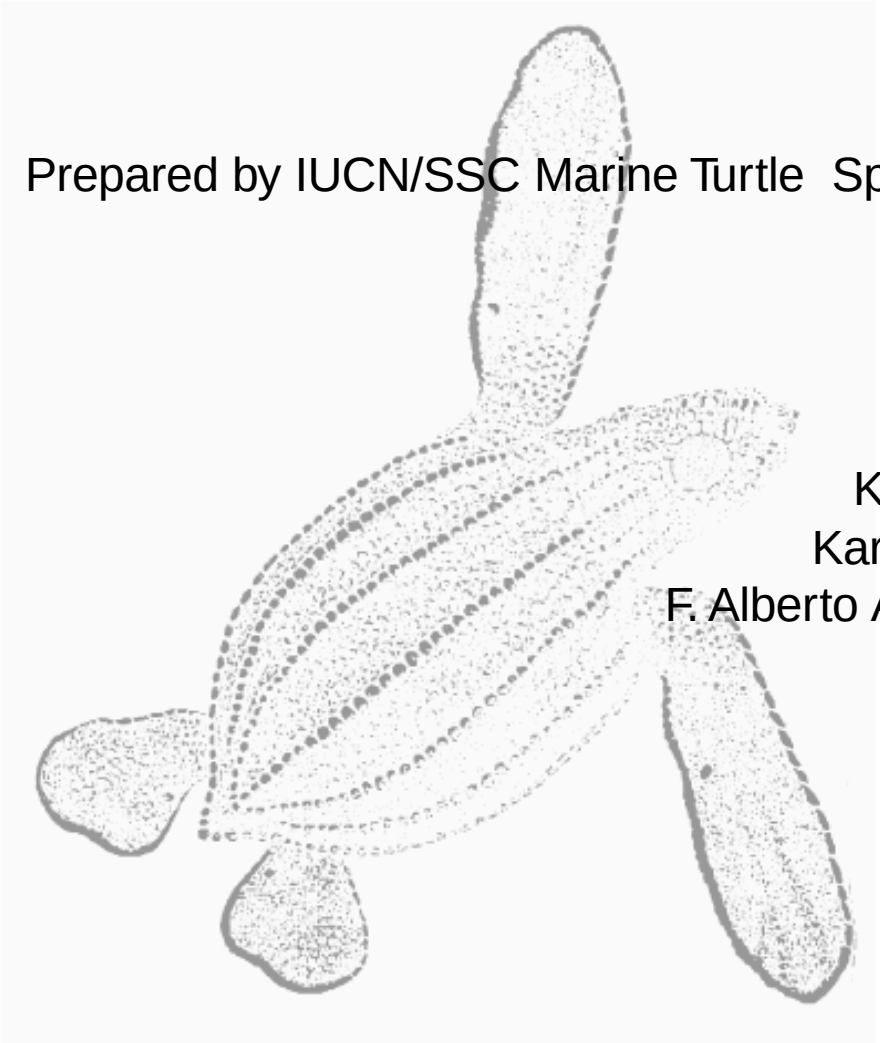
Research and Management Techniques for the Conservation of Sea Turtles

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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Ranching and Captive Breeding Sea Turtles: Evaluation as a Conservation Strategy

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The controversy over sea turtle "farming" has proceeded for 30 years with little change in polarized positions and little objective analysis. Proponents promote farming as a method to save turtles, while opponents claim that farms actively contribute to sea turtle declines. This chapter discusses the general implications of sea turtle farming from a conservation perspective and provides readers with a basis for their own opinion. Discussion is restricted to sea turtles raised primarily for commercial purposes, and whether such activities might have conservation benefits. The technical aspects of turtle farming are beyond the scope of this chapter. Wood and Wood (1980) and Jacobson (1996) provide an entry to this material.

There are two ways to "farm" sea turtles: (1) maintaining captive adults who breed in captivity and whose offspring are raised for use ("captive breeding," often termed "farming") and (2) collecting turtles from wild populations (usually as eggs) which are then raised in captivity for use ("ranching"). These definitions are derived from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which regulates international commercial trade from captive breeding and ranching in different ways. In this chapter, the term "farm" is used interchangeably to describe any facility holding captive turtles from either wild or captive bred sources, and sometimes both, for commercial production.

Constraints on Farms

Three factors affect the practicality and economic viability of sea turtle ranching and captive breeding: their marine habitat, their slow growth rates (measured in decades in most wild populations), and our relative ignorance of their diseases and parasites. Sea turtles must be maintained in sea water and require locations near the sea and expensive systems to supply flowing salt water. Attempts to maintain sea turtles commercially in natural or artificial enclosures in the sea have been uniformly unsuccessful. Sea turtles have reptilian physiology and the species of most commercial interest (green turtles *(Chelonia mydas)* and hawksbills *(Eretmochelys imbricata))* have a natural diet of very low nutrient and protein content. These two factors cause natural growth rates to be slow, increasing the expense of growing animals to economically marketable size. This can be offset by improving diet quality and protein content and providing warmer water, but again these necessitate increased expenses. Sea turtles are also subject to a wide variety of pathogens and parasites. In natural situations and at wild population densities these may have imperceptible effects, but in crowded and often unhygienic conditions of captivity, epizootic diseases cause catastrophic mortality *(e.g.*, Jacobson, 1996).

These factors create constraints to sea turtle farms which must be developed on a capital-intensive and technical basis. Specialized technical expertise, veterinary supervision and intervention, water quality control systems, carefully balanced high protein diets, and water temperature control all enhance production and economic success but at high costs of production requiring that products be sold at high prices. Obtaining farm stock from wild sources is relatively easy, but this can create unrealistically low expectations about the amount of capital, time, and skill that farm development will need. There is no currently operating, economically successful sea turtle ranch and only one captive breeding farm (Cayman Island Turtle Farm, Grand Cayman Island).

For purely conservation purposes, funding to farm an organism is justifiable for species that are immi-

nently in danger of extinction and for which *in situ* conservation mechanisms have been proven ineffective. Only one sea turtle, the Kemp's ridley *(Lepidochelys kempii)*, approaches this situation. It is instructive that a captive ranching and release ("head-starting") program for this species instituted by the United States government was discontinued after 15 years and many millions of $US, due to uncertainty about the results and other concerns (Byles, 1993; Williams, 1993; Eckert *et al.*, 1994). Long term head-starting programs, including those focusing on green turtles (Florida, USA; Huff, 1989) and hawksbills (Republic of Palau; Sato and Madriasau, 1991) have also been discontinued in recent years based on insufficient evidence of success.

History of Farming

Three attempts have been made to develop facilities for turtle farming, at Grand Cayman Island (U.K.) in the Caribbean Sea, Reunion Island (France) in the Indian Ocean, and in the Torres Straits islands (Australia), all with green turtles. Facilities were also started or planned in Suriname (Reichart, 1982) and Indonesia and are currently under development in Cuba.

Cayman Turtle Farm

Cayman Turtle Farm (CTF) was started under the name Mariculture Inc. in 1969 using green turtle eggs obtained from Costa Rica. The farm initially attempted to raise turtles in semi-natural surroundings, but quickly converted to closed tank systems located on Grand Cayman Island. Adult breeding stock was obtained from Mexico, Suriname, Costa Rica, and Ascension Island and these began laying eggs in captivity in 1973. Most of the farm's production was from wild eggs collected under license from Ascension Island, Suriname, and Costa Rica (constituting "ranching" in the present sense). The farm conducted intensive studies of reproductive biology of captive sea turtles and successfully bred captive raised sea turtles in 1975, and by 1978 discontinued importation of wild eggs, relying entirely on production from both wild-caught and captive-raised stock. Deep controversy ensued over whether CTF had legitimately achieved adequate captive breeding, and concerns were raised about the effects of re-opening the quiescent international trade in sea turtle products.

As a result of international opposition from the scientific community, CTF did not receive CITES approval to trade internationally. In 1979, CITES adopted a captive breeding definition requiring production of second generation offspring which CTF had difficulty meeting. Lacking CITES approval, the farm could not sell its products anywhere except the United Kingdom (being a U.K. dependency, such trade was considered domestic). The U.S. Endangered Species Act of 1973 prevented import or transshipment through the United States, greatly restricting CTF's marketing and sales. The farm went through a number of changes in ownership and serious economic difficulties. The addition of a component of tourism and diversification of products including shell, oil, and local sales of turtle meat in Grand Cayman failed to provide sufficient revenue. CTF entered bankruptcy in 1975 and was taken over from the second owners by the Cayman Islands government in 1983. Since then, CTF has continued to operate at a reduced scale largely as a tourist facility and to provide employment and turtle meat for the local market. The farm also releases immature green turtles into the waters around Grand Cayman Island (Wood and Wood, 1993). The farm returned its first operating profit in 1988, 19 years after establishment.

Farm Corail, Reunion Island

Sea turtle farming began on an experimental basis in 1972 under the direction of the Institutes de Peches on Reunion Island, a French overseas Department located in the southwestern Indian Ocean (Lebrun, 1975). The farm was stocked with hatchlings collected annually from green turtle nesting beaches on Tromelin and Europa islands located 600 km and 2,000 km distant. The farm has been producing meat and shell for sale to tourists and the French domestic market since about 1980. Several attempts to apply for international trading privileges under CITES were unsuccessful, and the farm remains oriented toward its local and domestic market and with a reduced scope of operations. The facility has had consistent problems with slow growth and disease, which are attributed to the artificial pelletized diet and the seasonally low water temperatures in the area. In 1996-1997, Farm Corail negotiated a transition to fish aquaculture, research, and education. No new turtle stock has been introduced, and the release of captives is proposed. Turtle tracks at the two nesting islands of Tromelin and Europa have been regularly counted to support the premise that the annual hatchling collection does not threaten the nesting colony. The data indicate normal fluctuations, but no decline in either

population over the period of hatchling exploitation (Le Gall *et al.*, 1986).

Torres Strait

Following initial studies by the National University of Australia, an organization created by the Australian government to assist development in aboriginal communities established a network of village-level sea turtle farms on the islands of Torres Strait, Australia, in 1970. Green turtle eggs collected from the large nesting aggregations at Bramble Cay and Rayne Island were transported to about 150 villagers located on islands in the Torres Strait. Difficulties with low hatch rates and high mortality were experienced at an early stage. The project was critically evaluated in 1972 (Carr and Main, 1973) and reorganized to concentrate turtle raising on nine islands with more intensive technical support, each with a capacity for 100-500 small turtles. During the period 1974-1978, the project undertook research on husbandry and disease, as well as general studies of sea turtle biology in the region, but was unable to overcome the basic problems of limited food supplies for young turtles and disease and parasites. In 1980, after government expenditure of $AU 6 million, the project was terminated.

Benefits and Disadvantages

A variety of conservation advantages and detriments have been claimed for turtle farms. These all lack objective or quantifiable information to evaluate them, which has led to a highly polarized and emotional discussion of these factors with little resolution. Ehrenfeld (1974) and Hendrickson (1974) provide two contrasting views.

Production of a Food Source for Tropical Coastal People

The prospect of using sea turtles to produce high quality protein from unproductive tropical marine systems and provide food for residents of tropical countries was initially supported by Carr (1967) and later strongly self-criticized (Carr, 1984). The high cost of growing turtles to edible size ensures that the price of farmed turtle meat is higher than wild-caught turtle. To recover costs, turtle farm products must be sold to overseas markets or tourists (Ehrenfeld, 1982; Dodd, 1982). The flavor of captive turtles fed non-natural diets is alleged to be inferior to that of the wild product, causing low acceptability among coastal people used to the real thing. Farmed turtle has therefore not proven to be the low-cost protein source originally envisaged.

Substitute for Wild Products

Production of turtle products in large quantities from farmed animals has been claimed to reduce demand for products from wild-caught turtles in both local and international markets, extending protection to wild turtle populations. Their high price may exclude farmed products from most local markets. Critics of farms, and of commercial use and international trade in turtles in general, argue that any increase in the availability of products on the international market will stimulate demand, which existing farms will be unable to satisfy, increasing pressure on wild populations and trade through illegal channels. Objective evidence on the reality of this scenario is contradictory, and some economic theory would argue that such stimulation is illusory. Clearly, effective national regulations and strict control of trade to prevent illegal commerce is necessary to prevent or minimize any such effect.

Removal of Animals from Wild Populations to Stock Farms

In both captive breeding and ranching, stock must be removed from the wild. For captive breeding, a relatively small number of adult breeders of both sexes is required. The very high reproductive value of such adults to the population, as determined by modeling studies *(e.g.*, Crouse *et al.*, 1987), may make the ecological effects of such removal significant, although data are lacking. For ranches, a continuing supply of eggs from breeding beaches is required. Some schemes for egg removal have used spurious models of sea turtle biology to support unreasonably high levels of collection (see Heppell *et al.*, 1995). Continued removal of a majority of the eggs must eventually cause population collapse. However, considering the life history strategy of sea turtles and the very high natural mortality of younger stages, it can be argued that removal of a small proportion of eggs is likely to have little effect on adult recruitment. More knowledge about juvenile survivorship and density dependent constraints on adult recruitment are needed to evaluate this factor and estimate what proportion of eggs may be safely harvested.

Animals for Release/Restocking

A proportion of the turtles raised on farms can be released back to the wild. Because of the presumed high mortality of sea turtles in the smaller size classes, largely from predation, it is argued that recruitment to wild breeding populations can be augmented by releasing larger sized turtles that are less subject to predation in a

process termed "head-starting." Proponents point to documented cases of long term survival of released turtles, and growth and movements suggesting that they have successfully adapted to the wild (Wood and Wood, 1993). Critics point out that very few head-started turtles have joined a breeding population (Shaver, 1996; Shaver and Caillouet, 1998) and argue that the complex migratory movements of sea turtles in their subadult years are compromised and that behavior is unlikely to be normal (Dodd, 1982). The aberrant behavior and movements of some newly released turtles are widely documented. The potential introduction of disease and parasites from released captives into wild populations is also a serious concern (Jacobson, 1996), and there are further concerns about releasing turtles from different genetic stocks into wild populations (Dodd, 1982). Criteria for evaluating the success of head-starting are described in Eckert *et al.* (1994).

Research

Farms provide a unique opportunity to study some aspects of the biology of sea turtles. Holding turtles in captivity allows manipulation and experimentation that is not possible in the wild. CTF made major contributions to the understanding of the physiology of sea turtles, supporting research by visiting scientists and making its facilities and animals available for studies (Owens, 1995). The farm undertook to hold and breed the highly endangered Kemp's ridley turtle starting in 1980, and by 1984 was successfully breeding and raising this species. The farm successfully solved numerous husbandry problems involving nutrition, disease, and reproductive physiology. Farm research is often directed toward questions of maintenance and husbandry that have only indirect application to conservation and wild populations. However, most commentators concede that the research activities, particularly those at CTF, have been broadly beneficial to our general understanding of sea turtle biology.

CITES Guidelines

A new perspective was introduced between 1992 and 1994 when a task force of the Animals Committee of CITES was assembled to draft guidelines for the evaluation of proposals to CITES for ranching sea turtles under Resolution 3.15 of the Convention. Attempting to move beyond the unproductive arguments of the past, the task force proceeded under two broad assumptions: (1) the conservation benefits required by Res. Conf. 3.15 (and also needed to satisfy a very skeptical conservation community) must be made explicit in any ranching proposal, and (2) the solution to all the issues raised about effects of increasing international commerce in turtle products must be met by a very strict control of international trade.

Returning to the fundamentals of sea turtle biology, the task force recognized that because of their migratory habit, sea turtles were rarely or never solely the jurisdiction or "property" of a single nation, and therefore represented a special case for CITES which justified some extraordinary solutions. Responding to the most recent results on the genetic composition of sea turtle populations, and on a long recognized need for international cooperation in sea turtle conservation, the task force proposed that genetic population units be defined and all the nations in which a population spent time be identified. Communication, cooperation, and a regional approach to conservation of the population was then proposed as a necessary component of any ranching proposal for that population.

To address the need for effective trade controls, the task force proposed measures that would prevent sea turtle products from entering trade from any source except legal, approved ranches, and again called for international and bilateral cooperation between producing nations and consuming nations to achieve this.

These two new approaches to ranching allowed a prospective scenario where a sea turtle ranching project would become the vehicle for regionally coordinated conservation programs. The application of similar guidelines for all commercial sea turtle use is similarly feasible. Lack of funds to develop research, conservation, and enforcement is the major impediment to all sea turtle conservation. By linking the development of commercial sea turtle farms to required conservation activities, a source of funding, an incentive, and political support to meet the CITES guidelines could be encouraged.

The proposals were accepted by the parties to the CITES convention in 1994 (CITES Res. Conf. 9.20). The requirements for regional cooperation and scientific and biological knowledge remain difficult obstacles to meeting these new guidelines. It remains to be seen, on one hand, whether the new guidelines can indeed be applied as they were conceived (that is, to be a very positive factor for sea turtle conservation) and on the other, whether the requirements for international cooperation and coordination are too complex to be feasible.

The first proposal to change the CITES listing for a sea turtle was submitted by Cuba to the 10th Meeting of the Conference of CITES Parties in 1997,

and it failed to receive the two-thirds majority required for approval. Additional proposals from Cuba and elsewhere are anticipated.

Conclusion

Sea turtle farms, whether for captive breeding or ranching, cannot be shown to be directly beneficial or proven to be fatally detrimental to the conservation of wild populations. What can be demonstrated is that they are very expensive, require advanced technical knowledge, and are, to date, of unproved economic viability. The linkage of farms to direct conservation activities and strict trade control, through international cooperation, provides the potential that farms could contribute to the conservation of sea turtles, but this potential remains unrealized.

Literature Cited

Byles, R. 1993. Head-start experiment no longer rearing Kemp's ridleys. Marine Turtle Newsletter 63:1-3.

Carr, A. 1967. Caribbean green turtle, imperiled gift of the sea. National Geographic Magazine 131: 876-890.

Carr, A. 1984. The Sea Turtle: So Excellent a Fishe. Univ. Texas Press, Austin. 280 pp.

Carr, A. F. and A. R. Main. 1973. Turtle farming project in Northern Australia. Union Offset Co. Pty., Ltd., Canberra, Australia. 42 pp.

Crouse, D. T., L. B. Crowder and H. Caswell. 1987. A stage-based population model for loggerhead sea turtles and implications for conservation. Ecology 68:1412-1423.

Dodd, K. 1982. Does sea turtle aquaculture benefit conservation? p.473-480. *In:* K. A. Bjorndal (Editor), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington D.C.

Ehrenfeld, D. 1974. Conserving the edible sea turtle: can mariculture help? American Scientist 62:23-31.

Ehrenfeld, D. 1982. Options and limitations in the conservation of sea turtles, p.457-463. *In:* K. A. Bjorndal (Editor), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington D.C.

Eckert, S. A., D. Crouse, L. B. Crowder, M. Maceina and A. Shah. 1994. Review of the Kemp's ridley sea turtle headstart program. NOAA Technical Memorandum NMFS-OPR-3. U.S. Department of Commerce. 11 pp.

Hendrickson, J. 1974. Marine turtle culture: an overview, p.167-181. *In:* Proceedings of the Fifth Annual Meeting of the World Mariculture Society. Louisiana State University Division of Continuing Education, Baton Rouge, Louisiana, USA.

Heppell, S. S., L. B. Crowder and J. Priddy. 1995. Evaluation of a fisheries model for the harvest of hawksbill sea turtles *Eretmochelys imbricata*, in Cuba. NOAA Technical Memorandum NMFS-OPR-5. U.S. Department of Commerce. 48 pp.

Huff, J. A. 1989. Florida (USA) terminates "headstart" program. Marine Turtle Newsletter 46:1-2.

Jacobson, E. R. 1996. Marine turtle farming and health issues. Marine Turtle Newsletter 72:13-15.

Lebrun, G. 1975. Elevage a la Reunion de juveniles de la Tortue Verte *Chelonia mydas* (Linnaeus 1758). Science et peche. Bulletin Institute Peches Maritime No. 248:1-25.

Le Gall, J., P. Bosc, D. Chateau and M. Taquet. 1986. Estimation du nombre de tortues vertes femelles adultes *Chelonia mydas* par saison de ponte a Tromelin et Europa (Ocean Indien) (1973-1985). Oceanographica Tropicale 21:3-22.

Owens, D. W. 1995. Book Review: *Last Chance Lost?* Or is it? Marine Turtle Newsletter 71:11-12.

Reichart, H. 1982. Farming and ranching as a strategy for sea turtle conservation, p.465-471. *In:* K. A. Bjorndal (Editor), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington D.C.

Sato, F. and B. B. Madriasau. 1991. Preliminary report on natural reproduction of hawksbill sea turtles in Palau. Marine Turtle Newsletter 55:12-14.

Shaver, D. 1996. Head-started Kemp's ridley turtles nest in Texas. Marine Turtle Newsletter 74:5-7

Shaver, D. and C. W. Caillouet, Jr. 1998. More Kemp's ridley turtles return to South Texas to West. Marine Turtle Newsletter 82:1-5

Williams, P. 1993. NMFS to concentrate on measuring survivorship, fecundity of head-started Kemp's ridleys in the wild. Marine Turtle Newsletter 63:3-4.

Wood, F. and J. Wood. 1993. Release and recapture of captive reared green sea turtles, *Chelonia mydas*, in the waters surrounding the Cayman Islands. Herpetological Journal 3:84-89.

Wood, J. and F. Wood. 1980. Reproductive biology of captive green sea turtles, *Chelonia mydas.* American Zoologist 20:499-505.