reference purposes.

### ***Other Associated Activities for Stranded Turtles***

Once an animal has been documented, it should be marked or removed from the stranding site (to prevent it being counted again). Live stranded turtles should be transported to rehabilitation facilities (the facility should be noted on the data form). Dead stranded turtles (fresh or moderately decomposed) and live stranded turtles that succumb during rehabilitation efforts can be salvaged for necropsy and specimen removal and are an important resource for obtaining additional information. Necropsies should be conducted using standardized protocol (see Jacobson, this volume). Dead turtles not salvaged for necropsy should be buried high on the beach or pulled behind the dunes. It is not recommended to mark them with paint or other materials since these markings usually disappear over time.

### **Acknowledgments**

We would like to thank participants of the USA's Sea Turtle Stranding and Salvage Network, including those early participants who developed the standardized stranding form and protocols used by the network today, and those participants who have continued the network's activities.

## **Record Keeping: Standard Information for a Data Form**

1. Observer's name, address, telephone number
2. Turtle number by day (enter a consecutive number for the individual observer for that day)
3. Stranding date (enter yr / month / day)
4. Stranding location in reference to the closest town or landmark. Include county, state, or other relevant geographical breakdown, as well as latitude and longitude. Note whether stranding was located inshore (bays, estuaries, or passes and their beaches) or offshore (oceans and their beaches).
5. Species code: CC = Loggerhead; CM = Green/Black; DC = Leatherback; EI = Hawksbill; LK = Kemp's ridley; LO = Olive ridley; ND = Flatback; UN = Unknown
6. Reliability of species identification (indicate "unsure", "probable", or "positive").
7. Species verified by Regional Coordinator ("yes" or "no")
8. Sex of turtle ("female", "male", or "undetermined")
9. How sex was determined (enter the method used)
10. Condition of turtle, coded as follows: 0 = Alive; 1 = Fresh dead; 2 = Moderately decomposed; 3 = Severely decomposed; 4 = Dried carcass; 5 = Skeleton, bones only.
11. Final disposition of turtle, coded as follows: 1 = Painted, left on beach; 2 = Buried, on beach/off beach; 3 = Salvaged specimen, all or part; 4 = Pulled up on beach or dune; 5 = Unpainted, left on beach; 6 = Alive, released; 7 = Alive, taken to holding facility.
12. Tag number(s). Enter type of tag (metal, plastic, PIT, living, etc.), tag numbers, tag position, tag return address, and disposition of tag. Draw located tags on the diagram.
13. Remarks. Enter information on tar or oiling, gear or debris entanglement, wounds or mutilation, propeller damage, papillomas, epizoa, etc. Draw noted items on the diagram.
14. Measurements (straight length / width; curved length / width). Circle measurement units.

# SEA TURTLE STRANDING AND SALVAGE NETWORK – STRANDING REPORT

PLEASE PRINT CLEARLY AND FILL IN ALL APPLICABLE BLANKS. Use codes below. Measurements may be straight line (caliper) and/or over the curve (tape measure). Measure length from the center of the nuchol notch to the tip of the most posterior marginal. Measure width at the widest point of carapace. **CIRCLE THE UNITS USED.** See diagram below. Please give a specific location description. **INCLUDE LATITUDE AND LONGITUDE.**

Observer's Full Name \_\_\_\_\_ Stranding Date \_\_\_\_\_  
year month day

Address / Affiliation \_\_\_\_\_

Area Code / Phone Number \_\_\_\_\_

Species \_\_\_\_\_ Turtle Number By Day \_\_\_\_\_

Reliability of I.D.: (CIRCLE) Unsure Probably Positive Species Verified by State Coordinator? Yes h No h

Sex: (CIRCLE) Female Male Undetermined How was sex determined? \_\_\_\_\_

State \_\_\_\_\_ County \_\_\_\_\_

Location (be specific and include closest town) \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_

Condition of the Turtle (use codes) \_\_\_\_\_ Final Disposition of Turtle (use codes) \_\_\_\_\_

Tag Number(s) (include tag return address and disposition of tag) \_\_\_\_\_

Remarks (note if turtle was involved with tar or oil, gear of debris entanglement, wounds or mutilations, propeller damage, papillomas, epizoa, etc.) continue on back if necessary.

## MEASUREMENTS: CIRCLE UNITS

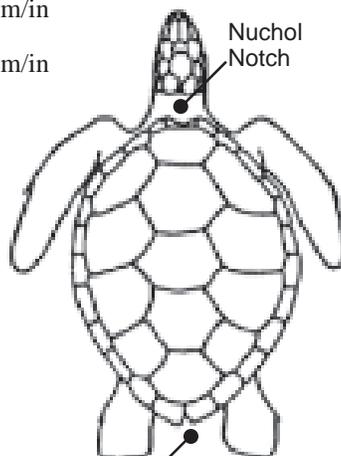
Straight Length \_\_\_\_\_ cm/in

Straight Width \_\_\_\_\_ cm/in

Curved Length \_\_\_\_\_ cm/in

Curved Width \_\_\_\_\_ cm/in

Mark wounds, abnormalities and tag locations



## CODES

### SPECIES:

- CC = Loggerhead
- CM = Green
- DC = Leatherback
- EI = Hawksbill
- LK = Kemp's Ridley
- UN = Unidentified

### CONDITION OF TURTLE:

- 0 = Alive
- 1 = Fresh dead
- 2 = Moderately decomposed
- 3 = Severely decomposed
- 4 = Dried carcass
- 5 = Skeleton, bones only

### FINAL DISPOSITION OF TURTLE:

- 1 = Painted, left on beach
- 2 = Buried: on beach / off beach
- 3 = Salvaged specimen: all / part
- 4 = Pulled up on beach or dune
- 5 = Unpainted, left on beach
- 6 = Alive, released
- 7 = Alive, taken to a holding facility

Figure 1. STSSN standardized stranding form