
WESTERN PACIFIC
SEA TURTLE
Cooperative Research
&
Management Workshop

PROCEEDINGS OF THE

WESTERN PACIFIC SEA TURTLE

Cooperative Research & Management Workshop

A forum to disseminate information and to promote greater regional collaboration for research and management of Pacific sea turtle populations.

February 5-8, 2002

Coordinated and edited by Irene Kinan

Sponsored by

WESTERN PACIFIC
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Editors' Note

The papers presented at the workshop and consequently contained in these proceedings have been edited for consistency in format; with only minor changes to language, syntax, and punctuation. The authors' bibliographic, abbreviation and writing styles, however, have generally been retained. Several presenters did not submit a written paper, or submitted only an abstract to the meeting. In these instances, a summary was produced from transcripts of their presentations, with abstracts included when available. The opinions of the authors do not necessarily reflect those of the Western Pacific Regional Fishery Management Council or of other meeting sponsors.

Workshop Sponsors

University of Hawaii
Pelagic Fisheries Research Program

PREFACE

This volume of papers is a record of the Western Pacific Sea Turtle Cooperative Research and Management Workshop which convened February 5-8, 2002 in Honolulu, Hawaii sponsored by the Western Pacific Regional Fishery Management Council (WPRFMC). The participants at the workshop comprised a mix of sea turtle biologists, conservation specialists, and fishery scientists; primarily from 18 countries of the Western and Central Pacific (Fig. 1).

Sea turtles migrate vast distances across Ocean basins, living successively in varying life stages on the high seas, and within the EEZs and coastal habitats of numerous Pacific nations. Consequently a collaborative integrated approach to management and conservation between nations is essential for the recovery of depleted sea turtle populations in the Pacific Ocean. Due to stringent U.S. endangered species legislation, the continued operations of U.S. pelagic fisheries in the Pacific (one fleet among many which interact with sea turtles) are contingent on the recovery of Pacific sea turtle populations. Workshop participants focused on five objectives with emphasis on the Western Pacific Region.

Workshop Objectives

- to facilitate collaboration and the exchange of technical information
- to identify gaps in information/ knowledge and prioritize research efforts
- to coordinate education and conservation techniques with management strategies
- to synthesize guidelines for standardized data collection methodology
- to integrate the Council and its resources with existing regional sea turtle conservation action plans

Results and findings from this workshop were derived from either plenary sessions or from seven smaller working groups which focused on particular issues. The plenary sessions were designed to identify programs operating in the Western Pacific and facilitate the exchange of valuable information. The driving force of the meeting, however, was through the working groups. It was here that networking and collaboration between stakeholders was achieved, direction for the Council was attained and priorities for future directed research and conservation activities were outlined for the Region.

Working Groups

- Conservation Methods
- Community Empowerment
- Data Gaps
- Standardized Methods: Nesting Beaches
- Standardized Methods: Aquatic Habitats
- Involving Fishermen in Research
- Regional Action Plans

These proceedings contain the 34 presentations and/or submitted papers presented at the workshop, and the results from both the plenary sessions and working groups. In addition, any discussion which may have followed an oral presentation is included at the end of each paper. Background papers submitted to the meeting, but not presented during the meeting's plenary sessions, are included in Appendix IV.

Figure 1. Workshop participants group photo. Photographed are those present Tuesday, February 5, 2002. Participant list is located in Appendix II.

ACKNOWLEDGMENTS

The Western Pacific Regional Fishery Management Council would like to offer its sincerest appreciation to the invited experts for their professional presentations, submitted papers and their graciously offered time, energy and resources to attend and participate in this workshop. Without the dedication of our participants, this effort would not have been possible. The Council thanks you! We are grateful to our chair, Dr. Craig Moritz from the University of California, Berkeley who agreed to come and preside over our meeting, and fortunate that his department of "Integrated Biology" was consistent with this workshop's vision of integrated management

The Council expresses its sincerest gratitude to workshop collaborators, Dr. Peter Dutton and Dr. Scott Eckert, and other scientific advisors, Mr. George Balazs, Dr. Colin Limpus and Dr. Milani Chaloupka for their thoughts, ideas and insights toward the development of this workshop. We thank all those who lent a helping hand or word of advice when the search for participants began. We are especially grateful to those who humbly declined to attend so that another could come in their place. In addition, we thank Patrick Ching for his artistic contribution to the logo.

The Council is in debt to our working group team captains, Dr. Scott Eckert, Dr. Mark Hamann, Dr. Milani Chaloupka, Dr. Peter Dutton, Dr. Laura Sarti, Dr. Colin Limpus, Dr. Christopher Boggs and Dr. Nicolas Pilcher, whose expertise and leadership we could not have done without. The success of this workshop would not have been possible without their skill, dedication and significant contributions. In addition, appreciation and thanks are extended to the reviewers of these proceedings, specifically Kirstin Dobbs, Trina Leberer, Nicolas Pilcher, Milani Chaloupka, George Balazs, Paul Dalzell, and Jeffrey Seminoff for their time, comments and suggestions towards the completion of the final document.

Finally, the Western Pacific Regional Fishery Management Council would like to thank the National Marine Fisheries Service and the Joint Institute for Marine & Atmospheric Research School of Ocean and Earth Science and Technology - Pelagic Fisheries Research Program (PFRP) for their funding and support, and for sharing in the vision of cooperative research and integrated sea turtle management of the Western Pacific Region.

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INTRODUCTION

In some creation myths, the sea turtle is the animal on whose back the world was created. A symbol of longevity, fertility, strength and protection from harm, sea turtles are revered in culture and customs around the globe. Archaeological evidence shows that these "sacred fish" have been utilized and revered by humans long before written records were kept.

Coastal populations have exploited sea turtles for their meat, eggs, shell, leather, and oil for centuries, but cultures which historically managed sustainable use and promoted ecological balance are degrading. The loss of traditional values combined with the negative effects of unregulated adult and egg harvest, habitat degradation, commercial trade and mortalities through incidental capture in fishing gear has accelerated the decline of sea turtle populations. The latter half of the 20th century has been marked by catastrophic declines of sea turtle populations throughout the Pacific Region.

Having endured for millions of years, sea turtle species are now categorized as "Critically Endangered," "Endangered" or "Vulnerable" by the 2000 IUCN[1] Red List of threatened species. Critically Endangered turtles include the hawksbill *(Eretmochelys imbricata)*, Kemp's ridley *(Lepidochelys kempii)* and leatherback *(Dermochelys coriacea)*. The loggerhead *(Caretta caretta)*, olive ridley *(Lepidochelys olivacea)*, and green turtle *(Chelonia mydas)* are listed as Endangered, with the exception of the Hawaiian green turtle which is considered Threatened (USFWS[2]). The flatback turtle *(Natortor depressus)*, native only to Australia, is listed as Vulnerable. Five of the six sea turtle species found in the Pacific Ocean were the focus of this workshop (Fig. 2): the hawksbill turtle, loggerhead turtle, olive ridley turtle, leatherback turtle, and green sea turtle including the distinct subpopulation of the Eastern Pacific 'black' turtle *(Chelonia agassizii)*.

The United States continues to dedicate an increasing amount of resources to the preservation of endangered species within our borders. However, conservation and management of sea turtle populations requires more than strongly focused domestic programs. Sea turtles are a shared international resource and their management requires cooperation across the Pacific Region.

[1] *World Conservation Union; http://www.redlist.org/*
[2] *U.S. Fish and Wildlife Service; http://www.endangered.fws.gov/*

The Western Pacific Regional Fishery Management Council (WPRFMC), the federal authority for fisheries in the U.S. Exclusive Economic Zones (EEZs) of the Western Pacific, has extensive experience in international negotiations and management of highly migratory and shared marine resources. The WPRFMC is now in the unique position to bring its experience in international fishery management to support and foster marine turtle conservation.

For this reason, the WPRFMC convened this group of researchers and conservation managers from the Pacific Region. The range of expertise within the group includes not only sea turtle biology and conservation, but also educators and project managers. Experts with proven abilities to work with local communities, implement effective research or conservation programs, and all stakeholders with the desire to preserve and recover threatened sea turtle species.

Recommendations from previous Southeast Asian symposiums emphasized the need to strengthen collaboration among stakeholders, promote community participation, support scientific research, and develop regional management guidelines for the conservation of sea turtle species. The WPRFMC thus provided this forum for the Western Pacific Region to exchange scientific information, update on the status of population trends, review the progress (when applicable) of recommendations from previous meetings and build consensus for a regional approach towards research and conservation.

Through this dialogue, the WPRFMC hoped to: 1) acquire direction towards the most efficient use of its resources to aid in the recovery of depleted Pacific sea turtle populations; 2) create momentum to facilitate and strengthen long-term conservation goals; and 3) drive essential research and foster greater collaboration between stakeholders and sea turtle conservation programs in the Central and Western Pacific.

Pacific Marine Turtles

Figure 2. The six marine turtle species occurring in the Pacific Ocean, all but the Flatback are the focus of this workshop. Not pictured is the subpopulation of the Eastern Pacific "black" sea turtle, *Chelonia agassizii* (Photo Source: C. Limpus).

Results

Workshop Sessions

Top left: Dr. Craig Moritz. *Top right:* Dr. Colin Limpus.

Plenary Session Summary

Workshop chair, Dr. Craig Moritz from the University of California, Berkeley, guided workshop participants through an extensive agenda that drew out current population trends, new information, identification of information gaps, and recognition of primary sources of mortality for sea turtles in the Western and Central Pacific region. Sea turtle stocks that interact with U.S. longline vessels were discussed and the Council was encouraged to continue efforts to ameliorate the impact of these fisheries on Pacific sea turtles. Dr. Moritz stated that there is a substantial information gap with respect to the way human populations in the Western and Central Pacific interact with sea turtles. Little is known about the principal economic and cultural factors driving egg and turtle harvests in the region and the trends in these factors; knowledge which is essential for development of programs to ameliorate this major impact on sea turtle populations. He also noted that WPRFMC can play a unique role in assessing impacts from by-catch mortality because of its observer programs and close links to other regional fishery organizations (e.g. Secretariat of the Pacific Community).

Dr. Colin Limpus from the Queensland Parks and Wildlife Service, summarized the groups view points with regards to species/stock priorities for management and conservation. Participants identified gaps in index nesting sites, foraging areas to focus research, key mortality/harvest areas, pelagic take in commercial fisheries of all types, and stock enhancement protocols (e.g. management of nesting beaches to improve the production of hatchlings). The overall consensus of the group in regards to research priorities to delineate sea turtle stocks is through integration of: 1) DNA stock identification; 2) satellite tracking; and 3) continued flipper tagging.

Dr. Limpus brought up key points regarding global warming, indigenous harvest, and lack of information reporting. Although the effects of global warming are not fully understood, it is expected to pose increasing impacts to both nesting and foraging habitats in the future as global warming trends become more common. In addition, he stressed the need to quantify sea turtle harvest by coastal communities. Every coastal village in the Central and Western Pacific, unless restrained by religion, will eat sea turtles and/or their eggs. What level of turtle harvest, if any, is sustainable? The volume of indigenous take in the region has yet to be properly quantified, and remains a serious impediment to population assessment and monitoring. Moreover, there is an opportunity to collect important biological data from sea turtles harvested for subsistence purposes which is currently not realized. Information on size, sex, maturity, breeding history, diet, parasites/disease, turtle health and samples for genetic stock identification could be collected from subsistence harvests.

A major role of the workshop was to encourage and strengthen communication and networking between stakeholders for future management collaboration. Participants left the workshop with a general sense of direction for future activities. Researchers agreed to work towards the development of a meta-database to manage tag information that would include information regarding tag records, tag returns, telemetry/migration data, and genotypes. Resource managers and policy makers agreed to work towards better delineation of stock boundaries, breeding, foraging and migratory ranges. It would appear that indigenous coastal communities which harvest turtles in the region are largely unaware of the serious condition of sea turtle populations, believing in many instances that the turtles they harvest are largely confined to their general locale. Thus there is an urgent need to provide information to coastal communities on sea turtle life history, and the impacts of harvesting eggs or killing adult turtles. In summary, increased capacity building between all stakeholders was encouraged through future technical training, workshops, and distribution of education materials. In this context, the WPRFMC can play a key role in promoting, and liaising with, other efforts to collate and disseminate data across the region.

The workshop provided new perspectives on the status of sea turtle populations that potentially interact with the fisheries relevant to the WPRFMC. The deficiency of information regarding hawksbills was noted throughout the Pacific Region. The population of leatherbacks from Peninsular Malaysia is severely diminished, but there is more hope for populations (many of which are undocumented) which exist in Papua (formerly Irian Jaya), Papua New Guinea (PNG) and extend to the Solomon Islands; these being the last remaining strongholds in the Western Pacific. The presentations of nesting data from Japan and Australia indicated that northern and southern loggerhead populations are in precarious state in the Pacific Ocean. Nesting numbers have dropped precipitously over the last the last 10 years, and it is estimated that there are less than 2,000 loggerheads nesting annually throughout the entire Pacific. Mexico's leatherback nesting aerial survey in 2002 was the worst on record with only about 200 nests counted (approximately 50 females). Presentations regarding green sea turtles expressed that some stocks appear to be stable or increasing (such as Hawaii, Australia's Southern Great Barrier Reef and the Turtle Islands of Sabah/Philippines), but other stocks appear to be declining such as the Eastern Pacific 'black' sea turtle. A preliminary Global Cheloinian Assessment[3] report indicates a global population decline of 50 to 80%, thus confirming the *Endangered*[4] listing of green sea turtles.

In total, thirty-four presentations helped to generate new information for all in attendance. Agreeably, the most critical area for understanding the demographic functioning of a turtle population is in the feeding grounds, yet the majority of research efforts remain at the nesting grounds. Sea turtles spend over 99% of their lives at sea and are important components of a healthy marine ecosystem. Throughout the workshop, Dr. Scott Eckert, Dr. Colin Limpus, Mr. George Balazs and others stressed the importance that to understand the demographics of an entire sea turtle population, including males and juveniles, research must be done in aquatic and foraging habitats. Moreover, knowledge of aquatic demographics is essential for understanding population status, and for improving response time where populations are declining. Satellite telemetry and tag return data (specifically from the SPREP program) reveal extensive migrations and mixed stocks in foraging grounds. This data also identifies important linkages between nesting and foraging habitats in the region between the Central and Western Pacific [e.g. America Samoan nesting turtles and foraging habitats in Fiji]. Also identified was the significance of the foraging habitats of the Sulu Sea and South China Sea of which limited information exists.

Integrating and involving fishermen in the research effort was an underlying theme throughout the workshop. Fishers could help provide substantial information regarding sea turtle migratory routes, aquatic habitat usage, and high seas stock demographics. Since accurate sea turtle population assessments are needed throughout the Pacific Region, the incidental capture of sea turtles by fisheries presents a unique opportunity for fishermen to: 1) tag turtles thus contributing to information regarding population assessments and high seas migratory routes, and 2) collect tissues for genetic sampling to assist in stock identification. Integrating fishers on an international basis could prove beneficial by helping to provide accurate levels of sea turtle interaction rates, opportunities for education and awareness, and encouragement for fishermen to develop sea turtle mitigation measures. In addition, developing incentives for fishermen to obtain better reporting of sea turtle interactions (without the risk of prejudicial retribution) was discussed and encouraged.

A primary gap in information that also has great applications towards management is the delineation of genetic stocks to identify management units. In an effort to define management units within the region, researchers from both sides of the Pacific announced that over 10,000 samples currently exist in the genetic archive data-base, with additional works in progress and intentions to establish a global Central repository.

In evidence of what collaborative efforts among stakeholders can accomplish, presentations from community-based programs expressed significant success stories in regards to raised community awareness and increased community empowerment towards conservation and preservation of sea turtle stocks. Presentations from relatively new conservation programs of Indonesia, Thailand, Vietnam, Papua New Guinea (PNG), Papua, Fiji, Vanuatu, Palau, Guam, and America Samoa show promise towards turtle recovery through the definition of future research goals, identification of primary threats to stocks, conservation needs and management requirements and/or initiatives for their countries.

Priorities for Future Directed Activities in the Region

- Aerial surveys of nesting beaches for leatherbacks [Papua, PNG, Solomon];
- Encourage in-water surveys and identification of key foraging habitats;
- Quantify directed take and indigenous harvest; Identify the source and quantify pelagic mortality in all fisheries;
- Continue genetic stock assessment;
- Convene technical workshops throughout the region;
- Promote increased hatchling production at nesting beaches [i.e. leatherback turtles]; and
- Promote and support the implementation of existing regional action plans [SPREP, Southeast Asia MoU, U.S. ESA Recovery Plans].

The workshop's plenary sessions and seven working groups outlined action items that are required to recover Pacific sea turtle stocks and identified areas where the WPRFMC could apply its abilities and resources. Priority setting in the final sessions was done with reference to three criteria: 1) relevance to the scope of the WPRFMC's mandate, 2) urgency – known declines in turtle stocks or critical data deficiencies, and 3) uniqueness of the contributions that can be made by the WPRFMC. These prioritized actions concerned:

- Liaison & Communication – with the regional scientific community, commercial fishers, and communities undertaking traditional harvests. This could be achieved through the appointment of a person to advise the Council on marine turtle biology, liaise with regional bodies and coordinate regular workshops. Via employment of a consultant to develop a strategy and information products appropriate to fishers and coastal communities.
- Gaps in knowledge – emphasizing survey and identification of stocks in key nesting and foraging areas (see, Priorities for Research in the Region, Colin Limpus), assessment of mortality via direct harvesting and fisheries bycatch, mitigation measures, and analysis of socio-economic drivers.
- Capacity building – via technical training and workshops, targeted and effective sharing of information and promotion of postgraduate education programs relevant to marine turtles with funding agencies such as USAID.

WPRFMC Priorities for Sea Turtle Conservation

- Increased liaison activities and communication with sea turtle management and research groups;
- Promote effective nesting beach management protocol (to increase hatchling production);
- Institutional strengthening and financial monetary support for specific programs;
- Continued focus on sea turtle fishery mitigation measures;
- Continued assessment of sea turtle mortality in pelagic fisheries, and incidental by-catch sampling and analysis; and
- Focus on the "Indo-Malay Archipelago" with emphasis in Indonesia, PNG, Solomon Isl., Vanuatu and Fiji.

[3] *See J. Seminoff's presentation this publication*
[4] *Based on 2001 ICUN Red List Criteria*

Priorities for Research in the Region

Discussion Led by Colin Limpus

SPECIES AND/OR STOCKS

- Leatherback Turtles: East and West Pacific
- Loggerhead Turtles: North and South Pacific
- Hawksbill Turtles: Southwestern Pacific
- Green Turtles: Eastern Tropical Pacific & Northwestern Pacific

NESTING AREA DISTRIBUTION AND ABUNDANCE

Key Index Beaches Needed for Each (Undocumented)Area:

- Leatherback turtles: north coast Papua New Guinea, Solomon Islands
- Pacific Island nations: especially Fiji, Vanuatu, Palau

FORAGING AREA

- Fiji: focal area for South Pacific green turtle foraging
- Sulu-Sulawesi Sea: focal area for Western Pacific green turtle foraging
- Bicol region and Central Philippines for leatherback turtles
- South China Sea for green turtles and hawksbills
- Leatherback foraging areas: Northwestern U.S.A., Chile, Peru, Northeastern Pacific west of Hawaii Marianas Trench region

ASSESS ALL SOURCES OF TURTLE MORTALITY, ESPECIALLY IN "GAP AREA"

- Direct take (harvest of eggs and turtles)
  - ~ Leatherback turtle and egg harvest: PNG, Solomon Islands, Kei Islands fishery
  - ~ Hawksbill turtles: PNG, Solomon Islands, Vanuatu, Fiji
  - ~ Green turtles: Berau Indonesia, village take in all countries

PELAGIC TAKE IN COMMERCIAL FISHERIES OF ALL TYPES

In Particular:

- Directed catch in Sulu Sea area
- Asian longline fleet bycatch
- South American fleet

STOCK ENHANCEMENT

- Promote increased production of hatchlings at nesting beaches

ASSIST RESEARCH INTO THE DELINEATION OF SEA TURTLE STOCKS THROUGH

- DNA stock identification
- Satellite tracking
- Flipper tagging

Working Group Summaries

Conservation Methods Working Group

The Conservation Methods Working Group considered the threats that conservation activities hope to mitigate. The group chose to characterize the primary, or most serious threats to sea turtles in the region, and the conservation methods that are best applied to those threats. For green turtles the primary threats are the over-harvest of adults and eggs, and the jeopardizing of management and conservation programs by political considerations. Threats to leatherback turtles are primarily over-harvests of eggs, predation on nesting females and eggs by feral animals, and mortality of leatherbacks in international pelagic fisheries. The status of Western Pacific leatherback populations is poorly understood. There is a similar lack of understanding of the population status of hawksbill turtles in the region, whose populations also suffer from intense over-harvest of adults and eggs. Loggerhead breeding populations have dropped to precarious levels, with probably less than 2,000 loggerheads nesting annually throughout the entire Pacific. Commercial fisheries that represent threats to loggerheads include pelagic longline fisheries in the North Pacific, prawn trawling in the coastal waters of Australia and Papua New Guinea, sub-surface pound nets in Japan, and coastal gill nets in Mexico (Baja California in particular). Coastal development, particularly on Japanese nesting beaches is also a significant threat. Eastern Pacific olive ridley stocks seem generally to be recovering, however, Western Pacific stocks still warrant concern. *In-situ* is the preferred hatchery management technique, and with proper management protocol, increased hatchling production may ensue (especially applicable to increase leatherback turtle stocks). Issues and threats common to all species included data deficiencies, lack of resources and coordination for international collaboration and initiatives, poor education and public awareness, coastal habitat degradation and loss of ecosystem function.

Community Empowerment Working Group

The results from this working group suggest a lack in the overall reporting of community-based conservation programs and knowledge of the function of conservation groups in the region. The group identified a need for coordination in the Western Pacific Region so programs can collaborate and design appropriate education materials (based on target audience), distribute essential information to communities/programs in need, and design incentive programs for conservation for coastal communities. A comprehensive survey to inventory all community-based conservation initiatives is needed, as is information regarding the types of fisheries in the entire Western/South Pacific Region, with emphasis to those which potentially interact with sea turtles. Existing organizations may be utilized and referenced, and that such an agency (e.g. SPREP[5], SEAFDEC[6], ASEAN[7], or other) act as an umbrella agency for the implementation of recommendations.

Data Gaps Working Group

The greatest information gaps occur in stock assessments, genetic identification of management units and in aquatic habitat characterization. The primary source of mortality and/or threat to sea turtles is the direct harvest of adults and eggs. A general lack of information reporting exists throughout the region. A major coordinated data collection initiative needs to be mounted, possibly through another "Year of the Turtle" campaign (the theme from the SPREP 1995 campaign). The anniversary of this campaign could be used to "jump start" a series of activities. This could include stock assessments of key index nesting sites by aerial surveys (followed by ground truthing; specifically for leatherback turtles, but also for other species); migration satellite tagging projects; and community involvement/awareness campaigns.

[5] *South Pacific Regional Environment Programme*
[6] *Southeast Asian Fisheries Development Center*
[7] *Association of Southeast Asian Nations*

Pelagic fishery observer programs in the region offer opportunities for genetic sampling integrated with tagging programs of sea turtles for all fishing fleets. Further, observer programs are needed to improve and update assessments of sea turtle take in pelagic fisheries, and continued efforts are required in the development of bycatch mitigation methods. A satellite tracking program across sites is needed, particularly in the Central Pacific (Fiji, Vanuatu, New Caledonia, Solomon Islands) to identify foraging areas and migratory routes. Captive rearing and release experiments using modern tagging technology could also prove useful. Other important actions include the establishment of a web-based meta-database (a database of databases), possibly coordinated or managed by the Council or another similar agency. This could include human population forecasts to assess potential impact on local sea turtle stocks. Overall, there should be enhanced capacity building in the region for capture-mark-recapture programs; methodology for age estimation; laparoscopy and ultrasound (gonad interpretation); sampling methodologies (genetics, population assessment surveys, biological demography); and necropsy.

Regional Action Plans Working Group

The Regional Action Plans Working Group looked at three broad areas: the 1998 U.S. ESA Sea Turtle Recovery Plans, communication linkages, and institutional strengthening. Action in support of the *U.S. ESA Sea Turtle Recovery Plans*[8] should include the implementation of recovery plans in the Western Pacific Region. Lead agencies (i.e., U.S. Fish and Wildlife Service, U.S. Department of State, and the National Marine Fisheries Service) should be contacted to request that funding be disbursed to individual Departments and/or action be taken to implement the Recovery Plans. One or more international workshops on the U.S. Recovery Plans should be convened to report on progress of implementation, and identifying mechanisms through which other countries could participate or develop similar plans, or contribute in any way towards the common goal.

Communication linkages should be improved to facilitate the exchange of information (e.g. through a meta-database). An evaluation needs to be made of current conservation programs in the Pacific Islands implemented through SPREP and by other agencies in the Western Pacific. The evaluation should determine at what level they are being implemented, and identify gaps where programs are needed. Information packets for nations and managers on turtle programs, international instruments, research, and general info on IOSEA MoU[9] and RMTCP[10] should be developed. There should be a timely flow of critical information from Secretariats (possibly through web list serves such as www.indonesiaturtles, Cturtle[11], and others). Website development and maintenance, uploading of information from other programs within the wider region, and dissemination of short notes as to the presence of the data, and/or media releases are required. Stakeholders and the different levels of government should be identified to involve them in implementation of sea turtle conservation measures. Two-way communication between the sea turtle community and other projects, bodies, and fisheries (e.g. U.S., Japanese, Chinese, Taiwanese, Korean fleets, etc.) should be developed. Marine Protected Areas (MPAs) which contain sea turtles and their habitats as a key component, should be monitored and coordinated with the International Coral Reef Initiative.

An assessment of the needs of and mechanisms for institutional strengthening should be conducted for community, country and regional levels. Linkages between the Western Pacific and adjacent regions should be characterized. Realistic targets should be set for what can actually be accomplished in a pre-determined period of time at the national level, and performance indicators within and among regional instruments should be identified. Research projects could be identified as rallying points so all members can focus attention on sea turtles (e.g. stock movements, pelagic phases, habitat usage, etc.). Providing access to scholarships for local post-doctoral, doctoral, or master students to carry out studies (anthropological surveys, scientific/genetic approach, etc.) could benefit and support capacity building on all levels. This would require promoting sea turtle research and conservation studies as national priorities.

[8] *Recovery Plans are required for all species listed under the U.S. Endangered Species Act.*
[9] *Memorandum of Understanding (MoU) on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia*
[10] *SPREP's Regional Marine Turtle Conservation Program*
[11] *The Archie Carr Center for Sea Turtle Research at the University of Florida, web list serve: http://accstr.ufl.edu/cturtle.html*

Standardized Data Collection Methods Working Groups

The Standardized Data Collection working groups were designed for the benefit of workshop participants to coordinate research activities and data collection methodologies in their respective programs. The focus was not specifically on the development of "action items," but to discuss technical and scientific issues and build consensus on standardized methods of data collection. Experts in the field of aquatic research and nesting habitats led discussions.

Standardized Methods: Nesting Beaches Working Group

This working group was used as a forum for discussion on technical issues/questions/problems, and exchange of experiences and information regarding use of techniques. As in other working groups, this group also identified stock assessments in the Western Pacific as a major "gap" in research. The group stressed the need for documentation and standardization of techniques and strategies utilized by various programs to assess nesting stocks and biological parameters. Census methodology of well established "Index sites" (e.g. Southern Great Barrier Reef, Hawaii, Sabah Turtle Islands, Sarawak, Tortuguero, etc…) should be incorporated by developing programs to promote uniform data collection and reciprocal exchange of information. For example, census data and methodology for Papua New Guinea leatherback turtles and East Pacific leatherback turtles should be exchanged to establish a regional strategy for nesting beach monitoring.

In addition to monitoring index nesting sites, aerial surveys could prove beneficial to identify undocumented nesting beaches. The advantages and disadvantages of various hatchery techniques for different species should be assessed, as well as promoting *in-situ* nest protocol (when possible) for hatching and hatchling sex ratio success. Overall, removal of eggs to hatcheries is most valuable where poaching and predation is high. There exists a wealth of material (publications, manuals, video footage) on techniques used for conservation and research of sea turtles on nesting beaches. However, there is a need for dissemination of material to developing programs in remote locations and hands-on, in-field training (i.e. workshops) to ensure standardization of techniques.

Genetic sampling should be incorporated into routine population assessment and nesting monitoring protocols. In addition to identifying management units, genetic studies confirm the scenario that satellite telemetry and tag return data provide to determine migratory routes, habitat usage and stock boundaries. Tagging programs should clearly identify objectives of tagging effort (e.g. long-term, short-term, etc.), cost-effectiveness, and logistical feasibility in order to design the appropriate approach, tag type, tag technique, or whether to do tagging at all. The recommended standard for leatherback turtles is to place flipper tags on

rear flippers. The use of Passive Integrated Transponders (PIT) was recommended for a long-term durable internal tag in combination with metal flipper tags. Other techniques applicable to nesting beaches include genetic sampling (blood, tissue), necropsy, laparoscopy, and hatchery design.

Standardized Methods:
Aquatic Habitats Working Group

Sea turtles spend most (99%) of their lives at sea and are important components of a healthy marine ecosystem. Hawksbill turtles are spongivores, maintaining coral/sponge balance in reef ecosystems. Adult green turtles are herbivores maintaining the coral/algae balance, and stimulating healthy seagrass meadows. Leatherback turtles are the primary predators of cnidarans (i.e. jellyfish). Moreover, knowledge of aquatic habitats is essential for understanding population status, and for improving response time where populations are declining. The important elements of aquatic habitat studies should include the utilization by sea turtles for foraging, transit, refugia, inter-nesting, and resting. The important factors in these habitats include food quality and quantity, water quality/temperature, refuge, isolation, and depth.

Habitat use by sea turtles is determined by sampling the foraging population through tagging (in combination with satellite transmitters and/or radio tags), food habit analysis (lavage method or stomach pump), and DNA studies. Aerial surveys are useful to identify "hotspots," but a critical factor is "observability" (e.g. how well turtles are found) which will influence survey design. Capturing sea turtles in aquatic habitats may require using various types of techniques and understanding how they work. Once again, survey design is a critical component to determine gear types to be utilized for captures. The types of data and analysis for aquatic studies should include the use of Geographical Information Systems (GIS) and mapping systems for home range and habitat use analysis (such as Minimum Convex Polygon analysis or Kernel method), and the interpretation of Argos data from satellite tags.

Involving Fishermen in Research

This working group considered the research opportunities arising from fishery interactions as well as the need for mitigation. The group began by first identifying the primary sources of fishery induced morality and finalized discussions by addressing the need to integrate fishermen into the research effort. As experience has shown [e.g. TED development] that fishermen can be instrumental in developing successful mitigation measures, they should be actively encouraged to develop their own "high seas" turtle mitigation measures. In addition, incentives for fishermen to report sea turtle interactions should be explored to obtain better reporting of interactions, without the risk of prejudicial retribution.

Fishing around fishery aggregation devices (FADs) with purse seines catches sea turtles, mostly alive and in excellent condition. The mortality risk is turtles dropping on deck and cracking the carapace, or being eaten by the crew. With correct handling the sea turtles can be returned to sea alive almost 100% of time. Removal from the nets is already a crew priority because turtles passing through the power block will break machinery. Guidelines on handling purse seine caught turtles have been developed for the ETPO[12]. These could be adapted and disseminated to purse seiners in the West-Central Pacific Ocean.

Drift netting on the high seas has ceased, although there are still driftnets in use that may be serious sources of continued mortality. The banning of high seas gear a decade ago may soon result in the appearance of more sea turtles at nesting beaches (if there has been a lag effect on the turtle populations resulting from driftnet mortality). Inshore, small-scale gillnets continue be a problem for hard shell species in some areas, but illegal drift gillnetting in EEZs may impact leatherback turtles. Some data indicate 80% of driftnet caught sea turtles die.

Buoy lines for fish traps kill turtles in Australia and elsewhere. Buoyed, bottom-weighted ropes form loops that catch sea turtles, as documented in Western Australia and Tasmanian fisheries. Recreational anglers catch sea turtles in Hawaii, along the U.S. Gulf and Atlantic coast, and probably around the world. Lines can tangle or hook turtles. This gear most likely has a probable cumulative large impact to sea turtles, and is one of the least recognized sources of mortality.

Longline impacts on sea turtles by changing depth of sets, and night versus day sets needs to be assessed. The majority of the longline effort in the Pacific stems from Japanese, Taiwanese, and Korean fleets, plus expanding fleets in other Pacific Islands and South Eastern Asian countries. More logbook and observer data on the style of longline fishing is needed. Principal question, however, is how many sea turtles are caught by longliners in the Pacific? Data collected by the Secretariat of the Pacific Community (SPC) suggests relatively low interaction rates. High-end estimates about 0.1 turtles/1,000 hooks for Asian fleets would indicate interactions of between 12,000-20,000 per year. It is important to note that these numbers represent catches of sea turtles and not mortalities.

An accurate level of sea turtle catch in the Central and Western Pacific must be assessed (e.g. a high priority need). This will only be accomplished through increased observer deployment on fishing vessels. Population size and stock boundaries are essential to determine impacts of fishery takes/mortalities. The incidental capture of sea turtles by fisheries presents an opportunity for fishermen to conduct tagging and collection of tissues for genetic sampling. Pole biopsy instrumentation should be disseminated for large turtles cannot be landed on board. For longline fishing, the mortality from different fishing hooks (size/shape/type) should be assessed and quantified, in order to develop de-hooking and hook cutting devices. Turtle bycatch should be brought to the attention of the west and Central Pacific Ocean fishery management authorities such as Forum Fisheries Committee, the annual Purse Seine Treaty consultation, and the new Tuna Commission.

The working group concluded that fishermen should be integrated into the research effort. Tagging programs should be developed that include fishermen (to gather information on population size and structure). Fishermen can also collect additional information including sex and size measurements, and photographs for identification. Fishermen should be actively encouraged to develop their own sea turtle mitigation measures. Fishermen have been instrumental in developing successful seabird mitigation measures such as tori lines, blue-dyed bait, setting chutes and strategic offal discards.

Incentives for fishermen to report sea turtle interactions should be explored to obtain better reporting of interactions, without risk of prejudicial retribution. This requires education and outreach programs and feedback to fishermen concerning interactions. Good outreach materials should be provided to fishermen and the need for much higher port presence and port sampling (retired fishermen may be good to use as port samplers). Rewards and gifts such as hats, shirts and mugs can promote goodwill and interest.

[12] *European Trade Promotion Organization*

The methods used to study fishery-induced mortality are currently under debate, but include pop-up and fixed satellite tags and conventional tags. Mitigation research is still ongoing covering a range of different measures such as deep-set swordfish fishing, "stealth" gear, circle hooks, and blue-dyed bait. Another measure that may be tested is degradable hooks versus standard hooks.

Experience has shown that fishermen can been instrumental in developing successful mitigation measures and should be actively encouraged to develop their own high seas turtle mitigation measures. The experience of TEDs introduced into shrimp trawl fisheries resulted not only in turtle conservation, but also in a target catch improvement by removing large objects from shrimp trawls. Australia's CSIRO[13] is conducting a study comparing U.S. versus Australia experiences with TEDs.

General Consensus by all Working Groups

Several findings arising from the different working groups had overlapping themes. The largest information gap continues to exist during a turtle's "lost years" or first approximate five years of life, and natural and human related mortality parameters remain predominately unquantified. The greatest information gaps occur in stock assessments and in aquatic habitats, especially in the Central and Southern Pacific Region. Aerial surveys are needed to assess key index nesting sites for leatherback turtles in the Western and Central Pacific, and satellite tracking needs to be expanded for all species. Technical workshops should be convened on bycatch mitigation, research methodologies and standardized techniques (for reciprocal data exchange), and community involvement and conservation.

It appears that the primary source of mortality and threat to sea turtles is by harvest of adults and eggs, and the indigenous cultural harvest in the Western and Central Pacific must be quantified. Incidental bycatch must be quantified in all fisheries that impact sea turtles. With respect to fishery interactions, there should be promotion at the international level to have fishermen involved in research to tag turtles and collect genetics, bycatch and high seas stock information.

The U.S. Recovery Plans need to be implemented and progress assessed. Coordination is needed in the Western Pacific Region to facilitate the exchange of information and collaboration between programs (research and conservation). A Central database (Meta DBMS) or website is needed for the entire Pacific Region to facilitate information exchange and coordinate conservation efforts. Financial and other resources need to be identified to support programs currently lacking support.

[13] *Commonwealth of Scientific and Industrial Research Organization*

Welcome and Introductions —

Dr.Craig Moritz & Paul Dalzell

WELCOME - Dr. Craig Moritz, Workshop Chair

Good morning and welcome. I would like to point out a couple of things from a discussion that I had with the Council last night. That is to say, I think it is terrific they brought together such a diverse group and it's clear we came to learn from the experience that we all have in basic turtle biology and turtles.

That said, I'm aware we need to avoid reinventing the wheel. There has been a lot of international symposiums, there are Memorandum of Understandings and we're all aware of these. We need to walk a balance between providing as much information as we can to the group to help in their immediate problems, to provide a broad geographic focus, but also to focus the outcome of the recommendations that will be brought forth as specifically as we can on the turtle management issues of the stocks which intersect with the range of the fisheries in the region.

As you're all aware, the range is very broad, not just the areas on the map, but we're dealing with the turtles, wherever they come from, that intersects with those economic demands, and that is obviously really, really broad. Let us try - particularly in the working groups - to come up with action items that make sense in terms of what the people here can achieve, rather than broad recommendations. With this said, Paul is going to offer some words of welcome to get things started.

INTRODUCTION - Paul Dalzell

Good morning, everybody. I would like to welcome you on behalf of the Council to the Western Pacific Sea Turtle Cooperative Research and Management Workshop. The Council regards this as a pivotal and important meeting for us. As you'll hear, and many of you already know, over the past couple years we have experienced problems arising from the interactions between the Hawaii-based longline fishery and sea turtles. We're moving just beyond the area of mitigating interactions, but becoming involved in regional efforts towards conservation of Pacific sea turtles. In this presentation I will introduce the Council, and give you some background about who we are, what we do and then wind down with the reasons why we convened this workshop.

The Western Pacific Regional Fishery Management Council is a U.S. federal government instrument for developing fishery management policy in the Western Pacific region. The Council's territory is a great archipelago of islands that extends from the Northern Marianas (CNMI) and Guam through Hawaii, all the way down to American Samoa. It includes elements of Polynesia and Micronesia. The Pacific Islands, in general, have a very high per capita fish consumption. So fish, fisheries and fishing is an integral part of the culture of Polynesia, Micronesia and in the maritime cultures of Melanesia. Even in Hawaii our fish consumption is 42 pounds per year, which is twice the national average. Added to the traditional communities in the islands of the Western Pacific, there are many migrants coming from East and Southeast Asia, particularly into places like Guam, CNMI and America Samoa. All these people also have an affinity with the sea and also with fish so that the demand for fish in all of our islands is extremely high. In addition, there's a high level of participation in fishing in all of the islands. Every person is a potential fisher, and in the island region virtually every village is a landing site. Fishing and fish are more than just part of the economy, they are an integral part of the culture.

This Council is one of eight Council's which operate under a federal statute called the Magnuson-Stevenson Fishery Conservation and Management Act. This act was promulgated in 1976 as the Fishery Conservation and Management Act, later renamed Magnuson and then Magnuson-Stevens Act. It's the primary law for conserving and managing fishery resources in U.S. federal waters. This is usually from the edge of the state waters out to 200 nautical miles. We manage the fisheries in most of the U.S. EEZ waters of the Western

Pacific Region. We are funded through congressional appropriations. The council system is designed to provide primary stakeholders a substantial role in managing fisheries and resources in their respective areas. The objective is to include the resource users and other stakeholders with developing management policy for federally managed fisheries.

The Council's role is to develop policies to manage fishery resources in the U.S. EEZs in the Western Pacific region, to prepare fishery management plans and plan amendments for fisheries and resources needing management, to provide a forum for discussion and decision making, and to provide recommendations for the Department of Commerce. So, basically, the Council is a policy body. It has a large family, and within that family there are various advisory bodies. These include standing committees, scientific and statistical committee, five plan teams, and four advisory panels.

Since the reauthorization of the Magnuson Act in 1996 we have to describe the essential fish habitat for management unit species. This is extremely important as we have to assess what impacts a plan or a regulatory amendment might have on stakeholders. We must also consider bycatch and protected species interactions. Of course, this is one of the reasons why we're having this technical workshop.

The regulations that are developed under the Magnuson-Stevens Act are not developed in a vacuum. They are part of a greater legal framework of other federal statutes. Whatever we develop must be consistent with difference articles of legislation. The core of those that we have to pay particular attention to include the National Environmental Policy Act (NEPA), the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), and the Regulatory Flexibility Act (RFA).

In summary, implementing a fishery management plan under this kind of comprehensive framework is a complex task. In many cases, some measures may essentially limit fishing activity and cause adverse economic impacts. A good example is the measures to limit turtle interactions in the Hawaiian-based longline fishery resulting in a loss of about a quarter of the fishing fleet and the loss of swordfish harvesting. But we have to do this to be consistent within the terms and conditions of the Endangered Species Act. The point I'm trying to make is we have to balance all of these different articles of legislation, along with our own driving force, which is the Magnuson Act. One of the things we have come to understand is the way the Endangered Species Act applies to the fishing industry.

The condition of Pacific marine turtles, as many of you know, is very serious. The two species of greatest concern are loggerheads and leatherbacks. We have to try to reduce fishery interactions as much as possible, indeed to zero them out if possible. One area of major concern to us right now is to minimize any further impacts of our fishing on populations, especially of those of greatest concern. As a consequence, in the fishery, from the equator northwards any longline vessel under the jurisdiction of the Western Pacific Council, can no longer set lines to catch swordfish; this means fishing fairly shallow in the water column, within 30 meters of the surface. There are also various provisions in the amendment: how gear can be rigged; what you can carry; lightsticks (cylumbe glow stick) cannot be used; and there are time (April to May) and area closures for the remaining fishing fleet.

However, taking care of our fisheries alone will not halt the decline in the populations of Pacific sea turtles. At this point, our swordfish fishery is closed. But what happens if populations continue to decline? Does there come a point where our tuna fishery then has to be further constrained or even shut down? In addition, we have an expanding longline fishery in American Samoa and there is an interest in starting longline fishing in the Micronesian Islands. At this point, the recovery of Pacific sea turtles is essential for the long-term continuity of pelagic fisheries in the Pacific, particularly for longline fisheries (which are our biggest fisheries),.

These kind of thoughts are what drove the Council to realize that mitigating fishery interactions in our fishery is not enough. If we are to ensure the survival of U.S. pelagic fisheries in the Western Pacific, then we have to be engaged in regional efforts towards turtle conservation. But we're newcomers on the scene, and I don't know much about turtles. We know there is an awful lot of work going on out there which you guys are all engaged in. We want to know who is doing it, where it's being done, what's being done and how we can help. How can we help within the area of our own jurisdiction, and also perhaps with research and conservation in other parts of the Western and/or Central Pacific?

The following are some basic questions which we thought about. In fishery management, these are what we have to deal with, with respect to looking at the whole issue of turtle interactions with fisheries. What I hope is that there will be some discussion and recommendations or advice that will come out of this workshop.

1. **Are there strategies for direct and indirect mitigation of fishery impacts?**

   Direct mitigation, minimizing the contact of turtles with fishing gear or the catch of turtles by fishing gear. But are there any other strategies that might work. Fishing vessels are catching turtles and killing some percentage of them. Is there perhaps something the fishing industry can do through a program, for example, to offset that impact? Although it may not be able to reduce the impacts any further while at sea, can it perhaps contribute to either hatcheries or nesting beach protection? A type of trade, if you like. The fishery knows it is doing wrong here, but can it make up for that somehow by doing good perhaps in the near shore or coastal environment in another part of the turtles' lifecycle?

2. **Which turtle stocks should we focus on?**

   We have a good idea of which turtle populations our fishery in Hawaii interacts with, but we have a longline fishery in American Samoa which is relatively new. It is likely there may be turtle interactions with that fishery. Which stocks of turtles could they possibly interact with?

3. **Could there be a limited cultural take of turtles in the Western Pacific Region combined with mitigation?**

   As I mentioned before, populations of our areas are comprised of a mix of different people and, particularly, Pacific Islanders. These are people that traditionally turtles have been part of their diet. Not only part of the diet, but again, like fish, part of the culture. We receive requests, for example, from the Carolinian population living in the Northern Marianas. They would like to be able to take two or three turtles a year for religious purposes. Right now they are not able to do that under the Endangered Species Act. However, is there some form of cultural take that might be acceptable? Especially if combined with mitigation?

   These are not trivial questions. The cultures of the Pacific are being eroded and we see the results of that erosion; urban drift, rising crime and poverty. I think that it's important to help preserve these cultures especially if communities and Island nations are requesting this preservation.

4. **What are the barriers to turtle research and how can we address these?**

   Most likely one of the major barriers is resources, particularly funding. On the other hand, we had a

workshop here recently in Honolulu on protected species modeling. One of the participants expressed concern that a lot of turtle tagging data, for example, is somewhat "balkanized". That is, there are individual groups tagging turtles, but there is not much interchange of data between programs. Are there things that we can do to improve this?

5. **How can we facilitate the exchange of data in the region?**

   I used to work at the Secretariat of the Pacific Community in New Caledonia and every year the Oceanic Fishery Program of SPC has what's called a Standing Committee on Tuna and Billfish. Basically, this is where the data managers and the scientists get together for the express purposes of putting their data and research on the table for a general discussion and review. It's worked to the extent that now about 80 to 85 percent of the fishing in the Central and Western Pacific for tuna is captured under the various regional data-sharing agreements here. Are there perhaps some kind of analogue that we can develop for turtle data in the Western Pacific Region?

6. **What are the most effective educational materials given the divers cultures in our region?**

   In reference to the diverse cultures of our region, how can the Council help to promote mitigation or to promote conservation of turtles? It is no secret that illegal harvesting occurs in the US Islands. Is there something we can do to minimize that? Are there things we could do to minimize all anthropogenic impacts in the whole of the Western Pacific region, all of our region, and what is the way that we can educate people in our region about this?

In conclusion, I want to say aloha and welcome to Hawaii. We hope you have a good workshop. I've given you a very quick, presentation fishery management in the Western Pacific, and in the process, I hope it's shown the reasons why we wanted to convene this meeting and what we're hoping to get out of it. Thank you.

Comments from George Balazs.

Conservation and Research of Sea Turtles in the Hawaiian Islands: An Overview

George Balazs

PRESENTATION

This workshop is the largest sea turtle event that NOAA, the Fishery Council, or even our agency, the National Marine Fisheries Service, has ever held in Hawaii. I congratulate the Council for bringing all these wonderful folks together to talk sea turtles and try to come up with answers to some serious questions. I look forward to making new friends and new colleagues, and I hope we will all take advantage of this opportunity.

This presentation will be an overview of the state of affairs of sea turtles in the Hawaii region and several of the other U.S. Pacific territories. Also included are some of the techniques and tools that we've used successfully here in Hawaii, and elsewhere in the Pacific, to promote research for a better understanding of regional conservation efforts of Pacific sea turtles.

Throughout this talk and in the coming days I want to emphasize what I feel are some of the most important "take-home points" from someone that has been trying to contribute for 33 years in Hawaii. These words of advice are – First, to take advantage of the opportunities to foster collaboration. We can do this here. You are here. You are meeting new people. Take advantage of it. Collaborate. Make new friends. Make new partnerships. Come up with new coalitions. This is a wonderful opportunity and I will be out there doing the best I can to do that. Second, constantly keep in mind that there are certain biological constraints of the animals we are dealing with. The green turtles in Hawaii that were hatched in 1979 when I gave a sea turtle status review presentation at the World Conference on Sea Turtle Conservation (Balazs, 1982) are just now thinking about becoming sexually mature. Several decades are needed for green turtles to reach adulthood. We cannot change that constraint, unless we're going to go out and put more protein in their diets and feed them in the wild (an unrealistic and unlikely proposition).

My third take-home message is - To draw upon the previously published literature. There is a lot out there and the internet can be a wonderful access for it. Do not reinvent the wheel, draw upon the information that is already present. There exists a tremendous body of journal articles, and published and unpublished reports.

And last, but not least, as a sea turtle scientist at the Honolulu Laboratory of the National Marine Fisheries Service, along with many of my colleagues at the Honolulu Laboratory, we stand ready to assist and collaborate and be a source of inspiration and advice to anyone that would like to come to us in any manner that is reasonable or appropriate for us to aid you in your efforts in your particular part of the Pacific region.

At the SPREP meeting in 1996 for the Regional Conservation of Sea Turtles held in Apia, Samoa, a wonderful vision statement was crafted by the participants, as follows:

> We see a future where generations of Pacific Island people will have choices about how they use and interact with sea turtles. This dream will come true if we take action now to ensure that sea turtle populations recover to become healthy, robust and stable. Sea turtles will be fulfilling their ecological role and be harvested by Pacific Islander people on a sustainable basis to meet their cultural, economic and nutritional needs.

Obviously, we need to have sea turtles in order for them to be important in the culture of Pacific Island people, or to anyone else in the world. Without turtles, that part of the culture is gone. So the first step is the animals, and the biological constraints that those animals have that inherently limit our actions on how they can be recovered.

TRENDS

Green Turtles

The status of the honu (green turtle) in Hawaii has improved, but continues to be threatened by a disease whose impacts are yet to be fully understood. The genetic source of the Johnston Island population is from the Hawaiian stock, and is stable with probable improvement. The Midway population has improved. There are more turtles at Midway (since first studied in 1975) with larger size classes present. There are very few turtles at Howland, probably as many now as in the past. There is no detectable change at Baker, and no change at Jarvis.

The coastal waters of the Main Hawaiian Islands represent foraging and resting habitat [e.g. Kilauea Point, Kaneohe Bay, Punaluu Bay]. Nesting takes place at French Frigate Shoals, Northwestern Hawaiian Islands which is located about the midpoint of the Hawaiian chain. Very little green turtle nesting occurs anywhere in the Main Hawaiian Islands (MHI). Anywhere from 90 to 95% of all nesting takes place at French Frigate Shoals and 50% of that nesting takes place on a 12-acre island known as East Island (Fig. 1). Monitoring started in 1973 on East Island, and over the years data collected has been standardized to quantify the level of annual nesting. As with many other field projects in the Pacific, a whole manner of measurements and taggings are done at French Frigate Shoals – which is now approaching its 30th season of research.

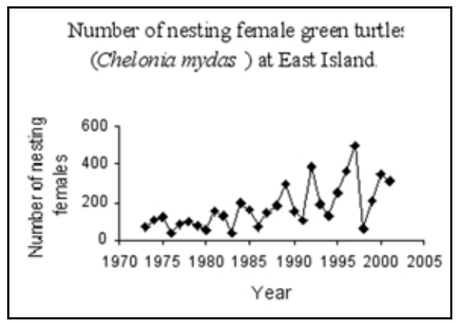


Figure 1. *Green turtle trends at East Island, accounting for about 55% of all nesting at French Frigate Shoals (NMFS, Honolulu Laboratory).*

Hawksbill Turtles

Hawksbills do not occur in the Northwestern Hawaiian Islands and do not migrate very far within Hawaii. Satellite tracking data show that hawksbills here are mainly coastal and do not traverse great distances. They reside and nest in the Main Hawaiian Islands. The population status has improved, but is still very low in numbers with only a few dozen nesters each year.

THREATS

Entanglement by both active and discarded fishing line is a problem, as may be the predation by large tiger sharks. The tumor disease (fibropapilloma) is still a research battle to understand. Not just for Hawaii, but to develop the capacity to respond anywhere in the Pacific with some substantive knowledge and expertise, if and when outbreaks of this disease occur in American Samoa, Tahiti, Fiji or anywhere else.

MIGRATIONS

Satellite tracking data show that the Main Hawaiian Islands are resident foraging areas for all sizes of green turtles, except during the pelagic phase. The pelagic phase cuts off for green turtles at a minimum of 35 cm, and typically between 40 to 45 cm straight carapace length. For example, satellite telemetry data of one of 12 turtles tracked from East Island, French Frigate Shoals, shows a route to King's Landing near Hilo, on the island of Hawaii, a distance of over 700 miles.

Other tracking data in the Pacific show Rose Atoll (American Samoa) nesting green turtles migrating to Fiji (Fig. 2). Eight of the nine satellite transmitted turtles went to Fiji. It would appear that a lot of turtles throughout the Pacific islands go to Fiji to forage. Metal flipper tags put on in French Polynesia show that turtles fan out across the Pacific and that Fiji foraging pastures are one of the major places for tag recoveries.

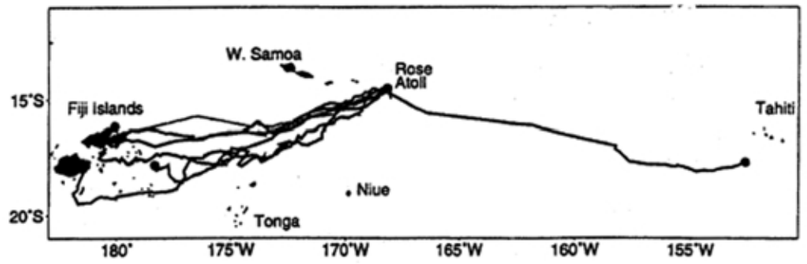


Figure 2. *Migration route of satellite transmitted green sea turtles from Rose Atoll, America Samoa (NMFS, Honolulu Laboratory).*

INTERESTING INFORMATION

Along with the increase at the nesting grounds, the behavioral changes seen in the Hawaiian green turtle population are an amazing phenomenon. At some sites turtles have become fearless of people. In the early 1970s if one saw a turtle in the water you saw its backside as it was screaming away from you in fear. This is no longer the case.

What do we attribute this to? I attribute it to the most powerful tool that we've had in sea turtle conservation in Hawaii and the United States, and that is the Endangered Species Act. "You protect them. You give them enough time. You leave them alone and they will restore, slowly but surely." The National Marine Fisheries Service is guided by various documents. For example, the recovery plans formed by the collaborative Fish and Wildlife Service, State of Hawaii, and National Marine Fisheries Service sea turtle recovery team. There are plans for six species used as guiding documents for research and recovery.

In addition, we are blessed in Hawaii with the isolation of our sea turtle populations, - that is, that the Hawaiian Islands are situated in the middle of the North Central Pacific. Except for the pelagic phase, our turtles do not cut across other boundaries of nations where complications in management can and do occur. This is a special circumstance.

With the greater number of turtles and behavioral changes, ecotourism (watching turtles, seeing turtles), has become far more common and prominent (for example, see <http://www.turtles.org>). This is a positive economic contribution that does not involve eating or selling turtles to restaurants or tourists. Turtles are also recognized in the Hawaiian culture where many adorn themselves with turtle art (tattoos), and are incorporated in traditional dance (hula) performances, and of course historically a food for feasts. The more people think about turtles, and the more we learn about them for management purposes, the more turtles become alive in the culture of the people.

LITERATURE CITED

Balazs, G. H. 1982. Status of sea turtles in the central Pacific. In: K. A. Bjorndal (ed.), Biology and Conservation of Sea Turtles, p. 243-252. Smithson. Inst. Press.

The following book is recommended as an excellent source of information for anyone interested in pursuing research and management efforts on behalf of sea turtles in the Pacific Islands:

K. L. Eckert, K. A. Bjorndal, F. A. Abreu-Grobois, and M. Donnelly (eds.), Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4, 235 pp.

Sea Turtle Conservation in the CNMI

Richard Seman

PRESENTATION

The Division of Fish and Wildlife under the Department of Land and Natural Resources is the government agency that is tasked with the responsibility to conserve, develop and manage the wildlife and fishery resources of the Commonwealth of the Northern Mariana Islands (CNMI). The Division has been actively developing plans for the protection of sea turtles. This includes a year round monitoring of nesting sites, enforcement and surveillance of active nesting areas, and near shore assessment of sea turtles.

In recent cooperation with the National Marine Fisheries Service, our staff conducted some near shore assessment on the three primary islands of the Marianas: Saipan (1999), Rota (2001) and Tinian (2001). Based on these recent surveys it is estimated that about 1,000 to 2,000 green sea turtles forage around these Southern Islands.

The Division has been very active in public education program. We conduct regular, but frequent, school presentations, news releases and public hearings. Presenters are accompanied by a single law enforcement officer from our division. Together, they make presentations. The reason law enforcement officers are sent is because they appear in uniform and talk about the rules and regulations that prohibit the harvesting of sea turtles. Since many children are interested in the restrictions applied to sea turtles, having a uniformed officer helps with education and awareness. In addition to poster and slide film presentations, educators bring mounted sea turtles and other items that have been confiscated, such as jewelry to give children additional awareness of the illegal nature of harvesting sea turtle. We hope that in this way they can fully appreciate why we should conserve them.

However, one area that we are strongly being asked to include in our presentation, other than management and conservation, is the Carolinian request to be given some limited take of sea turtles. The Saipanese Carolinian of the Commonwealth of the Northern Marianas Islands migrated from the outer islands of Yap and Chuuk state in the Federated States of Micronesia. It is difficult to unravel all of the Carolinian cultures on sea turtles because many of our elders have died and have buried valuable information with them. However, Carolinian cultural practices regarding the harvest of sea turtles continued up to the early 1970s.

Ceremonial traditions, like the reopening of the traditional navigational route from Yap to Saipan, and the traditional sailing of canoes includes bringing the sea turtle for the annual San Isidro Festival. The Carolinian sea turtle harvesting ceased when CNMI joined political union with the United States in 1978. The federal statute applying the Endangered Species provision thus affects and denies the Carolinians their sea turtle harvesting culture.

Carolinians in CNMI have been trying for many years to preserve their culture with the sea turtle. The Carolinian people have urged the federal government to consider and re-instate this cultural practice. Carolinians request the federal government to allow at least five turtles per year for cultural fiestas.

Cultural uses for sea turtles include, the wedding ceremony, traditional navigation achievement, and special ceremonies regarding important foreign visitors. Carolinians consider themselves experts and knowledgeable in traditional or unconventional navigation, sailing inter-Islands and in the open oceans using just the skies, winds, ocean swells and ocean current. When a young man completes all traditional navigational skills, on land and in sea, sailing a canoe by himself using nonconventional instruments then he is awarded the installation of a “traditional navigator.” This ceremony is celebrated by the traditional harvest of sea turtle.

Carolinians comment that many of their young men are now handicap in the knowledge of sea turtles, because

there is not training offered them to learn how and when to harvest and preserve these precious species for cultural - for continual multiplication of their young for future use. As a regulatory agency, we do not promote the harvesting of sea turtles, but we support the allowance of “limited take” in the territory. For many years one of the concerns of our elders in the Carolinian community is the absence of the bond between the people and the turtle. It is their belief that by having the younger generation see and experience the relationship between the turtle and their culture, not just talk about it, but to physically show them. Show them how to traditionally catch turtles, how to traditionally prepare them, how to traditionally do whatever it requires to bring the specialness into the younger generation. This is important so that younger generation has something to reflect upon on, so they understand that turtles not just any food that you see in the ocean, to harvest any time you come across it, but rather a reflection of what it means to their culture, how special it is and how it bonds them together.

This is where we, as a regulatory agency, come in. We want the younger generation to have respect for sea turtles so that they are no longer harvested indiscriminately. Some how, traditional respect for the sea turtle must be reinstilled so that the young generation does not simply catch sea turtles just because they see it. When the young people have the respect in them, the culture in them, they will leave the turtle alone and only reflect on how unique that species is to their culture.

Sea Turtle Conservation in America Samoa

Ruth Utzurrum

PRESENTATION

American Samoa is comprised of seven Islands. The five volcanic Islands of Aunu'u, Ofu, Olosega, Ta'u, and Tutuila are located between 170º 50' and 169º 25' W and between 14º 23' and 14º 10' S. The other two Islands are coral atolls: Rose Atoll, an uninhabited wildlife refuge under the joint administration of USFWS and ASG-DMWR, and Swains Island, are centered at 168º W, 15º S and 171º W, 11º S, respectively.

Turtle studies in American Samoa date back to the 1970's when flipper tagging was first initiated (Grant *et al.*, 1997). Satellite tagging was conducted between 1980 and 1993 exclusively on green turtles at Rose Atoll (Balazs *et al.*, 1994; Balazs, unpublished 1993 manusc.; Craig, 2002). An extensive survey of residents of Tutuila and Manu'a conducted by DMWR staff between 1990 to 1991 provided information on nesting activities (Tuato'o-Bartley *et al.* 1993). Information from these interviews were supplemented by primary observations of nesting females at Rose Atoll and from a village beach monitoring program at Swains Island over the same period.

Although a “turtle program” does not officially exist in the territory, opportunistic flipper tagging and recording of nesting and hatchling occurrences continues to the present. Additionally, combined efforts by the Information & Education and the Conservation Divisions of the Department of Marine and Wildlife Resources (DMWR) and the local NMFS ensure conservation awareness and regulatory compliance within the territory.

The following sections summarize biological information on turtle species that occur in the territory and conservation efforts currently in place. Priorities for future studies, management, and conservation are outlined in the concluding two sections.

SPECIES COMPOSITION AND DISTRIBUTION

Four species of sea turtles have been recorded from waters off American Samoa Islands (Table 1). The most commonly occurring species are greens and hawksbills. Greens occur predominately at Rose Atoll. Hawksbills tend to be common at Tutuila and the Manu'a Islands, but green turtles also occur at these Islands. Greens and hawksbills also are the two species known to nest in Tutuila, Manu'a, Rose Atoll, and Swains Island (Table 1; Fig. 1). There is one record of a juvenile leatherback that was incidentally captured from about five kilometers south of Swains (Grant, 1994), and three records of olive ridleys (between 50-60 cm CCL), two of which were dead (1991 and 2002), and one alive (1998).

Table 1. *Sea turtles recorded from American Samoa's water and/or beaches.*

Species	Tutuila	Manu'a	Rose	Swains
Chelonia mydas	+	x	+	x
Dermochelys coriacea	o	o	o	? (1)
Eretmochelys imbricata	+	x	?	x
Lepidochelys olivacea	? (3)	o	o	o

+: confirmed nesting; x: nesting only assumed; ?: limited data (nos. of individuals recovered from waters in parentheses).

POPULATION STATUS

Current Trends

A total of 84 turtles have been recovered between July 1995 and January 2002 from around Tutuila, of which 81 were positively identified. Greens (17 of 81) and hawksbills (63 of 81) accounted for 99% of the recoveries. 43% (36 of 84) of these recoveries were caught in fish lines, traps, and nets. Of the nine that were found dead, only one showed recent injuries (i.e., a hole, possibly by a spear, at the base of the skull) and one had an old (healed) injury (i.e., missing 1/2 right front flipper).

The majority of the turtles recovered were reportedly from the Pago Harbor and Pala Lagoon (Fig. 1). It is unclear whether the high concentrations of turtles in these two areas reflect a real preference for the surrounding waters at these sites, or whether the numbers are an artifact of the high levels of fishing in these areas as well as poor reporting by fishermen (i.e., confusing fish/boat landing sites with sites of captures during interviews).

Differences in the size structure of samples from pre-1995 and post-1995 turtle recoveries represent the most striking change in the nature of turtle populations around American Samoa. The majority of turtles recovered at Tutuila still are juveniles in post-pelagic stages between 30 and 60 cm (curved carapace length). However, smaller juveniles (11-20 cm CCL) and a few subadults (61-70 cm CCL), absent in pre-1995 recoveries (Grant *et al.*, 1997), appear in recent samples (Fig. 2). The age structure suggested by the size classes indicates that the waters around the Islands of Tutuila and probably Manu'a may not only serve as foraging grounds for post-pelagic stages, but may also be proximal to open waters where pelagic stages may congregate.

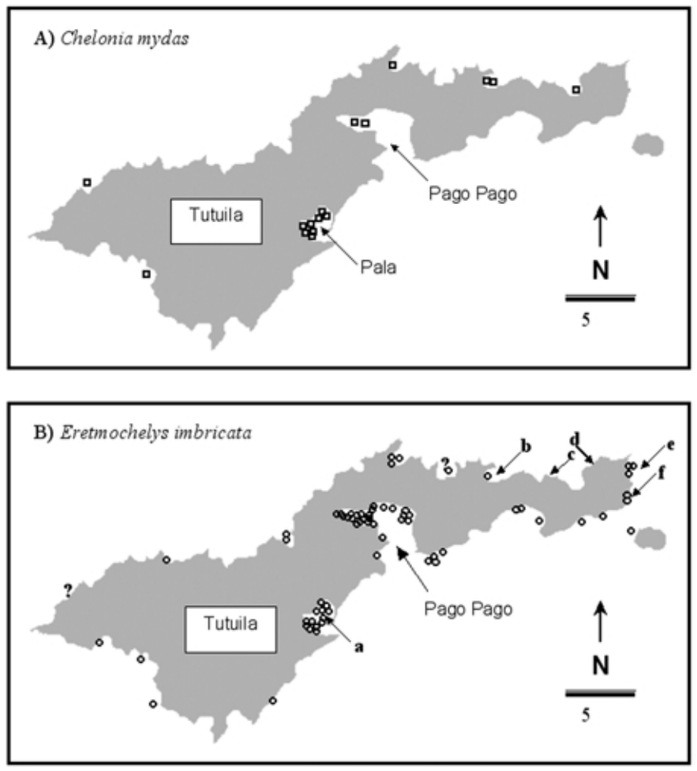


Figure 1. *Locations of turtle recoveries (squares and circles) and nesting sites of A) green (Chelonia mydas) and B) hawksbill (Eretmochelys imbricata) turtles on Tutuila based on 1995-2001 DMWR records. Nesting sites of hawksbill turtles were inferred from presence of hatchlings (marked by letters and arrows) and presence of females and/or tracks on beaches (marked by ?). Letter designations on Figure 1.B are as follows: a - Pala Lagoon, b - Masefau, c - Sailele, d – Onenoa, e – Tula, f – Alao. There was only 1 recorded green turtle hatchling for the period: at the Pala Lagoon area.*

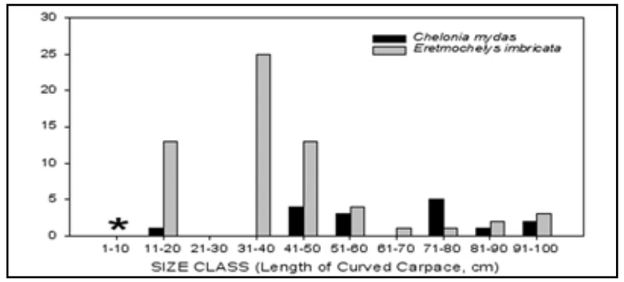


Figure 2. *Size distribution of turtles recovered in Tutuila, American Samoa: 1995-2001. [The asterisk denotes hatchlings recovered, primarily of hawksbills.]*

Nesting

Since 1995, the most consistent records of hawksbill hatchlings and adult females (> 80 cm CCL) on beaches (possibly to lay eggs) were from the eastern tip of Tutuila, including: Masefau, Sailele, Onenoa, Tula, and Alao (see, Fig. 1). Hatchlings appeared between January and April, indicating a nesting period that may be more temporally restricted (e.g., seasonal) than previously thought (see Tuato'o-Bartley *et al.*, 1993). Interviews conducted in 1991 to determine the numbers of nesting females projected a total number of 120 nesting females throughout American Samoa, 50 of which were projected to nest in Tutuila alone (Tuato'o-Bartley *et al.*, 1993). If these were realistic estimates, recent records indicate a decline in the number of nesting turtles based on number of confirmed sites and clutches of hatchlings.

A single green turtle hatchling was recovered in July 1998 from the Pala Lagoon area (Tutuila). Hatchling green turtles have been found on Rose Atoll as recently as February 2002 (J.O. Seamon, pers. comm.).

Olive ridleys are not typical in American Samoa. However, an examination of the dead individual recovered in January 2002 revealed that the individual may have laid eggs recently. The possibility that spawning olive ridleys may accidentally cross American Samoa territory waters should be taken into consideration with respect to regional management.

MIGRATION

There is limited information regarding local movements in the territory. Recapture data indicate that turtles tend to come back to the original site of capture, even if released elsewhere (Grant *et al.*, 1997; DMWR flipper tagging records: 1995-2001). Long range migration of green turtles originating from Rose Atoll revealed a generally westward pattern, with most satellite-tagged turtles heading toward Fiji (Balazs *et al.*, 1994; Balazs, unpubl. 1993; Craig, 2002). No attempts have been made to satellite-tag hawksbills from the territory.

MORTALITY

The majority of the turtles recovered since 1995 on Tutuila were in good condition, although excessive algal growth and abundant leeches have been recorded on occasion. There were no indications that local populations are inflicted with fibropapilloma (as in Hawaii). Rat predation on green turtle hatchlings on Rose was previously recorded by Swerdloff (Balazs, 1982), but rats have been successfully eradicated from the Atoll since becoming a National Wildlife Refuge. Preliminary examination of the dead olive ridley recovered in January 2002 suggest that it was injured by a shark. It is certain that a number of turtles are killed for consumption (also see Tuato'o-Bartley *et al.*, 1993), but no estimates are available. There are no current programs to collect mortality (or incidental take) data from by-catch.

CONSERVATION

At this time, the emphasis for America Samoa is in education. The Department of Marine and Wildlife Resources of American Samoa has an Educational Information Division that is involved in an educational campaign directed at school children. The Conservation & Enforcement Division in collaboration with local NMFS ensure compliance and also help raise awareness through media releases and talks to school groups. A SPREP 2001 grant was entirely used to reinforce the

educational and enforcement campaign, including a) regulation information on billboards to be placed at nesting sites, fish landing areas, and ports, b) information brochures for schools and the general public, and c) 5-15 minute video clips for local TV broadcasts and, possibly, for airline cabin viewing prior to landing in American Samoa.

In 1999 NMFS sponsored a workshop for the U.S. territories in the Pacific Ocean to draft implementation plans for turtle recovery in response to the U.S. ESA recovery plans. The draft for American Samoa is still in preparation, but it addresses both the biological information gaps and suggests priorities for research studies. The ASG working group draft also calls for a review of legal issues and regulatory issues for interagency overlaps and jurisdiction of beaches. This is especially critical since the beach and coastal area of American Samoa is very narrow and limited. Therefore, nesting turtles can easily be impacted by coastal development.

CONSERVATION AND MANAGEMENT ISSUES AND PRIORITIES

Turtle recovery data suggest that in-water interactions between turtles and the fishing industry will become a critical issue, especially with an expected expansion of the fishing fleet in Tutuila. Thus, it is very important to understand the importance of waters around American Samoa as foraging habitats. Seasonal and/or temporal patterns of occurrences to determine potential loci of high turtle activity must be investigated to address management actions related to fishing activities to minimize the impacts of accidental takes or injuries to foraging turtles.

With the exception of Rose Atoll (for green turtles), American Samoa may be a minor site for nesting turtles on a worldwide scale. However, it is important to determine whether the few hawksbills that do nest here are in fact migratory and to what stocks they belong to if some regional if we are to fit local management into a regional plan. Thus, we advocate opportunistic tissue sampling of the turtles recovered and the satellite tagging of some of the adult females that are found on occasions on local beaches. There is also a need to address a near complete lack of information retrieval on turtle activities in the Manu'a Islands – whether nesting or in-water captures.

Other future initiatives that could enhance research and conservation in American Samoa include: 1) an educational program which targets fishermen (in addition to school groups); 2) an observer program for fishing vessels that are 50 meters or greater in size to gather by-catch data (including turtles). These vessels are now excluded from fishing within the 50 nautical mile (nm) limit of the Island but are expected to expand in numbers in the near future; and 3) an equivalent observer program to collect data from vessels fishing within the 50 nm limit.

LITERATURE CITED

Balazs, G.H. 1982. Status of sea turtles in the Central Pacific Ocean. Pp. 243-252, in K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D.C.

Balazs, G.H., P. Craig, B.R. Winton, and R.K. Miya. 1994. Satellite telemetry of green turtles nesting at French Frigate Shoals, Hawaii, and Rose Atoll, American Samoa. Proceedings of the 14th Annual Sea Turtle Symposium. NOAA Tech. Memo. NMFS-SEFSC 351: 184-187.

Craig, P. 2002. Rapidly approaching extinction: sea turtles in the central South Pacific. In: Proceedings of the Western Pacific Sea Turtle Cooperative Research and Management Workshop. I. Kinan (ed.). WPRFMC.

Grant, G. S. 1994. Juvenile leatherback turtle caught by longline fishing in American Samoa. Marine Turtle Newsletter 66: 3-5.

Grant, G.S., P. Craig, and G.H. Balazs. 1997. Notes on juvenile hawksbill and green turtles in American Samoa. Pacific Science 51(1): 48-53.

Tuato'o-Bartley, T.E. Morrell, and P. Craig. 1993. Status of sea turtles in American Samoa in 1991. Pacific Science 47(3): 215-221.

Sea Turtle Conservation in Guam

Veronica Cummings

ABSTRACT

Two species of sea turtles, green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*), live and nest in Guam. In 1999, the Guam Department of Agriculture's Division of Aquatic and Wildlife Resources (DAWR) received funding from the NMFS Pacific Islands Area Office to begin a sea turtle recovery program. The purpose of this program is to determine Guam's resident and nesting turtle populations, and determine nesting turtle habitats. Nesting populations are monitored through beach surveys and satellite tracking. In June 2000, one nesting green turtle was satellite tagged on Guam and was tracked to the Philippines over a period of approximately 129 days. During the 2001 green sea turtle nesting season, surveys were done to assess nesting populations. Historical nesting data, aerial survey data and preliminary data for the 2001 nesting season are being compiled. In-water capture studies are planned to assess populations of both species. Weights, lengths, skin samples, and other information will be taken from all turtles captured. All turtles will be tagged to establish identity. An official study on mortality is not available, however, anecdotal evidence points towards illegal take as the number one cause of sea turtle mortality in Guam. Additionally, monitor lizards (*Varanus indicus*), wild pigs (*Sus scrofa*), rats (three species of *Rattus*), and ghost crabs (*Ocypode* sp.) are thought to prey on sea turtle nests (G. San Nicolas and B. Tibbatts, personal communication). This program will help to provide greatly needed information concerning Guam's turtle species. This information is essential in managing our sea turtle species.

PRESENTATION

The Division of Aquatic and Wildlife Resources in Guam, under the Department of Agriculture, has four goals in regards to sea turtles. The primary purpose is to implement a long-term sea turtle monitoring program, develop plans for nesting habitat protection, conduct annual resident population studies and increase awareness (mostly of school aged children).

TRENDS

The two turtle species that occur and nest on Guam are the hawksbill and the green sea turtle. There are also incidents of leatherback sightings (last reports date 5 years ago). The department is working to study the resident populations, and is currently involved with nesting and satellite tagging studies. Nesting surveys have been conducted since 1973, consistently since 1990, and most reliably for the 2000 and 2001 nesting season (Fig. 1).

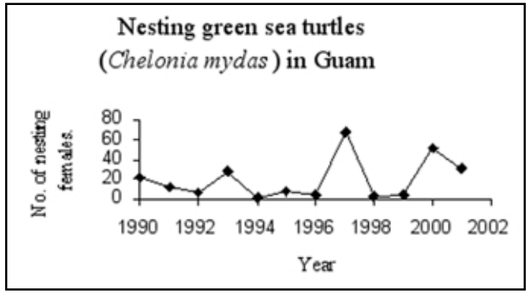


Figure 1. *Green sea turtle nesting trends in Guam.*

Data collected during field studies consists of tagging, tissue sampling, food sampling, statistical analysis, and bi-monthly aerial surveys. The following data seen in Figure 2 are from aerial surveys, 1990 to 2000, from 500 feet above water. A different person surveyed before 1994, which may account for the increase in number of sightings. In-water surveys are also planned contingent on acquiring the necessary equipment (e.g. nets).

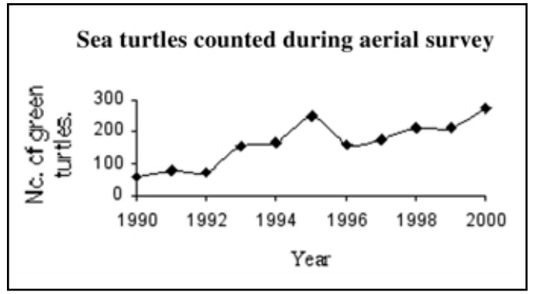


Figure 2. *Number of sea turtles counted during aerial surveys, 1990 - 2000.*

MIGRATIONS

A nesting green sea turtle was fitted with a satellite transmitter June 28, 2000. Transmissions were received until November of 2000, with her last transmission originating from the Sulu Archipelago in the Philippines. Based on this limited data, it would appear that Guam nesting turtles migrate to foraging areas in the Philippines. This data indicates an important habitat linkage and evidence of shared stocks of the Central and Western Pacific.

THREATS

There exists a high level of illegal take on Guam for cultural reasons. Turtles are harvested during fiestas for the patron saints of villages. The department aims to talk to fishermen regarding both illegal takes and incidental by-catch. It is also believed that eggs and adult females are poached during the nesting season (anecdotal information). At this time, there also exists an egg predation problem by monitor lizards, wild pigs, rats and crabs.

Top left: Agus Dermawan, Indonesia. *Top right:* Kamarruddin Ibrahim, Agus Dermawan, Colin Limbus. *Bottom:* Left to right: Craig Moritz, Colin Limpus, Mark Hamann, Milani Chaloupka, Peter Dutton, Scott Eckert.

Conservation and Research of Sea Turtles in the Western Pacific Region – An Overview

Dr. Colin Limpus

PRESENTATION

Sea turtles have been around for millions of years and used by coastal peoples in the tropics for a long time. They have become a part of many cultures, being embedded in the beliefs and way of life for so many of the folks in the Pacific. Today, as we have increasing human populations and at the same time decreasing turtle populations in most areas, a basic question to address is, "What level of turtle harvest is sustainable?".

For many people in the Western Pacific, it is not a question of taking the European or the United States conservation model of total protection, which essentially equates to no one harvesting anything. Among Pacific Island countries, use of turtles goes beyond just using them for food. It can be an integral part of their way of life. So the challenge comes back to us as managers who are trying to help people understand the functioning of their turtle populations to address the question of what level of harvest is sustainable. This understanding is necessary if traditional harvest is not to be detrimental to the functioning of the turtle stocks.

In recent decades we have expanded our understanding of sea turtles beyond levels that were available to traditional folks: the grand scale of migrations, the great age to maturity (Fig. 1), temperature dependent sex determination and mechanisms for imprinting. Understandings that are beyond the capacity of people, be it traditional culture or western culture, to understand without modern research methodology being brought to bear to address the questions. The old traditional knowledge falls short of being able to answer some of these questions in the same way that western knowledge fell short of being able to answer these same questions in the in the recent past.

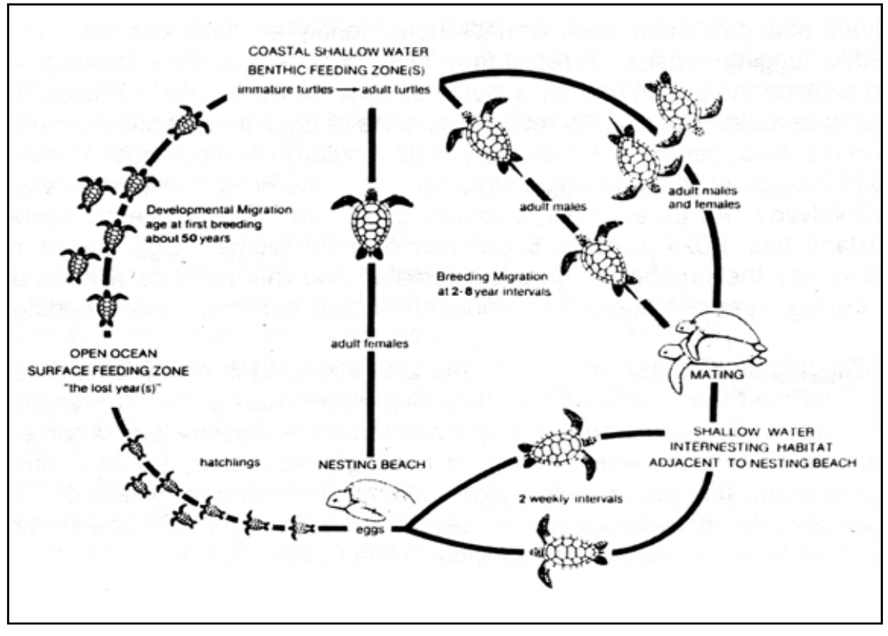


Figure 1. *General sea turtle life history strategy.*

Turtles that are a major concern in the Western Pacific are the greens, hawksbills, loggerheads, and flatbacks. These have their interaction with people primarily in the benthic feeding life history phases within habitats over continental shelves and shallow oceanic reefs and on the nesting beaches. I'm going to focus my discussion to the issues within the shallow water areas and on the nesting beaches.

For high seas fisheries, we need to deal with the issues occurring in the open ocean pelagic phase where the turtles spend the early part of their time. Leatherbacks are an exception (possibly some olive ridleys as well), spending almost all their life in the open ocean pelagic habitat. I'm not going to address this pelagic phase in my talk today because of shortness of time, but this is an important area that needs to be addressed.

A significant issue to address if we are going to ask, "How many turtles can I take?", is how big is the population from which I want to harvest? Bycatch mortality should be addressed similarly. If I don't know the size of my population, I cannot put a sensible figure to the size of the sustainable take or loss. Suppose someone wants to take 100 turtles. Taking 100 out of 300, or 100 out of 30,000 make a big difference to population stability. The one component of a turtle population that is consistently available for census is the nesting female.

How can we find out how big the population is? One traditional approach is to tag individuals and give them each an individual identity so each can be recognized and counted; a tagging census. A result from tagging census is the knowledge that a turtle doesn't walk on the beach and lay a clutch of eggs for the season. Rather, the turtle will come ashore repetitively and lay multiple clutches of eggs throughout the nesting season. In Southeast Asia, particularly, managers have regularly counted eggs. When reports are of 100,000 eggs, or 200,000 eggs; what does that mean with respect to the number of turtles involved? As an example, a female green turtle which recently nested in South Queensland laid 1,024 eggs in 8 clutches over 77 nights. Egg counts need to be translated into the number of breeding females and this requires a knowledge of the number of eggs per clutch and the number of clutches per female per breeding season.

Tagging studies also reveal that the turtles nesting in one year are not the same animals that nest the next year, that they skip many years between breeding seasons. This is a very important parameter that tends to be underestimated. Another significant phenomenon is that the entire cohort of nesting turtles does not nest simultaneously within a season. It is not like many bird rookeries, for example, where one can make a single count of the number of breeding pairs and the nesting population for the season is known. That type of census does not apply to sea turtles.

At the nesting beach, turtles progressively arrive through the breeding season, and then as some are arriving, others are leaving. There is no period when the total number of turtles using the nesting beach for that season is present. However, the period of maximum availability of nesting females (= peak period of the nesting season) is predictable from year to year. If sampling is done during the peak period of availability, there is a reasonable correlation between the number of turtles present at peak availability and the size of the total annual nesting population. Thus options are available to the manager for census studies: does one use five months of tagging to record every turtle present, or does one apply a sampling design using only the peak of the nesting season with correction factors?

Tagging is very labor intensive. Workers must be on the beach all night, every night, for months on end if the goal is to take a total tagging census for a whole population. However, other parameters, like tracks, are surrogates, or indexes of what is happening with the nesting population. In the morning one can count tracks and determine which species came up on the beach during the previous night. There is a very good relationship between the total population tagged through an entire season of tagging census and the average number of turtle tracks per night during the peak period of the nesting season. Track counts taken at a standard period of the season can be used as a cost-effective index of the size of the annual nesting population.

Similarly, it is logistically expensive and almost impossible to tag every turtle on every beach throughout the whole country. Other cost effective ways of conducting a census across an entire country must be considered. Aerial surveys are one cost effective way to provide an overview of nesting density across large numbers of beaches in a single nesting season. The down side is that aerial surveys are not usually conducted over many nights for the whole nesting season and therefore wider confidence limits around the estimated size of the nesting population must be expected than for census techniques involving a greater number of sampling nights. Again, choosing when surveys are conducted is important. The best results will be obtained from surveys conducted at the peak of the nesting season for the species in question.

In many of the remote areas where turtles are nesting in the Pacific, it is the local people who are interacting with these animals and they are just as capable of counting how many eggs they are gathering or counting the number of tracks on the beach as biologists. With appropriate sampling design and applied rigor, getting local people involved in gathering census information can be very effective. A good index of how a turtle population is performing can be achieved using a long-term census, whether we count eggs (Fig. 2), clutches, tracks, or tagged turtles.

Bringing together census data from a variety of sources can be a challenge but useful. Depending on how much rigor is required for delivering the management end product, one can choose the census techniques to suit the local situation and budget. A mix of census techniques is often the most effective with total tagging census at a limited number of index beaches, mid season census (tagging, clutch, egg or track counts) at other representative beaches and less labor intensive methods such as aerial surveys encompassing the larger region.

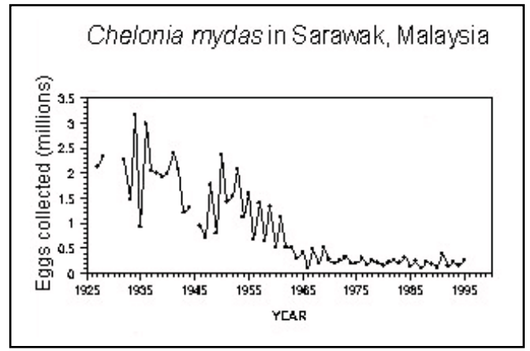


Figure 2. *Annual egg harvest as a population index of green sea turtle, Chelonia mydas, in Sarawak, Malaysia.*

NESTING DISTRIBUTION

For green turtles, this part of the world [Western Pacific] is one of the major breeding areas (Fig. 3). In Northern Australia, there are huge numbers of nesting green turtles. The same applies for Northern Borneo (Sabah, Southern Philippines, Northeast Kalimantan). Virtually any nesting beach throughout the area is likely to have nesting green turtles in varying numbers. It may be tens; it may be hundreds; in a few places we're talking thousands of turtles per year. In addition, there are many locations where green turtles breed but where nesting has not been quantified. However, throughout Indonesia and Papua New Guinea and out into the Western Pacific Islands there is reasonable information and understanding of the size of many of the nesting populations.

It is an entirely different nesting distribution for loggerheads. The loggerhead nesting for the Western Pacific is concentrated in Japan and in Eastern Australia (Fig. 4). An additional small nesting population occurs in New Caledonia and an even smaller one in Vanuatu. That is effectively the total nesting area for the Pacific Ocean. No loggerhead nesting has ever been demonstrated through the mid tropical area of the Western Pacific other than isolated single nesting events, and no loggerhead nesting occurs in the Eastern Pacific.

In contrast the hawksbill turtle is primarily a tropical nesting species. There are lots of questions marks for the nesting distribution for this species - there have been many places where hawksbill nesting has been reported, but not quantified. Hawksbill nesting information mostly is deficient in the Southeast Asian and Western Pacific Region. This applies especially for the beaches and islands along northern Irian Jaya and northern Papua New Guinea and into the Solomon Islands and Vanuatu.

For the leatherbacks, sadly, the big population of Peninsular Malaysia has been almost totally lost (Fig. 5). There are still substantial numbers nesting in Irian Jaya. Nesting across northern Irian Jaya, PNG, and Solomon Islands has been poorly documented, but as data continues to become available, many small nesting populations are being identified - 100 females here, 50 or so there, and so on. Essentially, the strip that runs from northwestern Irian Jaya out into the Solomon Islands is the last remaining stronghold of leatherback nesting in the Western Pacific.

Unquestionably, the stronghold for olive ridleys (at least in this part of the world), is in the Indian subcontinent. They are genetically different from the ridleys that nest in the Western Pacific. Therefore conservation cannot just focus on the big populations and forget about the smaller ones. Although there are no large populations of olive ridleys nesting in the Western Pacific, ridley populations there continue to surprise us. "New" populations are now being documented, for example in the Philippines where tens of nesting females are still breeding at the type locality for the species and, in Southern Indonesia and across into northern Irian Jaya, substantial numbers of scattered small nesting populations are being identified. The lack of information largely reflects a lack of reporting, a lack of specialist examination of the region. In addition, there are a thousand or so nesting olive ridley females per year in Northern Australia.

Flatback nesting is restricted to the Australian territories, although the feeding distribution spreads up to southern Irian Jaya and into southern Papua New Guinea. The entire Northern Australian continental shelf area, up to Indonesia and Papua New Guinea is the primary feeding area for flatbacks.

MIGRATIONS

Where do the turtles live when they are not at the nesting beaches? When managing stocks, turtles in foraging grounds need to be matched back to nesting populations. In the past, traditional flipper tags have been used to identify breeding migration end-points. A vast amount of tag recovery data has been established over the last decades and I recommend that people continue to use tagging studies to identify foraging ranges. Recently, satellite telemetry has become popular for identifying migratory pathways, but it is expensive and usually only a small numbers of animals will be tracked. Bringing together both sets of tagging information can lead to a more comprehensive understanding of the distribution of the feeding grounds relative to the nesting beaches. Genetic analysis can assist in some areas for defining the distribution of foraging turtles relative to the nesting beaches.

As a general rule of thumb based on results of tagging studies, adult females will be foraging within a radius of up to 2,500 kilometers of a nesting population, wherever there is suitable foraging habitat in that range. Similarly, it can be expected that turtles nesting within a region will be migrating from foraging areas spanning

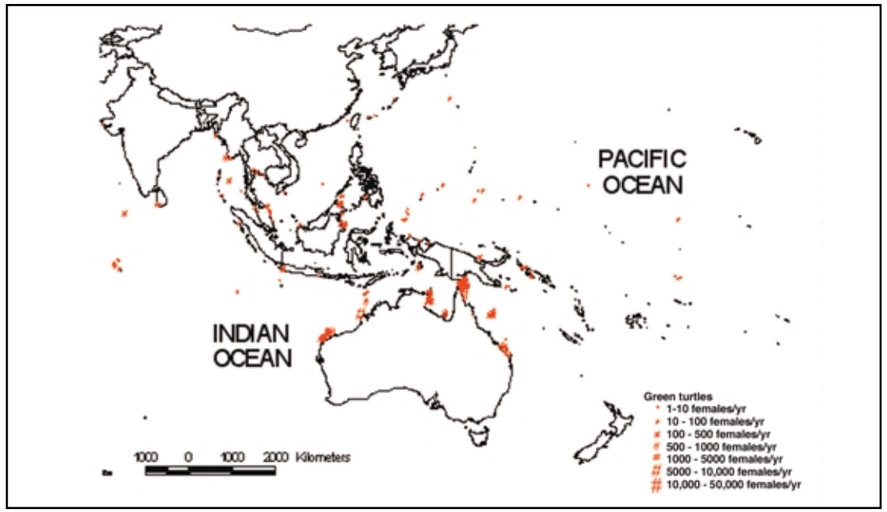


Figure 3. *Green turtle, Chelonia mydas, breeding distribution in the Western Pacific and Southeast Asia.*

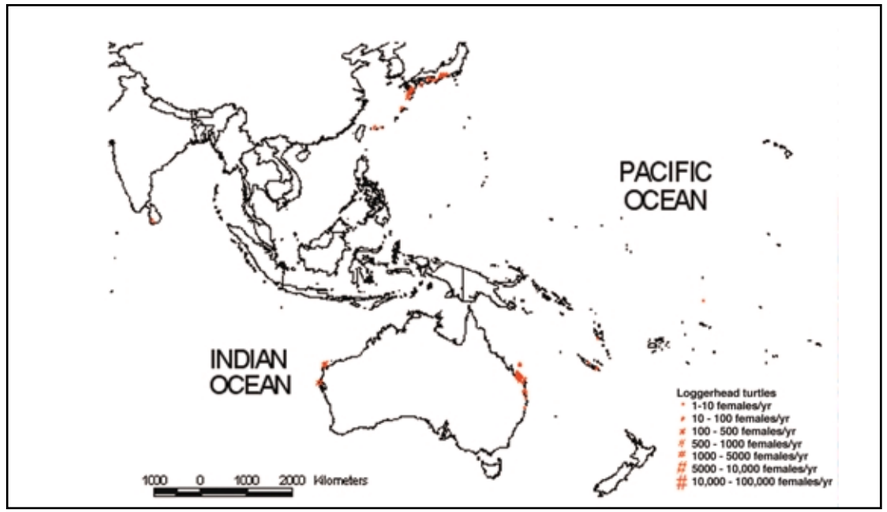


Figure 4. *Loggerhead turtle, Caretta caretta, breeding distribution in the Western Pacific and Southeast Asia.*

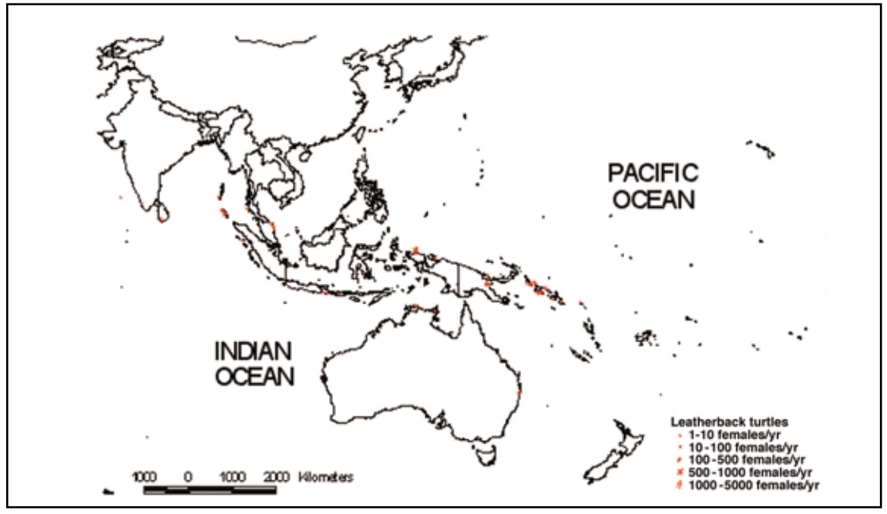


Figure 5. *Leatherback turtle, Dermochelys coriacea, breeding distribution in the Western Pacific and Southeast Asia.*

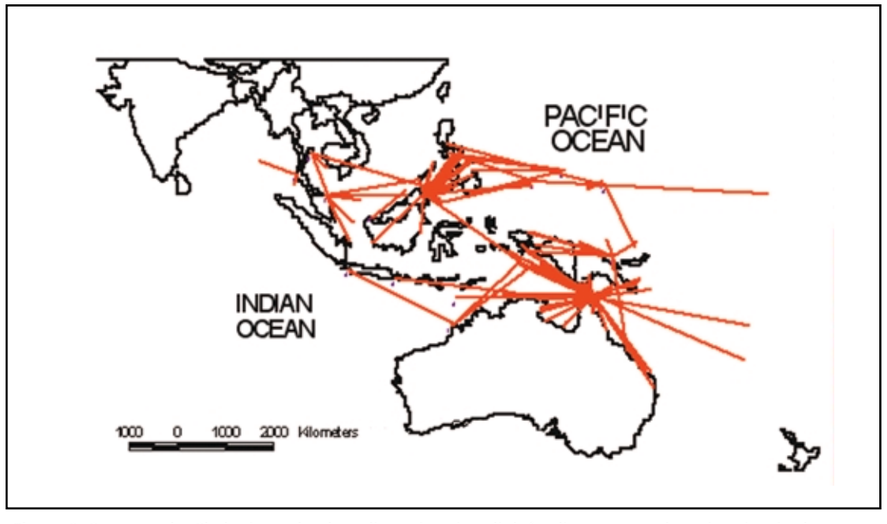


Figure 6. *Green turtle, Chelonia mydas, breeding migrations link feeding areas and nesting sites in the Western Pacific and Southeast Asia. The lines are not intended to represent precise migratory paths.*

multiple nations. The reverse is also true. Within individual feeding areas, there can be different stocks of turtles mixing together. If a green turtle is caught for example in Eastern Indonesia, without tags or genetic information, the individual could not be identified as to whether it nests in the Sulu Sea, comes from a population nesting in Western Australia, nests in the Great Barrier Reef, or nests along the North coast of Papua New Guinea (Fig. 6). Tag recoveries from the SPREP and Sabah tagging programs are identifying the Sulu Sea as an important common feeding ground for multiple turtle stocks. One of the challenges regarding mortality within these foraging areas, is how to petition mortality to a particular stock of concern.

Loggerheads stocks do not have overlapping foraging areas between the North and South Western Pacific, but each stock radiates out into very wide foraging areas. Adult female hawksbills from individual nesting beaches, for the most part, are widely distributed in feeding areas spanning numerous countries. It should be noted that it isn't just females that make long breeding migrations. As with green turtles, recent data for hawksbills males reveal that they are migrating long distances like the adult females. Data of leatherbacks from the Terengganu tagging program indicated that they spanned out over big distances to foraging areas throughout eastern Asia and into the central North Pacific. The tag recovery data that exists needs to be added to the satellite telemetry data to get a better understanding of the movements of leatherbacks.

POPULATION DYNAMICS

There is more to understanding sustainability of turtle populations than knowing where turtles live and where they migrate to breed.

Population genetics studies can now be used to identify independent stocks and hence identify groupings of rookeries that constitute the respective management units. This is something that could not be effectively addressed 20 years ago, but can certainly be addressed today.

Even more importantly, population dynamics needs to be understood. Demographic data is currently almost totally dependent on mark-recapture tagging census studies which require a commitment to many years of study to derive some essential data like remigration, survivorship and recruitment rates. Short term projects are insufficient to understand stock dynamics. For efficiency, it is critical to identifying the key parameters in regard to mathematical modeling of data to address the question of what level of population loss is sustainable? There is more to be gained from planning demographic studies from an integrated stock perspective rather than as a series of disconnected studies.

At the nesting beach key demographic parameters include: number of clutches per individual female per season; remigration interval; hatchling production; quantified mortality; and a quantification of the responses to management and other human interventions. For many populations we are still data deficient.

The number of clutches per female has been poorly quantified around the world for most sea turtle populations. Available data are largely guesses and sometimes significantly in error. Tagging has been the commonly used method to measure remigration intervals between breeding seasons. Tags that don't last as long as the event being measured will produce a spurious answer. An important finding from using durable tags (titanium or Inconel flipper tags; PIT tags) in the Western Pacific has been that remigration intervals are much longer than previously imagined for species like greens and hawksbills.

Hatchling production is an important parameter that must be well documented in modeling. Many programs deal with nesting females, they're easy and fun to work with, but it is more difficult and often tedious to spend

months on the beach quantifying hatchling production. As a result, hatchling production has rarely been rigorously quantified on natural nesting beaches. As an example of its importance, 1996-1997 saw the largest green turtle nesting populations ever recorded in the northern Great Barrier Reef of Eastern Australia - isn't that marvelous, a huge nesting population. It also happened to be a year with an unusually wet wet-season and there was approaching 100% mortality of the eggs for the season. The moral of the story is that hatchling production needs to be quantified.

The mortality data for turtles, eggs and hatchlings in the natural system need to be quantified, as does additional mortality from human activities. If management programs are initiated, then there should be some long-term measure of their success; a measure which can be linked to the nesting beach demographic work to give an indication of the success of the management program.

However, a complete understanding of the functioning of a population cannot be obtained if we restrict our observations to the nesting beaches. In Eastern Australia, for example, there are over 30 years of census data for the size of the green turtle nesting population at Heron Island (Fig. 7). There have been massive fluctuations in nesting numbers at this index beach for the Southern GBR stock of green turtles. Current studies started at Heron Island in 1974. At that time there were huge numbers of nesting turtles. Five years is often considered a long-term study and if the Heron Island study had ended after five years, results then would have appeared to indicate that the population had crashed, 'something terrible must have happened'! Or had the study began in 1975 and spanned ten years to 1984, arguments could have supported the view that the green turtle population was increasing and management was good. However, in terms of the overall population performance, both of these conclusions are not acceptable.

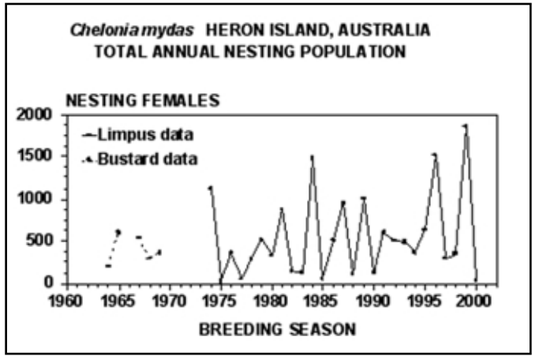


Figure 7. *Three decades of tagging census data for green turtle nesting at Heron Island, the index rookery for the southern Great Barrier Reef stock.*

In the 2000 nesting season, instead of hundreds of nesting females at Heron Island, there were only 27 individuals. The conclusion is not that the turtles have died out, but rather the turtles have remained at home and are just not breeding. This was established by examining the population in its foraging areas. For green turtles particularly, there is a high variability in annual nesting numbers which is not a measure of how many turtles are in the population, but a measure of what proportion of the population is actually breeding. Green turtle breeding in the Western Pacific and Southeast Asia is regulated by the El Nino Southern Oscillation (ENSO) and the size of the annual nesting population is climate-dependent. This is a clear example that stock dynamics needs to be understood in the distant foraging areas to understand population fluctuations at the nesting beaches.

The most critical habitats for understanding the demographic functioning of a turtle population are the feeding areas. However, most study efforts continue to be primarily focused on the nesting beaches. Turtles spend most of their time in the feeding areas. This is where the majority of the demographic processes are determined and where a large proportion of the problems occur.

For the scientist, systematic tagging-recapture programs are the most effective method for quantifying essential demographic information in feeding grounds especially when the tagging is linked to gonad examinations. Surgical procedures with laparoscopy combined with ultrasound can be used to examine gonads in live turtles. This provides a wealth of information on sex ratio, maturity ratio by sex and annual breeding rates by sex. In addition, with mathematical analysis of the tagging-recapture data, rigorous estimates of growth functions, age estimates, annual survivorship and recruitment and rates of change in population size can be derived. These data with appropriate population modeling provide valuable insights into population function and are powerful tools for the conservation manager.

Much of the same information could be obtained wherever large numbers of turtles are killed annually: for example, at the Daru market in Southern Papua New Guinea or at a slaughterhouse in Bali. Does one have to be scientists to quantify demographic data from these feeding area samples? No, not necessarily, but it would be a considerable benefit. We can learn much from a turtle that is being taken for traditional use or accidentally killed in fisheries if comprehensive biological data is recorded as it is butchered. Currently, vast numbers of turtles are being killed, probably hundreds of thousands, throughout the Western Pacific and Southeast Asia area for food consumption. Almost no information is coming back from these harvests. As a challenge to managers and the scientific community, how can we work to link the activities of traditional use to provide critical needed knowledge and information to help achieve more effective conservation management? Valuable basic demographic information from such turtles from their feeding areas includes identification of species, size and sex. With training to interpret gonads, one can determine the turtle's maturity and breeding history: would she have breed this next season; did she breed in the previous two seasons; or is she a new recruit to the adult population. From a skin sample, information regarding its genetic stock could be obtained. Stomach contents can provide information about diet and habitat use. Parasites and pathology tissue samples could provide valuable information regarding turtle disease and health.

Eastern Australian studies indicate that no one foraging area can provide an adequate summary of growth rates, size at maturity, annual breeding rates and annual survivorship for an entire stock. These demographic parameters are habitat dependent. Therefore, when selecting index feeding ground populations, multiple sampling sites selected to represent the range of foraging area types and their geographical spread are recommended.

Finally, if a serious attempt is to be made at modeling the impact of harvests in the Western Pacific, then traditional harvests in coastal villages have to be quantified. Because traditional harvests often do not involve large harvests at any one locality they are frequently ignored. However, if a village accounts for a few tens or hundreds of turtles annually and there are thousands of coastal villages through the Western Pacific Island nations, the potential for a combined harvest of vast proportion exists.

With increasing human populations for the region and no evidence of correspondingly increasing turtle populations, my view is that there is a very high probability that almost all marine turtle populations of the Western Pacific are currently at risk of being exposed to non-sustainable mortality levels. These harvests and fisheries bycatches often occur in relatively remote areas and the depth of understanding of modern turtle biology by the local people is usually very limited. In some situations the people involved will not want outsiders to know of the mortality that they cause. The challenge for managers of regional turtle stocks will include finding ways to bridge the social barriers and the remoteness barriers to obtain the critical information needed to guide management for sustainable use of these internationally shared resources.

Status of Marine Turtle Conservation and Research in Malaysia

Hock Clark Liew

PRESENTATION

Malaysia is made up of two halves; one half is on the peninsula and the other is on the island of Borneo i.e. West Malaysia and East Malaysia respectively. In total, there are 13 states, 11 of which are in the peninsula and two in the island of Borneo. In Malaysia when turtles are in the water they are under the jurisdiction of the federal government, however, when they are on land, the state has jurisdiction. Unfortunately, each state has its own legal jurisdiction in dealing with sea turtles on the beach.

Currently, sea turtle nestings occur primarily in seven of the states in Malaysia namely Perak, Malacca, Terengganu, Pahang, Johore, Sabah and Sarawak. Four species of turtles nest in Terengganu namely hawksbills, greens, olive ridley and leatherbacks. Green sea turtle nestings are more widespread and found in all the states above except Malacca. Large aggregations of greens are found in the Turtle Islands of Sarawak (with some olive ridleys and hawksbills as well). In the Sabah, Turtle Islands and Sipadan Islands, there are large aggregations of greens, and some hawksbills. Hawksbills nest primarily at Sabah, Malacca, Terengganu and Johore

TRENDS

In general, the nesting trends of recent years have decreased. Some species, like the greens, and in a few cases, the hawksbills, have stabilized, but other species such as leatherbacks and olive ridleys are not fairing well.

The first large aggregation of leatherback sea turtle were first recorded at Terengganu. The Rantau Abang, Terengganu area was once a renown area for leatherbacks. They used to nest in very large numbers, about 10,000 nests in the 1950s which has decreased to 20 or less in recent years (Fig. 1). A tragedy in terms of turtles.

Green turtles are widely distributed in Malaysia. Important rookeries occur in Sabah in the Turtle Islands, where there are about 10,000 nests; in the Sipadan Islands, about 800 nests; in the Sarawak Turtle Islands, about 2,500 nests; in Terengganu, with 2,500 nests; and some nesting in Pahang (250) and Perak (200).

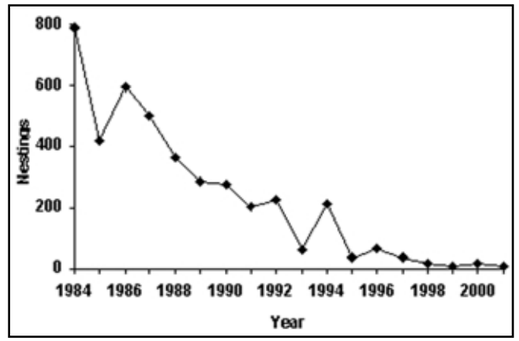


Figure 1. *Leatherback nesting trends in Terengganu, Malaysia.*

The green turtles have more or less stabilized in numbers in Terengganu (Fig. 2), if taken from 1984 onwards. Previous to 1984, the numbers were about two to three times higher. The Sarawak Turtle Islands population has more or less stabilized, but previous to 1970, it was very much higher (Fig. 3). The rookery at Sipadan has decreased. The only rookery in the region that has shown an increase in nestings is the Sabah Turtle Islands (Fig. 4).

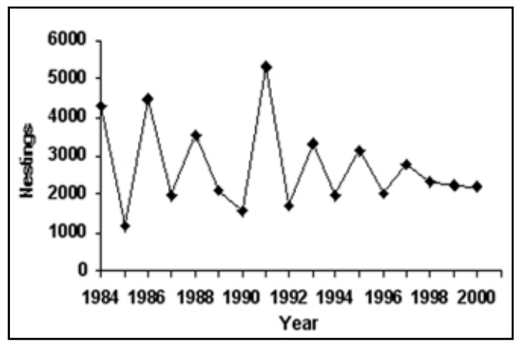


Figure 2.*Green turtle nesting trends in Terengganu, Malaysia.*

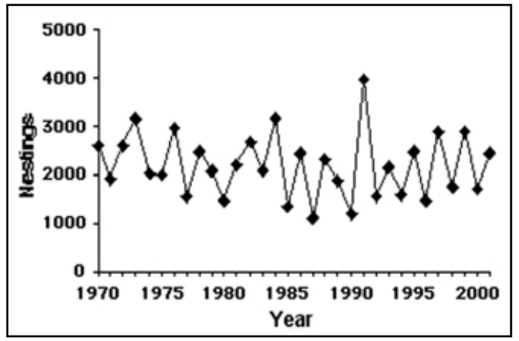


Figure 3. *Green turtle nesting trends in Sarawak, Malaysia.*

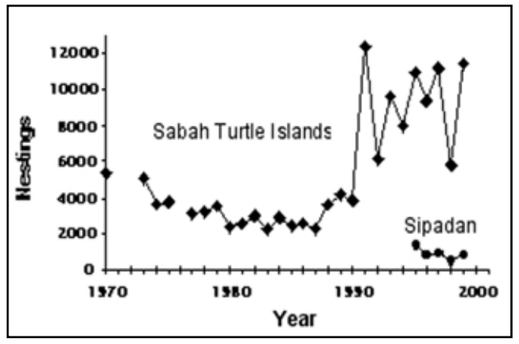


Figure 4. *Green turtle nesting trends in Sabah Turtle Islands, Malaysia.*

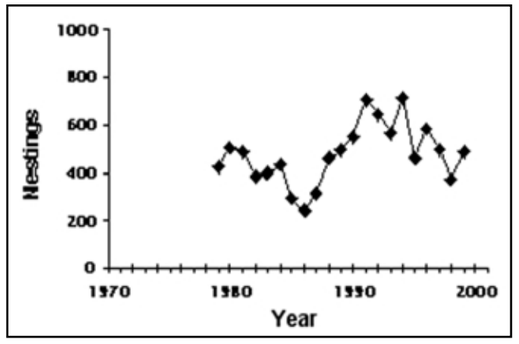


Figure 5. *Hawksbill turtle nesting trends in Sabah, Malaysia.*

Hawksbills do not nest in very large numbers in Malaysia. In the Sabah Turtle Islands, there are approximately 500 nests a year (Fig. 5). In Malacca, there are only about 250 nest per year; nesting in the other states occurs in very small numbers. Hawksbills in Sabah have stablized, but in Terengganu, it has decreased significantly in recent years (see, Fig. 6). There is not enough long-term data to tell what is happening in Malacca, but this population appears to have stabilized.

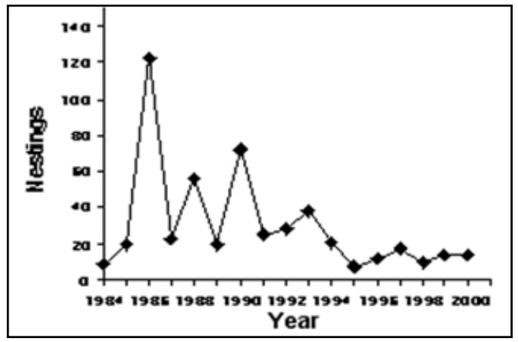


Figure 6. *Hawksbill turtle nesting trends in Terengganu, Malaysia.*

There are very few olive ridley left. They used to nest in fair numbers, but most populations have decreased significantly. In Terengganu, about 400 olive ridleys use to nest in the 1980s but this has decreased significantly. (Fig. 7)

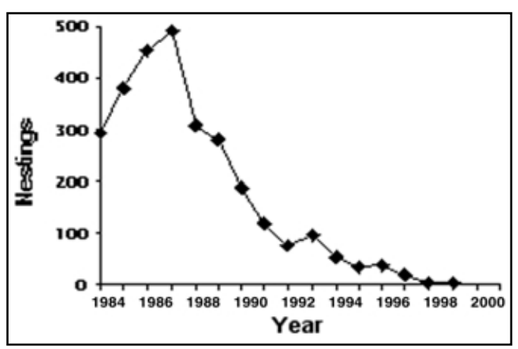


Figure 7. *Olive ridley turtle nesting trends in Terengganu, Malaysia.*

THREATS

There are quite a number of threats facing the turtle populations in Malaysia, but decades of excessive egg collection and exploitation is the single most important factor which has caused the decimation of sea turtle population in Malaysia (Fig. 8). The consumption of turtle meat is "haram" (not permitted) due to religious reasons, but eggs are readily consumed and continues to be the major threat. Eggs are collected and some are poached, but in some cases there exists legal egg harvest due to egg collection licenses; especially in the state of Terengganu where only leatherback eggs are banned, not for the other species. Other states have banned the harvest of eggs, but there exists a significant problem as eggs are smuggled and can still be bought in the markets freely.

Incidental capture of sea turtles in fishing gear is another major problem. Turtles are caught in various types of gears ranging from driftnets, lift nets, ray nets (which are like sunken driftnets with a large mesh to target rays and sharks), trawl nets and purse seines. There's very little information as to the relative ability of these nets to catch turtles, so interview and surveys of fishermen are conducted to generate bycatch information (Table 1).

Table 1. *Summary of 1994/95 Sample Survey of Fishermen for incidental catch of sea turtles in Terengganu, Malaysia.*

Gear Type	No. of Fishermen Interviewed	No. of Fishermen with past experience incidentally capturing sea turtles
Hook and line	77	0
Fish Traps	35	4 (11%)
Purse Seine	27	6 (22%)
Drift/Trammel Nets	23	3 (13%)
Long Lines	20	0
Trawls	20	11 (55%)
Ray Nets	9	6 (67%)
Lift Nets	7	2 (27%)
Beach Seine	4	4 (100%)

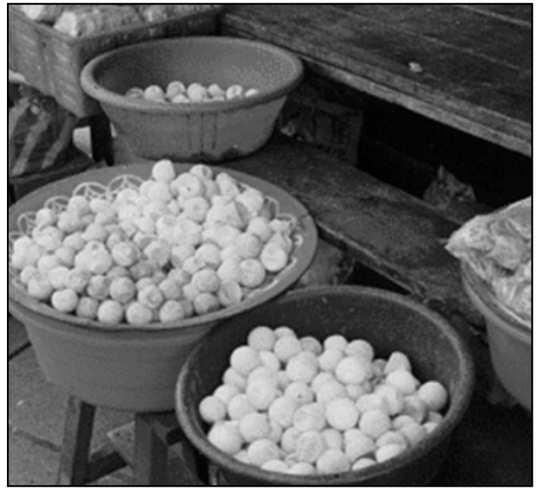


Figure 8. *Collected sea turtle eggs at market.*

Sea turtles caught in fish traps were essentially caught not by the traps, but got entangled in buoy lines of the traps. Turtles caught in driftlets, lift nests, purse seines and beach seines were generally released alive and unharmed. The major incidental bycatch problem exists with trawlers and ray nets. Ray nets are very effective in catching turtles and were banned, but enforcement is a problem and operators still use them illegally. One interesting point to note, is that hook and lines and longlines do not seem to be catching turtles within Malaysian territorial waters, although they are known to take turtles in offshore areas.

Another cause of mortality of which there is little data, are those caused by garbage and pollution. A lot of garbage washes ashore in this region. There are numerous cases where turtle skeletons have been found entangled in discarded fishing nets and other debris (Fig. 9). Entanglement in discarded debris is a problem, but there are no statistics as to how many turtles are killed by marine debris. Oil pollution and tar balls are also present in Malaysian waters. Tar balls which wash ashore are approximately the right size for hatchlings to feed on. Thus this may be an additional hazard to hatchlings at sea, but there is no information or records quantifying this problem.

Turtle watching activities used to be a problem in the sense that there were large numbers of tourists that came to Rantau Abang, Terengganu especially to see leatherbacks. There have been a number of reports of disturbances caused by tourists. But this is not a problem anymore as there are no leatherbacks left for them to watch! However, in some of the nesting beaches, certain development activities have taken place especially for tourism, and for the petrochemical industries.

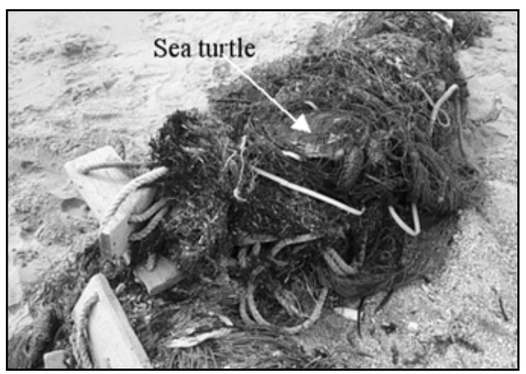


Figure 9. *Photo of discarded fishing net with entangled sea turtle.*

Inappropriate hatchery practices was also another possible cause of the decline. The movement of eggs into hatcheries can result in poor hatching success and male/female sex ratio bias problems. Insufficient egg quota for hatching, poor hatchery management and coastal management strategies (e.g. removal of trees and vegetation along major nesting beaches) may have contributed to the decline in the leatherbacks. In addition, there are natural predators, which can be significant if nests are kept *in-situ*. It is important to note that although directed harvest is totally banned in Malaysia, neighboring countries do harvest Malaysian nesting turtles.

CONSERVATION

There is a long history of conservation programs in Malaysia dating back to the 1950s. These programs are focused mainly in the protection of turtle eggs through some quota system. Today, Sabah and Sarawak are close to 100% egg protection, but on the peninsula there is less than 50% protection. Although major nesting sites are protected, licensed egg collection still occur in certain states.

Several agencies are involved (private, government and universities) in public education programs, but there is a need to have a uniform federal legislation for turtles in Malaysia. With regards to regional collaboration, a MoU has been signed, and there are bilateral programs, especially the TIHPA(Turtle Island Heritage Protected Areas) and the research and conservation network through SEAFDEC and the SEASTAR2000 program with Japan and Thailand.

RESEARCH & MIGRATION

In Malaysia, there are quite a number of different types of on-going research including: tagging and monitoring work (a continuing effort); hatchery related research, temperature and its effect on hatchling and sex ratio; captive rearing and growth; satellite tracking studies; internesting habitats using radio and ultrasonic tracking; population genetics; and TED trials.

Long term tagging programs have been carried out at Sarawak since the 1940's, Sabah Turtle Islands since 1970's and in Terengganu since 1960's. These programs have provided valuable information on tag loss, population dynamics and reproductive biology. Results from hatchery related research has provided the following valuable information:

- Hatchery related research should be carried out by anyone involved in artificial incubation of turtle eggs in hatcheries in order to improve hatchery techniques and criteria to assess nest success and hatchling quality.
- Leatherback eggs can tolerate rough handling for only up to 4 to 5 hours after oviposition (Chan *et al.*, 1985). Beyond this threshold, careful handling is needed and movement is not recommended.
- As a management measure, eggs should be replanted in hatcheries within 3 hours of oviposition.
- Temperature regimes in hatcheries should reflect the temperature in natural nests to ensure production of both male and female hatchlings.
- Open air beach hatcheries are capable of producing 100% female hatchlings.
- Styrofoam box incubation in the shade can produce 100% male hatchlings.
- *In-situ* incubation of green turtle eggs in Redang, Malaysia produced about 80% female and 20% male hatchlings.

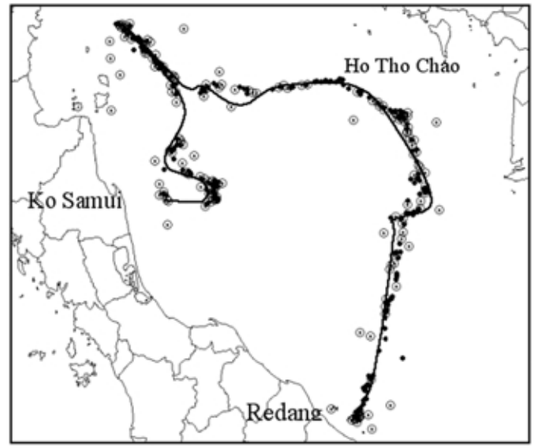
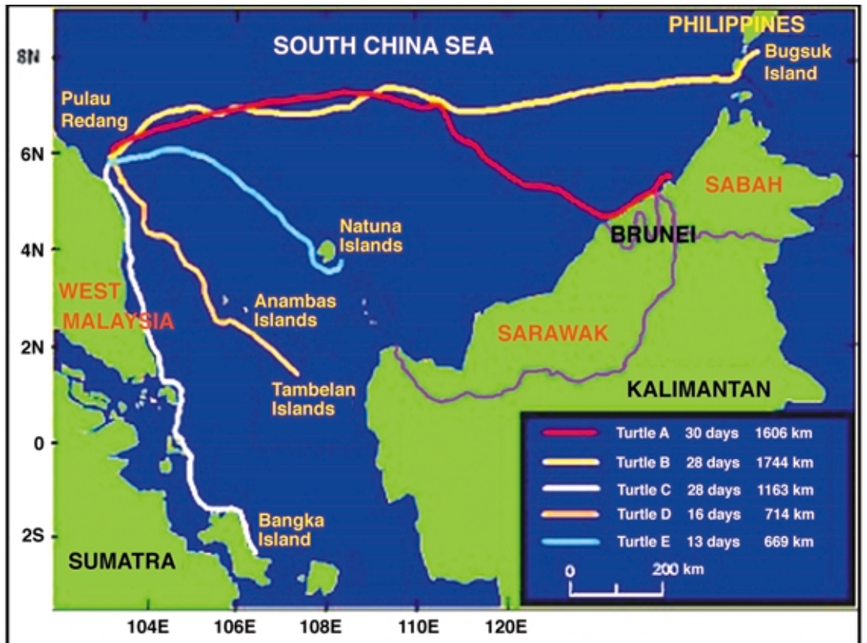


Figure 10. *Migratory pathway of a captive reared, 5 year old juvenile green sea turtle, released from Redang, Terengganu, Malaysia.*

There are countries that rear hatchlings for several weeks to a few months prior to release. These programs believe that captive rearing raises the chance for survival in the wild; although no assessments have been made of this conservation strategy. We are also experimenting with limited green turtle captive rearing to find out more about this. They are grown for up to three to five years until they reach a 'demersal life stage' and are then released. Since these turtle have not yet seen the sea, the question is whether they will survive when released. Thus far 11 captive raised turtles have been released, some have been resighted and others have been tracked by satellite.

The transmitted female turtle seen in figure 10, stayed around the release site at Redang, Malaysia for three days, then headed out to the open sea, ending up near Koh Samui, Thailand. She was tracked for 51 days over a distance of 1,200km. Although never having seen the ocean, she was very active in terms of moving around and utilizing what appears to be a pelagic habitat.

Other tracking studies have been geared to study internesting migrations, and define the range of internesting habitats and post nesting migrations. Green turtles that were satellite tracked from Pulau Redang, Terengganu indicate migrations to the South China Sea and Sulu Sea areas (Fig. 11). In addition, satellite tracks of green turtles nesting in the Sarawak and Sabah Turtle Islands and some from Thailand also travel to the Sulu Sea. It would appear that the Sulu Sea Region is a very important feeding area for greens, and it is probable that large aggregations of green turtles occur in the Sulu-Sulawesi area. Additional studies of satellite tracked hawksbills revealed movements of great distances over 1,000 kilometers.



Routes taken by five female Green Turtles tracked by satellites after nesting at Pulau Redang, Malaysia in 1993 and 1994.

Figure 11. *Routes of five satellite transmitted green sea turtles from Malaysia.*

Malaysia has also been identified as the lead country in the SEAFDEC programs for conservation and research on sea turtles and responsible for compiling information for the Southeast Asian region, coordinating tagging programs, and continuing regional research efforts in collaboration with Japan. Future research efforts include the determination of migratory pathways of green turtles in the South China and Andaman Seas using satellite telemetry; temperature and sex ratio studies; population genetics; and sea turtle bycatch in trawl fisheries.

Marine Turtle Distribution in the Philippines

Renato D. Cruz

SPECIES DISTRIBUTION AND SIGNIFICANT MARINE TURTLE HABITATS

There are five species of marine turtles found in the Philippines, namely: green turtle *(Chelonia mydas)*, hawksbill turtle *(Eretmochelys imbricata)*, olive ridley turtle *(Lepidochelys olivacea)*, loggerhead turtle *(Caretta caretta)* and leatherback turtle *(Dermochelys coriacea)*.

Green Turtle

The green turtles are widely distributed throughout the country, with high nesting aggregations in the Turtle Islands and the San Miguel Group of Islands, both in the Province of Tawi-Tawi (Cruz, 1999). Panikian Island in Pitogo, Zamboanga del Sur has been found to have moderate nesting aggregation. Languil and Malamawi Islands in the Province of Basilan have been reported in 2001 to have significant nesting aggregations. However, further assessments of these islands are needed.

The surrounding waters of the main islands of the Provinces of Tawi-Tawi, Sulu and Basilan are the feeding grounds of nesting turtles coming from the Turtle Islands, which belong to both Philippines and Malaysia. This was the result of the satellite telemetry project of the Turtle Islands Heritage Protected Area conducted in 1998 to 2000 by the PCP-PAWB and Sabah Parks-Malaysia in collaboration with the WWF-Philippines, Coastal Resource Management Program-USAID, and the Smithsonian Institute. All of the identified major nesting areas of green turtles in the Philippines are found in Mindanao (Fig. 1).

Hawksbill Turtle

The hawksbill turtles are also widely distributed in the Philippines. However, unlike the green turtle, there is no known major aggregation of hawksbill throughout the country. Lagunoy Gulf in the Bicol region has been identified as a developmental habitat of hawksbill turtles (de Veyra, 1994).

Olive Ridley Turtle

In the early 1900's Taylor reported that olive ridley turtles were quite common in Manila Bay (de Veyra, 1994). However, to date, there were only three confirmed sightings in the bay. Confirmed sightings have also been reported in Luzon (Lingayen Gulf in La Union, Malabon in Manila Bay, Apo Reef in Mindoro, Ragay Gulf in Quezon, Lagonoy and Albay Gulfs in the Bicol region, Sta. Cruz in Marinduque), Visayas (Himamaylan, Pontevedra and Sipalay in Negros Occidental, San Joaquin in Iloilo, Carigara Bay and Palompon in Leyte, Santander in Cebu) and Mindanao (Lianga Bay in Agusan del Norte) (Cruz, 1999). In 2000, additional confirmed sightings were reported in Aklan, Guimaras and Roxas, Capiz.

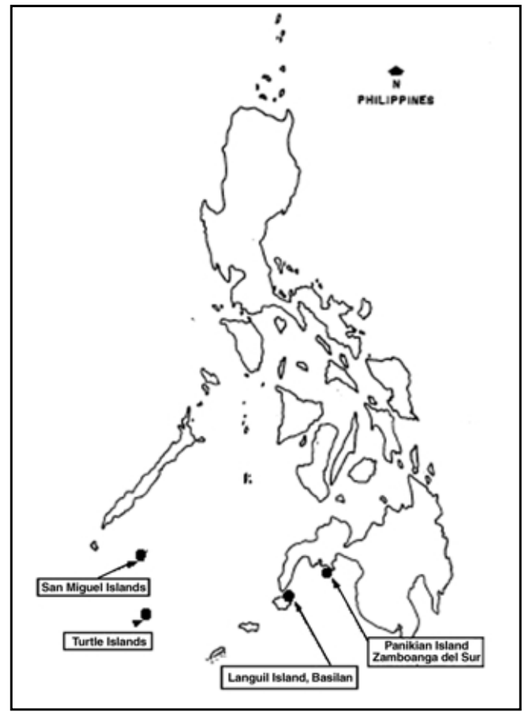


Figure 1. *Major Nesting areas of green turtles in the Philippines.*

Since 1995, the only confirmed olive ridley nesting area is within the Subic Bay Free Port. However, in 1997, a significant nesting area was discovered in Morong, Bataan. Reports also show that the coastline of the Province of Zambales caters to olive ridley nesters. Both provinces border Subic Bay. Other nesting areas are in Lian and San Juan in Batangas, and the western portion of Puerto Princesa, Palawan. Most nesting sites border the South China Sea (Fig. 2).

Loggerhead Turtle

No loggerhead nesting has been confirmed in the Philippines; however, two loggerhead turtles from Japan have been tagged. These turtles were caught by fishers in Pilas Island, Basilan in 1992 and Rapu-Rapu, Albay in 1993 (de Veyra 1994). In 1997 and 1998, the presence of these tagged loggerheads was confirmed at Honda Bay in Palawan, Bais in Negros Oriental and Cortes in Bohol (Cruz, 1999). In 2001, a loggerhead turtle was caught in San Miguel Bay, Siruma, Bicol Rock, Calabanga, Camarines Sur (Fig. 3).

Leatherback Turtle

Leatherback turtles are occasionally caught by local fishers in southern Luzon specifically in Catanduanes, Daet and Albay Gulf within the Bicol region. In 1997 and 1998, there were two confirmed reports from Salay City in Negros Occidental and Mambajao in Camiguin (Cruz, 1999). In 1999 and 2000, the PCP-PAWB received three reports from Santa Fe, Bantayan Island, Cebu, Barangay Naisud, Ibajay, Aklan, and Roxas City, Capiz (Fig. 4).

All of these reports were accidentally caught turtles that were eventually released to the wild. The reports indicate that the Philippines are a feeding ground for leatherback turtles, which concentrate in the Visayan Islands. Similarly to loggerhead turtles, no leatherback nesting has been documented in the Philippines.

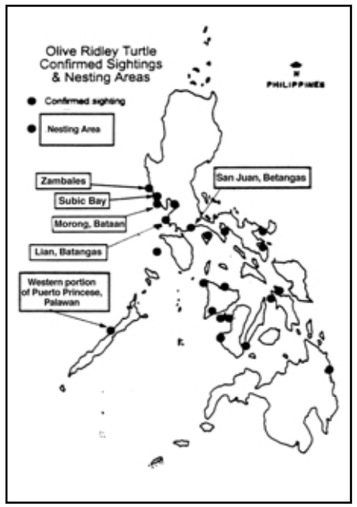


Figure 2. *Olive ridley nesting sites in the Philippines.*

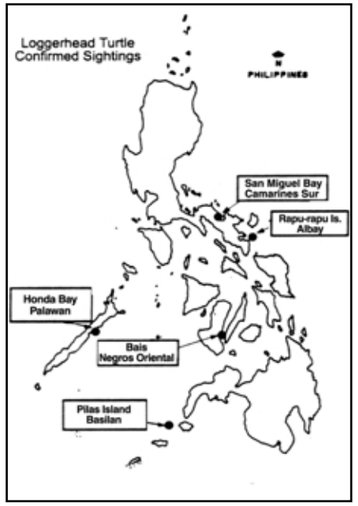


Figure 3. *Loggerhead turtle confirmed sightings (no nesting) in the Philippines.*

Figure 4. *Leatherback turtle confirmed sightings (no nesting) in the Philippines.*

NESTING SITE CHARACTERIZATION

Turtle Islands

The Municipality of Turtle Islands is a group of islands under the Province of Tawi-Tawi. It is 1,000 km southwest of Manila, 40 km northeast of Sandakan, Sabah, Malaysia and part of Mindanao. The group of Islands is composed of six islands, namely: Taganak, Boan, Lihiman, Langaan, Bakkungan and Baguan. Taganak is the biggest island, covering an area of 130 hectares and Langaan is the smallest island with an area of 7 hectares. All of the islands are inhabited except Baguan Island (see, Fig. 5).

Some of the Turtle Islands belong to Malaysia, namely: Palau Selngaan, Palau Bakkungan Kechil and Palau Gulisaan, which are part of Sabah. The Turtle Islands harbor the largest green turtle rookery in Southeast Asia, recognized as one of the 16 major nesting areas in the world and considered as one distinct population.

Green turtles nest in the Turtle Islands throughout the year. The peak of the nesting season occurs between April and October (Fig. 6). The Turtle Islands produce more than one million eggs in a year. From 1984-2000, more than 21.6 million eggs were produced (Fig. 7, and Table 1).

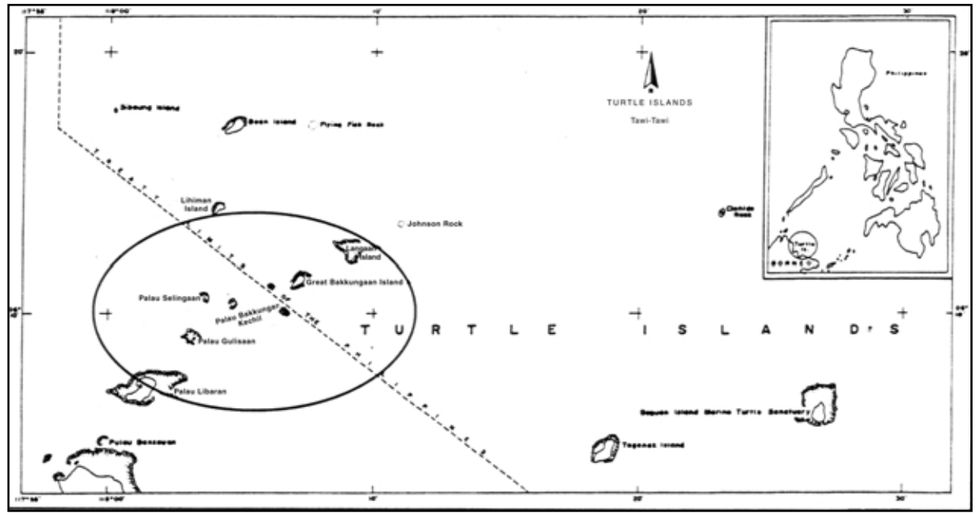


Figure 5. *Philippinel Malaysia Turtle Islands (Islands in circle area).*

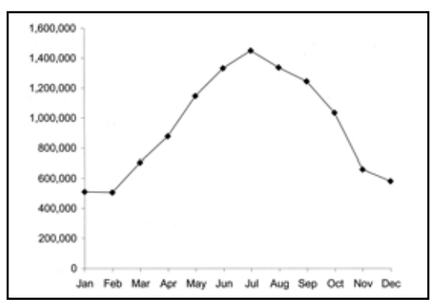


Figure 6. *Nesting Season based on Egg Production at Baguan Island (1985-2000).*

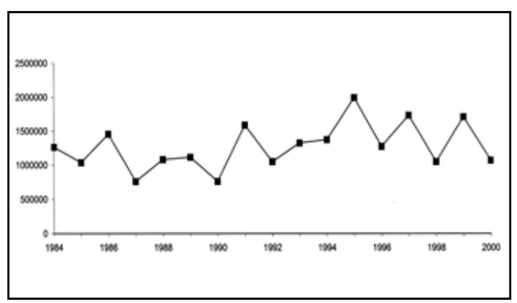


Figure 7. *Egg Production at the Turtle Islands from 1984 to 2000.*

Table 1. *Egg production in Turtle Islands, Tawi-Tawi from 1984-2000.*

Year	Total number of eggs			% of eggs
	Produced	Conserved	Collected	conserved
1984	1,264,898	638,669	626,229	50
1985	1,039,278	590,882	448,396	57
1986	1,456,276	782,302	673,974	54
1987	762,341	595,259	167,082	78
1988	1,083,651	680,022	403,629	63
1989	1,118,376	822,585	295,791	74
1990	763,603	546,817	216,786	72
1991	1,590,387	1,140,353	450,034	72
1992	1,052,168	804,990	247,178	77
1993	1,326,977	1,015,859	311,118	77
1994	1,375,179	1,025,900	349,279	75
1995	1,996,432	1,545,355	451,077	77
1996	1,275,099	937,814	337,285	74
1997	1,736,011	1,351,223	384,788	78
1998	1,051,496	755,524	295,972	72
1999	1,714,115	1,307,745	406,370	76
2000	1,071,822	818,093	253,729	76
Total	21,678,109	15,359,392	6,318,717	71

Baguan Island ranks the highest among these islands in egg production. It produces 60% of the total egg produced in the Turtle Islands (Fig. 8 and, Table 2). The Sabah Turtle Islands also harbor a significant nesting population of hawksbill turtles, however, less than five hawksbill turtles nest per year in the Philippine Turtle Islands.

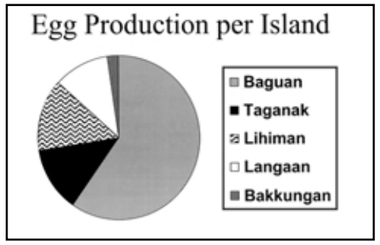


Figure 8. *Share of Eggs Produced per Island (Turtle Islands, 1991-2000).*

Table 2. *Egg production in Turtle Islands, Tawi-Tawi from 1991-2000.*

Year	Baguan	Taganak	Lihiman	Langaan	Bakkungan	Total
1991	947,481	265,316	184,340	159,858	33,392	1,590,387
1992	612,868	162,653	127,404	118,603	30,640	1,052,168
1993	800,021	191,682	154,318	149,055	31,901	1,326,977
1994	786,285	163,596	252,973	152,098	20,227	1,375,179
1995	1,243,411	257,280	269,021	196,396	30,324	1,996,432
1996	735,078	182,949	181,012	140,789	35,271	1,275,099
1997	1,095,749	184,557	228,067	188,104	39,534	1,736,011
1998	563,984	110,487	211,100	133,409	32,516	1,051,496
1999	1,055,551	190,211	244,786	188,254	35,313	1,714,115
2000	633,674	117,759	161,232	131,654	27,503	1,071,822
Total	8,474,102	1,826,490	2,014,253	1,558,220	316,621	14,189,686

Panikian Island

Panikian Island is part of the Municipality of Pitogo in the Province of Zamboanga del Sur. Panikian Island is about 500 km southeast of Manila and part of Mindanao. The island is an important nesting area for green turtles.

Turtle egg production data initially gathered in 2000 show that green turtles nest all year round in the island with April to September as peak season (Fig. 9). Panikian's nesting profile is similar to the Turtle Islands. More than 38,000 eggs were produced in that year and at least 120 neophyte marine turtles were tagged. Ninety-eight percent (98%) were green turtles and only 2 % were hawksbill nesters (Tables 3 and 4).

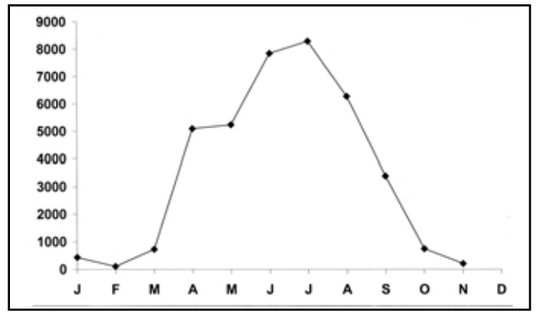


Figure 9. *Nesting Season of Green Turtles based on Egg Production in Panikian Island in 2000.*

Table 3. *Egg Production at Panikian Island in 2000.*

Month	Green	Hawksbill
January	430	0
February	105	0
March	722	0
April	5,093	508
May	5,235	231
June	7,845	220
July	8,288	0
August	6,277	0
September	3,384	0
October	740	0
November	208	0
December	0	0
Total	38,327	959

Table 4. *Tagged neophyte turtles at Panikian Island in 2000.*

Month	Green	Hawksbill
January	5	0
February	1	1
March	7	1
April	8	0
May	0	0
June	2	1
July	36	0
August	30	0
September	21	0
October	4	0
November	2	0
December	1	0
Total	117	3

Morong

Morong is a Municipality of the Province of Bataan, 50 kilometers West-North-West of Manila. It is a 40 km long peninsula oriented from North-North-West to South-South-East, connected to mainland Luzon thru the Province of Zambales on the north, bounded by the Manila Bay on the east and the South China Sea on the west. Its southern tip guards the approach to Manila. In 1997, Morong was discovered to be an important nesting area for olive ridley turtles.

Presently, there are three sites in Morong that are regularly being monitored for nesting turtles, namely: Sitio Fuerte and Sitio Matiko of Barangay Sabang and Barangay Nagbalayong. Nagbalayong's residents constructed the first hatchery in Morong in 1999, while the other sites constructed their hatcheries in 2001 before the nesting season. Most of the turtle eggs laid in these areas are transferred to the hatcheries.

Data gathered in the three areas show that the nesting season for olive ridley is from September of the present year to February of the following year (Table 5). The peak months are November, December and January (Fig. 10). There are also nesting green turtles in the area but 91% are olive ridley nesters (Table 6). From January 2001 to January 2002, more than 9,000 eggs were transferred to the hatcheries with an 86% hatching success (Table 7).

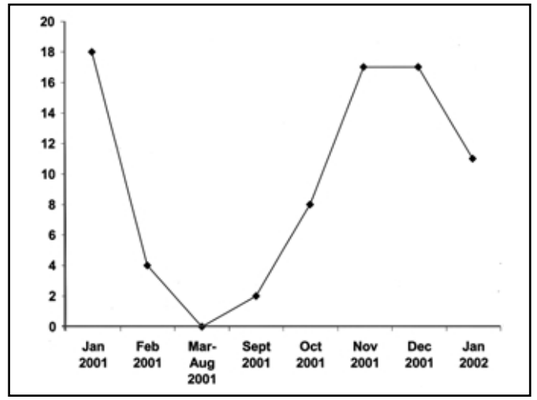


Figure 10. *Number of olive ridley turtle nests in Nagbalayong throughout the year.*

Table 5. *No. of nests/eggs transferred to the hatchery in Brgy. Nagbalayong, Morong, Bataan from January 2001-January 2002*

Month & Year	No. of nests	Total no. of eggs
January 2001	18	1448
February 2001	4	326
March-Aug 2001	0	0
September 2001	2	186
October 2001	8	941
November 2001	17	1787
December 2001	17	1679
January 2002	11	996
Total	77	7363

Source: Bantay Pawikan, Morong, Bataan

Table 6. *Number of tagged neophyte marine turtles in Morong, Bataan from January 2001-January 2002.*

Species	Nagblayong	Fuerte	Matiko	Total
Olive Ridley	10	2	8	20
Green	1	1	0	2
Total	11	3	8	22

Source: Bantay Pawikan, Morong, Bataan

Table 7. *Number of eggs transferred in hatcheries in Morong, Bataan from January 2001- 2002.*

Month & Year	Nagbalayong	Fuerte	Matiko	Total
January 2001	1448	No data	No data	1448
February 2001	326	No data	No data	326
September 2001	186	No data	No data	186
October 2001	941	No data	95	1036
November 2001	1787	158	111	2056
December 2001	1679	864	373	2916
January 2002	996	220	—	1216
Total	7363	1242	579	9184

Source: Bantay Pawikan, Morong, Bataan

CAUSES OF MORTALITY

Conservation awareness on marine turtles significantly increased during the past decade in the Philippines due to information and education campaigns, and marine turtle distribution (tagging) activities conducted by the national government in collaboration with non-government conservation organizations, people's organizations, local government and the media. The best indication of the increased awareness is the numerous reports received by DENR field offices from fishers about accidental catches of marine turtles. However, in spite of this increase in conservation awareness, the killing and selling of turtle meat and eggs for consumption, and trading still takes place. This occurs mostly in remote areas of the country for the following reasons.

- Lack of law-enforcement personnel/agency in the area;
- Lack of implementation of existing local and national law/ordinances/orders;
- The penalties incorporated in the particular ordinance/order are not enough to deter violators;
- Traditional use of the species especially in the celebration of town fiestas and weddings; and
- Poverty.

In the Turtle Islands, there was a significant drop (88%) in egg production due to almost a 100% exploitation of turtle eggs. This figure was the result of the comparison done between the egg production data gathered by Domantay in 1951 (Domantay, 1953) and the PCP data. However, from 1984 to 2001, collection of turtle eggs was regulated by the National Government in an agreement with the local government. This resulted to a 71% conservation of turtle eggs, or approximately 1 million to 1.5 million eggs per year (see, Table 2).

Aside from egg harvesting, an increasing number of floating dead turtles have been seen in the Turtle Islands during the past three years. More than 10 nesters were counted in a particular year. The main cause is the increasing number of fishing vessels operating in the area. These types of fishing vessels included purse seiners, shrimp trawlers, and hulbot-hulbot (demersal drive-in net). Most of these vessels come from Sabah, Malaysia and Manila. Although, less common than in other coastal areas in the Philippines, the Turtle Islands are not spared the ravages of cyanide and dynamite fishing. There are some residents who now practice these kinds of destructive fishing.

Today, the number of Chinese fishing vessels operating within Philippine waters is increasing. These Chinese fishers, aside from fishing illegally, are also catching marine turtles. On January 2002, four vessels from China were caught in Tubbataha Marine Park, a UNESCO Natural Heritage Park located in the Sulu Sea. More than 58 marine turtles, mostly green turtles, were discovered on these vessels. A composite team

composed of the Philippine Navy, WWF-Philippines and the Provincial Government of Palawan apprehended the group.

LEGISLATIONS AND INTERNATIONAL AGREEMENTS

Several current statutes indirectly address the threats to the marine turtle populations in the Philippines. These include the Republic Act No. 8550, The Philippine Fisheries Code of 1998, approved on February 19, 1998 and the Republic Act No. 7586, and then Act Providing for the Establishment and Management of National Integrated Protected Areas System, approved on June 1, 1992.

In simple terms, provisions in R.A. No. 8550 protects municipal coastal areas from destructive fishing methods while R.A. No. 7586 establishes biodiversity critical areas as protected areas. A number of these areas have been established as protected areas, including the Turtle Islands.

On July 30, 2001, the Republic Act No. 9147, Wildlife Resources Conservation and Protection Act, was enacted by Congress. This law covers the conservation of all wildlife classified as threatened and endangered species. Included in this statute are heavier penalties that may deter exploitation of endangered wildlife species in the Philippines.

These laws will hopefully ensure the maintenance or possibly increase marine turtle populations in the Philippines, as well as shared populations with other countries. Other proclamations and international agreements related to the conservation of marine turtles in the Philippines are:

1. Presidential Proclamation No. 171 – Declares the Turtle Islands Municipality and its surrounding waters reckoned 15 kms from the shoreline of each of the islands located in the Southwestern Sulu Sea, Province of Tawi-Tawi, as a protected area pursuant to Republic Act. 7586 (NIPAS Act of 1992), and shall be known as the Turtle Islands Wildlife Sanctuary, signed by the President on August 26, 1999.

2. Turtle Islands Heritage Protected Area – Memorandum of Agreement between the Governments of the Philippines and Malaysia on the joint management of the Philippine-Sabah Turtle Islands, signed on May 31, 1996.

   In recognizing the importance of this area, a Memorandum of Agreement on the establishment of the Turtle Islands Heritage Protected Area was signed by the Governments of the Philippines and Malaysia on May 31, 1996. Collaborative management of the area is the cornerstone of the Agreement.

3. Memorandum of Understanding on ASEAN Sea Turtle Conservation and Protection – signed on September 12, 1997 by the ASEAN Ministers on Agriculture and Forestry.

4. Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats in the Indian Ocean and South East Asia – countries started signing the MoU on June 23, 2001. To date, Australia, Comores, Islamic Republic of Iran, Myanmar, the Philippines, Sri Lanka, United Republic of Tanzania, United States of America and Vietnam signed the MoU.

LITERATURE CITED

Cruz, Renato D. 1999. Research, Conservation and Management of Marine Turtles in the Philippines in: Nasir, Mohd Taupek Mohd, Abdul Khalil Abdul Karim and Mohd Majib Ramli (rapporteurs) Report of the SEAFDEC-ASEAN Regional Workshop on Sea Turtle Conservation and Management. Marine Fishery Resources Development and Management (MFFDMD) and Southeast Asian Fisheries Development Center (SEAFDEC). 26-28 July 1999. Kuala Terengganu, Malaysia.

De Veyra, Rhodora T.D.Ramirez. Status of Marine Turtles in the Philippines in: Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Elizar (Compilers). 1994. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351, 323 pp.

Domantay, J.S. 1953. The turtle fisheries of the Turtle Islands. Bulletin of the Fisheries Society Philippines 1952-3, 3-4:3-27.

WORKSHOP DISCUSSION

DR. LIMPUS: Would you be comfortable to give a sort of ballpark figure on what you think the actual level of harvest of turtles throughout the Philippines is? Are we talking few thousand turtles a year? Are we talking tens of thousand a year? Could it be up to 100,000? Give me some feel for turtle usage in the Philippines.

MR. CRUZ: We feel about 1,000 nesters are being killed.

DR. LIMPUS: That's in the nesting areas?

MR. CRUZ: Based on interviews we have made in different areas throughout the Philippines, it may be more, especially in remote areas in the Philippines. There is no national agency that operates in that area and there is wide exploitation. The meat is sold within the community. We have identified this area and we will begin to go there and have collaborative efforts with government organizations.

Marine Turtle Management and Conservation in Indonesia

Agus Dermawan

INTRODUCTION

Indonesia is the world's largest archipelago, consisting of 17,508 islands with a total land area of about 1.9 million square kilometers (km^2) and a coastline length of 81,000 kilometers. Indonesia's maritime area covers 5.8 million km^2, including approximately 0.3 million km^2 of territorial sea, 2.8 million km^2 of archipelagic waters, and 2.7 million km^2 within the Exclusive Economic Zone (EEZ).

Indonesia's marine resources are known to be among the most biologically diverse in the world. However, it is believed by some that these rich marine resources have not yet been effectively developed. For example, in 1991 it was reported that the level of exploitation only reached 30% of the total marine resource potential. Conversely, over-exploitation of certain marine biota has increased, including on marine turtle species, due to increasing coastal population size, economic pressures, as well as illegal harvesting practices. These have led to circumstances where several marine species, including their habitats, have been increasingly threatened.

Currently, exploitation of marine turtles still takes place throughout Indonesia. Several efforts have been made by the national government including joint cooperation with neighboring countries to address the problems of over-exploitation of. A number of marine biodiversity conservation programs involving local communities and stakeholders have been developed to conserve endangered marine species including marine turtles.

POPULATION TRENDS AND DISTRIBUTION

Distribution

Millions of years ago, marine turtles were more diverse than today, and included seven families, with three genera of the family Chelonidae or hard-shelled marine turtles, in addition to five families of leatherbacks. Today, however, only seven species remain, belonging to two families and six genera. Marine turtles are excellent navigators, frequently migrating hundreds or even thousands of kilometers between foraging and nesting grounds, crossing international boundaries. They spend their lives at sea but return to land to reproduce. Adult females nest in multiyear cycles, coming ashore several times to lay hundreds of eggs during each nesting season. After about 50 to 60 days of incubation, the hatchlings emerge and head for the ocean to begin life as pelagic drifters. While maturing over the course of several decades, they move in and out of a variety of oceanic and coastal habitats. This pelagic existence often complicates efforts to study and conserve them

Six out of the seven species of marine turtles occur in Indonesian waters. These include: the leatherback turtle *(Dermochelys coriacea)*, olive ridley turtle *(Lepidochelys olivacea)*, hawksbill turtle *(Eretmochelys imbricata)*, loggerhead turtle *(Caretta caretta)*, flatback turtle *(Natator depressus)*, and green turtle *(Chelonia mydas)*. The most abundant species in Indonesia is the green turtle, followed by the hawksbill, olive ridley, leatherback turtle, flatback and loggerhead.

Status of Marine Turtle Species

Limited information and few reliable data sets are available regarding the current status of the six marine turtle species occurring in Indonesia, and to what extent they are being utilized. Reports by the management authorities in marine conservation areas, turtle researchers and local communities indicate that turtle species have been gradually decreasing for over 50 years. This may be due to unsustainable egg and adult turtle harvest, as both eggs and meat of which have high economic values.

Green Turtle *(Chelonia mydas)*

The local names of the green turtle are Penyu Hijau, Penyu Daging and Penyu Laut. In Indonesia, coastal communities have traditionally utilized the green turtle for centuries, particularly as a part of the Balinese culture (Fig. 1). The green turtle is the most recently protected species among the six species occurring in Indonesia. Since the Indonesian Government

Legislation No. 7/1999 was formally promulgated, all six marine turtle species in Indonesia, including green turtles, are now listed as protected species.

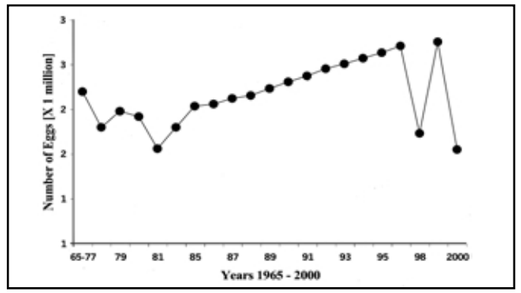


Figure 1. *The number of harvested green sea turtle eggs in Indonesia from 1965 to 2000 (Schultz, 1984).*

Green turtles are widely distributed throughout the Indonesian archipelago. This species can still be found nesting in high numbers, such as in the Berau district of East Kalimantan province, the Aru and Kei islands in the Molukkas, and other small and remote islands throughout Indonesia. In the Berau district, the green turtle has contributed economically to the income of both, the local government and the island communities.

There are five green turtle major nesting sites throughout the Berau district: the islands of Sangalaki, Mataha, Belambangan, Bilang-bilangan, Balikukup and Sambit. According to the Berau Fisheries Department in the year 2000 approximately 1,554,102 green turtle eggs have been collected in Berau district (Table 1).

Table 1. *Number of collected nests on five Islands in Berau District, East Kalimantan between 1998 and 2000 (Berau Fisheries Dept., 2001).*

Egg Concession Island	No. of Nests 1998	No. of Nests 1999	No. of Nests 2000
Sangalaki	6,985	10,346	5,065
Belambangan	2,602	3,819	2,314
Sambit	482	1,050	430
Bilang-Bilangan	4,483	7,847	3,935
Mataha	2,746	4,058	2,334
Total	17,298	27,120	14,078

Currently a high percentage of all eggs laid by marine turtles in Indonesia are harvested by local fishermen on behalf of local businessmen (Fig. 2). Although once a subsistence take, the eggs are now sold to distant markets within the country and an uncertain proportion is illegally exported to Singapore, Brunei and Sarawak, Malaysia. Many of the largest rookeries have decreased in the last 50 years, due to over-harvest (Schulz 1984, Salm 1984; Kitchener 1996). A good example of the devastating impact of this egg trade can be found on Pangumbahan beach, another major green turtle nesting site in Indonesia and the only remaining nesting beach of any importance on Java. Green turtles are nesting at Pangumbahan throughout the year, with a peak season from June to October.

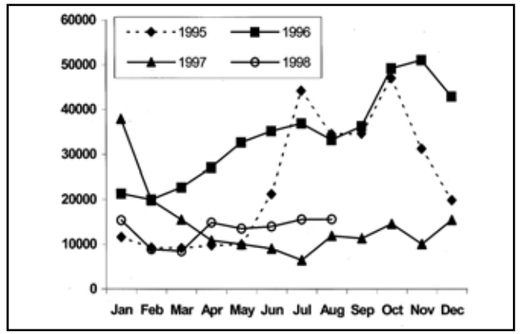


Figure 2. *Monthly fluctuation of green turtle egg harvest at Pangumbahan Beach, West Java.*

Hawksbill (*Eretmochelys imbricata*)

The local names of this turtle are Penyu Sisik, Fonu Koloa, Penyu Genteng, Penyu Kembang, Penyu Katungkera and Wau (Adisukresno 1993). Decree No. 882/Kpts-II/1992 of the Minister of Forestry has protected it. Hawksbill turtle populations have also been declining, but at present hawksbill turtles can still be found throughout Indonesia in significant numbers (Salm 1984; Salm & Halim 1984. Schulz 1984,1987,1989, Halim 1998). Important nesting areas are the Anambas and Natuna-Riau islands; Lima Momperang; Pesemut-Belitung, Segamat Islands, Lampung; South of Ujungpandang; Bira-Birahan, and the Derawan Islands, East Kalimantan (Salm & Halim 1984, Shulz 1984; Soehartono 1993, Halim 1998). The hawksbill turtle is a difficult species to monitor for a number of reasons. Small numbers of hawksbills nest on a wide variety of beaches across a broad geographic area. Further, hawksbill beaches tend to be remote, inaccessible and sometimes so narrow that the turtle leaves no crawl trace. Moreover, hawksbill turtles exhibit large year-to-year fluctuations in nesting numbers (characteristic also of green turtles). For instance, in Kepulauan Seribu Marine National park (108,000 ha), in the vicinity of Jakarta Bay, hawksbill turtles nest are wildly distributed in few small rookeries among 110 coral cays.

Data on Hawksbill nesting trends are available for three different locations such as Alas Purwo National Park, East Java; Jamursba-Medi beach, Irian Jaya; and Sukamade beach, Meru Betiri, East Java (Fig. 3). The nesting season of this species varies among sites, for instance Kepulauan Seribu NP (December to April); Segamat Island, Lampung (December to April); Belitung (January to June); Paloh, West Kalimantan (February to May) and Tambelan, Riau (February to May).

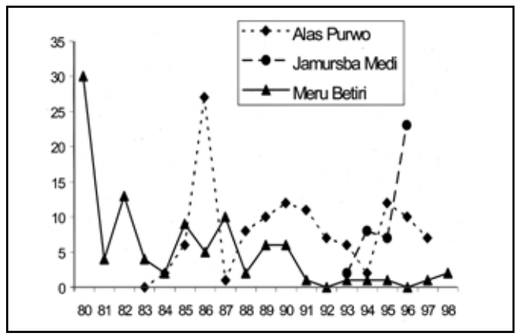


Figure 3. *Annual nesting trends of hawksbill turtles in three sites of Indonesia.*

Olive ridley (*Lepidochelys olivaceae*)

The local names of olive ridley turtles are Penyu Lekang, Slengkrah, Penyu Abu-abu and Penyu Ridel. It has been protected since 1980, based on the Decree No. 716/Kpts-Um/10/1980 by the Ministry of Agriculture. Olive ridley turtles are found in small numbers throughout Indonesia (Fig. 4), with the main nesting areas in Sumatra, Alas Purwo-East Java, Paloh-West Kalimantan and Nusa Tenggara (Salm and Halim 1984; Schulz 1984; Kitchener 1996; Darmawan 1996).

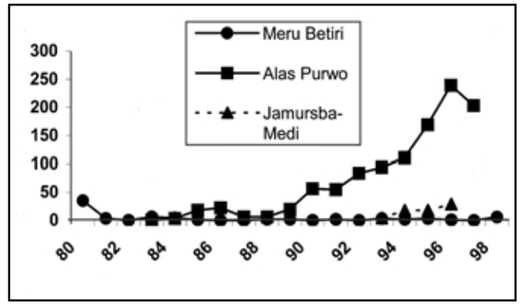


Figure 4. *Annual trend of Olive ridley nesting in three sites of Indonesia, years 1980 – 1998.*

A comparison of the annual nesting trends of olive ridley's nesting in Meru Betiri NP, East Java, Alas Purwo NP, East Java and Jamursba-Medi beach, Irian Jaya shows that Ngagelan beach in Alas Purwo NP is the most important nesting habitat for Olive Ridleys with up to 250 females nesting in 1996. The nesting fluctuation of this species seems to be increasing, which is one of the reasons why this area must be well managed and controlled.

Leatherback (*Dermochelys coriaceae*)

Adiskresno (1993) noted local names of the leatherback were Penyu Belimbing, Penyu Raksasa, Kantong, Kantong Gelingsing and Mabo. It has been protected since 1978 based on the Ministry of Agriculture Decree No. 327/Kpts/Um/5/1978. The leatherback turtle can be found nesting of the western coast of Sumatera, South Java and isolated area in Nusa Tenggara (Salm and Halim 1984; Kitchener 1996). However, the largest rookery in Indonesia and the largest known leatherback rookery in the world, can be found on the north coast of the Bird's Head peninsula of Irian Jaya, on the beach Jamursba-Medi (Bhaskar 1984). Nababan and Jacob (1996) described the leatherback population in Jamursba-Medi declining rapidly in the last 15 years due

to exploitation and habitat destruction. In 1984, nesting activities can reach 200 to 250 clutches per night during nesting reason (May to September) on 18 km of beach. Clutch production of all species occurring at Jamursba-Medi during 1993 to 1996 can be seen in Table 2.

Table 2. *Nesting trends of marine turtles in Jamursba-Medi, Irian Jaya, 1993-1996.*

Turtle Species	Total Clutches			
	1993	1994	1995	1996
Leatherback	3,324	3,298	3,382	5,058
Green	4	11	20	11
Hawksbill	2	8	7	28
Olive ridley	4	18	18	29
Flatback	0	0	0	0

Loggerhead *(Caretta caretta)*

The local people call the loggerhead Penyu Tempayan, Penyu Karet and Penyu Bromo. The Ministry of Agriculture has protected them since 1980 based on Decree No. 716/Kpts/Um/10/1980. Loggerhead turtles are rare in Indonesia, but there are unconfirmed reports that they may be nesting in the province of Maluku, where they are also found feeding (Salm and Halim 1984). Loggerhead turtles can also be found foraging in waters close to Taka Bona Rate atoll, south of Sulawesi (Wicaksono 1992).

Flatback *(Natator depressus)*

The local people call it Penyu Pipih. This species received protection status in 1992 based on Decree No. 882/Kpts-II/1992 by the Ministry of Forestry, and is currently an unexploited species in Indonesia. This species ventures only into Indonesian waters to feed, and nests exclusively in Australia (Sumardja 1991, Limpus 1993, Kitchener 1996). As such, it must be considered a shared resource.

THREATS TO MARINE TURTLES

The main threats for the sea turtle populations in Indonesia are human activities such as unintended fisheries bycatch using trawls, long lines, gillnets, etc.; harvesting female turtles for the meat trade; illegal harvest of turtles for subsistence and the trade both for meat and shells; illegal collection of turtle eggs; pollution and debris including lost and discarded fishing gear. According to WWF/IUCN (1984), green turtles have been collected from all over Indonesia to supply up to 30,000 turtles in Bali, making Bali the world's largest trade in live green turtles.

Several reports indicate that turtle meat from Indonesia is served in several restaurants in Indonesia, and has been exported to Japan, Hong Kong, South Korea and Europe. Turtle eggs and shells have been illegally exported to make ornamental crafts. The demand for turtle meat in Bali has also been increasing for decades; the local population within the Balinese-Hindu culture area of Southern Bali has used turtle meat as a standard source of food and in religious festivities. The average demand for marine turtles for Bali alone is about 17,000 per year, whereas the government used to permit the harvest and slaughter of only 3,000 turtles per year throughout Indonesia. More rigorous implementation of the existing laws in 2001 led to confiscations of several ship loads of live turtles and the temporary closure of turtle slaughter houses on Bali.

Another interesting example is the Berau District, East Kalimantan. On one side, the national government is committed to conserve turtle species, while on the other side, the auctioning of green turtle eggs has contributed to the yearly district income for the last 50 years. Several efforts by local and national NGO's as well as by the central government have been undertaken to solve this dilemma. This led to the full protection of green turtle eggs on two of six former concession islands.

The current serious status of Indonesian marine turtle populations is due to legal and illegal harvesting of eggs without attention to basic biological principles or habitat conservation. Moreover, the implementation and enforcement of existing laws have thus far been ineffective. Conservation awareness and law compliance among the Indonesian public is weak, and the number of conservation officers to control and enforce laws against illegal hunting and harvesting is limited.

Other factors contributing to the decline of turtle populations in Indonesia include the lack of coordination among parties concerned with management of marine turtles and their habitats; a focus on short term rather than long-term economic interest and lack of supporting programs for research and management of endangered marine species, particularly for marine turtles. As a consequence, existing programs for marine turtle conservation are insufficient to support the recovery of sea turtle populations in Indonesian waters.

POLICY AND LEGISLATION

All marine turtle species depend on the integrity of their environment. This means that conserving marine turtles must be accompanied by simultaneous conservation of marine habitats. In addition, since marine turtles are highly migratory, the management of these species should be large-scale in scope. Efforts to conserve these species may not be effective and efficient without joint cooperation between countries both at regional and international levels.

Indonesia has implemented conservation efforts to promote wise and sustainable management of sea turtle populations to ensure their continued survival. There are several national legal instruments that have been provided to conserve and protect marine turtles. These are Act No. 5, 1990 regarding the "Conservation of Living Resources and their Ecosystems," and Act No. 9, 1985 regarding Fisheries. Both regulate the management and protection of endangered species as well as respective sanctions.

The Government Regulation No. 7, 1999 regarding "Preservation of Plants and Wildlife" states that all species of sea turtles in Indonesia are declared protected species. This affects the utilization of marine turtles, including their eggs and the catch of female turtles. The Government Regulation No. 8 in 1999 has regulated a headstart program for sea turtles.

From the international conservation perspective, all species of sea turtles are rare and should be protected. They are categorized as endangered species in the Red Data Book of the International Union for Conservation of Nature and Natural Resources (IUCN), and are listed on Appendix I of the Convention on International Trade of Endangered Species (CITES). Indonesia signed the CITES agreement and has ratified the agreement through the Act No. 43, 1978. CITES states in Appendix I that all species of sea turtles are categorized as endangered species and are therefore prohibited from being traded internationally. In supporting of this agreement, Indonesia also signed the biodiversity convention and ratified it through the Act No. 5, 1994 regarding Ratification of the United Nations Conventions on Biodiversity.

At the regional level, Indonesia and other member countries of the Association of South East Asia Nations (ASEAN) signed the Memorandum of Understanding regarding Conservation and Protection of Marine Turtles, which took place in Thailand, September 12, 1997. This agreement aims to boost efforts to protect, conserve, improve and rehabilitate marine turtles as well as their habitats. These efforts should be founded on scientific studies and should consider specific characteristics of social, economic and cultural aspects of the member countries. The member countries agreed to adopt a co-management approach to protect and conserve all species of sea turtles and their habitats in ASEAN marine waters by applying an integrated approach in formulating and achieving the management goals, as well as an integrated approach in strategies to conserve and protect marine turtles. To follow up on

this agreement, each country, including Indonesia, commit to develop a National Action Plan to conserve and protect marine turtles and their habitats.

Further regional cooperation has been established through an international workshop in Manila in March 2001, at which Indonesia, Malaysia and the Philippines participated and formulated a joint vision to conserve marine biodiversity in the in Sulu-Sulawesi marine eco-region. The concept of marine eco-region conservation focuses not only on the management to conserve and utilize living marine resources on an individual basis, but also includes broader aspects, that may affect conservation areas such as socio-economics and the culture of related communities. This workshop also took into consideration the existing network of scientists and sea turtle specialist groups, to work together for the purpose of conservation. It also underlined the need for a trans-boundary agreement on marine turtles in the form of focused bilateral cooperation.

Other regional cooperation efforts have been undertaken such as the South Pacific Regional Environment Program on Sea Turtle Conservation of 1989; the Memorandum of Understanding on the Turtle Island Heritage Protected Area of 1996; at the CITES Conference held in Nairobi in 2000; the Memorandum of Understanding of ASEAN and Indian Ocean which was held in 2000; and the Inter-American Convention on the protection and conservation of Sea Turtles which was held in 2001.

There are several factors that may support the management and conservation of marine turtles in and by Indonesia. These include:

- The national strategy to conserve and manage marine turtles which was established in 1991 should be revised and adjusted with the current development and should be formally legitimated;
- Coordination between related stakeholders (including central government, provincial governments, the private sector, local communities as well as non-governmental organizations) should be improved;
- Clarify the regulation and management of marine turtles which occur outside conservation areas;
- Centralize data and information which is scattered among many institutions;
- Increase the effectiveness of laws and their enforcement, particularly in relation to realistic and enforceable sanctions for violators.

RESEARCH AND MANAGEMENT

Research on marine turtle biology and population dynamics is of major importance to provide knowledge and information upon which to base successful management. Although Indonesian studies have been limited in the past, there is currently an increasing interest among government agencies, universities, NGOs and the private sector to support and carry out marine turtle research. This is a positive sign and these institutions and organizations are encouraged to continue such activities, particularly when the research benefits conservation efforts.

Research Activities

Despite widespread distribution and species diversity of marine turtles in Indonesia, limited research has been conducted on their biology and its management. Most studies of turtles have been short term and were confined to nesting beaches on Java and nearby islands (Erwan, 1980; Nuitja *et al.*, 1979; Reksowardojo, 1961; Salm, 1984; Silalahi, 1976; Sunawan, 1978). Several studies (Nuitja and Akmad, 1982; Polunin and Nuitja, 1979; Salm and Halim, 1984, 1989; Kitchener, 1996) contain only limited information on population sizes and dynamics, which are needed to support the management of marine turtle populations. Headstarting and tagging of marine turtles has been carried out in several conservation areas such as; Kepulauan Seribu National Park (NP), Meru Betiri NP; Alas Purwo NP; Pangumbahan Beach and Cikepuh Wildlife Reserve.

Tagging Programs

Tagging of green turtles has been conducted quite intensively at Sukamade Beach, Meru Betiri NP since 1984. During 1984 to 1998, 1,172 green turtles were tagged (mostly females) and 1,135 green turtles were recaptured. The recapture data do not indicate multiple recaptures of individual tagged green turtles. This indicates that the recording methodology should be improved to accurately estimate the green turtle population in Meru Betiri NP (Fig. 6). The Japan Bekko Association funded the hawksbill turtle tagging and monitoring program, which was conducted from June 1995 until 2000. At present, 124 hawksbill turtles have been tagged and two have been incidentally captured by fishermen at their release site.

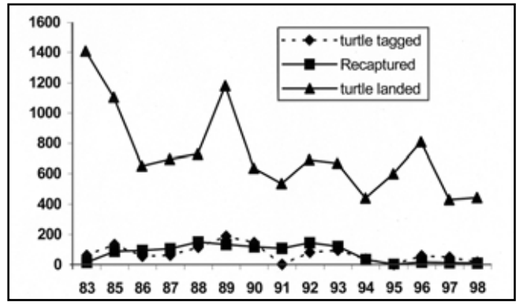


Figure 5. *Green sea turtles tagged and resighted at Sukamade Beach, Meru Betiri NP.*

Head-starting

Head starting of hawksbills is conducted in Kepulauan Seribu NP. The size and growth rate of the released individuals are recorded, as well as the size and weight of the eggs.

Nest Monitoring

Monitoring of post nesting hawksbill turtles has been carried out by using ST-10 PTT satellite transmitting units in Kepulauan Seribu National Park. Transmitters have been attached to three adult female hawksbills and monitored by the French ARGOS satellite for six months.

DNA Analysis

DNA analysis from tissue samples of hawksbills has been carried out at Kyushu University, Fukuoka, Japan in collaboration with PKA, Dept of Forestry and Estate Crops, Republic of Indonesia.

RECOMMENDATIONS AND ACTION PLANS

There are several recommendations and action plans that Indonesia should carry out in the near future, particularly considering the current status and the problems faced by this country in order to manage and conserve marine turtles effectively.

- Revision of existing national strategies for conservation and management of marine turtles by involving all stakeholders in the planning process up to the implementation level;
- The content of national strategies should accommodate various related interests, particularly related to the sustainable utilization of marine turtles by putting the local community in a strategic role;
- To revise and implement the action plan which has been set up in the form of a long-term program of 25 years, and a short-term program of five years, as well as annual programs;
- To study the regulations on the management and conservation of marine turtles, and to formulate regulations for the management and conservation of marine turtles which exist outside conservation areas;
- To establish data and information centers on marine turtles. Marine Turtles Research Centers should be developed in four representative sites such as in Irian Jaya for leatherback turtle, Alas Purwo National Park for olive ridley turtles, Derawan Islands, Meru Betiri National Park or Pangumbahan beach for green turtles, and Thousand Islands National Park or Belitung island for hawksbill turtles;
- To improve knowledge and skills of human resources in managing marine turtles by attending and following

various kinds of training conducted domestically and overseas, as well as conducting comparative studies; and

- To increase domestic and international cooperation on research, conservation and management of marine turtles.

ACKNOWLEDGEMENTS

We are very grateful to the Western Pacific Regional Fishery Management Council for inviting us to the workshop. We would also like to thank Dr. Achmad Abdullah, Director for Conservation and Marine National Parks, Dr. Matheus Halim, Directorate for Conservation of Biodiversity, Dr. Jan Henning Steffen from the Indonesian Biodiversity Foundation Kehati and Mr. Akil Yusuf from Yayasan Alam Lestari for their assistance, information and advice.

LITERATURE CITED

Adisukresno, S. 1993. Petunjuk Pelaksanaan Pembinaan dan Pengelolaan Penyu Laut di Indonesia. Ditjen. Perikanan, Direktorat Bina Sumber Hayati, Jakarta. 40 pgs.

Bhaskar, S. 1987. Management and Research of Marine Turtle Nesting Sites on The North Vogelkopf Coast of Irian Jaya, Indonesia. Unpublished Report. Jakarta. 38 pgs.

Darmawan, R. 1996. Pengaruh Perbedaan Waktu Pengambilan Telur dari Sarang Alami ke Sarang Semi Alamiah terhadap Keberhasilan Penetasan Penyu Lekang *(Lepidochelys olivacea)* di Taman Nasional Alas Purwo-Banyuwangi Selatan. Article in Proceeding Workshop Penelitian dan Pengelolahan Penyu di Indonesia. Jember, Jawa Timur, November 1996. Wetlands International/ PHPA/ Environment Austrsalia, Bogor. pp. 243 - 258.

Erwan, T.S. 1980. Perkembangan Penyu Laut di Ujung Kulon. WWF Indonesia Program Report, Bogor. 76 pgs.

Halim, M.H and A. Dermawan. 1999. Marine Turtle Research, Management and Conservation in Indonesia. In Report of SEAFDEC-ASEAN Regional Workshop on Sea Turtle Conservation and Management. Kuala Terengganu, Malaysia. 328 pgs.

IUCN, 1984. Sea Turtle Trade in Indonesia. IUCN/WWF Project 3108 Field Report No. 5, Marine Conservation, Bogor. 56 pgs.

Kitchener, D. 1996. The status of Green and Hawksbill Turtle Rookeries in Nusa Tenggara and Maluku Tenggara, Eastern Indonesia. With Observation on Other Marine Turtles in the Region. In D.J. Kitchener and A. Suyanto (eds), Proceedings of the first international Conference on Eastern Indonesian-Australian Vertebrate Fauna, Manado, Indonesia, November 22-24,1994. pp. 97-109.

Nababan, M.G. & Jacob. 1996. Kondisi Penyu Belimbing *(Dermochelys coriacea)* dan Suaka Margasatwa Pantai Jamursba-Medi serta masa depan pengelolaannya. Sub Balai Konservasi Sumber Daya Alam Irian Jaya I Sorong. 9 pp.

Nuitja, I.N.S., M.Eidman and K.A Aziz. 1979. Studi Pendahuluan tentang Populasi dan Habitat Peneluran Penyu Laut di Indonesia. DI-10, 17 pgs. In Perhimpunan Biologi Indonesia- Kongres Nasional Biologi IV 10-12 Juli 1979, Bandung, Indonesia.

Nuitja, I.N.S., and S. Akmad. 1982. Management and Conservation of Marine Turtles in Indonesia. Paper presented at the Third World National Parks Congress, October 1982. Bali, Indonesia. 16 pgs.

Polunin, N.V.C and I.N.S Nuitja. 1979. Sea Turtle Populations of Indonesia and Thailand. In K.A Bjondal (ed.), Biology and Conservation of Sea Turtles. Smithsonian Institution, WWF, Washington DC.

Rekoswardojo, R. 1961. Penyu di Pantai Pangumbahan. Penggemar Alam, Jakarta 40 (1): p. 16-24.

Salm, R. 1984. Conservation of Marine Species in Indonesia.Vol 5 of Report prepared by IUCN/WWF for PHPA. Bogor, Indonesia. 76 pgs.

Salm, R. and M.H. Halim. 1984. Marine Conservation Data Atlas Indonesia. Planning of the survival of Indonesia's seas and coasts. IUCN/WWF Project 3108 Marine Conservation. Prepared for Directorate General of Forest Protection and Nature Conservation, Bogor Indonesia. 29 maps, text.

Schulz, J. 1984. Turtle Conservation Strategy in Indonesia. Field report No. 6, Marine Conservation. Bogor, 99 pgs.

Schulz, J. 1987. Status of *Chelonia mydas* and *Eretmochelys imbricata* in Indonesia. Concultancy Report prepared for the Conservation Monitoring Centre, Cambridge, United Kingdom.

Schulz, J. 1989. Report on observation of Sea Turtle in Eastern Indonesia. Report to IUCN/Van Tienhoven Foundation. Bogor. 85 pgs.

Silalahi, S. 1976. Suatu studi tentang Hubungan Panjang-Berat, Fecunditas dan Factor Kondisi Penyu Sala *(Chelonia mydas)* di Pantai Ketapang, Kab. Sumbawa. Unpublished. Fakultas Perikanan IPB. Bagor.

Soehartono, T. 1993. Marine Turtle Conservation in Indonesia. In Proceedings of the First ASEAN Symposium Workshop on Marine Turtle Conservation Manila, Philippines. pg 75-85.

Sunawan, E. 1978. Penyu hijau *(Chelonia mydas)* di Pantai Sukamade SM Meru Betiri. UNPAD. Bandung.

Witjaksono, A. 1992. Berau Turtle Islands in the Regency of Berau, the Province of East Kalimantan. Unpublished. Jakarta. 11 pgs.

Population Trends and Mortality of Japanese Loggerhead Turtles, Caretta caretta, in Japan

Dr. Hiroyuki Suganuma

ABSTRACT

The current population level of the Japanese loggerhead is considerably low compared to those of in other ocean basins. It is highly probable that there are currently less than 1,000 female breeding annually in Japan. Census data from major nesting beaches indicate changing trends in population size through time for the Japanese rookeries. The points of the population trends are as follows:

1) in the 1990's, there has been a consistent major decline in the size of the annual nesting populations;

2) in the 1980's, there were increases in the population size. However, the individual populations at about 1980 were in most instances larger than the size of the respective nesting population some twenty years later at the end of the 1990s;

3) in the 1970's, there are indications that this was a period of approximate population stability with respect to breeding numbers;

4) for the population with census data extending back to the 1950's, there is a very clear signal of population decline.

Given the similarity of population trends across multiple rookeries for which census data available on the shorter term, the composite of the trends within the above four time periods is used to describe the long term trend of total Japanese nesting population since the 1950's.

Gill-nets and pound-nets are very popular everywhere along the coast in the Japan, and intensive trawl fisheries for anchovy post larvae are operated off shore of some major rookeries during nesting season. These coastal fisheries might be strongly related with strandings. At least 80 mature loggerheads are found every year. This number is not negligible considering current population level of Japanese loggerhead.

PRESENTATION

This presentation will be about loggerhead turtles in Japan with focus on their current population status. In the North Pacific, loggerheads are found in Japanese waters and both nesting females and hatchlings can be seen on Japanese beaches. On the other hand, a major proportion of these turtles are found on the opposite side of the North Pacific. The DNA analysis prove that loggerhead populations found in the Southern Pacific are from the North Pacific, Japanese stock (Fig. 1). No other rookeries occur in any other areas.

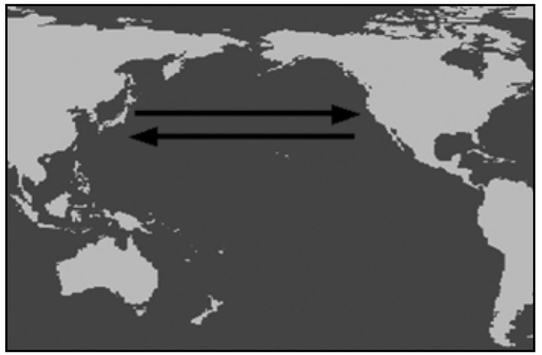


Figure 1. *Japanese Loggerhead turtle migratory movement.*

TRENDS

Current census data from the Japanese rookeries is the first index for the population size of the Northern Pacific loggerhead. Major nesting of loggerheads occurs on the Pacific Coast of West Japan. The Sea Turtle Association of Japan has compiled nesting data since 1990. In recent years, almost all rookeries are surveyed throughout the nesting season to count all nests. In all sites in Japan in 1998, there were 2,479 nests; in 1999, 2,255 nests; in 2000, there were 2,589 nests. Considering multiple nesting estimates, approximately less than 1,000 females come on Japanese beaches to lay eggs per season.

This population is considerably smaller than others in different basins throughout the world. As a whole, the population size of Japanese loggerheads has decreased since the 1950s (Fig. 2). This information is based on population census and tagging information.

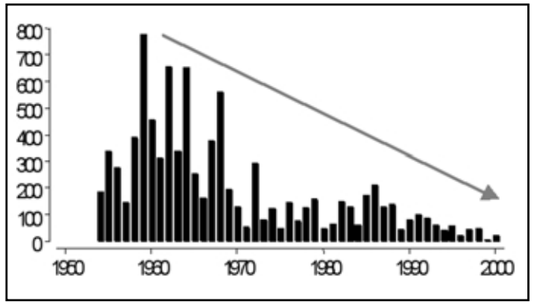


Figure 2. *Loggerhead sea turtle nesting population trends in Japan.*

THREATS

In Japan, loggerhead meat has not been utilized as food, except in some local communities. Egg harvest of the population is negligible, if any. Turtles eggs were once utilized in many coastal areas, and their use is traditional in some local communities. Some people still believe that the turtle egg have many valuable properties. However, egg poaching has almost disappeared in the main rookeries. Probable egg predation is due to dogs or lizards that get to the small rookeries in some regions.

The most serious problem is beach erosion along the coastline. Much of this obstructs nesting females. However, there have been no studies related to this impact. Incidental bycatch in fisheries is also a major concern. Gillnets and poundnets are very popular everywhere along the coast of Japan and are a significant source of sea turtle mortality. Poundnets have a sheeting, so turtles cannot come up to the surface for air (Fig. 3).

The negative impacts on Japanese loggerheads must be quantified, and a solution to remove turtles caught in nets must be found. In addition, intensive trawl fisheries for anchovy operate offshore of some major rookeries during the nesting season. Coastal fishery may be strongly related with strandings, at least 80 mature loggerheads are found every year. Consequently, based on the current population size this number is not negligible.

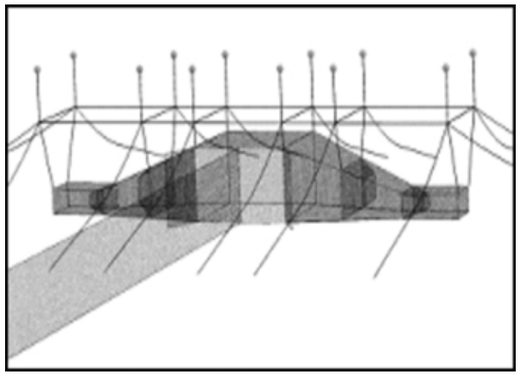


Figure 3. *Pound net gear deployment.*

In summary, the current population level of Japanese loggerhead is considerably low. As a whole, the population has declined since the 1950's. The negative impact of incidental bycatch is substantial.

WORKSHOP DISCUSSION

MR. HYKLE: How is the fisheries agencies in Japan responding to your findings?

DR. SUGANUMA: The claim to have, "No response."

DR. CRAIG: Do you have any information on the bycatch of other fisheries, besides the nets, like the longline fishery?

DR. SUGANUMA: No, sorry.

DR. MARQUEZ: The opinion of your group, is it increasing in importance to the Fishery Ministry, are they taking care of what you are doing? What is your relationship with them?

DR. SUGANUMA: Horrible.

DR. MATSUZAWA (Sea Turtle Association of Japan): Japan has a very difficult problem. The Japanese - this is my personal opinion - do not have enough knowledge of the sea turtle issues, and I think they do not think it is so serious a problem. So what we have to do is raise the opinion and make a suggestion of conservation to the fishermen for sea turtle conservation.

Marine Turtle Conservation in the Great Barrier Reef, World Heritage Area, Queensland, Australia

Dr. Kirstin Dobbs

PRESENTATION

The Great Barrier Reef World Heritage Area (GBRWHA) is found on the east coast of Queensland and is comprised of almost 3,000 separate reefs and over 900 islands. The Great Barrier Reef Marine Park was established in 1975 as a multiple use marine park and the area became a World Heritage site in 1981. The GBRWHA is managed by a combination of Commonwealth or federal/national government agencies, state agencies and local governments. There are about five or six main agencies involved in management, but depending on the location up to 20 different agencies could have jurisdiction.

There are various obligations to marine turtles in the GBRWHA. Being a Commonwealth authority, the Great Barrier Reef Marine Park Authority must have regard for international conventions [UN World Heritage Convention, Convention on Biological Diversity, Bonn Convention, CITES, IUCN, and other Regional/International Treaties]. Environment Australia, a counterpart in the federal government, also has obligations for turtle conservation. Specifically the Great Barrier Reef Marine Park Act 1975 established the Great Barrier Reef Marine Park (GBRMP) and the Great Barrier Reef Marine Park Authority (GBRMPA). The goal of the GBRMPA is to provide for the protection, wise use, understanding and enjoyment of the Great Barrier Reef in perpetuity through care and development of the GBRMP. The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is a piece of national legislation which regulates activities occurring in commonwealth areas in regard to matters of national environmental significance. These include such things as world heritage areas, and whether a species is a listed threatened species or a listed migratory species (under the Bonn Convention). Marine turtles are included in just about every matter of national wildlife significance. They are one of the natural values associated with the listing of the Great Barrier Reef as a World Heritage Area. They are a listed threatened species. They are a listed migratory species, and a listed marine species. The EPBC Act also allows for the establishment of recovery plans for listed threatened species and conservation plans for listed migratory or listed marine species. The Nature Conservation Act 1992 is the main piece of conservation legislation for the state of Queensland, and the Coastal Protection and Management Act 1995 helps guide ecologically sustainable development in the state. These acts result in coastal management plans and regional management plans along the coast.

A range of activities occur within the GBRWHA: boat use; defense [military] exercises; fishing; a shark control program; indigenous hunting; marine construction, such as dredging and building of jetties; research and monitoring; tourism and recreation; and coastal development.

One of the key issues for the GBRMPA in regards to turtles includes water quality and coastal development. Water quality is a huge concern for the GBRMPA especially since this may be a potential causal link to fibropapillomas. Of special concern is the impact of sediments and nutrients from the land on the marine habitat and to the animals that use the habitat. Recent action has been the development of a Water Quality Action Plan, which sets "end-of-river" pollutant load targets for all the catchments flowing into the Great Barrier Reef. Hopefully, this will help guide better water quality in the future.

Tourism is the largest business on the reef. In the 1980s day trips generally stayed fairly close to the coast (~20 nautical miles). Through increases in technology, tours have been able to extend farther and farther (~160 nautical miles). Now, essentially, there are not too many areas on the reef that cannot be reached in a day trip. The main actions to deal with tourism included strategic planning instruments, which provide detailed site plans for high impact areas, codes of conduct, industry self-regulation and partnerships through the tourism industry.

There exists a range of fisheries: commercial, recreational, traditional/indigenous and charter. Types of fishing includes trawl, line, harvest (e.g. coral, marine aquarium fish, tropical rock lobster) and net fisheries (inshore and offshore). The shark control program cannot really be classified as a fishery; it is mentioned just to let people know it exists. It is a combination of net and drumlines along the coast.

Recent actions with respect to fisheries in the Great Barrier Reef and in Queensland include the mandatory use of TEDs and BRDs in the East Coast Otter Trawl Fishery. The use of these devices just became mandatory for the entire fishery last year (2001), and is a big step forward, especially for turtles. Also, vessel monitoring systems allow for vessels to be charted and their locations within and use of the GBRMP identified.

TRENDS

Loggerheads

Six of the world seven sea turtle species occur in the World Heritage Area in Queensland. Loggerheads are found along the entire coast, but generally are located in the Southern GBR and Southeast Queensland. They nest mainly in the southern section of the GBRMP in southeast Queensland and one of their main foraging sites is in Moreton Bay, near Brisbane.

Loggerheads in Australia are of one genetic stock, and are treated as one management unit. About 300 loggerheads nest annually in Queensland. They recruit from the open ocean pelagic habitat at about 10 to 15 years of age or approximately 78 cm in carapace length. Age at first breeding is around 25 years, and they can breed for up to 28 years at regular three, four, or five year intervals. Tag recoveries indicate migratory links between Moreton Bay, Papua New Guinea, Gulf of Carpentaria and New Caledonia. The recent issue of Chelonian Conservation and Biology has a good summary of satellite tracking movements of loggerheads which shows movements in Southeast Queensland, as well as to New Caledonia.

Loggerhead turtles have faced many threats over the last few decades. In particular, incidental catch in trawl, net and drumline fisheries, boat strikes, ingestion/entanglement of marine debris, and fox predation of mainland nests has severely impacted the loggerhead population. The population decline of nesting loggerheads at Wreck Island, the largest nesting site in Queensland, can be seen (Fig. 1). Over the last few decades, this population has declined 70 to 90%.

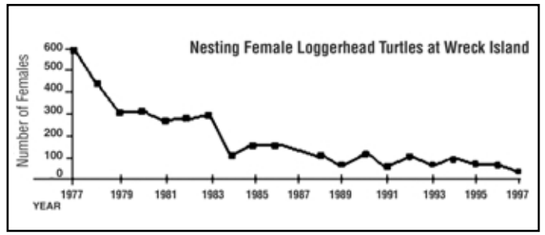


Figure 1. *Loggerhead turtle nesting data at Wreck Island, Australia. Source: Col Limpus, QPWS in D.Wachenfeld (1998) State of the Great Barrier Reef World Heritage Area.*

Green Turtles

There are four genetic stocks of green turtles in Queensland, based on breeding areas: the Northern Barrier Reef centered around Raine Island; the Southern Barrier Reef, mainly in the Capricorn/Bunker Group of islands and along the coast; the Coral Sea Islands Territory; and the Gulf of Carpentaria. Annual nesting numbers include: ~30,000 green turtles in the Northern Barrier Reef; ~8,000 in the Southern Barrier Reef; ~5,000 in the Gulf of Carpentaria; and ~1,000 in the Coral Sea.

These are big averages because the number of green turtles nesting on an annual basis is a function of the El Niño Southern Oscillation which can result in big seasons followed by low seasons (Fig. 2). Juveniles recruit from the open ocean pelagic areas at about four to seven years of age at 44 cm carapace length. The age at first breeding is approximately 46 years. Tag recoveries from outside of the Great Barrier Reef area have been recorded from Torres Strait, Papua New Guinea, Indonesia and the Northern Territory.

Trends are difficult to establish for the green turtle population (Fig. 2). In general, the status of northern GBR nesting populations is considered to be stable and that of southern GBR nesting populations is increasing. Threats affecting green turtles in Australia have been incidental catch in trawl, net and drumline fisheries, boat strikes, hunting, ingestion of/entanglement in marine debris and disease including fibropaillomas.

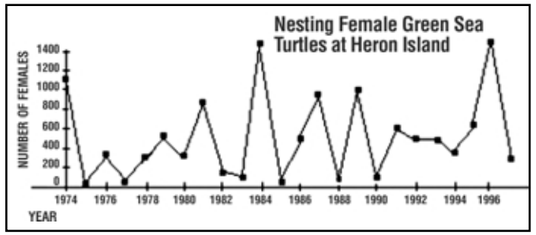


Figure 2. *Green turtle nesting data at Heron Island. Source: Col Limpus, QPWS in D.Wachenfeld (1998) State of the Great Barrier Reef World Heritage Area.*

Hawksbills

Within the GBRMP, hawksbill turtles generally do not nest south of Princess Charlotte Bay, but they can be found foraging all along the coast. Two key foraging study sites are in the Capricorn/Bunker Group of islands and near Princess Charlotte Bay. There are two genetic stocks, with about 4,000 females nesting annually in Queensland.

Hawksbills recruit from open pelagic ocean areas at about five to seven years of age and at about 36 cm carapace length. Interesting to note, juveniles and subadults primarily forage in the southern GBR, and adults and large subadults mainly forage in the northern GBR. The age at first breeding is approximately 30 to 35 years. Tag recoveries indicate links with the Solomon Islands, Vanuatu, Papua New Guinea and Indonesia (Fig. 3).

Since a study began in 1990 at Milman Island, there has been a three percent per annum decline in the number of females nesting and a four percent decline in the number of clutches laid over the past ten years (results based on, Limpus and Miller, 2000). Human induced threats include: hunting (especially overseas), ingestion/entanglement in marine debris, and disease.

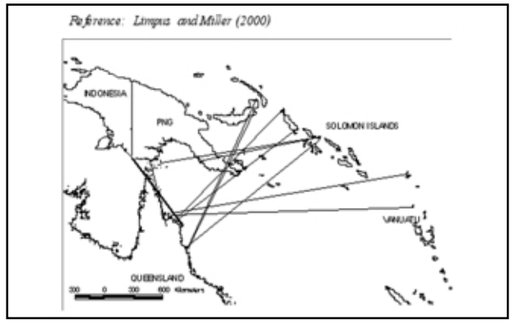


Figure 3. *Hawksbill turtle migrations, data based on tag returns.*

Flatback

The flatback turtle nests primarily in the southern Great Barrier Reef with scattered coastal nesting in the central Queensland coast. There are two genetic stocks (eastern, western Queensland) and tag recoveries have been recorded from southern Irian Jaya (Papua) and along the Queensland coast. Flatback turtles are not known to leave the Australian Continental Shelf. Age at first breeding is approximately 20 years based on a recovery of a female this year at Bundaberg. A turtle marked as a hatchling came back to nest for the very first time, 20 years later; very exciting!

The conservation status of flatback turtles is unknown. This coincides with the recent change in the listing for flatbacks by the IUCN from vulnerable to data deficient. Threats to flatbacks include capture in trawl fisheries and ingestion of/entanglement in marine debris.

Leatherbacks

Leatherback turtles generally nest outside of the Great Barrier Reef in southeast Queensland. Nesting is very sporadic, less than a handful each year. Essentially there is no genetic stock or tag recovery information, and their status is unknown. Human related threats include the incidental capture in fisheries and ingestion of/entanglement in marine debris.

Olive ridley

Olive ridley's nest along the western side of Queensland's Cape York Peninsula, outside of the GBRWHA. No information exists regarding their genetic stock or population status. Threats include boat strikes, pig predation, and incidental capture in trawl and net fisheries.

MARINE TURTLE MORTALITY

Information from stranding data reveals a gradient of turtles found stranded (either alive or dead) in Queensland, increasing from north to south. Approximately 500 turtles a year are reported and found dead or stranded along the Queensland coast. These are primarily green turtles, followed by loggerheads and hawksbill turtles. The cause of death has not been determined in about 63 percent of the cases. Of the 140 human-related incidents identified in 2000, 78 were from boat or propeller fractures; 24 entangled; 15 ingested marine debris; three in the shark control program; two from dredging; 18 from other human-related mortality sources and none for commercial fishing. However, there is no mandatory reporting requirements for turtles caught in Queensland waters, so it is hard to know what is really going on in regards to fishing activities.

MANAGEMENT

There are many tools available for managing the GBRWHA. The main tools are Zoning Plans in which different zones along the reef are used to separate conflicting uses, e.g. fishing from tourism activities. Activities are classified as "as of right," requiring a permit, or "prohibited." Statutory regulations, policy, development of best environmental practices are other ways in which management can be implemented for all users of the area. With respect to fisheries, in general, the EPBC Act sets guidelines for ecologically sustainable management of fisheries. This is a new area for the Commonwealth government, to assess the ecological sustainability of fisheries.

In regards to indigenous culture and turtles, the objective is that cultural values are maintained. To do that, obviously turtles need to be around. The GBRMPA is involved with developing cooperative management arrangements with local Indigenous communities and identifying cultural and heritage sites and values. Native title rights and interests exist in Australia and apply to Aboriginal and Torres Strait Islander peoples. Native title extends to marine areas, but not to the exclusion of others. The GBRMPA in collaboration with the Queensland Parks and Wildlife Service and Environment Australia have developed a population model that will help examine sustainable limits for hunting of the southern GBR green turtle stock. In addition, communities are developing their own hunting management plans and deciding how to regulate their own hunting.

LITERATURE CITED

Limpus, C.J. & Miller, J.D. 2000. Final report for Australian Hawksbill Turtle Population Dynamics Project. Unpublished report to the Japan Bekko Association, Queensland Parks and Wildlife Service, Brisbane, 147p.

Wachenfeld, D. 1998, State of the Great Barrier Reef World Heritage Area 1998, Great Barrier Reef Marine Park Authority, Townsville.

WORKSHOP DISCUSSION

MS. COUSINS: In regards to the shark culling program. If sharks eat turtles do you think that by taking sharks out, has had an effect on turtles? Have there been studies to show that the removal of sharks is a benefit to turtles?

DR. DOBBS: The shark control program has been operating for 40 years. It started in 1962. It's primarily nets, but they're gradually moving to drumlines. There are issues with that, though, because loggerhead turtles tend to get caught more on drumlines than in nets. If you look at the graphs, the shark control program hasn't benefitted loggerheads, in that respect, because they are still going down over about the same time period. I would say probably not, because sharks don't only eat turtles and they are still catching plenty of sharks out there, although the actual size of sharks they are catching is decreasing.

DR. BOGGS: What's a drumline?

DR. DOBBS: A drumline is basically great big baited hooks that hang vertically in the water column. They have a marked buoy on top and baited drumline all the way down. The drumlines have mainly been taking more tiger sharks and about equal numbers of bronze whalers (phonetic) as what the nets do.

DR. MORITZ: Can you tell us about the size and structure of the indigenous harvest. How much do we know or how much don't we know?

DR. DOBBS: We know very little. Within the marine park we require permits for traditional hunting. However, native title rights that have just been found to exist in marine areas probably negate the need for a permit. So we have very little knowledge of what the actual take is. We have anecdotal information that ranges from a few 100 to maybe up to 1,000 Southern Great Barrier Reef marine turtles. It's really one of the key areas that we have no information on.

A Message from the Eastern Pacific

Top (Left to right): Laura Sarti, Tran Minh, I-Juinn Cheng, Rene Marquez-at dinner *Bottom:* Nesting beach working group in action. Faces visible: Colin Limpus, Peter Dutton, Laura Sarti

Current Population Status of *Dermochelys coriacea* in the Mexican Pacific Coast

Dr. Laura Sarti Martinez

ABSTRACT

In the early 80's, the population of the leatherback sea turtle *Dermochelys coriacea* in the Mexican Pacific was considered the most important in the world. Since then, activities for the conservation of this species were started at several beaches such as Bahía de Chacahua, Oaxaca; Tierra Colorada, Guerrero; and Mexiquillo, Michoacán. Mexiquillo Beach is the only one where a continuous protection and monitoring program has been maintained for more than 15 years. Therefore, it has been considered as the index beach of the Mexican Pacific coast. During the mid 80's, more than 5000 nests per season could be counted along the four kilometers monitored at this beach. By the early 90's, a drastic population decline was observed, specifically in 1993 when less than 100 nests were counted along the whole beach (18 km). Due to this fact, a monitoring coordinated effort was initiated in all the known nesting beaches in the Mexican and Central America Pacific, with the objective of determining the causes of the population decline and achieving the recovery of this population.

Initially it was thought that the cause for the decline at the known beaches would be that females were moving to colonize new nesting areas. This hypothesis was discarded since no new nesting beaches were found during aerial surveys along the coastline from Baja California to Panama. The aerial surveys allowed the assessment of the nesting distribution and the yearly evaluation of the total number of nests. The results of the surveys showed that the decline is not a fact exclusive to Mexiquillo, but of all the Eastern Pacific population.

According to Sarti *et al.*, 1994, the collapse of the population may be mainly due to:

1. An intense poaching of eggs and females in the nesting beaches. In the known nesting beaches up to this date, 90% or higher of the total nests could be poached.
2. Incidental catch of adults and juveniles during high seas fisheries operations.

From 1995, coordinated efforts have aimed to have a more accurate estimate of the population status of the leatherback turtle population in Mexico, and to achieve its recovery. As part of this initiative, aerial surveys have been conducted along the Pacific coast, as well as daily surveys and night patrolling to protect the eggs, the females and the hatchlings along the index beaches. The following are the results of such evaluation:

- Mexiquillo and Tierra Colorada were confirmed to be the main nesting beaches for Leatherback Turtles.
- Chacahua, previously considered as a main nesting beach, does not currently have an important number of nests.
- Llano Grande, in the state of Oaxaca, was discovered as a main nesting beach during the first aerial survey (Sarti *et al.*, 1996).
- These three main beaches show an annual average from 50 to 60% of the total nests along the Mexican Pacific.
- Barra de la Cruz y La Tuza, in Oaxaca; Playa Ventura, in Guerrero; and Agua Blanca, in Baja California Sur, were established as secondary nesting beaches.
- All of these 7 beaches together (main and secondary) show around 75-80% of the total annual nests of the Mexican Pacific.
- Nesting of the Leatherback turtle along the Eastern Pacific was confirmed, from Baja California Sur to Panama, with few areas of high density.
- Three countries are of importance for the nesting of the Leatherback turtle: Costa Rica, which has the highest abundance and density; Mexico with several important nesting beaches, and Nicaragua, with two important nesting areas.

During the past six years from the beginning of this project, aerial surveys and standardized methods for the Leatherback's nesting population estimates along the Mexican Pacific, have been used. Along this time the

trend shown by the population is discouraging. It is easy to visualize the magnitude of the collapse of the population in only one decade, considering that in 1986 at Mexiquillo beach there were as many nests in only four km as the total estimated for the whole Mexican Pacific coast in 1996 (5,080; Sarti *et al.*,1987).

For the first three years no remigrant turtles were found, even utilizing PIT tags, a fact considered to indicate a high mortality of nesting females. During the 1999-2000 and the 2000-2001 nesting seasons along the Mexican and Central American Pacific coasts, a small increment in the number of nests and remigrant turtles was observed. Does this fact represent a high mortality of juvenile and sub adult animals? The number of females and the number of nests at the present nesting season (2001-2002) has been the lowest of the whole known history up to now.

Even that the low numbers of females and nests during the last season could have been the result of climatic factors or of other factors, it is a fact that the Leatherback population of the Eastern Pacific is very small. It is obviously experiencing a drastic decline due to human causes. Therefore, in order to achieve the recovery of this population, the following is necessary:

1. To continue the programs to protect the eggs, the females and the hatchlings in the main and secondary nesting beaches in Mexico and Central America.
2. To establish regional fisheries programs and agreements, in order to minimize or eliminate the incidental capture.
3. To strengthen awareness programs in the local communities and to provide economic incentives for the development of alternative economic activities.
4. To avoid tourist and urban developments in the main nesting areas.

SYNOPSIS FROM PRESENTATION

The current nesting season (2001 - 2002) was the worst in 20 years with 200 to 300 nests in Mexico, and approximately 50 nesting females (Fig. 1). After two promising nesting seasons (1999 - 2000; 2000 - 2001), what happened to the leatherbacks this year? Possibly, as Dr. Limpus pointed out (see, C. Limpus pg. 41 this publication), maybe it is not their year to nest. But the population is small and climate and environmental conditions can visibly affect the nesting population. If the population were larger there would be less concern.

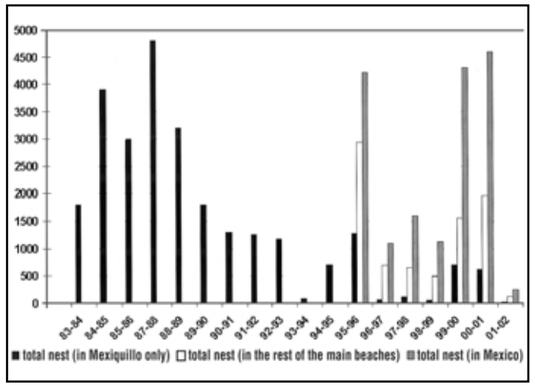


Figure 1. *Leatherback turtle nesting in Mexico, 1983-2002.*

In Mexico, unless beaches are protected, 100% of clutches will be collected. Seventeen years of egg protection, and movement of clutches to hatcheries has resulted in 271,094 hatchlings released. But the real decline of the Mexican leatherback population is due to fisheries. In Hawaiian waters, genetic studies indicate that 93% originate from the western Pacific and 7% from the eastern Pacific. Implicated countries include the U.S., Korea, Japan, and Taiwan. In Chilean waters, 50% are from the western Pacific and 50% are from the eastern Pacific. Implicated countries in this case are the artisanal fisheries of Chile, Spain, Japan, Ecuador, and Peru. The relationship between leatherback nesting numbers (from Mexiquillo) and fishing effort in Chilean waters is obvious (Fig. 2).

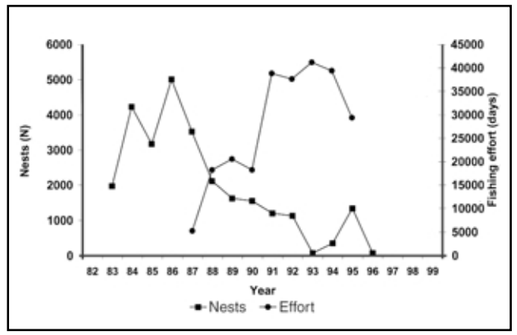


Figure 2. *Relationship between sea turtle nesting at Mexiquillo and Chilean fishing effort.*

What can we do for the leatherback population in Mexico? It is important, to maintain a long-term standardized census and tagging program, and maintain a regular program to promote egg protection at the main nesting areas. Avoid mortality, increase recruitment and enforce protection programs at the main beaches, both major and minor beaches. Increase the knowledge and information regarding fishery bycatch and its effects on the population. Raise community awareness and avoid coastal development of the main nesting beaches through effective coastal management plans.

WORKSHOP DISCUSSION

DR. DUTTON: I'm going to lead up to a loaded question, but picking up on one of the themes that Paul brought up at the beginning of this meeting; the focus of this workshop, "opportunities for mitigation from the fishing industry," and from agencies involved with managing fisheries. Laura's program is part of a bi-national program of which National Marine Fisheries Service is providing resources for beach protection. The increase in nest protection has been quite dramatic with this collaborative effort. An example, of an opportunity for mitigation on nesting beaches. My question is this, are there still more opportunities to increase beach protection?

DR. SARTI: If it is not possible to increase the effort, it is very important to at least maintain the current effort. We are now protecting the three main beaches. I think we need to increase the protection in the main beaches and in the minor beaches. It is important. It is also important to increase the education programs and awareness programs for the benefit of the released hatchlings and research activities for the population.

DR. MARQUEZ: Just one comment. The hawksbill situation was a long-time problem, for over 20 years. The increase of the Mexican hawksbill was more directly correlated with an increase in protection rather than the decrease in hawksbill catch in Cuba.

DR. DOBBS: You put up a graph showing the leatherback numbers from the 1980s to the 1990s which showed the number of nesting leatherbacks from the 1980s up to the present (Fig. 1.). There appears to be a peak in the '80s, then a trough and then another peak in the late '90s. Has anyone else seen similar sorts of trends with leatherback? Is this more of a cycle?

DR. HAMANN: That is certainly common, datasets showed that before the decline in the mid 1970s there was exactly the same sort of situation.

DR. SARTI: With a very small population, these trends maybe the results of reproductive cycles. We can see it better because the population is small. I am not sure if it can be compared to other population of the world.

Defining Management Units

Left: Peter Dutton, Nancy FitzSimmons, Craig Moritz *Top right:* Comments from Peter Dutton, wearing a designer cap from PNG. *Bottom right:* Damien Broderick and Nancy FitzSimmons, "working late."

Defining Management Units: Molecular Genetics

P. Dutton/ D. Broderick/ N. FitzSimmons

PRESENTATION – Dr. Peter Dutton

The National Marine Fisheries Service (NMFS) just recently established a National Sea Turtle Molecular Genetics Program at the Southwest Center in La Jolla. There are over 10,000 samples in this DNA tissue archive from sea turtles around the world. The intent is to have a central global repository for genetic material. This collection has been amassed during the course of several years of research, with the help and partnership of collaborators around the world. One of the primary goals of much of this research has been to define and identify the genetic stocks of sea turtles. Generally, we tend to think of sea turtles in terms of nesting populations, so in defining management units, turtles are thought of as populations of nesting females. This is because as humans we tend to deal with sea turtles mostly in the terrestrial part of their life cycle, when the females haul out of the sea to nest on tropical and subtropical beaches. Population trend and abundance data, upon which population status is determined, are based on counting the number of females that nest on beaches each year. It is much easier and cheaper to count turtles on beautiful beaches, than to try to monitor the migratory populations at sea. However, in doing so we ignore males and juveniles, and essentially limit our studies to only one portion, the adult female portion, of the population. Of course, it is more complex than that. Turtles spend over 90 percent of their time at sea. Linking to the theme that the Council is interested in, how do we get at that other part of the life history phase? The phase in the open ocean: the juveniles; the migratory phase; in order to identify foraging areas and better define stock boundaries.

There are three basic tools to work with: molecular genetics, tagging and telemetry. Molecular genetics is a very powerful tool that turtle scientists have been using used to help define stock boundaries, identify juvenile migration routes, foraging areas (which are sometimes on the opposite side of the ocean), and how they are they linked to nesting stocks. Genetics has its pros and cons. It cannot tell everything, and the sort of black box approach that sometimes could be used is dangerous. Thus it is very important to include tagging and telemetry in interpreting genetic data. These tools need to be applied and integrated together. In defining management units, these three tools used in conjunction will help define the appropriate geographic scale for monitoring and management.

Continued population declines, despite management efforts, illustrate that there is much more work to be done. If the appropriate management unit is not worked with, there is mortality in the forage grounds. If only nesting beaches are protected, these efforts are negated if turtles die when they migrate to unprotected foraging areas where they may be hunted or killed accidentally in fishing gear. It is very important to define the entire scope of the management unit. Genetics is a very powerful tool for identifying the stock origin of animals on the foraging ground and as bycatch. This also depends on having a complete database and source populations identified.

In the pelagic environment, there is a tremendous sampling opportunity to be had from fishing fleets. Samples collected in the Hawaiian longline observer program have helped to generate the mixed stock analysis of foraging populations. For example, two genetic stocks of olive ridleys have been identified through mitochondrial DNA (mtDNA). The Eastern Pacific is one big metapopulation in terms of mtDNA, and although there are limited samples from the Western Pacific, genetics can differentiate between the two sides of the Pacific. Of olive ridley's sampled, 30% of the animals were from the Western Pacific (Fig. 1). In addition, over the last four years in the same fishery, 16 leatherbacks have been sampled. Of those sampled, 15 out of 16, were from Western Pacific nesting stocks. However, larger sample sizes are needed in order to make accurate determinations using genetics to identify high seas management units. International efforts are needed to promote fishermen involvement.

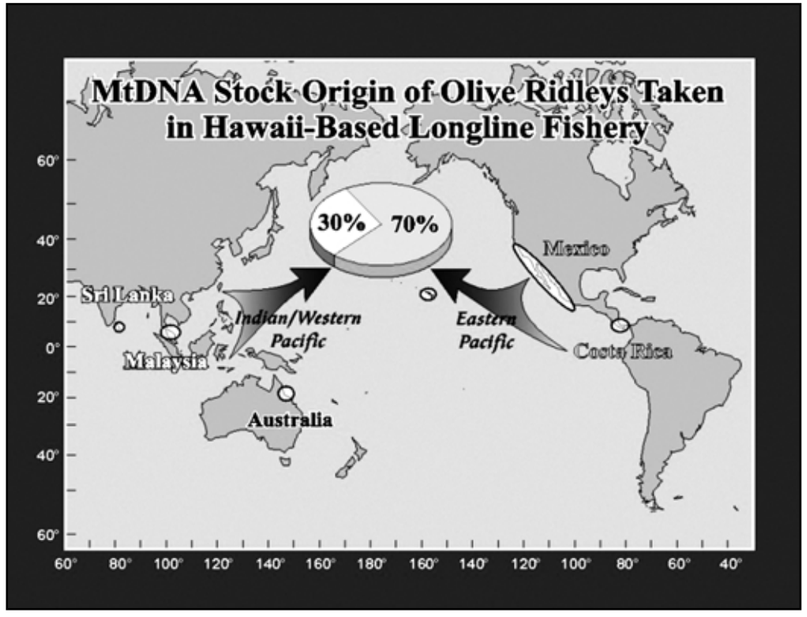


Figure 1. *Sea turtle stock origin of olive ridley's incidentally captured by the North Pacific, Hawaii-based longline fishery.*

The loggerhead story is fairly well established. In the Pacific, it is either a north stock (Japan) or a south stock (Australia). In the North Pacific, interactions are with Japanese nesting stock. My recent ongoing work in collaboration with Miguel Donoso and observers for the longline fishery in Chile has discovered some small brown turtles that have turned out to be loggerheads. Two samples indicate that they are from the Australian haplotype. Possibly a similar sort of migratory pattern is occurring with the southern gyre as in the north. In other words, animals from the Australian nesting population are crossing the ocean to the Eastern Pacific in the southern hemisphere.

There is no genetic difference between the main leatherback nesting populations of Costa Rica and Mexico. Essentially, they are all one genetic metapopulation (also confirmed by tag returns and PIT tags). On the basis of small sample sizes from the Solomon Islands, Irian Jaya, and Papua New Guinea, mtDNA differentiates between the Eastern Pacific and the Western Pacific leatherback populations. Based on genetic data from samples collected in the Hawaiian longline fishery, as well as U.S. West Coast driftnet fisheries and from strandings, the hypothesis is that the nesting stocks from the Western Pacific are using the North Pacific as developmental and foraging habitats. In addition, tag return information and some genetic data reveals that animals found along the Peruvian coast are from Eastern Pacific nesting stocks. This information suggests that in general, nesting leatherbacks from opposite sides of the Pacific utilize separate foraging habitats.

Satellite telemetry is another approach to test this hypothesis. A leatherback transmitted in Monterrey Bay, California (identified by genetic analysis as being from the Western Pacific stock) migrated almost straight back to the Western Pacific (Fig. 2). This backs up the genetic data and confirms that these animals are ocean travelers that use the whole Pacific; foraging grounds on one side, fisheries operating in the middle,

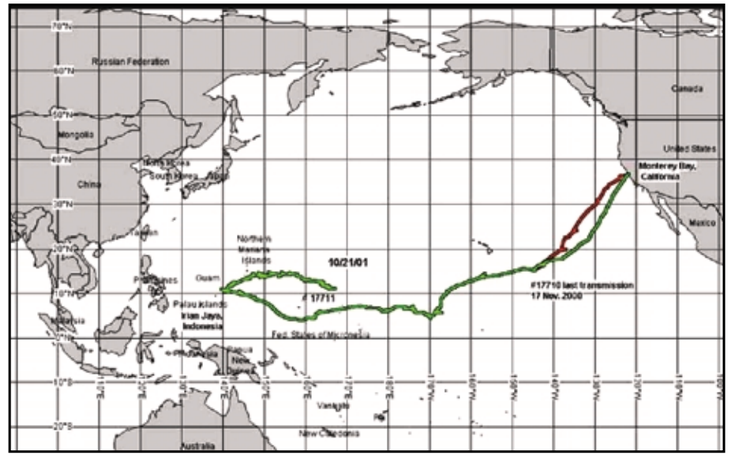


Figure 2. *Leatherback migration route of two satellite transmitted female turtles tagged in Monterey Bay, California. Data source Hubbs-Sea World Research Institute: www.hswri.org/.*

and nesting beaches being protected on the opposite side of the Pacific Ocean. Satellite telemetry data also confirms the picture suggested by genetic studies that females nesting in the Eastern Pacific (Mexico) migrate south towards South America. In both cases, clear evidence of the need for integrated management efforts among nations of the Pacific Region.

PRESENTATION – Dr. Damien Broderick

The general pattern of genetic diversity for green and hawksbill turtles in the pacific is one of heterogeneity among rookeries separated by more than a few hundred kilometers. This is a consistent feature previously found among hawksbill (Bass) and green turtles (Lahanas, Encalada) in the Atlantic Ocean and from global surveys of genetic variation in other marine turtle species (Dutton, Bowen). All of these studies describe clusters of marine turtle rookeries being differentiated by significant shifts in allele frequencies and is consistent with a natal homing model of female migration. Of prime conservation relevance is that genetically discrete rookeries are also demographically independent over ecological time scales relevant to management (Avise). This implies that restoration of recently depleted populations via natural colonization of females from other genetic stocks is unlikely except over the very long-term (100 or 1,000's of generations). Accordingly, management to restore these populations will require local effort to increase survivorship and reduce mortality, especially at nesting beaches and feeding areas.

The data presented here is a result of decades of collaborative effort and sample collection. Obtaining representative samples from rookeries throughout this region is difficult task especially for rookeries in remote locations and/or are characterized by low density nesting. Fortunately, genetic techniques and lines of communication (such as this meeting) are constantly improving enabling us to obtain more information over a larger area from smaller amounts of tissue.

For hawksbill turtles we have sampled all the major rookeries throughout the pacific but have had difficulty obtaining samples from remote, low density rookeries, especially those in the south pacific. Two major clades of mtDNA haplotypes are represented in the Pacific. Some mtDNA variants are restricted to particular rookeries while others have pan Indo-Pacific distributions. There exists a poor relationship between the degree of genetic divergence and geographic distance among sampled rookeries. However, despite the presence of widespread alleles occurring at high frequency among

surveyed hawksbill turtle rookeries, most tests for genetic differentiation among populations were significant allowing us to define several demographically independent management units or stocks (Fig. 3).

For green turtles we have also sampled all of the major rookeries throughout the pacific and our coverage is close to complete. Six major clades of mtDNA haplotypes are represented in the Pacific. Some mtDNA variants are restricted to particular rookeries while others have pan Pacific distributions. The degree of genetic structuring among Pacific Ocean rookeries varied markedly with some populations being separated by slight mtDNA frequency shifts while others were fixed for unique and highly divergent alleles. There is a poor relationship between the degree of genetic divergence and geographic distance among sampled rookeries for both green and hawksbill turtle. Again, despite the presence of widespread alleles occurring at high frequency among surveyed green turtle rookeries, most tests for genetic differentiation among populations were significant allowing us to define several demographically independent management units (Fig. 4).

If natal homing were the only force driving rookery differentiation then we would expect to find a better relationship between geographic and genetic distance but this is not the case. While both tagging and genetic studies suggest that natal homing is a dominant contemporary force driving rookery differentiation, the distribution of divergent alleles throughout the Pacific may be best interpreted as the result of ancient dispersal events. The ability of sea turtles to migrate long distances and their potential for long distance dispersal, especially during the pelagic phase, provides a mechanism for this dispersal. Pleistocene climatic and sea level changes may have strongly influenced green and hawksbill phylogeography throughout this region. So while contemporary levels of gene flow among rookeries are restricted, historical events or long distance colonization have contributed to the spreading of variants around ocean basins over evolutionary time scales.

From a management perspective, an important feature of molecular markers is that they can also be used to examine stock compositions of resident or fished populations of marine turtles. The primary assumption of mixed stock analysis (MSA) is that all of the potentially contributing stocks are known and adequately characterized. As sampling gaps can substantially reduce the utility of this approach it is paramount that efforts be made to genotype all potential contributing rookeries prior to its use. We have used this approach to better

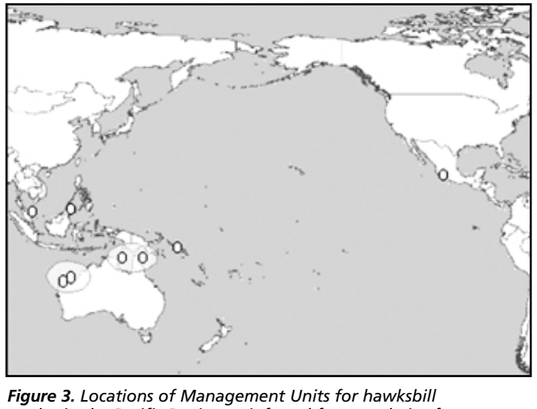


Figure 3. *Locations of Management Units for hawksbill turtles in the Pacific Region as inferred from analysis of geographic structure of mtDNA variants. Large circled areas encompass multiple sampled rookeries belonging to the same Management Unit.*

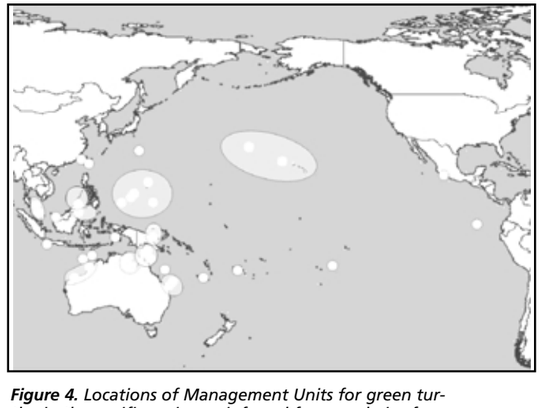


Figure 4. *Locations of Management Units for green turtles in the pacific region as inferred from analysis of geographic structure of mtDNA variants. Large circled areas encompass multiple sampled rookeries belonging to the same Management Unit.*

understand the subsistence harvest of marine turtles in the Solomon Islands by quantifying which stocks are being impacted. The genetic data was combined with conventional monitoring and anthropological data to develop a comprehensive picture of turtle use in the Solomon Islands. Nesting green turtles are rare in the Solomon Islands but the resident population is hunted for food. The genetic evidence suggests that these turtles predominately breed to the north in Micronesia and is consistent with tag return data indicating that few turtles nest to the west among east Australian stocks. In contrast, a large hawksbill turtle rookery here was once subject to heavy commercial hunting pressure for bekko and is now exploited for food only. Genetic evidence suggests that these turtles migrate from Eastern Australia to breed and is also consistent with tag return data.

It is important to realize that independent breeding populations, or management units, are not equivalent to management areas. To manage specific breeding populations, it necessary to protect other geographic areas used by the component individuals during their life times (Limpus). In the case of marine turtles, this is typically a vast geographic area, with foraging areas being of particular importance. For this reason there is a need to determine the geographic extent of foraging areas used by an individual stock and, conversely, to identify the stocks contributing to an individual foraging area or harvests. Some clues as to the management area for each management unit or Stock recognized here could come from a combination of tag returns, satellite tracking and genetic analysis of feeding and fished populations.

PRESENTATION – Dr. Nancy FitzSimmons

Management units aim to represent the logical units on which to base recovery actions (Fig. 5). Using mitochondrial DNA (mtDNA) to look at marine turtle stocks is a particularly useful genetic marker because it is inherited directly from mothers to their offspring. The males have no contribution. Thus mitochondria mtDNA is a wonderful tool to have when the focus of management is on nesting beaches. Differences in the frequencies of mtDNA variants at different nesting beaches can be used to define management units. These differences also allow stock assessments of feeding ground populations and harvests.

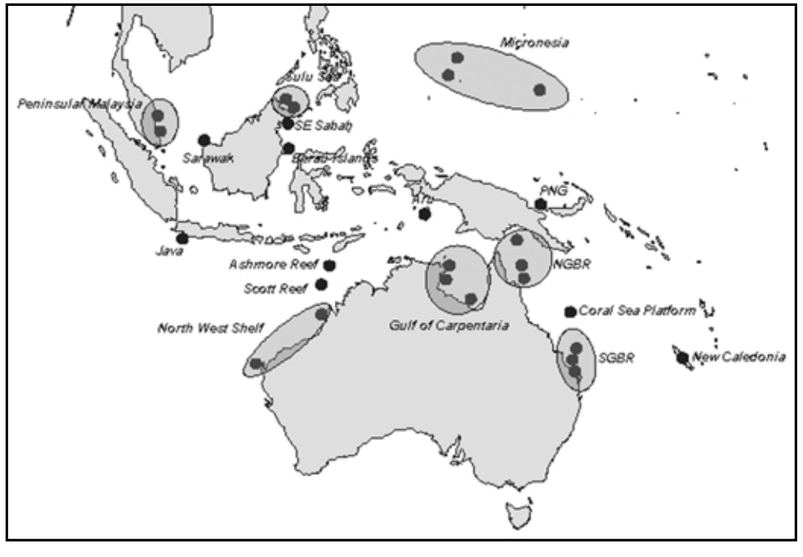


Figure 5. *Management Units in the Western Pacific Region.*

Unfortunately, sometimes the statistical power is not strong enough to distinguish among different nesting populations when doing stock assessments. A different approach involves the analysis of samples with nuclear markers to provide an individual genetic profile of each turtle. The marker of choice has been nuclear microsatellite loci that are characterized by having very high mutation rates. Through this type of analysis, there can be greater statistical power to determine the origins of individuals and estimates can be made as to how much genetic interchange exists between populations. This is important because the geographic management unit for a particular stock is likely to encompass a vast area, much larger than that of the nesting region.

In regards to green sea turtles, our study using nuclear markers is only halfway through the analysis, with five of ten microsatelite loci done. Some management units are already distinguished including Scott Reef and Ashmore Reef in Western Australia, the Gulf of Carpentaria, but the Northern and Southern Great Barrier Reef do not appear to be different. The genetic interchange that exists along the Great Barrier Reef is believed to be mediated by the males crossing through breeding grounds. Other management units known to exist in Micronesia cannot yet be distinguished and the analysis may have to wait until ten loci are identified. Work is continuing to determine where the turtles in the Bali harvest are coming from: Northern Australia, Torres Strait, or Papua New Guinea?

Loggerheads

In Australia there are two major populations of loggerheads (east and west; Fig. 6). They are both endangered, strong declines have been documented, and management is a great concern. Genetic sampling was used to clarify whether nesting loggerheads on the mainland and the offshore islands of the east coast constituted a single stock. In Western Australia there were small post-hatchling waifs coming ashore and there were questions about whether these post-hatchlings originated from Western Australian populations or whether they had crossed over from Africa.

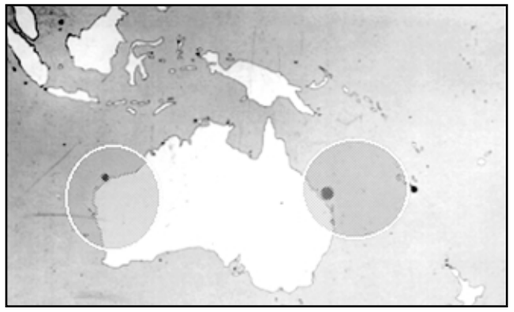


Figure 6. *Loggerhead turtle nesting in Australia.*

In this study, mtDNA haplotypes and microsatellite markers were examined, including a comparison of different years using the microsatellites. Within Australia (supported by Brian Bowen's findings), the whole Pacific population of loggerheads have a single mitochondrial haplotype. This A haplotype, is the same one that shows up in Baja California and Chile. But in Western Australia, a new haplotype (B) predominates, with only 33% representation of the A haplotype. These haplotypes are only one base pair different, thus there is not much mtDNA variation. MtDNA analysis of the post-hatchling waifs in Western Australia indicated that they originated from Western Australian rookeries. Microsatellite markers showed a high genetic variability (76 to 82%), and the east and west coast rookeries were genetically different. Some differences were found among the mainland and offshore islands of the east coast, suggesting limits to gene flow between some rookeries. With regards to management, the east coast and west coast rookeries form distinct management units, and the east coast rookeries should be regarded as a metapopulation to be managed as single unit.

Flatback

The endemic flatback turtle nests only in Australia, as far as we know (Fig. 7). Tagging studies suggest that there is limited gene flow and that there is some segregation in the use of feeding grounds. . Flatback turtles are one of the most frequently caught species in the northern prawn trawl fishery, and this impact needs to be assessed (note that TEDS are now required).

Samples were taken at all the major rookeries and analyzed using nuclear microsatellites and mtDNA. A common mtDNA haplotype was found everywhere in Australia, and unique haplotypes were found at low frequencies at several rookeries The microsatellite results indicated a low level of genetic variability (20-45%) and limited gene flow among rookeries. An analysis of gene flow in flatback turtles indicates an "isolation by distance" effect where if two rookeries are near each other they will have more genetic interchange. The further away two rookeries are, there will be less gene flow. This isolation by distance effect is not seen in other marine turtles and results from the lack of trans-oceanic migrations. At present we recognize four management units; Western Australia, Northern Territory, North Queensland and Central Queensland.

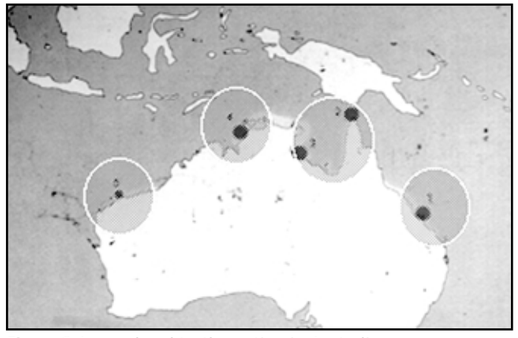


Figure 6. *Loggerhead turtle nesting in Australia.*

WORKSHOP DISCUSSION

MR. DALZELL: This is not really a question, just a comment. It was interesting about what Peter was saying about sampling from observer programs of longline vessels in the Pacific. We have a Standing Committee on Tuna and Billfish that meets this year in Honolulu and that would be an ideal opportunity, I think, if you wanted to come and present. You will have all the fishing nations in one spot. We've also got Deirdre Brogan from the SPC, who is the observer coordinator. So perhaps you two can get together over drinks this evening and talk about the potential for integrating fishermen in the effort to collect genetic samples.

MS. COUSINS: Peter, you mentioned that the sampling of genetic material is pretty easy for people to do. Do you have a write up that you can give the people here on how they can sample for genetic material and where to send it?

DR. DUTTON: Yes. That's something I think we might be able to work a special session once we've identified people that might be able to help out. There are a number of different protocols and there's a number of different ways to do it, depending on the resources and the situation. That brings up the other thing that Paul mentioned, was dissemination of information. Through a website that we're setting up and linking to the IUCN Genetics Task Force, that's exactly the sort of thing that we will try to disseminate information on. So someone could get access to it by getting on the computer and see what those protocols are, who to send it to and so on.

DR. DUTTON: That is an area [web] that the Council could help. Also training videos, we're interested in making a training video. There's a whole slew of approaches. Probably half the people in this room have collaborated in one way or another with genetic studies and in every conceivable situation, from remote areas without any sort of refrigeration or other things. I do have copies of a paper that summarizes the techniques so you can make copies and hand it out.

DR. ECKERT: Just one question relative to using nuclear DNA. Because our primary index of population status is nesting females, adding in the male component to that to try to define stocks has become quite problematic. Because you've extended the stock boundaries beyond what a female stock boundary is. So that means if you're now getting a mesh, males and females, it increases the size of the stock boundary for these populations, and I can't quite wrap my mind around right now how to address that when we use nesting female populations as an index of abundance for a population.

DR. FITZSIMMONS: The one thing I would say to that is, I did one study of green turtles in Australia and we looked at the breeding males with mitochondrial DNA and showed that the males, like females, were returning to their natal regions to breed. So that by including males, it may not necessarily expand the boundaries In terms of say the Northern and Southern Great Barrier Reef, although they are not distinguishable with nuclear DNA, you still have to consider primarily what the mitochondrial DNA is telling you for management of nesting beaches. But it's no surprise that expanded area simply is taking in some of your feeding grounds, which you have in your management unit anyway.

DR. DUTTON: Plus, the problem that you're talking about really is when you get two distinct nesting female populations, that shows up in microsatellites. It's where you don't get differentiation that possible caveats come up, and one of them is that the male component is exchanged. So the male mediated gene flow is just the same stock. So you can always set up your mitochondrial DNA as a sort of a test of microsatellites. Quite the opposite, for instance, with the leatherbacks in the Atlantic where mitochondrial DNA tells us that there is no distinction between African and Caribbean turtles. It's the same haplotype. When we apply nuclear markers or microsatellite, it's quite distinctive. You can identify individual groups.

DR. MORITZ: What is happening in that case is unusual. We think the hypothesis has been that Southern Great Barrier Reef turtles are migrating through the Northern Barrier Reef population at the same time that the Northern Barrier Reef males are jumping on anything that moves. So they may be getting mated on the way down. But demographically, the males are still hunting females. So we still get the Southern Barrier Reef turtles as a separate breeding area. Just a bit of funny business going on during the migrations.

DR. ECKERT: Yes, I understand that. The question is, how do you address the fact that your management unit is no longer as distinct as it was? In other words, we count females…

DR. MORITZ: Demographically, it is still the same.

DR. ECKERT: OK, you still use the home stock, the nesting stock, if you will, as your primary management monitoring tool.

MR. SHARMA: I Just want to find out, as we improve the science and get more science towards identifying management units, all the problems that turtles have continue to prevail. I'm more interested once we define these units, how then do we prioritize populations irrespective of where they are.

DR. DUTTON: That's the challenge, and I think at this point - it may take years to finally get the perfect science. At this point the only way to advance turtle conservation is multi-lateral strategies. Even with the bilateral strategy, the two countries getting together like we have, Mexico and U.S., to protect the nesting beaches, it's not going to work because you haven't encompassed the entire management unit. One can still take the measures right now and move forward to try and find mechanisms to address the multi-lateral problems, like the high seas fisheries.

DR. LIMPUS: I guess I've had a problem with stock identification, when we get into each village as we go across the coast of Papua New Guinea or Irian Jaya is harvesting some turtles, and can we afford to go in and sample at every village for whose stock are you using. So one of the things that the group of us from Australia has been considering is we've actually started the collecting, but we haven't got any of the analysis. But I'll throw it out as an idea so you can see the sorts of things we've been thinking about, what if we took a transect line across from the Solomons across to basically the western end of Java, where we have some samples from the Solomons, we have some samples from Southern Papua New Guinea, we have some samples from Torres Strait at Queensland, we have some samples from many areas. Now, I'm talking from feeding grounds, not nesting turtles. So with samples like that, to look at some sort of modeling of the way the genetic composition changes as we move through the longitudinal transect there, and another similar north transecting here to see if it is possible to cut across some of this problem of how do you answer to every community that is harvesting, rather than sampling every individual place. I'm just throwing it out there, this is the way we've been thinking and whether through some sort of broader collaboration it's possible to design something like this that catches the variability of the various stocks that might be useful.

DR. MORITZ: I'll just close this with one brief comment. That is, what we've been doing so far in terms of defining these management units is really very crude because we're just saying, is there a significant difference in frequency or isn't there. Of course, in San Diego people have been arguing that rather than that sort of black and white approach, we need to be asking what level of migration is needed to sustain a stock given the threatening process we're operating with. For that, you need the full life tag and demographic analysis, and the quantification of threats to be able to pose that question. We're nowhere near that yet. But in the long term, the integration of the genetics, plus the demography, plus the quantitative analysis and threatening process is what is really needed to come up with for rigorous models. I think we have a way to go to get to that point.

Community Based Awareness Programs

Both photos: the "Community Empowerment" working group (see Appendix II for participant lists).

Community Based Empowerment: Bringing Cultures Together

Dr. Mark Hamann

PRESENTATION

There are around 40,000 Indigenous people in the Northern Territory (N.T.), and they are custodians of approximately 85% of the coastline. During the last two decades, the increased effectiveness of many homeland resource organizations have supported the ability and desire of Aboriginal people to not only move back out onto their traditional lands, but to stay on them. Aboriginal people are responsible, and accountable, for the natural and cultural resources of the land and waters within their estates. Increasing population and technologically enhanced harvest efficiencies (eg. large scale commercial fishing operations) means Indigenous communities are increasingly expressing the need to access and implement effective strategies for managing their natural resources. Western science linked with Indigenous knowledge can support land and sea management initiatives, and collaborative community based conservation projects are becoming common.

Community based conservation is a buzz phrase often used in contemporary conservation biology. It is not a strict science, rather a philosophy, relying on the participation of community members in active bottom-up conservation to protect, preserve or manage the resources and customs in their native areas. Similar to other indigenous peoples from many parts of the world, Aboriginal Australians have close ties to their land, which encompass both the marine and terrestrial environment. In many coastal areas, sea turtles are and have been an integral part of the diet, culture and history. Sea turtles have been sung about, and they are part of the "dreamtime." Turtle meat has been used as an important food source for many thousands of years in some coastal communities. Historically, turtle bones have been used for tools, and hawksbill turtle shells were traded with the Macassans (from Indonesia).

In the Northern Territory (NT) of Australia, there are globally significant populations of three sea turtle species (green turtles, flatback turtles and hawksbill turtles). Moreover, much of the coastline is suitable habitat for foraging turtles. In addition, approximately 86% of the coastline is under indigenous land ownership. However, with increased land ownership comes the increased need to become responsible and accountable for the resources that the land contains. Whether this is for commercial products, such as the bark harvest for bark paintings or the wood harvest to make didgeridoos that are sold in the tourist trade, or whether it is taking responsibility for subsistence resources such as sea turtles, their eggs or their meat.

The first step is to understand what resources are in the area need to be managed and by what available means can these resources be managed effectively. We can do this through a two-way learning system. An interchange with indigenous people which promotes interaction. They (indigenous people) first want to share what they know about, in this case sea turtles, and then require that information be passed to them about what western scientific methods can tell them about sea turtles. When speaking to elders or to people responsible for management, this two-way exchange of information is essential. No matter how much one thinks they know about sea turtles, it is always important to sit down and chat with the local people, the local experts. It is also important to talk to many different people in the community, the women, men, children, and people from different social

or political roles in the community. For example, if one wanted to find out how many eggs are being harvested in a community, one would ask the women or children because they are responsible for that part of the harvest. Whereas, if one wanted to find out what reefs were good to located turtles, then one would ask the men because they are responsible for hunting on the reefs.

Indigenous people in many communities share many of the same concerns as western scientist. They see that turtles are getting trapped in the marine debris that washes ashore on beaches, and in some areas they have seen turtles with the fibropapilloma disease. They have similar conservation concerns, but often do not have the capacity such as adequate resources or information necessary to address problems. The best knowledge that western science has provided indigenous people with is a wider temporal and spatial understanding of sea turtles.

Satellite tagging has been one mechanism that has been used in Northern Australia by the Dhimurru Aboriginal Land Council, Northern Territory University and World Wide Fund for Nature, to educate people and communities about the migratory abilities of sea turtles. Satellite tagging a nesting turtle on one beach and following its migratory path to its foraging area opened communication between two separate communities which would not have otherwise realized they shared a common resource (Fig. 1). The understanding gained by both parties that to manage sea turtles effectively needs communication amongst themselves and that sea turtles are a shared resource was groundbreaking in terms of community-based conservation and awareness in northern Australia. Another important aspect of the two-way learning cycle was to show Aboriginal people from Northeast Arnhem land that loggerhead turtles don't lay eggs at sea near their country, rather they migrate to nest and lay eggs in Queensland or Western Australia. These two projects with indigenous communities proved that there is definitely work to be done to both broaden the scope of knowledge of the indigenous people and western science knowledge of the indigenous culture.

Figure 1. *The migratory route of one satellite transmitted green sea turtle raising awareness (Tag applied by Umbakumba, WWF and NTU).*

Whether the indigenous harvest of sea turtles is a cultural right or a threat to their survival is a widely contested issue. But regardless, a non or mis-managed harvest of sea turtles (and eggs) could be potentially detrimental to the population(s) in question. This problem is confounded when there are different harvest rates between different areas and the possibility of different genetic populations being affected. For example, a community which has access to both nesting and foraging turtles. In this case there is the potential to harvest from both ends of the system which could lead to a more substantial take than a community with access to only foraging turtles. For this reason, it is easy to see why some groups may be more enthusiastic certain management strategies than other communities. Moreover, most harvests of foraging turtles are likely to be taking turtles from one or more nesting populations. Thus more that one group of "geographically separated"

people could theoretically be harvesting from the same population. An example of this occurs in the Northern Territory, whereby indigenous people from three states of Australia, Indonesia and Papua New Guinea are likely to be harvesting turtles from the Gulf of Carpentaria nesting population.

A current project in the Northern Territory to help quantify the level of harvest, identify how many parties are involved and much the sea turtle resource is shared, involves including aboriginal hunters in the scientific/management effort. Aboriginal hunters have been supplied with small tubes to collect genetic material, tape measures, and disposable cameras (for correct species identification and estimates of size). They have been trained how to collect information from the turtles they catch on sex, breeding condition, and other things that can be very useful to gather during harvest [see Colin Limpus presentation, this publication]. Results, thus far, have been very promising and a greater understanding of the harvest level in this region is being acquired.

A few pro active communities (eg. Dhimurru, Umbakumba and Mabunji) have received local grants to clean up the beaches, remove marine debris (especially fishing nets), and record local information about sea turtle and dugong issues. In some areas local Councils have acted to prevent vehicle access by maintaining gates and fences across roads, or not repairing damaged roads. A few communities have instilled their own customary laws to prevent the taking of nesting turtles such as outlawing the take of nesting females or stating that only half of the clutch of eggs can be taken.

Towards future conservation efforts, however, an education package is needed. Information which gets the message across to communities about how to manage their resources efficiently, and most importantly why it is important to manage resources. Posters and education material directed towards school age kids and the teachers would be of benefit.

In conclusion, a lot of work has been accomplished through trial and error, some things have not worked, but some things have shown a lot of promise. The most important thing to remember is that indigenous people want feedback about the success, failures and/or implications of activities so that they can make their own decisions about managing their resources efficiently.

WORKSHOP DISCUSSION

DR. MORITZ: You were saying that one of the results from this is that the different communities are working together, but some have different aims. How is that playing out? Is there a sort of general cooperation?

DR. HAMANN: There has not been a very smooth relationship in the past between a lot of these communities. Going back into history, many of them are traditional enemies. But with this, they both have one common goal, and that is to manage the sea turtles because they want them there. So we're finding, especially between the Dhimurru, who have done a lot of work with white people, they are turning out to be some quite active spokes people in the community that have gone down to the other areas and they're being well received at the moment. So that should continue.

MR. BALAZS: Is the harvest sustainable? Would you estimate that it is sustainable, do you have any feeling one way or the other -- I'm talking about the aboriginal harvest of green turtles.

DR. HAMANN: This is a very hard question to answer because we don't have a lot of information about the sea turtle population itself; how big it is to start with, or how large is the geographic region that the turtles are being harvested from. But definitely there are regions where there are a lot of turtles, hundreds and hundreds of turtles being harvested, and I guess most of us in this room would quite easily call that unsustainable. But hopefully, some of the awareness work we are doing will start reducing that, or at least gives us some information to base it on.

MR. BALAZS: What do the old fishermen have to say, do they feel there's been a decline in their lifetime?

DR. HAMANN: I've spoken to a few people in one community. They tell me that they don't see as many turtles nesting now as they used to.

DR. LIMPUS: If I may. The question of sustainability is going to be a really difficult one because that part of Northern Australia, we know from tag recoveries, is actually drawing turtles from some of the biggest green turtle populations in the world and, therefore, people can say it can stand some chance of being sustainable. But until we know the stock composition in there, which stocks are being impacted and what level of take, you really can't answer that question. I think Mark answered it fairly well.

Community Conservation in Vanuatu, A Case Study: Wan Smolbag Turtle Conservation Programme

George Petro

PRESENTATION

The Wan Smolbag (WSB) Traveling Theater Group has been in operation since 1989. Based on the island of Efate, Vanuatu, this group makes village tours putting on plays that simultaneously entertain and inform villagers about important issues such as HIV/AIDS, malaria reduction through mosquito control, and most recently sea turtles. Wan Smolbag "Turtle Conservation Program" began in 1995 following the Year of Sea Turtles campaign coordinated by SPREP.

The turtle conservation program was initiated by actors of WSB visiting villages of north Efate to collect information and custom stories of sea turtles. The information and stories were then used to improvise a play/drama called "I'm a Turtle" which was later performed in villages by actors of WSB. In 1995 the theme of the main play was the plight of sea turtles and the need to conserve them. The villagers were apparently receptive to this message in part because, as many informants told us, they were already aware of a marked decline in turtle numbers in their waters over the previous several decades. Actors of WSB suggested that turtles should not be killed, and that each village should select a "turtle monitor" in order to help encourage turtle conservation. The primary task of turtle monitors was to monitor sea turtle activities in their respective village, but since 1997 they have expanded their activities to include tagging nesting turtles and turtles caught in nets before release.

There are now 150 turtle monitors in roughly 80 Vanuatu coastal villages. The "Turtle Monitors Network" program is regarded as a successful project by several environmental organizations in Vanuatu, including the Government's Environment Unit and the Fisheries Department. Reports from the turtle monitors show that many local communities have become more aware of the life of sea turtles and other marine species because of the program. Two main positive outcomes of the program are the ban of turtles harvest imposed by communities with turtle monitors, and the apparent increase in turtle populations in some areas.

In Vanuatu, it is against national law to harvest turtle eggs, but there is no national law prohibiting the taking of adult turtles. Until recently in most coastal communities sea turtles were killed whenever the opportunity arose. Turtle monitors report anyone who is found taking turtles or turtle eggs to the village leaders. In some instances, monitors have taken it upon themselves to post signs at nesting beaches during the egg-laying season to remind people that it is illegal to take eggs. Communities that do not have turtle monitors reportedly continue to take turtles whenever they can. In 1993 no villages surveyed mentioned tabooing the taking of turtles. Now more than half of the communities interviewed acknowledge this taboo. The reason for this striking change is unusual but instructive.

In recent surveys, villages with turtle monitors tabu the killing of turtles. In general, these communities appear to have reapplied cultural values regarding sea turtle harvest, and in such villages, compliance with the government prohibition on disturbing turtle nests has increased. In other villages people are allowed by their leaders to kill one or more turtles only on special occasions. Where these regulations are in effect a number of informants reported now seeing many more turtles in their waters than they had seen for many years.

From the sea turtle program, it is now known that there are three main species of turtles in Vanuatu; mainly green sea turtle, hawksbill turtle and leatherback turtle. Threats to the turtle populations in Vanuatu are mainly humans, cyclones and the clearing of nesting beaches for coastal development. The overall trend of sea turtle populations is unknown, since there has never been any scientific study or population census, however, in specific areas there appears to be marked changes in populations of green sea turtles. The area of north Efate is experiencing an increase in turtle numbers with more

sea turtles sighted in their waters. Reports suggest that this was not a common occurrence in the years before turtle monitors in this area. One of the main factors contributing to this increase is attributed to turtle taboos/ bans that have been instilled in villages of north Efate. At Epi, an outer-island and one of the two main nesting sites for leatherback turtles, similar population increases from monitors have been reported. In addition to tagging, future research activity proposed by turtle monitors is to collect information of nesting females to determine the size of the nesting population.

Experience in many Pacific Islands has been that protecting sea turtles is one of the hardest conservation measures to persuade islanders to observe. The World Bank (1999) found that the perceived compliance with turtle regulations was very low and was perceived (during a survey of 'attitude' in Pacific Island communities) to be quite poor. Communities felt such rules conflicted with cultural obligations, such as the custom at some sites of giving turtles to chiefs, and that "turtle meat was just too tempting to resist." Wan Smolbag's accomplishments in this regard seem to be setting a new standard.

With World Wildlife Fund and European Union funding, and the Department of Fisheries participation, WSB now runs workshops to train turtle monitors. At their most recent meeting in June 2001 the turtle monitors voted to broaden their mandate to coastal resources in general and to change their name to Vanua-tai Resource Managers (Vanua=land; tai=sea). In addition, Wan Smolbag's latest play encompasses a wider range of issues of coastal resource management. WSB is shaping up to become an important conservation force in Vanuatu and provides a model for community empowerment towards sea turtle conservation and recovery.

WORKSHOP DISCUSSION

MR. BALAZ: I have a two-part question. First, what is the most prevalent species that nests in Vanuatu and what is the ballpark figure as far as nesting numbers? Like, how many nests per season.

MR. PETRO: We have not had any specific study so far. We are thinking of doing some research studies in the future, but now I cannot answer your question.

Awareness and Participation in Marine Turtle Conservation in the Philippines

Renato Cruz

INTRODUCTION

The Pawikan (marine turtle) Conservation Project (PCP) of the Protected Areas and Wildlife Bureau (PAWB), Department of Environment and Natural Resources (DENR) is the lead group in the conservation of marine turtles in the Philippines. One of the major tasks of the PCP-PAWB is to increase awareness and participation of the country's populace concerning the conservation of marine turtles and other related marine resources. Since 1983, the Project has been utilizing all possible means of communication to promote marine turtle conservation. These means of communication are as follows:

CONSERVATION PROJECT

Documentary film

Two documentary films of 15-20 minutes duration were produced by the PCP-PAWB and focused on marine turtle biology, causes of decline of marine turtle populations in the Philippines, brief history of the project and the activities being conducted by the project. Besides being often shown in schools and colleges, copies of the film were also distributed to the regional offices of the DENR and some tourist resorts. The last documentary film produced by the PCP-PAWB in 1998 contains a Filipino version to cater to the larger populace of people living in the countryside.

At present, as a cost-cutting measure, the PCP-PAWB collaborates with local television programs that produce documentary films on wildlife conservation and ecotourism focusing a particular area in the country.

Radio

As the Philippines is archipelagic an country with inadequate communication facilities, radio is the most effective and accessible media tool. A 15-second radio plug that emphasizes the ban on collecting or killing endangered sea turtles was produced and translated into five common Filipino dialects. This was aired free of charge in the different regions of the country (Cruz, 2000).

Posters

The PCP-PAWB has so far produced five poster designs for distribution nationwide. One of the designs depicts a turtle and dugong imposed on a collage of dinosaurs, with a caption saying, "Are we to let our children inherit only stories?" (Cruz, 2000).

Primers/ Brochures/ Bookmarks

Print materials containing a brief description of the biology and ecology of marine turtles, as well as the pertinent laws concerning their conservation have also been produced for distribution. Mimeographed versions in both English and Filipino are distributed during habitat surveys and IEC, and more specialized primers are given during seminars, lectures and training-workshops. The PCP-PAWB also distributes these print materials to individuals who request for them (Cruz, 2000).

Billboards

Billboard signs have been erected in strategic locations, such as piers and gates of a complex that houses more than 100 native souvenir shops and in areas adjacent to nesting sites. In spite of the ban, local businessman still engaged in the trade of marine turtle by-products. In fact, surveillance and confiscation conducted by the PCP-PAWB and the enforcement arm of the DENR in Metro Manila has yielded not less than U.S.$ 8,000.00 worth of by-products in 1996 and 1997 alone. DENR personnel deployed at the international airport have confiscated from departing foreign tourists a number of stuffed turtles and guitars made of turtle carapaces (Cruz, 2000). However, from 1999 to the present, there was a significant decrease in the number of confiscated marine turtle by-products.

T-shirts/ Baseball caps

The project has produced t-shirts with different turtle designs, and a baseball cap with an embroidery patch designed with a turtle and dugong. Along with a Certificate of Appreciation, either of these products are

given to individuals, especially fishermen, who have reported turtles with metal tags or surrendered the turtles to the DENR for tagging and/or for release. In 1994, a manufacturer of popular t-shirts with conservation designs forged an agreement with the PAWB to donate 10% of the sales of its marine turtle-designed t-shirts to the PCP-PAWB. This undertaking significantly helped in promoting marine turtle conservation awareness in the people, especially since the t-shirts are widely distributed in major cities in the country. In addition, many of the PCP-PAWB's activities were financially supported through this donation (Cruz, 2000).

Postcards and Stamp Canceller

Pre-paid postcards depicting the five species of turtles found in Philippine waters are distributed to the DENR Regional Offices, concerned individuals, non-government organizations, local governments and community schools. Through the data gathered from the postcards and Field Action Officers' reports, the PCP-PAWB has plotted the distribution of turtles in the entire country (Cruz, 2000).

In 1989, in commemoration of the 10th year of the Project, a stamp canceller with marine turtle design was produced in collaboration with the Philippine Postal Corporation. This activity lasted a year (Cruz, 2000).

Training-Workshop for DENR Personnel

The Project has been fully utilizing the assistance of the DENR's 15 regional offices and branches, 69 Provincial Environment and Natural Resources Offices (PENRO) and 159 Community Environment and Natural Resources Offices (CENRO). These offices are in the forefront in implementing DENR's mandates at the grass roots level. In 1989, DENR Special Order No. 884 was promulgated, designated all Regional Technical Directors for Environment and Natural Resources as PCP Field Action Officers (FAO). One of the specific duties and responsibilities of the FAO is to assist the PCP-PAWB in conducting a Conservation Education Program in their respective regions. The Project conducted Orientation-Training Workshops for DENR field personnel to equip them with the necessary knowledge to conduct IEC and implement other PCP-PAWB activities. The topics of the training workshop include: Biology and Ecology of Marine Turtles, Tagging and Hatchery Procedures, Existing Marine Turtle Rules and Regulations, Concepts of Marine Wildlife Conservation and Management, and Identification and Functions and Commitment of the Participants for Marine Turtle Conservation. From 1989-1997, more than 300 DENR personnel were trained by the PCP (Cruz, 2000).

This year, 2002, the PCP-PAWB is planning to conduct an Orientation-Training Workshop in Region 13, the northeastern part of Mindanao covering four provinces, namely: Surigao del Norte, Surigao del Sur, Agusan del Norte and Agusan del Sur.

Seminars/ Lectures

As a cost-effective strategy, IEC is integrated with the habitat surveys conducted by the research unit of the PCP-PAWB. The method used is the interpersonal-group approach consisting of a simple lecture with a slide presentation or a film show. In areas with no sources of electricity, flip charts are used as visual aid. About 50-300 people, mostly children and fishermen, attend each of these lectures. From 1992-1996, the PCP-PAWB conducted IEC in 253 local communities in 26 provinces. The PCP-PAWB also gives lectures in schools upon invitation (Cruz, 2000).

Dalaw-Turo (Visit and Teach)

This is an outreach program of the DENR that employs a non-traditional education participatory communication design of teaching biodiversity and sustainable development. The most interesting feature of this program is the integration of lectures, drama and games as a technique in imparting conservation of natural resources among its audience. The marine turtle has become a part of this program (Cruz, 2000). From 1992-2000, more than 46,829 students, 964 teachers, 3,422 communities and 576 DENR personnel from all regions have participated in the Dalaw-Turo.

Media Coverage

From 1991 onwards, media coverage was intensified, which have elicited considerable public support. The Department of Tourism sponsored a group of journalists from different newspaper and magazine publications to visit the Turtle Islands, some 1000 km south of Manila, the country's capital (Cruz, 2000). The Turtle Islands and Morong, Bataan were featured in two leading television programs and local tourism programs.

Exhibits

Many non-governmental organizations (NGO) have had collaborative undertakings with the PCP-PAWB. In 1994,1997, and 2000 these NGOs coordinated with the project to set up month-long exhibits on marine turtles and other endangered species in popular shopping malls. Due to their strategic location, these projects elicited a number of patrons who contributed financial support to the project. The PCP-PAWB also encourages school organizations to collaborate with the Project in this undertaking.

Network

Cooperation and collaboration with other national and local government agencies and non-government organizations that include universities/schools, people's organizations and cause-oriented organizations are important ingredients in the success of any conservation endeavor. Since 1997, the PCP-PAWB has been constantly expanding its collaboration and tapping the resources of these organizations in terms of manpower in support of identification and establishment of protected areas or sanctuaries for marine turtles. Aside from reports sent by the DENR Field Action Officers, we receive reports from the non-government organizations that significantly contribute to the PCP-PAWB marine turtle distribution program.

LITERATURE CITED

Cruz, Renato D. 2000. Information education campaign of marine turtle conservation in the Philippines in: Abreu-Grobois, F.A. Briseño-Dueñas, R. Marquez, and L. Sarti. Compilers. In: Proc. of the 18th International Sea Turtle Symposium. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-436.

WORKSHOP DISCUSSION

DR. MARQUEZ: This is a hard question. What are you doing with the hatchlings when they hatch out? Are you putting them in a tank, all of them, or are you releasing them immediately? Because if you're not releasing them immediately, keeping the hatchlings in a pond might make problems for them during their lifecycle.

MR. CRUZ: We don't put then in a tank. Most are released immediately. Those that are kept and placed in a tank are the weak ones, and these are a very, very few. These are used to showcase to the community, as an attraction to school children; to go there and look at the turtles in the pond.

DR. PILCHER: What made the people change their minds from being poachers to being guardians. What was the driving force behind that?

MR. CRUZ: This took a lot of community work, and you have to be really good in community organizing. We got that ingredient from an NGO. Another important driving force was $4,000 of funding from the provincial government, the local government. This was used to supplement the livelihood of these people. These were the two main ingredients. When

they saw success, UNDP gave $35,000. I think they thought that this was a good project. Eventually, this area will be an ecotourism area. So they realize there is more money to be made maybe in ecotourism.

DR. MORITZ: If I can ask one more question, and that is what do you think is needed for it to be sustainable in the longer term? As peoples' economic fortunes go up and down, what do you think will keep it going?

MR. CRUZ: The income that is derived from egg collection is very, very small. In one season, one guy can only make 5,000 [Philippine dollars]. So maybe through explanation by the NGOs, by us, and the government they will realize that turtles are a better potential income through ecotourism.

Sea Turtle Status and Conservation Initiatives in Fiji

Aisake Batibasaga

OBJECTIVE

The purpose of this paper is to present an update of the current status of sea turtles in Fiji. The paper makes clear the need for further conservation actions to ameliorate the threats to sea turtles in Fiji and the Pacific in general. An immediate priority is to request that the Fiji government to extend a previous 3-year moratorium on sea turtles for a further period. The ban commenced in March 1997 and ended in December 2000. The moratorium should be extended for another 5-l0 years, since sea turtles have a long lifespan, and some species may take between 25 to 50 years for them to become sexually mature.

INTRODUCTION

In the last fifty years sea turtles population in Fiji and elsewhere in the Pacific have declined due to increases in exploitation pressure, largely arising from a rapidly increasing human populations. There are very few remaining nesting populations of sea turtles in Fiji today, most are declining and some have become extinct. The reasons for this decline are due to subsistence and commercial harvests, accidental capture in fisheries, alteration and degradation of foraging and nesting habitats; and to some extent, competition for space with coastal developments, pollution or degradation of near shore ecosystems.

The campaign to save the sea turtles has been identified as a regional and national priority and supports biodiversity conservation initiatives. All countries in the South Pacific have undertaken various level of commitments toward this end. Fiji's participation in this effort will enhance its image as a leader in the region and will reverse Fiji's image as a primary killer of sea turtles. This campaign will be consistent with international conventions, such as the Convention on International Trade in Endangered Species (CITES) which was designed to prevent wild life from becoming endangered through international trade.

The commercial ban on sea turtle meat and products was instituted in Fiji in 1997. It was an important first step towards protecting these endangered species in Fiji and will hopefully assist in establishing a public environment conducive to future protection and conservation efforts. These steps taken by the Fiji Government reflect the growing interest locally in sustainable resource utilization and environmental awareness.

Of the seven known species of sea turtles, six are found in the Pacific region. All are currently listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which restricts commercial trade in sea turtle products. The following four species of sea turtles found in Fiji, in order of abundance, are:

- Green Turtle *(Chelonia mydas)*:
  Vonu dina (Fijian)
- Hawksbill Turtle *(Eretmochelys imbricata)*:
  Taku (Fijian)
- Loggerhead Turtle *(Carretta carretta)*:
  Tuvonu (Fijian)
- Leatherback Turtle *(Dermochelys coriacea)*:
  Tutuwalu (Fijian)

Of these species, three (with the exception of loggerhead turtles) are known to nest in Fiji. The last remaining nesting sites for green turtles are isolated Islands, and sand isles north of Taveuni. These sites are found within the Hemskercq and the Ringgold Reef Systems (positions: 16º 43'15"S; 16º 18'00"S and 179º 26'30"W; 179º 24'30"W).

TRENDS

Hawksbill nesting is more widely dispersed in Fiji, but in very small populations. Nesting is more common on

the Eastern and Southern parts of the Fiji Islands. One of the last major nesting site for hawksbills is Namena Lala Island (17.25º S; 179.1º E) which used to have over 100 nests per season during the early 1970's. Namena Lala Island should be made a national marine park area. Current tagging programmes suggest that hawksbills have shorter migration routes in Fiji compared to the other three species, as could be gauged. Nesting populations in most sites have been reduced to only 10-20% during the last five years.

Population assessments conducted by the Fisheries Department from 1994 to 1997 showed that the sea turtle population has dropped or declined dramatically from 1984 to 1994. This decline has largely been attributed to over harvesting, notably from commercial harvesting pressure; although there are other contributing factors, like alteration of nesting and foraging habitats.

Nesting at many sites has been markedly reduced and nest counts continue to decline. Sites such as Makogai, Leleuvia, Caqelai have had only 2-4 observed nestings from 1995 to 1999, and only one nest was recorded in Makogai Island during the 1999 – 2000 nesting season. Nesting of green turtles at other Islands have been reported to have ceased entirely, with the last nesting observed in 1977. Estimates of green turtle nesting from the Hemskercq and Ringgold Reef Systems (North of Taveuni) are now amount to approximately 25 to 30 nests per season. Namena Lala Island is now the last main nesting site for hawksbill turtles in Fiji (approximately 40 nests per season between 1995 to1999).

THREATS

Sea turtles are seriously threatened, at national, regional and global level. Efforts must be made urgently if we are to save them from imminent extinction. There is a need to assess the current stock levels and gauge the success level of previous and current conservation strategies, such as the imposition of a moratorium on harvest, particularly on commercial take in Fiji.

Commercial harvesting is the single main reason for the decline in sea turtle populations in Fiji. If commercial harvest of sea turtles is stopped, traditional subsistence harvests may continue in the future, without the fear for this resource being driven to extinction.

RESEARCH

There is a priority need to undertake sea turtle field research in Fiji to assess stock levels to assist in decision making for conservation, and institution of strategic action plans for the management of this resource. Field research, yet to be undertaken, would have two major areas of focus:

1. Research to assess stock levels of the two major species *E. imbricata* and *C. mydas*; to determine population structure and population dynamics. This would include genetic data analysis, supported with the tagging programmes that have been ongoing since 1990.
2. Assess the conservation success of captive reared hawksbills and green turtles which have been hand reared in the mini-hatchery and released back into the sea. This analysis will enable us to determine or estimate surviving populations, migration patterns and other bio-data assessment, with the aim to enhance wild populations, and assist decision-makings on a strategic action & management plan.

Satellite Telemetry

In the wild, some turtles mature very slowly, taking between 25 - 50 years to first become reproductively active. Research indicates that Hawaiian green sea turtles take approximately 25 years to mature and enter the breeding population, while it takes approximately 47 years for Australian green turtles.

Sea turtles will commence long migrations and are known to migrate long distances (from 3,500 – 5,000 km) between their nesting and foraging grounds. Satellite tagging of a nesting green turtle from Palmerston Island (Cook Island) November 2000 showed that nesting female turtles migrate between Fiji and the Cook Island during the breeding season; a distance of over 2,100 km; evidence of important habitat linkages between Fiji and the Central Pacific.

Due to the long and complex migratory patterns of sea turtle populations, it has been suggested that heavy exploitation of turtles and their eggs in one South Pacific country, may have a direct effect on reducing the relative abundance of turtles in neighboring countries. Turtle exploitation in several areas of Solomon Islands may have had such a deleterious effect on the abundance of turtles in Fiji and vice versa.

Additional satellite tagging experiments in American Samoa, provide direct evidence that green turtles migrate between Fiji and American Samoa. Three green turtles were tagged at Rose Atoll, American Samoa in 1993. They migrated 1,600 km to various locations in Fiji, a journey taking 34-35 days to complete at an average swimming speed of 1.8 km per hour. One turtle went to Natewa Bay on Vanua Levu, the second went to Naweni Point, also on Vanua Levu, while one went to the Lau Group (see, P. Craig, Appendix IV, this publication). It is expected that they would remain at those locations for 2-3 years before returning to Rose Atoll to nest again.

Tagging and Head-start Programmes.

Sea turtle tagging programmes have been ongoing in Fiji since 1990, along with artificial breeding of hatchlings (particularly hawksbill turtles). Turtles are hand reared and later released back into the water from 3-4 weeks of age (released without tags), to 8 months and older (with metal tags). With the assistance of SPREP and Dr George Balazs of the National Marine Fisheries Service in Hawaii, over 550 hawksbill turtles have been tagged from two tourist resorts during the last three years alone. This is also viewed as a promotional programme for visitors.

CURRENT LEGISLATION

Legislation in Fiji and other countries in the region needs to be reviewed for provide effective and strategic protection of sea turtles. For example, Fiji may need to accommodate the complete protection of rare or low populations species such as the loggerhead and leatherbacks, which are not covered under current legislation. There is also a need to review size restrictions, and nesting season egg taking bans (currently the ban takes place from Nov-Feb), since green turtles commence nesting from August and September; and Hawksbills complete nesting from March, each year.

The moratorium of killing sea turtles in Fiji, instituted in 1997 ending in December 31, 2000 has resulted in some improvement of foraging populations. However, this was too short a time period, and needs to be extended for between 10-20 years to have an effective impact. Although the ban clearly assisted sea turtle population recovery, this was an ad hoc measure, without any clear action plan, or allocation of resources. Clearly, there is a need for a long-term conservation plans.

- Regulation 9 of the Fisheries Regulations provides that:
  1. No person shall harpoon any turtle unless the harpoon is armed with at least one barb, of which the point projects not less than 9.5 (3/8 inch) from the surface of the shaft.

- Regulations 20 of the Fisheries Regulations provides that:
  1. No person shall at any time dig up, use, take, offer or expose for sale or destroy turtle eggs of any species or in any way molest, take, sell offer or expose for sale, or kill any shell of which is less than 455mm (18 inches) in length. No person

during the months of January, February, November or December in any year shall in any way molest, take, sell offer or expose for sale, or kill any turtle of any size.

2. No person shall be in possession, sell, offer or expose for sale or export any turtle shell the length of which is less than 455mm (18 inches).
3. A moratorium on harvest effective as of March 1, 1997 to December 31, 2000.

The closed season for the taking of turtles and their eggs spans the main breeding season. Regulation 26 of the Fisheries Regulations (Cap. 158 as amended) provides that, "No person shall export from Fiji":

- Turtle flesh
- Turtle shell unless worked into jewelry or otherwise processed into a form approved by the Permanent Secretary for Primary Industries and Cooperatives (now Fisheries and Forest).

RECOMMENDATIONS

It is recommended that a further five to ten years prohibition be placed on all harvesting of sea turtles to allow the Ministry of Agriculture Fisheries & Forestry (MAFF) to carry out further field research, assisted by other research and donor organizations, to gather the necessary information required to developing an appropriate Management Plan for Sea turtles in Fiji. MAFF will consider the amendments to the legislation being suggested, which should widen the scope of the proposed moratorium.

LITERATURE CITED

Anon. Fisheries Annual Report (1995-1999).

Craig, P. 2002. Rapidly approaching extinction: Sea Turtles in the Central South Pacific. In: Proceedings of the Western Pacific Sea Turtle Cooperative Research and Management Workshop. I. Kinan (ed.). WPRFMC.

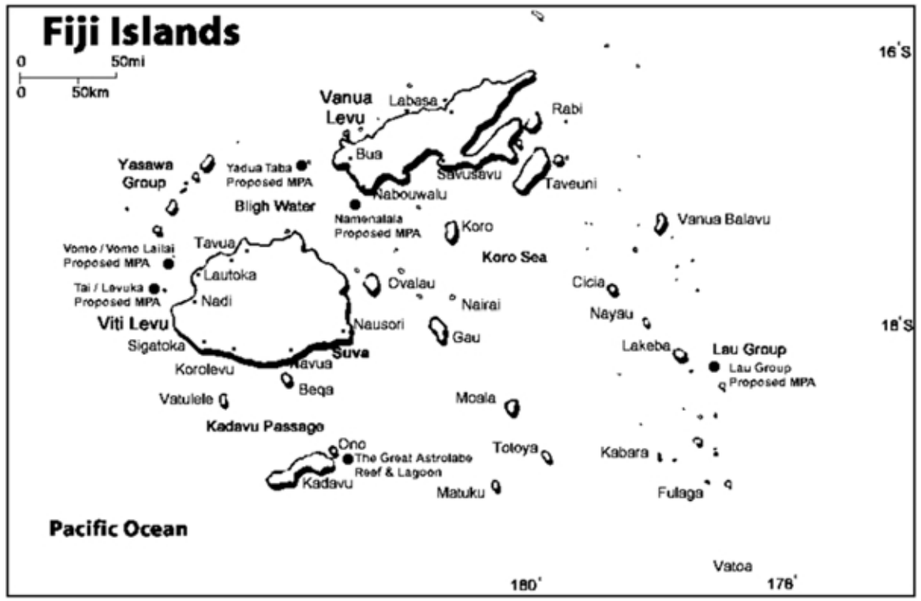
Government of Fiji rev. 1985. Laws of Fiji, Chapter 158. Fisheries

Guinea, M. 1993 The Sea Turtles of Fiji. Apia, SPREP Report and Series no.65.

IUCN/SSC Marine Turtle Specialist Group. 1995 A Global Strategy for the Conservation of Marine Turtles. HJCN

Establishing Replicable Community-Based Turtle Conservation Reserves in Fiji

Etika Rupeni[1], Sangeeta Mangubhai, Kesaia Tabunakawai, Peter Blumel



ABSTRACT

Fiji is an island country located in the central Pacific area, made up of over 300 islands, of which only one third are populated. Fiji is an area of high biological diversity where many communities remain highly dependent on natural resources for their sustenance. To varying degrees, many of these communities are experiencing increasing pressure to move into the cash economy and this often necessitates changing from sustainable resource use to less sustainable practices. In terms of marine ecosystems and biodiversity, the Western Pacific has the highest marine diversity in the world, and Fiji has one of the best-developed coral reef systems in the Pacific. However, there is no inventory of Fiji's marine plants and several marine species have become extinct in recent times and several others now in danger of extinction (1993 Government of Fiji and IUCN – The World Conservation Union).

The World Wide Fund for Nature (WWF) South Pacific – Fiji Country Program works with communities to assist them with the design and implementation of marine reserve areas and no-take zones as a means for protecting coral reef and other ecosystems within resident landowners' customary marine areas. This community-level work is based upon the traditional practice of many Pacific Islanders in setting aside tabu areas (seasonal no-take zones), a management system which has been used successfully for generations to maintain healthy marine populations of fish and other marine life.

TURTLE EXPLOITATION & CONSERVATION ACTIONS

The main threats to Fiji's sea turtle populations are from traditional harvesting of adults for ceremonial purposes, subsistence and commercial harvesting of adults, their eggs and shell, and mortality in commercial fishing nets.

[1] *Presenting author*

However, a lack of local capacity and financial resources has meant that the extent and intensity of each of these threats is currently unknown.

Traditional Harvesting

Traditionally turtle hunting was one of the duties of the clan 'mataqali' who were called 'gonedau' with the 'tunidau' as the head (Guinea, 1993). These members of the community were well educated in natural history and traditional taxonomy of turtles, and were responsible for supplying animals at the chief's request for consumption on special occasions. Hunting was conducted by day, with nesting turtles being collected by night. During the day turtles sighted from canoes were chased until exhaustion.

In addition, if turtles were observed on reefs or in shallow areas, a large mesh *(lawa ni vonu)* or coconut fiber *(lawa tabu)* net was spread to encircle the animal at the most likely point of escape, and driven towards the net (Guinea, 1993). However, turtle eggs were not traditionally harvested for special feasts.

Subsistence and Commercial Harvesting

With the weakening of traditional restrictions on who, where and when turtles could be hunted, many Fijians, Indians and Rotumans now consider turtles to be common property (Guinea, 1993). Turtles are now being targeted for general consumption as well as for sale in local markets. The eggs are also targeted for subsistence purposes. In addition, turtle shells are still being sold for both ornamental purposes and jewelry.

Mortality in Fishing Nets

Discussions with the Department of Fisheries indicate that turtles are being caught, by commercial fishermen operating in Fiji's waters. A number of these operators have requested permits to sell the turtles on domestic markets. Very little is known about the numbers of turtles being caught, how many are being released, and mortalities resulting from drowning in nets.

LEGISLATION AND REGULATIONS

Hunting in Fiji is generally unregulated and uncoordinated, and the sale of sea turtles is dictated by demand, market price and the relative ease of obtaining other sources of income. Currently the legislation prohibits the taking of turtles and their eggs during the breeding season, from December to March. Since 1990, small changes have been made to legislation in Fiji to address the conservation of turtles nationally. A ban on the export of turtle shell was imposed in 1990, though a number of exemptions have been granted. A five year moratorium was imposed on the killing of turtles, the taking or destroying of eggs, and the trade of turtle meat, eggs from 1995 to December 2000. The Department of Fisheries is hoping to extend this moratorium for a further period.

National Actions for Turtle Conservation in Fiji

In 1998, in recognition of the "Year of the Turtle", the Fiji Government in consultation with the University of the South Pacific and other non-government organizations, developed "The Fiji Sea Turtle Conservation Strategy". The Strategy is not formally adopted by government, but it is currently being used to manage turtle conservation efforts in the country. The strategy identifies the following actions for turtle conservation:

1. **Institutional capacity building –** To provide the personnel requirements for successful implementation of the strategies
2. **Limiting and regulating harvest –** To manage turtles in Fiji to allow a sustainable subsistence and ceremonial harvest (of certain species) whilst enhancing population of all species
3. **Education and awareness –** To communicate with target groups about national and regional situation concerning sea turtles in order to facilitate positive decisions leading to sea turtle conservation
4. **Marine conservation touring workshops –** To build community-based capacity for conservation management of sea turtles by means of dialogues, education and awareness and local participation in management activities
5. **Protection of nesting sites and nesting turtles –** To develop key turtle nesting sites to effect conservation of eggs, protection of nesting and conservation and sustainable use of these sites
6. **Protection of foraging areas and foraging turtles –** To manage the most significant foraging sites in such a way as to offer protection to foraging turtles and their habitat, and opportunity for research to be conducted that will assist management in the future
7. **Captive turtles –** To ascertain numbers and location of captive turtles and consider the role of captive turtles in management of sea turtles in Fiji
8. **Pollution –** To conduct research into pollution threats to marine turtles in Fiji Waters
9. **Bycatch –** To gain understanding of possible by catch of sea turtles from commercial fishing vessels operating in Fiji waters
10. **Regional Strategy –** To compile regional database as recommended in the Regional Marine Turtle Conservation Program.

POPULATION & DISTRIBUTION

Five of the seven species of turtle found globally are found in Fiji: green sea turtle *(Chelonia mydas)*, hawksbill *(Eretmochelys imbricata)*, olive ridley *(Lepidochelys olivacea)*, leatherback *(Dermochelys coriacea)* and loggerhead *(Caretta caretta)*. The green and hawksbill species are relatively common and are known to nest in Fiji. No data is available on the olive ridley turtle.

Hawksbill turtles

Hawksbill turtles *(taku)* are commonly observed on coral reefs where they feed on sponges, seagrass, ascidians and soft corals. The species is considered to be less migratory than others (Batibasaga, pers. comm.), although long distance migrations have been recorded for example, between Solomon Islands and north eastern Australia. One thousand hawksbills are thought to nest in the Pacific Ocean which includes a Fiji breeding population of approximately 120-150 (Batibasaga, pers. comm.). Known nesting sites include Heemskereq reef, Ringgold Reef, and the islands of Namenalala, Laucala, Leleuvia, Tavarua and Vatulele (Sue 1996; Guinea, 1993). The estimated numbers of adult hawksbill turtles for Fiji is estimated at 2-3,000. However, harvest for hawksbills has been high in recent years. Approximately 30,000 shells were exported during the 1980s with some 2,000 kg of shell exported in 1989 alone.

Loggerhead turtles

Loggerhead turtles *(tuvonu)* are uncommon in Fiji with recorded sightings in Nasese (Suva) Aiwa (Lau) and Taveuni (Guinea, 1993). The Department of Fisheries estimates that there are some 50-60 loggerheads in Fiji. There are no reports of nests, although there is anecdotal evidence of nests on Yadua Island. They are also known to nest in Kiribati, on the Southern Great Barrier Reef and adjacent to Australian mainland coastal areas, and southern New Caledonia. Loggerhead turtles feed predominantly on shellfish, crustaceans, sea urchins and jellyfish. Their distribution in Fiji is patchy and is likely to reflect both their preferred habitat and possibly the lack of hunting pressure.

Leatherback turtles

Leatherback turtles *(vonuda kulaca)* are the largest living species of sea turtle. They are also one of the rarest. They are not common in Fiji but there have been recorded sightings and four nesting attempts in Fiji (Guinea, 1993). Leatherback nesting and sightings have been recorded for Savusavu region, Qoma, Yaro passage, Vatulele and Tailevu. The number of leatherbacks in Fiji is likely to be around 20-30 individuals. Although the numbers are low in Fiji, the significance of the population is likely to be high due to the very low numbers in the region. Guinea (1993) suggested that most leatherbacks are merely passing through Fiji on westerly moving ocean currents, and may represent the remains of relic population. The threat of extinction both locally and internationally is therefore extremely high.

Green turtles

Green turtle *(vonu dina)* according to Guinea (1993) is the most prized food of the Fijians and is an important ceremonial gift. The only known nesting sites are located on the islands of Heemskereq Reef and Ringgold Reefs. The Department of Fisheries estimates that of the population of 4-5000, 30–40 green turtles nest in Fiji. The remaining ones are likely to nest in other parts of the Pacific. Green turtles feed primarily on seaweed and sea grass, and utilize the rich feeding grounds offered in Fiji waters. A tagging program by the Regional Marine Turtle Conservation Program (SPREP) has shown that male green turtles migrate between Fiji, French Polynesia, American Samoa and Eastern Australia.

WWF – FIJI CONSERVATION INITIATIVES

WWF's turtle conservation program in Fiji is in its initial stage. A strategy is being developed to integrate turtle conservation into community-based marine protected areas (MPA) in the Great Astrolabe Reef, Kadavu.

WWF has carried out marine conservation awareness programs targeted at customary resource owners, and will be working with them to establish an MPA to protect hawksbill turtle nesting site at Qasibale Island. As part of establishing an MPA, WWF will be assisting customary resource owners with an assessment of their current harvesting practices (traditional and non-traditional), and developing and implementing management measures to protect and conserve turtle populations in the area.

In Fiji, WWF is helping the customary resource owners of Ono Island to set up a community-based marine protected area (MPA). Local people have acquired new skills in monitoring the health of their reefs, and the use of fish poisons, destructive fishing practices and poor land-use practices has been outlawed. In addition, there is currently a ban on the harvesting of turtles within their MPA. To enforce the rules developed by the community, a number of villagers have been appointed and trained as honorary fisheries wardens.

Ono Islanders have rediscovered the art of weaving fish traps using local vines. They plan to introduce the traditional fish trap back into their community, slowly cutting down on the use of spear guns and other destructive fishing methods. Turtles are specially regarded and looked after in Waisomo. It is perceived that involvement with turtle conservation will be particularly meaningful for the Waisomo community (managers of the Ulunikoro Marine Protected Area) as the animal is the traditional totem for the village.

WWF will focus its conservation efforts on changing turtle harvesting practices of customary resource owners through education and awareness. It will work with communities to develop mechanisms by which communities can have a direct role in the conservation of turtles in Fiji.

LITERATURE CITED

Guinea, M.L. 1993. The sea turtles of Fiji. South Pacific Regional Environmental Programme. Apia, Western Samoa. Series No. 65.

World Wide Fund for Nature South Pacific Programme. 1996. A Fiji Sea Turtle Conservation Strategy. Report prepared for Fiji Sea Turtle Working Group, Fiji. Project no. 9P005.01.

WORKSHOP DISCUSSION

DR. HYKLE: Could you elaborate on the ban that was in effect apparently from 1995 to 2000, how effective was it?

MR. BATIBASAGA: Fiji government wants to change the perspective that the region of Fiji, next to Solomon, was the biggest killer of sea turtles. That originates from the turtle trade with the Japanese before 1990. In 1990, we had a ban on hawksbill shell trade from Fiji. The moratorium, as I see it, serves as an education and an awareness tool. Before the moratorium Fijian people or coastal indigenous communities were not aware that something was wrong with the turtles because traditional take with them, they've been doing that for 1,000 years. A problem is when you equate that with commercial harvest and unregulated commercial harvest and next to that when traditional harvest or subsistence is unregulated, then that becomes a problem. It served as a stepping stone to move forward on the sea turtle conservation.

MR. BALAZS: In the latter part of 2000 we worked with the Marsters' (phonetic) family at Palmerston Atoll in the Cook Islands. Some of you may be well aware of the history at Palmerston and the settlement of the middle 1800s and their tradition of rearing turtles and looking after nesting turtles and also eating nesting turtles at Palmerston. Bill Marsters was able to deploy a satellite tag in December 2000 and the data was fed through our program here in Honolulu to the World Wildlife Fund in Rarotonga and Jackie Evans

used it in educational programs. It was an amazing track. It went a couple thousand kilometers across, through Tonga and right to Vanua Levu Island in Fiji, the northern end, where obviously, it was her home pasture and she stayed there for months and months with excellent transmissions coming from here. Due to the good work of Aisake and others in Fiji, they got press releases out. This turtle had been named Mamma. Mamma Marsters Honu is the local name for their green turtles there, and word was put out if anyone saw this turtle with the transmitter, please don't kill it, and Aisake was responsible for the wonderful publicity at that end. The transmission ended in a reasonable fashion at about six or seven months of time and there is every reason to believe the animal is still well, living off the northern end of Vanua Levu. The Marsters family are eager to see if the turtle will come back again, will she still be alive to come back again either this nesting season or the next.

DR. LIMPUS: We just recently had a tag recovery from a turtle nesting in the Southern Great Barrier Reef from Northeast Fiji, as well, only that one went to the market.

DR. MORITZ: Part of the problem with trying to control the commercial harvest is because of the dual ownership, do you think it would it be more effective if more of the control of the resource was in the hands of the local communities? Is the commercial harvest from people in the local communities on their piece of land or are other fishermen coming in from other communities under the state rights?

MR. RUPENI: Commercial harvest only happens in the open sense. So most of the other rural areas really don't have access to the markets. In terms of the ownership, yes and no, because most of the commercial people that are selling turtles will be the Indian fishermen who have been given a license from the government. So that is an issue of ownership, obviously. For the traditional owner, it will provide them more incentive to come and sell their turtles. So that is why we are seeing it as a threat. If they start selling it commercially, then a lot of traditional Fijians, who own the traditional fishing grounds, will start harvesting for commercial. Right now they're not really into commercial harvesting. So it's just in Sua City that there actually is commercial harvesting. This is pretty much controlled by the fisheries now, who go out and police illegal selling of turtles.

Partnerships in Turtle Conservation: A Case Study at Ma' Daerah, Terengganu, Peninsular Malaysia

Dionysius S.K. Sharma[1] and Lau Min Min

INTRODUCTION

Marine turtle conservation in Peninsular Malaysia has had a long history, dating back to the 1950's. Hatcheries managed by the Department of Fisheries Malaysia (DoFM) have produced thousands of leatherback turtle *(Dermochelys coriacea)* hatchlings from eggs bought from licensed egg collectors. In support of this effort, WWF Malaysia has been assisting the DoFM in conservation efforts, particularly in the State of Terengganu, and support intensified in the late 1980's. Whilst collaborative work has been conducted in the past, no attempt was made to formalize a partnership and to strategize on approaches and define long-term conservation objectives.

A relatively recent turtle conservation initiative has been at Ma' Daerah, Terengganu. Ma' Daerah is 1.7 kilometers (km) long and together with three other beaches in the Paka-Kertih area has about 200 to 250 clutches of green turtle *(Chelonia mydas)* eggs produced per year. There have been instances of leatherback and olive ridley *(Lepidochelys coriacea)* turtles nesting here, however, green turtles are the main species that use this beach for nesting. The status of marine turtle egg production at Ma' Daerah, in relation to coastal development in the area, has been reported by Sharma (2000). Egg production from 1997-2001 is presented in Table 1. As with many places in the world, amongst the biggest threats to turtles in Peninsular Malaysia, especially the east coast, is the issue of incidental catch in various kinds of fishing gear and human collection and consumption of turtle eggs. Although marine turtle conservation in Peninsular Malaysia has had some successes over the decades, new threats continue to emerge and threaten conservation efforts and the survival of the species.

This paper briefly describes how the Department of Fisheries Malaysia has established a partnership with BP [British Petroleum] and WWF Malaysia in their endeavors to conserve green turtles at Ma' Daerah. Programmes and activities conducted are briefly presented. The application of such partnerships as a model for marine turtle conservation in Peninsular Malaysia is discussed.

Table 1: *Turtle nests and eggs harvested at Ma' Daerah between 1997-2001*

Year	Leatherback turtle		Green turtle	
	Nests	Eggs	Nests	Eggs
2001	0	0	209	20,133
2000	0	0	93	8,853
1999	2	145	107	8,221
1998	4	254	142	11,618
1997	0	0	105	9,688
Total	6	399	656	58,513

(Source: Department of Fisheries Malaysia)

BACKGROUND: THE LAW AND EGG COLLECTION

The Fisheries Act 1985, allows the various states in Peninsular Malaysia to draw up their own rules and regulations regarding turtle conservation. This has led to a lot of inconsistency between the states. Some states have laws that are more proactive in protection of turtles whilst other states merely regulate exploitation. In Terengganu, the Turtle Enactment (1951) Amendment (1987) is the state law that affords protection and management of turtles and their eggs. In all states, interested parties may apply for licenses to collect eggs. In the State of Terengganu for example, for two to three thousand Ringgit Malaysia (RM 3.8 = 1 U.S. dollar), one can win in a bidding system managed by the State Government and have the exclusive egg-collection rights for a section of beach. The price paid often depends on previous years' nesting trends. The exclusive rights to collect eggs for a given beach may be for a 2-3 km stretch. Conditions are attached to the rights and are served in writing and orally to the egg collectors. For example, of all the eggs harvested, 70% are to be sold to the government to be incubated state-run hatcheries. As such, 30% may end up in the open market for human consumption. There are exceptions to this, however. In the States of Terengganu and

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Pahang, laws established in the 1990's prohibit the sale of leatherback eggs. All eggs harvested must be sold for incubation purposes. There are, however, not enough monitoring of rules and regulations by DoFM due to limited staff and financial resources. In some places it would appear that approximately 30% of eggs harvested end up in hatcheries and 70% goes to market. From the egg collectors' point of view, there are no incentives to sell eggs to the state-run hatcheries. Egg collectors usually get paid several months later by the state. On the contrary, they get paid in cash immediately for eggs sold to middlemen traders for the open markets. Additionally, prices paid by traders are often higher by RM 0.20-0.30. Eggs are generally sold at RM 1.50 per egg. Today one can easily see green, olive ridley and hawksbill turtle eggs in markets although volumes of eggs traded are no where the levels of decades ago. On a more proactive side, the DoFM uses administrative regulations to try and ensure that licensed egg collectors sell all olive ridley eggs to the Department for incubation purposes.

BACKGROUND: DEVELOPMENT AT PAKA-KERTIH IMPACTING MA' DAERAH

The Paka-Kertih area has undergone quite rapid development for the petrochemical industry. There are at least 17 industrial sites around the Kertih area, encompassing some 600 hectares of land and these have been in operation since the 1990's. The types of industries include those related to petroleum/gas, polyethylene/ethylene production, paraxylene/benzene, production, engineering works, vinyl chloride production, acid acetic production, glycol and olefin production. This has created a series of additional threats to sea turtle populations over the last couple of years. The beach is now very brightly lit up in the nights by the burning of flue gas at the petrochemical plants. What used to be an undisturbed dark beach has in relatively few years been transformed into a brightly-lit area. Driving along the coastal road at night at Kertih one can't help but compare the brightly-lit industrial area to a Christmas tree. Beaches that once used to be productive in terms of turtle nesting has seen severe declines in recent years (Sharma, 2000). For purposes of laying pipes underground for transporting oil and gas, there's been a lot of beach activity which has compacted the sand resulting in many false crawls (unsuccessful attempts to nest). Additionally, one of the biggest problems affecting turtles using the area to nest and feeding off the coast is solid waste disposal, both land and sea-based. With the subsidence of the North-east monsoon, the beaches at Paka-Kertih are heavily laden with solid wastes, polluting some of the last remaining nesting beaches. Another problem that has been seen to impact turtle species is unregulated tourism development. Whilst the famous leatherback turtle nesting beach Rantau Abang has been extremely popular amongst foreign tourists in past decades, the decline in the nesting population, down to less than five animals has led to the decline in tourists. With very few good nesting populations on mainland Peninsular Malaysia, the green turtle population at Ma' Daerah is now fast growing as an important tourist attraction, particularly to the guests in nearby local hotels. This in itself is obviously not a threat, but tourists need to be regulated, managed and controlled such that nesting turtles are not disturbed, as has been the case at Rantau Abang.

ESTABLISHING PARTNERSHIPS FOR TURTLE CONSERVATION

The partnership to conserve green turtles at Ma' Daerah began when the Department of Fisheries Malaysia (DoFM) realized that working alone, it could not achieve the desired conservation results. The DoFM realized that it had to bring on board partners such as WWF Malaysia and BP. It was quickly realized that if these agencies got together and formed a partnership, something positive could be done at Ma' Daerah that may actually be a move forward for marine turtle conservation. This led to the establishment of Ma' Daerah Turtle Sanctuary Centre in June 1999 with the support of the Terengganu State Government. The Centre currently comprises a very modest, small operation with an interpretation center and basic hatchery facilities.

CURRENT MANAGEMENT FRAMEWORK

Ma' Daerah Turtle Sanctuary Steering Committee

A Ma' Daerah Turtle Sanctuary Steering Committee was established in 1999 to facilitate and oversee the conservation and management programmes at Ma' Daerah (Table 2). This Committee also facilitates stakeholder consultation and serves as a platform to address conservation issues and identify practical solutions. The committee has and will meet at least once a year. The list of members below is not exhaustive and will include new partners with the expansion of turtle conservation effort to Paka-Kertih area.

Table 2. *Ma' Daerah Turtle Sanctuary Steering Committee*

Stakeholders	Role
BP Sdn Bhd	Sponsor and Ma' Daerah Working Committee member
BP Petronas Acetyls Sdn Bhd	Sponsor and Ma' Daerah Working Committee member
Department of Fisheries Malaysia	Agency for the management and enforcement of fisheries-related activities and marine ecosystem, and Ma' Daerah Working Committee member
WWF Malaysia	Technical support agency; facilitation of education programme, and Ma' Daerah Working Committee member
Marine Research Institute/ South-east Asia Fisheries Development Centre	Main agency in carrying out research in marine and fishery-related fields
Kemaman and Dungun District Education Offices	Key co-operating agencies in ensuring the success of the Turtle and Terrapin Education and Awareness programme
Dungun and Kemaman Fisheries/Fishermen Associations	Community groups utilizing the same habitat as marine turtles and terrapins; affected by some of the similar threats facing marine turtles
Kemaman District Office	Key agency responsible for planning and administering development at the district level
Kemaman District Forestry Office	Supervises forest management; enforces regulations; important support towards protection of Ma' Daerah hills
State Economic Planning Unit	Key agency in land-use planning within State land area
JKKK (village committee)	Support group to encourage community participation in turtle conservation efforts at Ma' Daerah
Kemaman and Dungun District Education Offices	Key co-operating agencies in ensuring the success of the Turtle and Terrapin Education and Awareness programme
Dungun and Kemaman Fisheries/Fishermen Associations	Community groups utilising the same habitat as marine turtles and terrapins; affected by some of the similar threats facing marine turtles

Ma' Daerah Turtle Sanctuary Working Committee

A Working Committee comprising BP, BP Petronas Acetyls, DoFM and WWFM was established in 1999. This committee meets periodically to develop, implement, monitor and evaluate all conservation and management programmes at Ma' Daerah and present development plans to the Steering Committee for endorsement. As with the Steering Committee, this committee will include new partners in the Paka-Kertih area.

Ma' Daerah Turtle Conservation Trust Fund

The Trust Fund was jointly set-up in 2000 by WWFM, DoFM and BP within the framework of WWFM as a reputable charitable trust. Its purpose is to facilitate management and administration of the financial aspect of Ma' Daerah programmes. All funds raised from various sources will be disbursed for various programmes supporting turtle conservation at Ma' Daerah area. OPTIMAL support will be part of this fund and will also undertake the responsibility of authorizing the disbursement of the fund.

PROGRAMMES AND ACTIVITIES AT MA' DAERAH

The Ma' Daerah Turtle Sanctuary conservation efforts consist of a small hatchery; education and interpretive materials (posters and pamphlets in the local language) that explain the issues in the state and more specifically to Ma' Daerah. A turtle awareness kit is being developed by WWF Malaysia. The turtle awareness kit includes a series of slides and text that is going to be used to train the fishery staff in all states of the country to communicate turtle conservation methods to local communities. WWF is responsible for the educational awareness program; the Department of Fisheries Malaysia does the research; and BP provides some of the necessary funding necessary to make conservation work possible.

The education and awareness program is directed at school age children which are brought to the sanctuary and are taught various things, both in a classroom setting and in the field. In Malaysia there has been a very long tradition and history of egg consumption. Thus the education component is directed a children because it is felt, that if there is to be any hope for the turtles, then educating the young generation would be a step in the right direction. A 'Volunteer Program' and a 'Weekend with the Turtles Programme' was also initiated, and they are responsible for a wide range of both education and research activities. Turtle adoption and nest adoption is open for public support and for a small fee that goes into the Trust Fund members of the public can contribute to the costs of management and research. In addition the local community gets involved prior to every nesting season to clean up the beach for the turtles.

In having worked with children, the next step in community education is to reach out to the fishermen. Education sessions have already begun, and interviews have been conducted to quantify the incidental capture of turtles in fishing gear. This project is expected to continue and hopefully work to build support from the local communities.

WHAT LIES AHEAD: THE MAIN CHALLENGES

The largest obstacle towards conservation efforts at Ma' Daerah is the lack of financial resources and the fact that the area is not legally gazetted as a protected area, both land and offshore. Programs such as the volunteer program, adopt a turtle and adopt a nest have been set up to raise money for the Ma' Daerah Trust Fund. At this time, the money is being used to employ a Sanctuary Manager to manage the sanctuary, volunteers and programs. But certainly, we look forward to getting financial support from wherever we can to support the sanctuary, education and hatchery research. The partners are now developing a Ma' Daerah Management Plan and will use this document to demonstrate to the Terengganu State Government that turtle conservation need not be at the expense of development at Ma' Daerah. With the possibilities of managed tourism or 'eco-tourism' Ma' Daerah can be used to generate income that can be used for conservation work. With dwindling sea turtle nesting numbers throughout the country, the State may realize that it is not too late to expedite conservation efforts. Partnerships such as that established at Ma' Daerah can be replicated elsewhere in the country and there are opportunities to do so in other parts of Terengganu, Perak, Pahang and Melaka. With a sound Management Plan that can function as a living document, and one that takes note of new developments in our understanding of turtle ecology and management, there will be hope for the green turtles at Ma' Daerah.

LITERATURE CITED

Sharma, D.S.K. 2000. Impacts from development, nesting population trends and the future of marine turtles at Paka-Kertih, Terengganu. In: Kalb, H. and Wibbels, T. (Compilers). Proc. of the 19th Annual Sea Turtle Symposium. NOAA Tech. Memo. NMFS-SEFSC-443. pp. 88-92.

WORKSHOP DISCUSSION

DR. PILCHER: Is the number of licenses that are bought by people on the beaches increasing or decreasing over the years?

MR. SHARMA: There are two systems that are applicable to the peninsula because of the different state laws. In the state of Terengganu, the system is such where you call for a meeting and people pay for a license for a specific stretch of beach. Over the past two decades, all beaches that were offered for tenders were taken out. But recently, out of the 43 stretches of beach that one can apply to get exclusive rights, there were only 16 takers because people realize that there aren't many turtles nesting and it was just not worth it to pay a sum of money up front and hope to sell eggs to make their money back. But in the state of Melaka on the west coast, it's a different problem. One pays five ringgits for a license and you can collect eggs anywhere you want. But yes, in general it has been decreasing. What has happened now is the Department of Fisheries suddenly has the responsibility to manage the beaches, that earlier was managed by the licensed egg collectors.

MR. DERMAWAN: The federal government is to protect the turtle, but yet when it comes to the beach the government cannot do anything for that. So how is the correlation between stiffer regulation and federal regulations, are they linking the concession for turtle egg harvest by the local government? Any concessions for egg collection by the government?

MR. SHARMA: If I recall correctly, Agus is asking me to try to explain if there is any strategy between federal legislation and state legislation, as far as marine turtles are concerned. And if there are any concessions for egg collection at the state level.

In Peninsular Malaysia, the Federal Fisheries Act of 1985 allows for the states to draw up their own rules and regulations, as far as turtle management is concerned. This has been because even before Malaysia was formed as a country, certain states already had regulations regarding turtle management. And as I mentioned earlier, these are primarily regulating exploitation. The State of Perak, for example, has laws from1915 that one-third of the eggs could be taken for human consumption, one-third of the eggs had to be submitted to the Sultan of the Perak State and one-third of the eggs would go into conservation. But when the federal legislation was drawn up they decided to let all the states have their own rules and regulations. To answer your question, the Department of Fisheries and WWF have drawn up a

new model legislation, as we call it, and we're trying to get it passed through the Attorney General's Chambers and get it adopted by all the states so we can be consistent. It focuses on conservation rather than exploitation. In essence, it calls for the ban of human consumption of turtle eggs.

So the second part of the question is yes. As the states create their laws or rules and regulations, it is their purview to decide what percentage of eggs harvested must be sent to the hatcheries. But that has been fairly consistent. All of the states have basically said 70 percent must be sent to the government hatcheries, 30 percent can still be sold in the open market, but only for hawksbill, greens and olive ridleys because for the leatherback in 1990 they had a total ban irrespective of each state.

Left: Dr. Christofer Boggs, *Right:* "Involving Fishermen in Research" working group.

A Review of Turtle By-catch in the Western and Central Pacific Ocean Tuna Fisheries[1]

Dedrie Brogan[2]

EXECUTIVE SUMMARY

The western and central Pacific Ocean (WCPO–Pacific Ocean west of 150°W) currently supports the largest industrial tuna fishery in the world, with much of the catch coming from the Exclusive Economic Zones (EEZs) of Pacific-Island countries. Marine turtles may be taken as by-catch within this wide area.

This review focuses on the issues of incidental marine turtle catch in the WCPO tuna fisheries based on information currently available to the Oceanic Fisheries Programme (OFP) of the Secretariat of the Pacific Community (SPC). Various forms of tuna fishery information and data held by the OFP have been compiled, analyzed and presented in a form providing some indications of the extent of marine turtle encounters in the WCPO tuna fisheries.

The review uses three sub-areas of the SPC Statistical Area, the western tropical Pacific (WTP, 10°N–10°S), the western sub-tropical Pacific (WSP, 10°S–35°S) and the western temperate Pacific (WTeP, 35°–45°S), to describe marine turtle by-catch in the WCPO tuna fisheries (Fig.1).

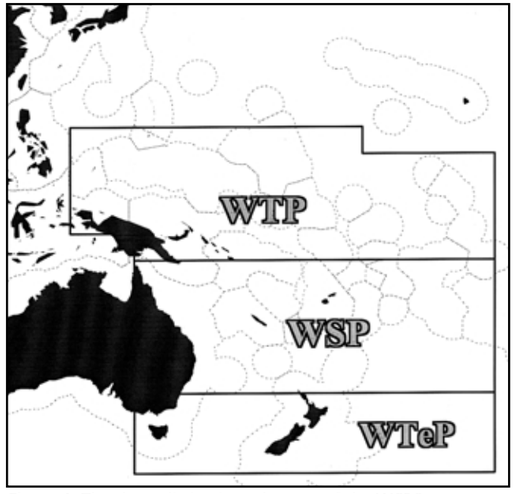


Figure 1. *The three distinctive sub-areas of the WCPO.*

Annual tuna catches in the WCPO have averaged about 1.5 million metric tones over the past decade. Around 60% of the catch is taken by purse-seine vessels which comprises a fleet of more than 200 purse seine vessels that set large nets around entire schools of tuna. These vessels operate almost exclusively in tropical waters (i.e. 10°N–10°S), originate from a variety of fishing nations and catch a high-volume product (mainly skipjack and yellowfin) for the canned tuna market.

A fleet of several thousand longline vessels catch individual tuna on anywhere up to 3,000 baited hooks per line (Fig. 2). These vessels operate throughout the waters of the WCPO from around 45°N to 45°S with their catch mostly destined for the high-priced Japanese sashimi markets. This review concentrates on marine turtle by-catch in the longline and purse seine fisheries, as by-catch in the other fisheries is either considered non-existent (e.g. pole-and-line, troll) or there is no information available (e.g. ring-net).

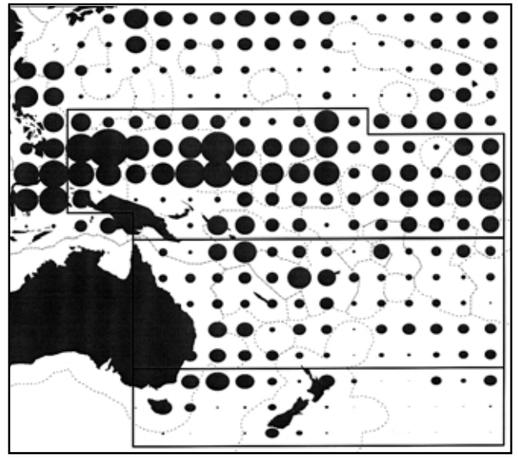


Figure 2. *Longline fishery effort in the WCPO (larger circles indicate greater effort).*

Information from studies elsewhere suggests that marine turtles spend some part of their life cycle in the epipelagic layer of the open ocean. Interactions with

[1] *A report prepared for the South Pacific Regional Environment Programme (SPREP) by Oceanic Fisheries Programme, Secretariat of the Pacific Community (SPC), Noumea, New Caledonia.*
[2] *Presenting author*

tuna fisheries are therefore thought to occur during the period when they are in the open ocean, drifting with or without debris and prior to association with inshore feeding grounds. Certain species of marine turtles are more prevalent in oceanic waters than others. Marine turtles rely on their visual senses in their search for food, but need to surface at regular intervals to breathe. They also exhibit some preference for distinct thermal regimes. These basic attributes have certain implications for potential interaction with tuna fishing gear.

Incidental catch in the longline fishery occurs when opportunistic-feeding marine turtles encounter baited longline hooks or when they are accidentally entangled with the longline gear (Fig. 3). Turtle mortalities, when they occur, are directly related to entanglement or hooking with the longline gear and typically result from drowning. Marine turtles that are hooked or entangled not long before being hauled on board normally survive. Statistics on the life status of the marine turtle encounters varies by area and no conclusions can be drawn from the available data at this stage. There have been only rare reports of marine turtles being kept for crew consumption on longline vessels as most of the observed catch was typically released. It is worthy to note that improving crew awareness and handling has contributed to reducing marine turtle mortalities in the Hawaii-based longline fishery.

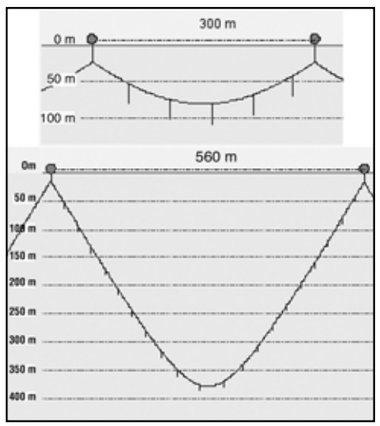


Figure 3. *Longline gear set.*

Observers have covered most of the fleets throughout the SPC Statistical Area with at least one trip, despite the overall low coverage level (<1%). The three longline fleets, for which observer data collection (in regards to marine turtle encounters) is currently lacking, and therefore of some priority, are the Japanese and Korean distant-water longline fleets operating in the eastern areas of the WCPO, and the recently-established Australian swordfish fishery operating in waters off the eastern Australian coast (i.e. WSP).

Observer-reported encounters clearly show that tropical areas have more turtle encounters. Of the various factors thought to affect the level of marine turtle encounters in the WTP longline fishery, the depth of set appears to be the most important. Analysis of available observer data suggests that the bait used, and whether the gear is set in the water during the day or night, does not have as marked an effect as do the strategies to set the longline gear shallow or deep. Estimates from observer data and studies elsewhere (e.g. the Hawaii-based longline fishery) show that marine turtle encounters on shallow-set vessels are an order of magnitude higher than encounters by those vessels utilizing the deep-set strategy. Analysis of the observer data also shows that when marine turtle encounters occurred on deep-setting vessels, they were almost always on the shallowest hooks. *This suggests that there is probably a critical depth range of hooks where most marine turtle encounters would be expected to occur in the WTP longline fishery.*

A very preliminary estimate of 2,182 marine turtle encounters per year in the WTP longline fishery has been determined from available data, of which an estimated 500–600 are expected to result in mortality given the current level of awareness in this fishery. This estimate, however, is expected to have wide confidence intervals since observer coverage has been very low (<1%).

Marine turtle encounters in the purse seine fishery occur when turtles are found within the pursed net after the operation of encircling a school of tuna. Marine turtles are frequently found near logs and other drifting debris, attracted by the diverse prey items in the vicinity and the protection the debris offers. Purse seine vessels search for, and set on, tuna schools that are often associated with drifting debris.

Turtle mortalities in the purse seine fishery, when they occur, are due to drowning as a result of entanglement in the net or, in rare instances, to being crushed during the process of loading the net on-board. In most cases, turtles are encountered alive in the net and are subsequently scooped up and released over the side. Observers reported a 17% mortality rate in the WCPO purse seine fishery, but a breakdown of factors for mortality was not possible with the available information.

Marine turtle encounters in the purse seine fishery appear to be more prevalent in the western areas of the WTP. The main factor affecting marine turtle encounters in the WCPO purse seine fishery is set type. Animal-associated, drifting log and anchored-FAD sets have the highest incidence of marine turtle encounters, compared to drifting FAD and sets on free-swimming schools (unassociated sets).

A very preliminary estimate of 105 marine turtle encounters per year in the WCPO purse seine fishery has been determined from available data. It is expected that less than 20 of these encounters would result in mortality given the current level of awareness in this fishery. As with the WTP longline fishery, this estimate has wide confidence intervals since observer coverage is less than 5%.

The review suggests specific measures that might mitigate turtle by-catch and mortality, identifies gaps in the present knowledge-base and recommends where future work might be directed. Specific recommendations include: (i) the introduction and adoption by Pacific Island countries of a formal mechanism to advise all (longline and purse seine) fishing fleets of their responsibilities regarding the live discard of protected species, and (ii) the introduction of initiatives focussing on crew awareness and training in regards to reducing marine turtle mortalities.

Please contact the WPRFMC or SPREP to obtain a full copy of this report.

WORKSHOP DISCUSSION

DR. BOGGS: When you talk about a shallow bigeye fishery, is that a night fishery?

MS. BROGAN: That will be in the tropical area. We have different fleets. We've got like the Japanese fleet and the Chinese fleet, and the Chinese tend to do a shallow set. We also have the Japanese in the same area doing a deeper set. But they're targeting the 15 degree isotherm and that's much shallower up in the tropical areas.

DR. BOGGS: I guess there is a Chinese bigeye fishery in shallow waters, but I thought the Chinese fishery fished at night.

MS. BROGAN: The Chinese fish differently to the Japanese. In fairness, you're right to be surprised. The numbers of bigeye they catch are considerably lower than the Japanese fleet, but they continue to set. They set their line at nighttime and they haul it during the day, which is in direct contrast to the Japanese fleet. But probably most of the turtle interactions are from that fleet.

DR. BOGGS: I just can't imagine catching bigeye at those depths during the day.

MS. BROGAN: They catch very few bigeye, in fact, but they continue to do it.

MR. DALZELL: I was just going to make a comment. This profiling of fleets I think is extremely important. A chap called Tim Parks from the Federated States of Micronesia, which has virtually every nationality of fishing fleet, has actually done this, has actually profiled the different vessels, their characteristics and how they fish. Of course, this has direct bearing on if you're going to try to look at mitigating interactions. The report that he generated is a confidential one, but I'll check on that if people want to get copies. I'll check with Tim and see what can be disseminated.

Fishers and Sea Turtle Research

Carolyn Robins

INTRODUCTION

This report presents the lessons learnt from a sea turtle monitoring program conducted in the Australian Northern Prawn Otter Trawl Fishery, before and after the introduction of Turtle Exclusion Devices (TEDs) in order to evaluate their effectiveness. Trained fishers reported sea turtle captures from July 1998 to June 2001: 1.5 years before TEDs became mandatory and 1.5 years after.

Without the help of volunteer fishers this project would not have been possible. One of the main advantages of enlisting fishers in these types of projects is the low cost. This project cost a fraction (less than 10%) of the estimated cost of the project if observers were to be employed for the same length of time. Many additional advantages became apparent throughout the running of this project. Particularly obvious was the improvement in cooperation between scientists and fishers. This resulted in an improvement in understanding, both for the fishers and the scientists. Fishers gained an appreciation of the difficulties of scientific research and scientists gained an appreciation of the role of fishers. It is hoped that the cooperative relationships cultivated by this project will benefit the level of cooperation for future research projects involving this industry.

PROGRAM OUTLINE

Volunteers

Initially volunteers were called for from the fishing fleet with faxes and messages on the Vessel Monitoring System (VMS) sent to all vessels. Their position on the boat was considered irrelevant: fishing masters, crew, cooks or engineers were accepted. Enthusiasm and genuine interest in sea turtle conservation was the main criteria. Throughout the project, participants were asked to recruit other fishers who found the project interesting and wished to become a part of it.

Observers

Throughout the years of the project there were various other bycatch projects conducted in the NPF some using observers to record bycatch rates. Sea turtle data were obtained from these projects and used by us. This data allowed us to compare verified observer catch rates with unverified fisher catch rates.

Workshops

The training workshops were fundamental to the success of this project. The taggers were taught all the necessary skills in handling, measuring, tagging (Fig. 1) and resuscitating sea turtles as well as scientific data collection procedures. Turtle identification skills were taught with a short lesson on reading species identification keys followed by practice and finally testing on preserved turtle shells. Measuring, tagging and handling skills were taught in a similar way – practice on real turtles – preserved and live, when possible.

Figure 1. *See turtle tagging.*

Data recording procedures were explained during classroom sessions with informal testing throughout the day and at the end of the workshop. During the first workshop we found that written tests were not the most suitable method to check that taggers were clear on procedures. In order to adequately test the taggers the exams needed to be long and quite arduous for some of the volunteers. We felt an informal approach was more

suitable as it was less intimidating than a 'formal exam.' A common request given in feedback questionnaires after each workshop was that they would prefer less classroom training and more fieldwork. Workshops in the second and third years included method and data reviews.

Sea turtle biology and conservation was presented to increase the volunteer's appreciation and awareness of the global nature of bycatch problems, principally with respect to sea turtles. Many of the taggers expressed a keen interest to learn more about sea turtles and readily participated in discussions on all aspects of sea turtles including behavior, stock status and migration.

Provision of Equipment

The provision of equipment was important in allowing taggers to work efficiency. We found that the taggers must have everything that was needed easily accessible or they could not carry out their tagging duties. They were therefore provided with a backpack with all the equipment, plus spares when possible. It was not easy to provide extra equipment when supplies were depleted during the season so the taggers were given an excess of what we though as adequate for items such as turtle tags, pencils, data sheets and cameras.

Pre- and Post-season Contact

Before the start of the season each year AFMA personnel contacted each tagger to check for any problems, re-fill their tagging kit and ensure any changes to the procedures was understood. This was undertaken either by port visits or over the phone. Ongoing support was available.

Recording Procedure

During the fishing season the taggers decided at the start of the day if they would be recording turtles on that day. This was noted on the data sheet. Daily vessel information was also completed if possible, this included latitude and longitude, hours fished, number of shots, time of shot away and winch up. If this section was unable to be completed then data was taken from skipper logs. The procedures changed slightly each year to accommodate suggestions made by the taggers and to improve the data collection process. The aim was to enable taggers to complete the project requirements without impeding on their routine fishing duties.

When possible the turtle was tagged (inside front flipper with QDoE titanium turtle tags), measured, accessed for health and injuries and released if either healthy or dead. If the turtle was comatose it was kept on deck for up to 24 hours in the recovery position.

Data sheets were either posted or faxed throughout the season or at the end of each season. We found that data sheets were lost very easily once the boat returned to port and needed to be collected over the season rather than left until the end of the season.

The importance of remaining flexible was apparent throughout the project. In order to be able to tag and report on turtles while also completing their own work each tagger tended to adopt their own procedures within the general guidelines. We needed to be supportive of their own methods while ensuring they met our requirements and be aware that these taggers were not our employees but rather being paid by the fishing company. Initially, the data sheets were examined in detail and if any information was not clear the tagger was called and queried on the methods used. Once a set of general 'rules' was established for each tagger it was relatively straightforward to interpret data correctly.

Encouragement Rewards

We gave various gifts to participating taggers. T-shirts, caps, stubby holders, mugs and jackpot cash draws were not designed to only provide incentives to keep taggers in the project but also as a sign of our appreciation for their contribution. A tag reward consisting of a stubby cooler and a cash prize was provided to other fishers from the fleet returning tags. We felt that encouragement rewards were a contributing factor in the success of the project.

An additional advantage of these rewards was that they were also promotional material. All items, except cash, were printed with the project logo so were readily visible around the fleet. This could possibly promote discussions between crew members on sea turtles and encourage other fishers to become a turtle tagger.

Figure 2. *In-field data collection by Fishers.*

Identification Skills

The taggers proficiency at turtle species identification ranged from incompetent to proficient, even though all taggers demonstrate this ability at workshops. This skill was able to be tested using photographs of turtles taken with disposable cameras (Fig. 2). Not all taggers, however, returned cameras making it impossible to determine their identification skills. Out of 18 taggers, 7 were considered to be proficient with very few errors made (at least 90% accuracy), 3 regularly made errors (less than 90% accuracy) and 8 didn't provide enough verifying photographs to determine their level of identification skill (at least two of each species correct). The latter group of people is an issue, as photographs may not have been returned because they were unsure of their own identification skill. In future projects it may be advantageous to exclude identification of turtles by taggers and completely rely on photographs. This would remove the problem of taggers feeling the pressure of identify turtle species incorrectly and consequently they may be more likely to photograph all turtles.

We found the use of disposable cameras to be invaluable in determining the correct species identification and given the high level of incorrect identifications this was particularly important. Photographs may also become significant if turtles are recaptured and a comparison of visible injuries can be made. The problem of unreturned cameras, however, should be addressed in future projects that require fishers to identify species.

Tagging

Although not fundamental to the results from this project the tagging of turtles was, nevertheless, an important component of the study. The fishers, or taggers, liked the hands-on work involved with tagging sea turtles rather than simply recording numbers of turtles caught. Also, they felt that they were contributing to important research on a far wider basis than just counting turtles caught in their own fishery. A further advantage of the tagging component of this study as being able to report back to the taggers if any turtles they tagged was recaught elsewhere. It is our opinion that without the tagging component this project would have had a lower chance of success with respect to maintaining fisher involvement over the whole project.

Extra Information Provided by Taggers

Taggers provided, in many cases, a description of any thing about the turtles that they considered might be relevant, including both old and new injuries. This information may be useful if the turtle is captured again and injuries compared. Fishers also made efforts to

Figure 3. *Sea turtle in resuscitation position.*

resuscitate turtles when necessary (Fig. 3), although not mandated by the project.

Validity of Results

We consider the results from this project to be valid for a number of reasons, including:

- Fishers were volunteers and exhibited a genuine interest in, and appreciation of, sea turtles;
- Observer records were used to validate the results;
- Ultimately the results could not harm their fishery as TEDs became mandatory in 2000 irrespective of the results of this project.

WORKSHOP DISCUSSION

MR. SEMAN: With regards to the data not impacting on the fishery, how is that in regards to the government's management efforts? I guess I'm trying to relate this to the Hawaiian longline, where they provided as much data as they can in cooperation with research, and then based on that data the federal government used this against them to close the fishery.

MS. ROBINS: I think that was probably a test case, and fishermen know if there is a risk they're not going to take that risk. Unless it is actually forced on them, as in observer coverage, I don't believe you can send fishermen back out onto their boats and ask them to volunteer and record something that would wreck their livelihood in the future. If you can have projects, for example tagging projects, which do not actually record the number of turtles caught, but one where they could tag a turtle and release it, this is a different case. But when you're actually using how many turtles are caught by the fishery, which ultimately might close that fishery down, I don't believe you would have good answers.

DR. CRAIG: Did you solicit information, like mortality?

MS. ROBINS: Yes, mortality was a part of it. We found that 21 percent of the turtles that were caught ultimately died. A similar project was conducted in 1990, where they found a 39 percent mortality ten years ago. The difference was that around 20 percent of the mortality in that previous project ten years ago was due to comatose turtles being returned to the water, where they ultimately died. If comatose turtles from this study were returned to sea rather than kept aboard it would give a 40 percent mortality. Now, however, comatose turtles are never returned to the water. They are kept until they are determined dead or alive, and that has kept mortality at 21 percent.

DR. LIMPUS: Would you like to comment on what we learned in the pre-introduction of TEDs versus post-introduction of TEDs as to what happened with the turtle capture.

MS. ROBINS: The data is still being analyzed, but I have the raw figures here. Before TEDs, there were around 5,000 turtles caught per year. There is a 20 percent mortality, which meant around a thousand turtles killed per year for the Whole fleet. After TEDs we had 1,000 observer days or tagger days, and they caught 14 turtles. A simple math adjustment gives around 200 turtles per year and it has the same mortality as pre-TEDs, about 40 turtles dead. So that is about 1/25th of the catch before and after TEDs.

New Research & Current Information

Top left: Tran Minh Hien,Vietnam
Top: I-Juinn Cheng, Taiwan
Top Right: Dionysis Sharma, Malaysia.
Bottom: Comments from Karol Kisokau, PNG.

Marine Turtle Conservation in Papua New Guinea

Miriam Philip

ABSTRACT

Six species of marine turtle have been documented in Papua New Guinea (PNG) waters. These include *Dermochelys coriacea* (leatherback turtle), *Chelonia mydas* (green turtle), *Natator depressus* (flatback turtle), *Eretmochelys imbricata* (hawksbill turtle), *Lepidochelys olivacea* (olive ridley) and *Caretta caretta* (loggerhead turtle). Available information indicates that flatback turtles are known only in the Gulf of Papua while other species are distributed throughout PNG's waters. Despite the wide distribution of marine turtles and numerous sandy beaches along PNG coastal areas, nesting is restricted to only certain sites.

The Government of Papua New Guinea recognizes the importance of conserving marine turtles by regulating the trade of all the six marine turtles under the Fauna Protection and Control Act. PNG is also a signatory to the Convention on International Trade of Endangered Species (CITES). In PNG, leatherback turtles are listed as critically endangered in the 2000 IUCN Redlist of threatened species and listed as protected under the Fauna (Protection and Control) Act 1976.

Current major threat faced by marine turtles in PNG include over-harvesting of marine turtles including egg collection from nesting sites. Although Wildlife protection laws exist, enforcement is ineffective. Northern Papua New Guinea supports a sizable leatherback turtle nesting population with an estimated annual nesting population of 1,000 to 1,500 turtles in the Morobe coast between Labu Butu and Busama beach. The turtles are rarely killed. However, the total population is subjected to intense egg harvest with only a few hundred clutches per year being allowed to incubate for conservation purposes. Kamiali nesting beaches within the Kamiali Wildlife Management Area is about 11 km long with approximately 150 nesting females producing 500 - 600 clutches per season. The local community has indicated that the number of nesting turtles have declined over the years and has subsequently agreed to a no-take zone of 1 km in 2000 with the support of Village Development Trust (VDT), ORC, Wetland International Oceania (WIO) and SPREP through the turtle conservation and tagging programmes in Kamiali. After an awareness campaign in October 2001, the Kamiali Community have agreed to add an additional 500 km to the no-take zone to be effective this nesting season (December to February 2002).

This report will briefly summarize the distribution of the turtles in the context of the location of the rookeries and the feeding grounds and the marine turtle conservation initiatives in PNG. The Kamiali beach leatherback conservation project is used as a case example as there is currently an active leatherback turtle monitoring and tagging program. Conservation is supported by SPREP and Environment Australia through Wetlands International Oceania.

PRESENTATION

Papua New Guinea (PNG) is the eastern part of the main island of New Guinea (Papua). It covers a land area of about 462,243 square kilometers, and has diverse marine and coastal areas. Six species of marine turtles occur in PNG: flatback, olive ridley, hawksbill, green, loggerhead and leatherback turtles. Turtles have been widely exploited in PNG for human consumption, for both eggs and meat. Green turtles are most commonly utilized for consumption, but hawksbills are harvested to produce carvings of traditional ornaments and for trade. There are some religious communities (SDA) which do not eat turtles. In the past, hunting was limited because of small human populations and strong traditional taboos. But with the introduction of a cash economy and increasing human populations, increased pressure has been placed on turtle populations.

The conservation initiatives by the government of Papua New Guinea, Department of Environment and Conservation (DEC) are responsible for conserving marine resources, including marine turtles. Active marine turtle protection by DEC began in 1970 (mainly education and awareness programs), but was halted in

1980 due to lack of funding. Thus there is only one active marine project in effect, at the Kamiali nesting beaches.

Papua New Guinea has marine turtle conservation legislation but enforcement is a major problem. The DEC is the agency responsible for protecting marine turtles through the administration of the Fauna Protection and Control Act. This legislation regulates the taking, possession and the trade of marine turtles and other native fauna [PNG is a member of CITES]. It also regulates the establishment of fauna protection areas, for example, Wildlife Management Areas (WMA) and sanctuaries.

The establishment of WMA's, give opportunities to local community and landowners to manage their natural resources. This is important because most land and natural resources are owned by the people. The establishment of WMA's allows people to manage their own resources and make decisions and rules to govern the protection of resources and biodiversity, regulate harvests, and income-generating activities such as ecotourism. The community establishes Area Committees to oversee these activities. The Area Committees help to protect cultural values by establishing their own rules. They also provide opportunities for scientific research and educational opportunities.

The leatherback turtle is the only marine species that is protected under the Fauna Protection and Control Act, and is listed as a protected fauna of PNG. However, the use of other species is also restricted. As a protected species, the leatherback turtle can only be caught by traditional means and used only for cultural purposes, like feasts of important ceremonies.

TRENDS

Green sea turtles, hawksbills and leatherback turtles are known to nest in PNG, but much work needs to be done to get quantitative information on these nesting populations. There are some records and reports of scattered nesting of leatherback turtles along the northern beaches of PNG, but beach censuses are needed to estimate population trends and nesting abundance. According to the local people, reports indicate a decline in populations of all species. This is based on lower catches rates of turtles and fewer nesting turtles observed. But again, this information needs to be verified.

RESEARCH

The Kamiali nesting beach extends for 11 km and it is a project site of a local NGO, the Village Development Trust (VDT). The DEC, four international researchers, and VDT work at Kamiali; the only marine turtle program in the country. The leatherback turtle project at Kamiali is supported by funding mainly from SPREP and Environment Australia through the Wetlands International program. This project was initially a community-based conservation program established by Colin Limpus. The second phase of this project is to now establish a management strategy. In December, 2001, the program received funding, assistance, and training opportunities from the United States National Marine Fisheries Service, through Peter Dutton and his team. They went to Kamiali to conduct satellite tagging, genetic sampling and necropsy training.

Anecdotal information from the local people suggest that the Kamiali nesting beach is an important leatherback nesting beach in the region, with probably 150 nesting females every season, with approximately 500 to 600 clutches produced per year. The nesting season starts in October and finishes in January, with a peak in December and January. Through the support of VDT and DEC, in 2000 the local people were convinced to have a no-take zone of one kilometer. Although very few adults are killed, 99% of eggs are collected outside of the no-take zone. With recent work funded by Environment Australia, another 0.5 km was added, thus no-take zone is now 1.5 km. Unfortunately, the scientific staff are encountering a problem in hatching success rates within the no-take zone. It is obvious that work needs to be conducted to understand and improve the hatchling success in this area.

In conclusion, the Kamiali project is the only surviving project to date in Papua New Guinea. From this experience we have learned that the success of any conservation project, including marine turtle conservation programs, must involve the local communities. In addition, funding is needed for more studies and research on all six species of turtles which occur at Kamiali and throughout PNG.

WORKSHOP DISCUSSION

DR. SEMINOFF: I saw earlier you had mentioned that the local landowners are responsible for policing their own land, yet at the same time we see this 99% egg poaching rate. Can you comment on that? Based on the egg poaching, it doesn't seem like that system is really working that well.

MS. PHILIP: Thank you for the question. I'll answer, then probably I will ask my colleague Karol Kisokau to add some comments if he has any. Like I said, the establishment of the wildlife management area gives an opportunity for the local people to manage their resources in that they have a committee set up, and then using the committee they try to set up rules. One of the rules is that the local communities have a right to set up what type of rules, depending on their interest. So when it comes to the poaching of the eggs, we don't have any control, we meaning the government, doesn't have any control because the people decide and they set the rules. The no-take zone was actually set up by the local communities. But we still have to give them that rule. We (the government) and VDT feel that although the rule is there, we still feel they poach the eggs and sell them for cash. But we need to really get in there and do a lot of awareness to inform the people the turtles are important and they should conserve them.

MR. KISOKAU: Thank you very much and good morning to everyone. The basic essence of the wildlife management area, is a conservation concept, and it basically empowers landowners to make up their own rules of how to manage their resources. People want a wildlife management area to give them opportunities and committees to make rules. When the management area is in the National Government Gazette, then it becomes law and the enforcement goes back to the landowners. In regards to leatherback turtles, we are still evolving at the moment in terms of conservation because of the subsistence dependence on them, in terms of eggs and meat. It is very difficult to put in taboo, even though the law prohibits harvesting this species. But at the same time, there are the traditional values of the people using the resource. So it's a give and take, but with more studies of the dynamics of the species we hope to come up with a sustainable plan for people to harvest the eggs and still enjoy the same type of values they are used to and maintain the population.

MR. PALMA: You mentioned there are six species of sea turtles in Papua New Guinea and only leatherbacks are protected by law. How about the others, do people still use the eggs just for consumption? Second, any marine protected areas for marine turtles in Papua New Guinea?

MS. PHILIP: I would say in terms of the other species, their use is regulated by the government based on CITES legislation. They are listed in CITES, so they are also protected, and international trade is regulated by the government. But in terms of exploitation, turtles are used for meat and eggs. Second question: Currently we do not have any marine protected areas which target marine turtles in particular, but we do have six marine protected areas.

DR. MORITZ: I was impressed by George Petro's talk yesterday about Vanuatu with the turtle monitors. Is it possible that something like that would work in the cultural setting of Northern New Guinea?

MS. PHILIP: Karol can talk more on that. But with the existing project at Kamiali, the SPREP program has involved the local people there as monitors. We have the local community working every night to collect data. They are the ones who are actually doing a lot of the awareness education and informing the local communities. They are the ones who are talking to their own people. Local communities tend to listen to their own people rather than outsiders. These community leaders are doing a good job, but we need to do a lot more work to improve the situation.

MS. COUSINS: The marine protected areas, do they include the nesting turtle beaches or their foraging areas?

MS. PHILIP: That is correct. Some of the marine protected areas are usually areas that the government sees as important for biodiversity conservation. So that includes the sea turtles, as well.

DR. MORITZ: I just wanted ask, from the work you did in collaboration with Peter Dutton, is there any indication the nesting population is a separate stock to the population?

DR. DUTTON: In terms of a genetic stock, it seems like we have one genetic stock. But the satellite telemetry looks like those animals are probably nesting between Kamiali and over to Solomon Islands within a seasonal exchange, one turtle will scatter nests in a thousand kilometer span. It doesn't look like they're going up north, at least within a season. So in terms of the short term data, of the animals that we satellite tagged, they are staying within that gulf area, but scattering nests up and down the coast.

The Southeast Asian Fisheries Development Center's Role in Regional Marine Turtle Conservation

Dr. Kamarrudin Ibrahim

PRESENTATION

This presentation will be an update of the regional program carried out by the Southeast Asian Fisheries Development Center (SEAFDEC). In Southeast Asia, there are ten countries which have joined SEAFEDC, these include: Indonesia, Singapore, Brunei Darussalam, Malaysia, Philippines, Cambodia, Vietnam, Laos, Thailand and Myanmar. This association, i.e. the Association of Southeast Asian Nations, form the membership of the ASEAN (in short). The five original members of ASEAN established in 1967 were Indonesia, Malaysia, Philippines, Singapore and Thailand. Brunei Darussalam joined in 1984; Vietnam joined in 1995, followed by Laos and Myanmar in 1997; and the newest member, Cambodia joined in 1999. Although Japan is outside the region, it too is a member and acts as a main donor. SEAFDEC is recognized as a competent technical arm of ASEAN region.

The ASEAN area is close to 4.5 million square kilometers. The population size in the 1999 census was more than 520 million people. There are three objectives of ASEAN:

1. to accelerate economic growth, social progress and cultural development in the region through endeavors in the spirit of equality and partnership, and to strengthen the foundation for prosperous and peaceful community in Southeast Asia;.
2. to promote regional peace and stability through abiding respect for justice and the rule of law in the relationship among countries in the region, and adherence to the principles of the United Nations Charters; and
3. to promote active collaboration and mutual assistance on matters of common interest in the economic, social, cultural, technical, scientific and administrative field.

The Southeast Asian Fisheries Development Center (SEAFDEC) works in the ASEAN Region. It is an intergovernmental agency established in 1967, for which its mandate is to promote fisheries development in Southeast Asia, and assist member countries to develop fisheries potential for the improvement of food supply in the region through training, research and information. It has four departments which member countries approach for help. The Training Department (TD) is in Bangkok, Thailand. The TD is concerned with fishing and fishing gear technology, and is also conducting research on fishing gear. The second department is the Aquaculture Department (AQD) located in the Philippines. This department is concerned with aquaculture development, research, training and information concerning aquaculture. The third department, Marine Fisheries Research Department (MFRD) is located in Singapore. This department deals with post-harvest technology and processing. The fourth department of SEAFDEC is in Malaysia, the Marine Fishery Resources Development and Management Department (MFRDMD). This department is concerned with marine resources and marine fisheries development and management in the ASEAN area.

The MFRDMD was established in 1992. In addition to management of marine fishery resources, the focus of the department is on sustainable development, and thus the marine turtle program was initiated in 1996. The objective of the marine turtle program is to address immediate issues related to management and conservation of endangered marine turtles in the ASEAN area.

Six species of marine turtles occur in the ASEAN region. Of these, green turtles, leatherback, hawksbill, and olive ridleys either occur in the waters or nest in the region. Loggerheads can be found in Cambodia, Indonesia, Myanmar, Thailand, Philippines and Vietnam, but nest only in Japan and Australia. Flatback turtles are found in Indonesia, but nest only in Australia.

The marine turtle research and conservation programs conducted by SEAFDEC concentrates on three areas: research, training and information. A regional tagging

project was begun in 1998. MFRDMD provides tags to member countries to tag turtles. Each country has its own coded number series: Brunei is BN, followed by a number; Cambodia (KH); Indonesia (ID); Malaysia (MY); Myanmar (MM); Philippines (PH); Singapore (SG); Thailand (TH) and Vietnam (VN). Tags supplied thus far include: 200 to Brunei Darussalam; 1,000 to Indonesia; 2,500 to Malaysia; 1,000 to Philippines; 1,000 to Thailand; 300 to Vietnam; and 3,000 to each Cambodia and Myanmar. Next year (2003), these countries will be invited to report on their findings of the tagging program. There has been some difficulty to get Singapore to join the program, as they state that they do not have turtles.

In addition to the tagging program, MFRDMD is also involved in improving hatchery management. The hatchery research began in 2000 in only Malaysia and Thailand due to limited budget constraints. This study is focused on addressing the issue of low hatch rate success, hatchling sex ratio, and hatchling orientation. There are some initial findings, but this study is still in the preliminary stages. In regards to training, there have been two workshops conducted dealing with research and conservation of marine turtles. The first workshop was held in 1998. In 2000, a second training workshop was conducted for Vietnam, Cambodia and Myanmar on tagging and hatchery management. An information program also organizes and distributes education publications. To date only a few publications have been produced.

Japan provides some assistance through donations to the SEAFDEC-MFRDM program as well as Earthwatch and the Southeast Asian Sea Turtle Associative Research (SEASTAR). SEASTAR began in 2000 as a satellite tracking project, but now includes research on genetics and hatchery management. However, these programs require adequate funding for their maintenance. Funding at this time is limited, with programs running on less than $20,000 U.S. dollars per year, and a 40% budget cut has been proposed for 2003. For this reason, cooperation and collaboration with other organizations is essential!

WORKSHOP DISCUSSION

DR. CHENG: A small comment, you say you cannot find a person in Singapore doing sea turtle work. I know [confirmed by G. Balazs] that there is a very small population of sea turtles in Singapore. I also know there is a professor from Mainland China doing the satellite tracking work there. So I believe there can be someone in Singapore, a professor who knows about sea turtles in the area.

MR. BALAZS: We'll put him in touch with Professor Dong. There is hawksbill nesting there, it was a major thing in the press, big deal that hawksbill hatchlings were coming out. So he's very eager about sea turtles. He's been assisting Mainland China on some satellite tracking and I think if you don't know him already, we'll put him in touch with you.

DR. IBRAHIM: Thank you very much for that information. Actually, in the SEAFDEC program, we normally deal government to government. So maybe in the future we can open to professors, as well. This is very good information. Thank you.

MR. BALAZS: May I ask, of the researchers collaborating in the member countries, they have to be government funded researchers to collaborate?

DR. IBRAHIM: Not really.

DR. MORITZ: So as an example, in answer to your question, is there any interaction with Liew's group or SEASTAR? It seems to me, that a formal collaboration between your department would be beneficial.

DR. IBRAHIM: Actually, that project, SEASTAR, was initiated first by Thailand and Japan. After, we joined in with Liew from the university. So it is not necessarily the government, but it is often. In fact, we are now seeking collaboration with non-government agencies. Thank you.

MS. KINAN: Just a quick question. Since SEAFDEC is a fishery development center, do you work with fishermen in regards to fishing gear and turtles?

DR. IBRAHIM: No.

MS. KINAN: Your department?

DR. IBRAHIM: The department, yes. If you need information, like the tuna fisheries in the region, I can supply it to you.

DR. MORITZ: I have one more, and that is about the current level of the training through the university systems. So you're training sort of the next generation of turtle biologists and managers. Is there any programs built in the university sector in the ASEAN nations to try to generate new people to take on these roles in the future?

DR. LIEW: In our university, the resource people are there. It's just a matter of organizing training programs and funding to run those training programs. But we do have, occasionally, people coming to us for some training, and we have done that for some on an individual kind of basis, but no formal training.

DR. MORITZ: Is there a flow of graduate students or under grads that show an interest in doing marine turtle biology that in the future can take on some of these roles?

DR. LIEW: There are a few that come in, do their masters or post graduate on turtles and then they go off to a different university and they start some programs there. It's a very small individual thing, not a formal group training. Most of the group training is done through SEAFDEC where they organize regional workshops.

DR. PILCHER: This may be in support of what Liew has been saying, one of the problems that occurs in Malaysia that might occur in other places as well, is that where Liew and his team can train post graduate students in turtle biology, there are very often no positions for them to go into. There are one or two cases where they've been very, very lucky to head up programs at a university. But there are very, very few options for people to go into. So they get out of the university with a masters degree where they've worked on turtles for the last three years and end up working on some other program or going into the private sector simply because there are not many programs or projects to get into. This is something that we need to think about, that as we develop training programs for students to go through, we should also be thinking about the next few years after that, where are these people going to be. Because if not, we'll lose them.

Sea Turtles Conservation at the Sabah's Turtle Islands Park, Malaysia

Paul Basintal

INTRODUCTION

The Sabah Turtle Islands Park, 1,740 hectares (ha) in extent, is located some 40 km north of Sandakan in the Sulu Sea, within 6º 9' to 6º 11' latitude, and 118º 3' and 118º 6' longitude. In total, a chain of nine islands constitute the Turtle Islands Park; three in Malaysia and six belonging to the Philippines. In Malaysia, the Turtle Islands Park consists of: Selingaan (8.1 ha), Bakkungaan Kechil (8.6 ha), and Gulisaan (1.6 ha).

When the Fauna Conservation Ordinance of 1963 (Act No. 11) came into force, Selingaan, Bakkungaan Kechil and Gulisaan were among eight islands which constituted the Turtle Farms. As Turtle Farms, exclusive rights could be granted to tenders for egg collection. In 1972, these three islands were acquired from private ownership for RM 89,000.00 and were established as a Game and Bird Sanctuary. In October of 1977, the islands were declared the Turtle Islands Park. Their establishment as a park also ensures total protection of the coral reefs which are integral components of the islands' ecosystem.

This paper discusses marine turtle conservation efforts at the Turtle Islands Park, will provide an update on the status of turtle nesting based on previous reports of Basintal and Lakim (1993), and additional information of other nesting areas in Sabah, Malaysia.

Significance

The Turtle Islands Park, together with six other islands designated by the Philippines, and Berau Island of Indonesia form one of the nine remaining major nesting habitats of the green turtles in the world. Chan *et al.* (1996) pointed out that the park, more specifically Gulisaan Island, is a major nesting site for the hawksbill turtle in the entire South East Asian Region.

Early Turtle Conservation Efforts

De Silva (1982) reviewed the early marine turtle conservation policies in the State of Sabah. Attempts to conserve turtles, especially the hawksbill, started during the colonial period. Gazette notification Nos. 227 and 228 of 1928 prohibited the capture of turtles for 12 months. A closed season every alternate year for six years beginning 1929 was enforced but with little success. In addition, the 1931 and 1933 closed season was not enforced because trade in sea turtle products shifted from Kudat to the Philippines.

The Turtle Preservation Ordinance No. 5 of 1952 was enacted. The authorities, however, did not strictly enforce this ordinance as they had more pressing matters than on turtles at the time. The ordinance was repealed and replaced with the Fauna Conservation Ordinance of 1963 that came into force in 1964. Consequently, all matters relating to turtles were placed under the jurisdiction of the Conservator of Forests. A conservation policy was then formulated and accepted by the government. This policy banned the issuance of license to kill turtles and strictly enforced the close season in March for egg collections. Unfortunately, the closed season was not successfully implemented due to various problems.

An experimental turtle hatchery was established at Pulau Selingaan in August 1, 1966. Two other hatcheries located at Pulau Gulisaan and Pulau Bakkungaan Kechil were subsequently established March 5 and 6, 1968 respectively. The hatchery operations were not successful due to the difficulty in obtaining eggs from licensed egg collectors who preferred to sell eggs to Chinese middlemen for greater profit. The failure of the hatchery program, coupled with the threats to turtle habitats prompted the State Government to acquire the islands from private ownership.

MARINE TURTLE CONSERVATION PROGRAM

Sabah Parks continued the hatchery operations and initiated other research activities when Pulau Selingaan, Pulau Bakkungaan Kechil and Pulau Gulisaan were established as a park. While the management of Sabah Parks is aware of the negative effects of hatchery operations, i.e. the resultant skewed sex ratio and lower hatching rates, several factors justified its continuation. These factors include the existing environmental conditions of the islands, nest superimposition, and predation of natural nests.

Hatchery operations were improved by replacing the wire mesh enclosure placed around the surface of the egg clutches with plastic nylon mesh, as it is believed that the wire mesh interferes with the magnetic imprinting of the hatchlings. Turtle data collected for research activities include: turtle tagging, tag recovery, egg collection and transplant, re-nesting, carapace length and width of nesting turtles, mortality of adult turtle, rainfall and temperature. In addition, Sabah Parks staff and researchers from local universities conduct research on sex ratio of hatchlings produced from both ex-situ and in-situ nests.

Hatchery Operations

The rangers work in two shifts: 8.00 pm to 1:00 am, and 1:00 am to 6:00 am. During this period they patrol the nesting beaches to locate nesting turtles, excavate and transplant the eggs to the hatchery, tag the nesting turtles, release the hatchlings, and record turtle data and other data. After a turtle lays its eggs, the ranger excavates the nest, places the eggs in a bucket and brings them to the hatchery for transplanting. At the hatchery, he buries the eggs in a pit about 75 cm deep (for green turtle), and places a plastic nylon mesh around the surface of the egg pit. This mesh serves to prevent predation, and the hatchlings from wandering around upon emergence.

Hatchlings usually start emerging from their nests between 7:30 P.M. and 8:00 P.M. after 40 to 60 days of incubation. The ranger collects the hatchlings in a bucket and takes them to the beach. The hatchlings are released on the high tide mark to allow them to crawl seaward. The ranger alternately uses several points around the islands as sites for releasing the hatchlings so as to avoid establishing a "feeding station" for predatory fishes.

Turtle Tagging

Turtle tagging had been carried out at the Sabah Turtle Islands Park since 1970. A cattle monel tag is applied on the trailing edge of the left flipper of the turtle. The tag has a serial number and a return address, and offers a reward of $5.00 USD for information on tag recoveries. A total of 29,273 turtles have been tagged from 1993 to 2001, of which 27,959 were green turtles and 1,314 were hawksbill turtles. Beginning in July 8, 1999, nesting turtles are now doubled tag using Inconel tags; initially provided gratis by Southeast Asian Fisheries Development Center (SEAFDEC).

A total of 494 green turtles have been tagged with Inconel tags. Of these, 217 or 43.9% made their nesting returns: 112 turtles or 22.6% returned once, 69 turtles or 13.9% returned twice, and 23 turtles or 4.6% returned thrice. The return interval ranged from 1 day {for the turtle with tags MY(S) 0771/0772} to 78 days {for the turtle with tags MY(S) 0003/0004}. The long return interval, over a two-weeks period, could have resulted in some turtles having nested elsewhere prior to returning to nest at their tagging site.

Nesting Beach Protection

Nesting beaches are managed at the Turtle Islands Park to remove driftwood which often washes ashore due to logging activities carried out on the mainland of Sabah. These logs are obstacles to nesting turtles, and may pose threats or mortality caused by entrapment between logs. Additional beach management activities include: 1) cleaning nesting beach of debris and removal of driftwood; and 2) patrol of nesting beaches and fringing coral outcrops. This includes the inspection of beaches to ensure no turtle are trapped by logs, and examine fringing coral outcrops for turtles stranded during low tide (to avoid mortality due to dehydration).

Control of Fishing/ Offshore Protection

Fish bombing, cyanide fishing and trawl fishing are prohibited within the Turtle Islands Park. The park rangers together with the police personnel stationed at Selingaan carry out regular patrols within the park areas. At sea, outside the jurisdiction of the Sabah Parks, the Fisheries Department and the Wildlife Department take charge on the enforcement of their respective laws. For instance, the Fisheries Department launched the use of Turtle Excluder Devices (TEDs) in Sandakan on May 20, 1998 to comply with the US shrimp import embargo which took effect on May 1, 1996. The Department distributed fifty free TEDs to trawl fishing vessel operators. However, the response from vessel operators has not been satisfactory. The Deputy Fisheries Officer of Sandakan explained that fishermen feel reluctant to use the device because they feel the device affects their catch (pers. comm., 2001).

POPULATION TRENDS & NESTING SEASONS

Green Turtles

The nesting trends of green turtles, from 1993 to 2001, shows a continuation of the upward trend that started in 1988 (Fig. 1). In 1993, there were 9,557 nests, and increased to 10,992 and 11,192 nests in 1995 and 1997 respectively. A decrease occurred in 1994 and 1996 when 7,942 and 9,397 nests were recorded respectively. The lowest nesting for the period from 1993 to 2001 occurred in 1998 with 5,832 nests, while the highest occurred in 1999 with 11,361 nests. The low nesting in 1998 could be attributed to the long drought which made the sand very dry. Nesting turtles could not successfully dig the egg chambers as the sand kept on collapsing. A comparison with Sarawak from figures obtained from Leh (1996) revealed the same fluctuation pattern. In 1993, there were 2,148 nests, and in 1994 and 1995 there were 1,600 and 2,500 nests respectively. This fluctuation is typical for green turtles.

Each island shows a variation in the peak and low nesting season. The number of green turtles nesting, and eggs and hatchlings produced at the Sabah Turtle Islands from 1993 to 2001 can be seen in Tables 1,2,3 and 4. The peak nesting months for green turtles is April to August in Selingaan, March to July in Bakkungaan Kechil, and April to September in Gulisaan. Generally, the peak nesting months are March to August, and the low nesting months are November, December and January.

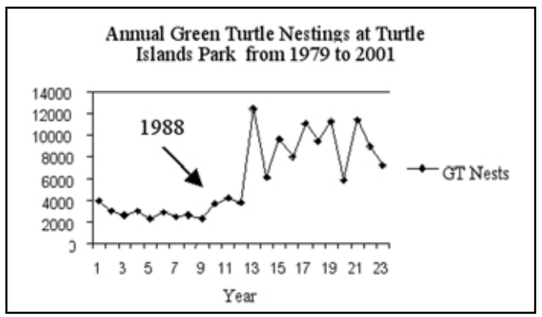


Figure 1. *Annual green turtle nesting trends at Sabah Turtle Islands.*

Table 1. *Green turtle nesting at the Turtle Islands Park from 1993 to 2001 (Source: Sabah Parks).*

Year	Selingaan	Bakkungaan Kechil	Gulisaan	Total
1993	4468	2358	2731	9557
1994	3134	2446	2362	7942
1995	4143	4102	2747	10992
1996	3975	2729	2693	9397
1997	5189	3385	2618	11192
1998	2575	1835	1422	5832
1999	5689	3523	2149	11361
2000	4507	2742	1700	8949
2001	3522	2540	1094	7156

Table 2. *Number of green turtle eggs collected and hatchlings produced at Selingaan Island (Source: Sabah Parks).*

Year	No. of eggs	No. of hatchlings
1993	390,221	236,538
1994	269,972	192,108
1995	351,550	245,683
1996	351,723	276,634
1997	454,447	338,343
1998	224,973	108,724
1999	482,628	363,215
2000	372,767	301,442
2001	273,974	202,398*

* to September only

Table 3. *Number of green turtle eggs collected and hatchlings produced at Bakkungaan Kechil (Source: Sabah Parks).*

Year	No. of eggs	No. of hatchlings
1993	206,067	172,399
1994	201,617	184,116
1995	364,395	321,930
1996	246,677	207,080
1997	303,919	244,531
1998	175,059	110,374
1999	326,553	243,441
2000	252,292	193,359
2001	228,381	148,462*

* to September only

Table 4. *Number of green turtle eggs collected and hatchlings produced at Gulisaan Island (Source: Sabah Parks).*

Year	No. of eggs	No. of hatchlings
1993	206,625	131,761
1994	171,315	94,521
1995	196,047	111,201
1996	237,489	143,037
1997	233,431	135,900
1998	127,508	61,292
1999	188,430	116,684
2000	139,096	85,617
2001	90,148	42,602*

* to September only

Hawksbill Turtle

In the Turtle Islands Park, about 87% of the hawksbill turtle nesting occurs at Gulisaan Island. One to four clutches of eggs are deposited during the breeding period with an inter-nesting interval of 49 to 57 days (Chan *et al.*,1999). Clutch size ranged from 22 to 180 eggs.

The nesting pattern for hawksbill turtles shows a different trend (Fig. 2). In 1993, there were 564 nests, which increased to 715 nests in 1994. However, beginning in 1995, a declining trend of nesting was noted. The number of nesting hawksbill turtles, and eggs and hatchlings produced can be seen in Tables 5, 6, 7 and 8. It has been observed that the island is experiencing severe erosion, thus unfavorable nesting conditions are predicted in the future.

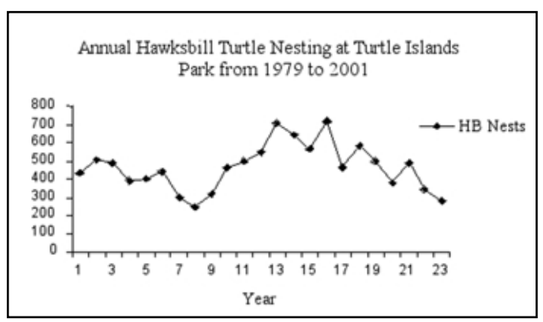


Figure 2. *Hawksbill turtle nesting trends.*

The peak nesting months are February to April, and June to July in Selingaan, while February to March, with peaks in June & August in Bakkungaan Kechil and in Gulisaan. In general, the peak nesting months at Turtle Islands Park are February to April, and June to August. The low nesting months are January, and September to November.

Table 5. *Hawksbill turtle nesting at Turtle Islands Park (Source: Sabah Parks).*

Year	Selingaan	Bakkungaan Kechil	Gulisaan	Total
1993	50	27	487	564
1994	50	48	617	715
1995	50	14	394	458
1996	94	30	459	583
1997	56	27	415	498
1998	38	26	313	377
1999	51	50	386	487
2000	44	33	260	337
2001	52	26	203	281

Table 6. *Number of hawksbill turtle eggs collected and hatchlings produced at Selingaan Island (Source: Sabah Parks).*

Year	No. of eggs	No. of hatchlings
1993	4748	2853
1994	4768	3039
1995	5238	3275
1996	9497	6480
1997	5520	4011
1998	3274	1437
1999	4791	3364
2000	4150	3000
2001	4496	3282*

* to September only

Table 7. *Number of hawksbill turtle eggs collected and hatchlings produced at Bakkungaan Kechil (Source: Sabah Parks).*

Year	No. of eggs	No. of hatchlings
1993	2907	2551
1994	5274	4454
1995	1393	1190
1996	3043	2421
1997	2891	2338
1998	2791	1978
1999	5682	4519
2000	3537	2772
2001	2761	1554*

* to September only

Table 8. *Number of Hawksbill turtle eggs collected and hatchlings produced at Gulisaan Island (Source: Sabah Parks).*

Year	No. of eggs	No. of hatchlings
1993	44,013	26,968
1994	52,952	25,119
1995	35,325	20,498
1996	48,927	24,692
1997	46,799	23,398
1998	40,060	15,398
1999	43,975	24,713
2000	30,024	16,093
2001	22,088	9,367*

* to September only

Olive Ridley Turtle

Another species, the olive or Pacific ridley turtle *(Lepidochelys olivacea)*, has also been reported to nest infrequently at Selingaan and Gulisaan. Since 1986, six nestings have occurred (Table 9). The first occurred on February 20, 1986 (de Silva, 1986). Subsequent nesting happened at Selingaan in January and February of 1987, and at Gulisaan in January of 1988 (Basintal & Lakim, 1993), and again in May 1994 and February 2001.

Table 9. *Olive ridley nesting at Turtle Islands Park (Source: Sabah Parks).*

Year	Date of nesting	No. of eggs	Place of nesting
1986	Feb. 20	97	Selingaan
1987	Jan. 2	98	Selingaan
	Feb. 12	75	Selingaan
1988	Jan. 4	127	Gulisaan
1994	May 15	97	Gulisaan
2001	Feb. 14	61	Gulisaan

MORTALITY

Sabah Parks also monitors the mortality of adult turtles through recording of carcasses stranded on the beaches and also those encountered floating in the waters between the islands. From 1993 to 2000, a total of 45 turtles were recorded dead. Of these (Table 10), 43 were green turtles and 2 hawksbill turtles. The carcasses were examined to determine the causes of mortality, however, the cause of death is difficult to determine in heavily decomposed carcasses. The mortalities were predominantly due to drowning in trawl fishing nets.

Table 10. *Adult Turtle Mortality.*

Year	Green	Hawksbill
1993	15	0
1994	Nil	-
1995	1	0
1996	2	1
1997	4	1
1998	1	-
1999	10	0
2000	8	0
2001	2	0
Total	43	2

OTHER NESTING BEACHES IN SABAH

Apart from the Turtle Islands Park, green and hawksbill turtles also nest in small numbers on other islands or beaches in Sabah. Green turtles can be found nesting in Lankayan Island and Sipadan Island, occasional nesting occurs in Mantabuan Island (Woods, 2001), and on the eastern end of Jambongan Island, specifically at Kg. Hujung (Suliansa *et al.*, 1997). Previous records show green turtles nesting in Bilean, Tegapil, Koyan-Koyan, and Nunu-Nunukan (de Silva, 1969).

Hawksbill turtles can also be found nesting at Lankayan Island. A small number of nesting (4-8 nests in a month) happens on the sand bar off Jambongan Island, and occasional nesting (10-15 nests per year) occurs at Tanjung Puru-Puru close to Pulau Kaniogan (Suliansa *et al.*, 1997). Some hawksbill nesting may occur at Sipadan Island with peak months from January to June (Mortimer, 1991), and there are additional reports of nesting at Mataking Island (Jum Rafiah Abd. Shukur; pers. comm., 2001).

Lankayan Island

Lankayan Island, N 6º 31' 15"; E117º 55' 19", is a tiny island located in the Sulu Sea. It is about one and a half hour by boat, north of Sandakan, and about half an hour from Turtle Islands Park. Lankayan Dive Resort, a dive operator based on the island, commenced monitoring of turtle nesting in June 1999. The company has a permanent staff to patrol the northeastern side of the island nightly (9:00 pm to 2:00 am) and monitor green turtle and hawksbill nesting (Tables 11 and 12).

Table 11. *Hawksbill turtle nesting at Lankayan Island from June 1999 to 2001 (Source: Lankayan Island Dive Resort, Andrada Bt. Hj. Ibrahim, Senior Counter Supervisor).*

Month	Year		
	1999	2000	2001
January	-	3	2
February	-	7	7
March	-	14	11
April	-	6	4
May	-	4	1
June	3	12	7
July	6	10	9
August	7	4	4
September	2	0	2
October	3	0	3
November	1	1	1
December	4	0	0
Total	26	61	51

Table 12. *Green turtle nesting at Lankayan Island from June 1999 to 2001 (Source: Lankayan Island Dive Resort, Andrada Bt Hj. Ibrahim, Senior Counter Supervisor).*

Month	Year		
	1999	2000	2001
January	-	0	0
February	-	0	0
March	-	3	0
April	-	4	0
May	-	5	0
June	3	12	5
July	9	7	8
August	11	12	7
September	13	10	4
October	7	5	7
November	1	2	4
December	1	0	3
Total	45	60	38

The resort operator has also established a small hatchery within the developed area of the island. These results can be seen in Tables 13 and 14. The State Government of Sabah has agreed to establish Lankayan Island as a Game Sanctuary under the jurisdiction of the Wildlife Department, and the island is in the process of being gazetted.

Table 13. *Number of hawksbill turtle eggs collected and hatchlings produced at Lankayan Island (Source: Lankayan Island Dive Resort, Andrada Bt. Hj. Ibrahim, Senior Counter Supervisor).*

Year	No. of eggs	No. of hatchlings
1999	2546	N/a
2000	6132	N/a
2001	4923	N/a

Table 14. *Number of green turtle eggs collected and hatchlings produced at Lankayan Island (Source: Lankayan Island Dive Resort, Andrada Bt, Hj. Ibrahim, Senior Counter Supervisor).*

Year	No. of eggs	No. of hatchlings
1999	3290	N/a
2000	4042	N/a
2001	3258	N/a

Sipadan Island

The incidence of nesting at Sipadan Island, N 4º 06' 49"; E118º 37' 56", has been monitored by the Sabah Wildlife Department since January 1, 1989. In general, the department carries out an *in-situ* conservation programme. However, turtle egg clutches are also transplanted into the hatchery if they were laid close to the resorts area. There are problems encountered in practicing *in-situ* conservation such as: 1) nests are often submerged by high tide; 2) clutches are sometimes displaced by future beaching turtles; and 3) occurrence of nest superimposition. These situations make it difficult to locate the egg clutches, and previously laid clutches may be destroyed.

In Sipadan Island, the peak period is from October through January with 5 to 10 nests per night (Gakim pers comm.,1993). Lately, the figure has increased to 20 nests per night (Jum Rafiah Abd. Shukur pers comm., 2001). The low season is from February to September with 3 to 5 nests per night. The incidence of nesting, egg production and hatchlings released from Sipadan Island can be seen in Tables 15 and 16.

Table 15. *Green turtle nesting in Sipadan Island from 1989 to 2001 (Source: Wildlife Dept. Tawau, Jum Rafiah Abd. Shukur, pers. comm., 2001).*

Year	No. of nests
1989 – 1991	399
1992	606
1993	469
1994	1140
1995	1367
1996	865
1997	1013
1998	545
1999	860
2000	600
2001	661

Table 16. *Number of green turtle eggs collected and hatchlings produced at Sipadan Island (Source: Wildlife Department, Tawau, Jum Rafiah Abd. Shukur).*

Year	No. of eggs	No. of hatchlings
1994 (*In-situ*)	+	55,169
1995 (*In-situ*)	+	59,223
1996 (*In-situ*)	+	27,219
1997 (*In-situ*)	+	9,778
1997 (Hatchery)*	80,796	50,470
1998 (Hatchery)	34,298	23,516
1999 (Hatchery)	53,236	53,236
2000 (Hatchery)	42,002	30,481
2001 (Hatchery)	39,488	31,915**

*+ not known due to in-situ hatching; * March onwards; ** up to September only*

ECO-TOURISM ACTIVITIES AT THE TURTLE ISLANDS PARK

The Turtle Islands Park forms one of the three main tourist attraction centers in the East Coast of Sabah, Malaysia. The park is internationally known because of the sea turtles. Unlike in most turtle nesting beaches of the world, the Turtle Islands Park is unique because of the year-round nesting. This situation gives a definite economic advantage in that the facilities built for tourists would not be left vacant as much as on most turtle beaches elsewhere.

The Turtle Islands Park provides a limited tourism development and activities at Selingaan Island. Presently, four chalets had been built which can accommodate fifty persons per night. A cafeteria is also available which serves food and drinks for visitors. Turtle watching forms the main activity where visitors can observe gravid females coming ashore to nest every night, and observe the turtle conservation program by Sabah Parks. Observations of turtle nesting activities are regulated by park rangers or park staff which guide and supervise visitors to see one turtle nest per night.

Tour operations throughout the state, notably those in Sandakan, promote the Turtle Islands Park to many visitors. Since the promotion, the number of overnight visitors has increased from 431 in 1982 to 10,131 in 2000. The increase in visitor's arrival does not have any effect on nesting turtles at Selingaan. In April, 1998 Sabah Parks handed over the operation of the chalets to a private company. In doing so, Sabah Parks can now fully concentrate on turtle conservation and research programs, and the management of the park.

The controlled tourism activity at Selingaan, overnight guests in the chalets and entrance fees have generated revenue for the program. This revenue provides partial financial resources for running the turtle conservation programs.

CONCLUSION

The turtle conservation program in the Turtle Islands Park is based on ex-situ hatching. Although Sabah Parks is aware of the negative effects of hatchery operations, several factors justified its continuation, such as existing environmental conditions of the islands, predation of natural nests, and nest superimposition.

In general, the nesting trend of green turtles from 1993 to 2001 shows a continuation of the upward trend which began in 1988. The nesting trend for hawksbills indicates a declining trend since 1994 because of unfavorable nesting habitat. The nesting season varies slightly between islands within the park. However, the best nesting months for green turtle are March to August, and for hawksbill turtles from February to April, and June to August.

Other than the Turtle Islands Park, several islands on the east coast of Sabah are nesting sites for green and hawksbill turtles, such as Sipadan and Lankayan.

ACKNOWLEDGMENTS

The author wishes to record his sincere appreciation to the Western Pacific Regional Fishery Management Council, especially to Ms. Irene Kinan, for providing travel and accommodation support to enable attendance to the workshop. Sincere thanks also to the Director of Sabah Parks, Datuk Lamri Ali, for his permission to leave the office for this purpose. Thanks is also extended to Ms. Jum Rafiah Abd. Shukur of Wildlife Department Tawau, for promptly providing turtle data on Sipadan and other related information. Thanks also go to Andrada Hj. Ibrahim of Lankayan Island Dive Resort for updating the turtle data in Lankayan. Lastly, the author wishes to express his appreciation to all individuals who had helped in one way or another in the preparation of this paper.

LITERATURE CITED

Abd. Shukur, Jum Rafiah. 2001. Official Correspondence. Ref. JHL.TWU.600-1/12Jld.3/17 dated 26 September 2001.

Abd. Shukur, Jum Rafiah. 2002. Official Correspondence. Ref. JHL.TWU.600-1/12 JLD 3/22 dated 29 January 2002.

Awang Haji Bakar. 2001. Personal communications

Basintal, P. & Lakim, M. 1993. Population Status and Management of Sea Turtles at Sabah Turtle Island Park. In Proceedings of the First ASEAN Symposium-Workshop on Sea Turtle Conservation, December 1993, Manila, Philippines.

Basintal, P. 2000. Regional Tagging Programme on Sea Turtles: Progress in Tagging Exercise in Sabah, Malaysia. A Paper presented during the Second Meeting on Regional Sea Turtle Tagging and Population Statistics, Kuala Terengganu, Malaysia 20-21 November 2000.

Chan, E.H *et al.* 1999. A Study on the Hawksbill Turtle (Eretmochelys imbricata) of Pulau Gulisaan, Turtle Islands Park, Sabah, Malaysia. Sabah Parks Nature Journal Volume 2 (1999):11-22.

de Silva, G.S. 1969. Turtle Conservation in Sabah. Sabah Society Journal Volume V. No.1. 26 pp.

de Silva, G.S. 1982. Protected Areas and Turtle Eggs in Sabah, Malaysia. Proc. Of the World Congress on National Parks, Bali, Indonesia, 11-22 Oct., 1982. Smithsonian Inst. Press Washington, D.C.1982.

de Silva, G.S. 1986. Turtle Tagging and International Returns for Sabah, East Malaysia. Sarawak Museum Journal. Vol.XXXVI No. 57 (New Series), 1986. pp. 263-269.

Gakim, D. 1993. Official Correspondence. Ref. JHL(SMP) 200/25/01 dated 25th November 1993.

Gakim, D. 1994. Official Correspondence. Ref. JHL (SMP)200/25/03 dated 1st March 1994.

Gakim, D. 1994. Official Correspondence. Ref JHL(SMP)200/25/3 dated 7th March 1994.

Leh, Charles M.U. 1989. The Green Turtle, Chelonia mydas (L.) in Sarawak: Is there a Future? Proc. 12th Annual Seminar of the Malaysian Society of Marine Science. Kuala Lumpur pp. 219-225.

Mortimer, J.A. 1991. Recommendations for the management of the marine turtle populations of Pulau Siapdan, Sabah. Report to WWF Malaysia. April 1991: 36p.

Suliansa, M.S. *et al*. 1997. "Tinjauan Awal Sumber Marin Di Sekitar Pulau Jambongan, Pulau Kaniogan dan Kawasan Paya Bakau, Beluran Sandakan."

A Scientific Expedition Report provided to Sabah Parks. 1997.

Woods, E. 2001. Semporna Islands Park Management Plan. 168pp.

Turtle Islands Park Annual Reports from 1979 to 2000

Turtle Islands Park: Turtle Data from January to 2001

WORKSHOP DISCUSSION

MR. SHARMA: Paul, do you have any indication as to why there is some severe erosion, as you say, happening at one of the islands, and why is it not happening in some of the other nesting beaches in the same series of islands?

MR. BASINTAL: Actually, the erosion problem happens in all our three islands, including the Philippine

Turtle Islands. The Philippine counterpart has a geologist and he visited our island and, according to him, the island is very young and it is still changing. But because of the area, Gulisan being very small, it is experiencing erosion.

DR. MARQUEZ: I think this is a very good example of how to work in the area. But I am not quite sure about the shadow of the incubation place. You say the temperature is between 25 to 31 degrees. We find for the male-to-female rate is about 29 degrees. Maybe you are getting more males than females. Are you getting the hawksbill information from sampling every year?

MR. BASINTAL: Yes. Every year we sample because in our first investigation about the sex ratio, prior to shading, the temperature was about 31 degrees Celsius. So based on that we were producing 100 percent female.

DR. MARQUEZ: So 31 degrees in the center of the clutch?

MR. BASINTAL: Yes. Yes, in the center of the clutch.

DR. MARQUEZ: Do you get high mortality in that case, what happens?

MR. BASINTAL: No, we have, as I mentioned, good hatching success.

DR. MARQUEZ: No, no, you were not showing hatchling success.

MR. BASINTAL: We were producing more females at that time. But even without shading, we have a hatch success of 70 percent.

DR. MARQUEZ: What is the female-to-male ratio now?

MR. BASINTAL: Now, I'm not too sure. The range of temperature, we are monitoring is 31 degrees. So I think we are, producing appropriate sex ratio for hatchlings at that island.

MR. MARQUEZ: You are getting more females than males now?

MR. BASINTAL: Yes, I think so, yes.

DR. CRAIG: Your data shows an increasing trend since 1988. That presumably reflects an increase in survival and so forth for the 10 to 20 years prior to that time. Any idea what those conditions might have been that changed?

MR. BASINTAL: I'm not too sure about that because we started work in 1966, and cannot prove it is due to the mass hatchlings released. We do not have a tag for hatchlings, so I cannot justify if it was because of our previous work before or through the release of mass hatchlings in the area.

DR. MORITZ: In this is a case where there has been a substantial population increase, yet there is a very active fishery operating out of Sandakan. Is there any prospects of getting data on bycatch numbers out of that fishery?

MR. BASINTAL: Yes. Actually, under the TIHPA program, that is one of the main agendas for research to be carried out for a period of one to three years from now. But we cannot start yet because of lack of funding.

Marine Turtle Conservation Program Jamurba-Medi Nesting Beach, North Coast of The Bird's Head Peninsula, Papua

Creusa Hitipeuw[1] and John Maturbongs

INTRODUCTION

It is clear that there is a lack of information regarding sea turtles in Indonesia. Most academic institutions show little interest in to study these endangered and protected species due to technical constraints. This creates difficulties in developing the best management strategies to conserve the species, although there is the political will to do so.

WWF Indonesia believes that the best management decisions should be based on reliable scientific basis, especially for species such as turtles with complex biological and ecological characteristics. Therefore monitoring and management related activities are often initiated and conducted in collaboration with relevant institutions or individuals. Published research results in technical reports, geared towards the public, are those related to *in-situ* (site) management. However, wider publication to the scientific community, especially at the international level is rarely achieved due to various constraints (e.g. lack of conservation science unit within the organization).

It has been realized by WWF that a large management unit is required for the conservation of highly migratory species, such as sea turtles. As Indonesian turtle populations are part of the global sea turtle population, information on the population status and threats as well as conservation actions should be in line with global actions to conserve the species.

This paper described the historical and current conservation efforts by WWF-Indonesia (Irian Jaya), and identifies additional management areas necessary for marine turtle conservation.

HISTORICAL BACKGROUND

Leatherback turtles have undoubtedly nested on the North Coast of Vogelkop, Irian Jaya for thousands or millions of years; as confirmed by local communities. The first publication by van der Zon and Mulyana (FAO, 1979), highlighted the importance of the North Vogelkop coast as a sea turtle rookery. An aerial survey conducted by WWF/IUCN in 1981 indicated that the beaches of Jamursba Medi and those which lie along the Vogelkop Coast (under administrative jurisdiction of Sorong and Manokwari, Irian Jaya) host the largest remaining Pacific leatherback populations in Asia, and the third largest in the world. This survey revealed that the relatively remote Jamursba Medi beaches were covered with enormous numbers of turtle tracks and estimated approximately 4,000 nests occurred along the five main beaches.

In 1984, WWF began a preliminary study to assess the status of the leatherback population. Based on survey results, an estimated 13,000 leatherback nests were found along the 17.8 km of coast extending eastward from Jamursba Medi (Bhaskar 1985), and recommendations were made for a conservation area designation for Jamursba Medi.

A rapid declining trend was discovered after the initial survey period in which Betz and Welch (1992) reported a decline of nesting levels to 25% of those reported by Bhaskar. It was concluded that the near total collection of eggs had most certainly contributed to the population's collapse. According to local information, the number of nesting turtles each night reached 300 in the past years and a sudden decline occurred after 1985 where only 25-30 nesting attempts occurred per night.

In 1992, Rolland Petocs (WWF Irian Jaya) conducted a quick survey to ensure the critical nesting status of the area and confirm the protected area designation. The proposed area comprise 5 beaches; Sausapor (14 km), Wewe-Kwoor (20 km), Jamursba Medi (28 km), Sidei-Wibain (18 km) and Mubrani-Kaironi (20 km).

In March of 1993, WWF in collaboration with KSDA-Sorong (coordinated by Jacob Bakarbessy) initiated a

[1] *Presenting author*

field project to protect the leatherback nesting population (beach monitoring and patrol), to collect important information (e.g. population size, predation, and threats), and develop management strategies. This project continues today with activities supported by the local communities (Karon ethnic group) due to their traditional connection to the leatherbacks. Young villagers (appointed by village customary council) are actively involved in beach patrol, and the right to protect the beach has been given to WWF by those who own the area around the extended beach.

The project objectives are:
- To identify the size and status of the nesting leatherback turtle population;
- To protect nesting female turtles and their nests from poachers and predators; and
- To work with local authorities and communities to develop effective management and conservation strategies.

To meet these objectives, the following activities were carried out:
- Patrol the nesting beach each night (by local people) and identify and count all nesting turtles during the nesting period;
- Protect the beach from egg and turtle poaching;
- Meeting with local government and members of the local communities to distribute information on the importance of reducing threats to the population and provide advice on conservation issues.

Information on the number of nesting turtles, population trends and the unique conservation needs of the leatherbacks were presented to District Sorong government. A collaborative work began to propose the designation of the area as a Turtle Sanctuary Area (10,000 ha) through recommendations of KSDA Sorong (no. 2599/II-SBKSDA IRJA/93 and supported by Bupati Decree, 1994; No. 522.5/1010)

Jamursba-Medi Beach Profile

Jamursba Medi beach (0º20'-0º22' S; 132º25' -132º39' E) is located between 2 forelands (capes), Jamursba and Medi on the North Coast of Irian Jaya, Vogelkop. The north border of the beach is the Pacific Ocean while the southern part is Tamrau Mountain with an elevation of 45º. The beach profile is fairly flat and stretches to about 21 km, divided into 3 sections and sequentially disconnected by few small forelands/ capes:

- **Wembrak beach** (total area approximately 8.2 km). Wembrak is the longest western-most beach (about 5.3 km), confined by cliffs at Jamursba Cape on the west and by a one kilometer rocky stretch on the east. The sand is dark and gray, and 2.2 km of the western most stretch of the beach is most favored by nesting turtles. Two perennial streams and two dry stream beds leading to the sea partition the main beach into five segments. The eastern end of the beach, approximately 3.5 km, is segmented into five sections by three perennial streams and one dry stream bed.

- **Baturumah beach** (total area approximately 5 km). The east end of Baturumah beach (1.8 km) is primarily rocky and unsuitable for leatherback nesting, although green turtles and hawksbill do occasionally nest here. About 400 m from the western end of this rocky stretch lies a prominent rock called Batu Rumah ('rock house'), a vegetation covered rock about eight meters high, undercut by the sea and situated about 20 m from shore. A narrow fringing reef also occurs here. A gap in the reef immediately west of Batu Rumah, provides reasonably safe boat access from April to September, which coincides with the main nesting season.

- **Warmamedi beach** (total area approximately 4.8 km). Warmamedi Beach, demarcated by a rocky outcrop, Ujung Warman, on the east and comprised of grayish white sand is the most favored leatherback nesting beach. Warmanmedi beach is partitioned into four segments by a dry stream bed, a perennial stream and by the Medi River. The western most 1.8 km is heavily utilized by nesting turtles.

The beach widths of the three sections fluctuate drastically throughout the seasons. At the end of the accretion period ending in August, the average width above the spring high tide line is about 25 m (range 0 to 65 km). The broadest beaches, which attract more nesting turtles than other areas, are roughly one km stretches immediately east of Jamursba Cape.

Based on the WWF study in 1999, the grayish sand of Jamursba Medi constitutes coarse (77.1 - 78.13%) and fine (18.83 - 22.38%) aggregates. It is suspected that beach substrates originate from transported sediment from the Pacific Ocean sea beds, brought ashore during huge sea dynamic periods (November to February).

Climate

Jamursba-Medi located south of the equator induces a tropical climate with relatively stable air temperature 29-32ºC and humidity 75-80% (Petocz, 1987). Annual rainfall density ranges from 1,500 to 2,500 mm during the west monsoon (October to March).

Vegetation

North Tamrau Mountain on the northern side of Jamursba Medi, is fringed by beach forest and lowland rain forest (0-100 m above sea level). Mangroves are absent due to the high energy dynamics of the Pacific Ocean. Littoral vegetation which occupy the fringe are Ipomea pes-caprae, Hibiscus tilleaceous, Baringtonia asiatica, and Pandanus canavalia, Pemphis acidula, Tournefortia orgentea, Scaevola sericea, Terminalia catappa, Calophyllum inophyllum, Crinum asiaticum, and Spinifex sp.

STATUS OF THE SEA TURTLE NESTING POPULATIONS

The northern coast of Papua located on the eastern perimeter of the Southwest Pacific Ocean, is inhabited by four species of marine turtle: Leatherback *(Dermochelys coriacea)*, Green *(Chelonia mydas)*, Hawksbill *(Eretmochelys imbricata)* and Olive ridley *(Lepidochelys olivacea)*.

Leatherbacks Turtles

Leatherbacks are the dominant marine turtle species that nest on the North Coast of Bird's Head Region of Papua. Nesting in this region is dependent on the monsoon season. Nesting season in Jamursba-Medi beach starts in March and ends in September, with peak nesting around June to July (Fig. 1). During this period, when the sea surface is calm, 20-30 clutches are laid per night. Bhaskar found the average of nesting interval of 9.53 days and as many as eleven clutches laid per female in a breeding season based on 467 samples.

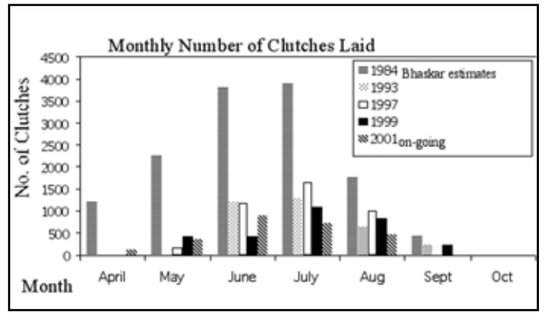


Figure 1. *Leatherback turtle seasonal nesting trends.*

The beginning of western monsoon and rough sea surface period starts in late August. Thus nesting activities shift to War-Mon beach (the four km beaches situated east of Jamursba Medi). This is likely related to the strong eastward current of the western monsoon makes it difficult for turtles to swim westward (with the assumption that they migrate from the north or north-east direction). It is possible that the leatherback nesting period occurs throughout the year along the northern part of Irian Jaya, but the concentration at a particular site of such an extended coastline depends on the monsoon and consequently the prevalent ocean current.

Data on the status of the leatherback nesting population in Jamursba Medi has been collected intensively by WWF-Indonesia (Irian Jaya Coordination Office) in collaboration with KSDA Sorong since 1993. The data of nesting turtles and tracks counted along the 17 km beach during the peak nesting period (May-September)

can be seen in Table 1 (although there has been some variation in the data collection period). There exists a gap in the data (Table 1) for years 1998 and 2000 due to the lack of financial support and transition of management regimes (e.g. project changed to a bioregion based program). The current data is part of an on-going data collection effort. Survey results of leatherback nesting trends from Table 1 were recalculated and adjusted by Peter Dutton *et al.* (1992; Table 2). Adjusted data indicate that between 456-601 female leatherback turtles laid nests at Jamursba Medi Beach, North Coast of Irian Jaya between April and August, 2001.

Due to the variation of survey period and the absence of tagging activity, it is difficult to perceive an understanding of the number of nesting females during a breeding season. Therefore adjustments were made by Dutton *et al.* (1992) based on original data from Bhaskar's 1984-85 survey (Fig. 2). This adjusted population data is also consistent with previous data which indicates population decline over the years.

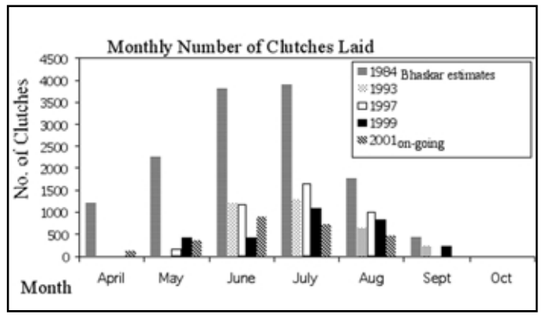


Figure 2. *Bhaskar 1984 monthly leatherback nesting distribution data adjusted by Dutton et al, 1992.*

Table 1. *Number of leatherback sea turtle nests reported from Jamursba Medi Beach.*

Year	Numbers of nests recorded	Sources/ Researchers
1984; August	1,775 nests (estimate of 12,000-18,500 eggs)	Bhaskar & Bakarbessy (WWF, 1984)
1984;September	435 nests	Bhaskar & Bakarbessy (WWF, 1984)
1985[1]	approx. 3,000 nests	Bhaskar & Bakarbessy (WWF, 1984)
1991[2]	approx. 3,340 nests[5]	Betz and Welch, (1992); In: NMFS & U.S. FWS (1998)
1992; 26 to 30 May[3]	68 tracks (?)	Stark (1993)
1993; June to September[4]	3,247 nests	Bakarbessy (WWF-IP-KSDA, 1993)
1994; June to September[4]	3,298 nests[6]	Bakarbessy (WWF-IP-KSDA, 1994)
1995; June to September[4]	3,382 nests	Bakarbessy (WWF-IP-KSDA, 1995)
1996; June to September[4]	5,058 nests	Bakarbessy (WWF-IP-KSDA, 1996)
1997; May to August	4,001 nests	La Muasa (WWF-Sorong, 1997)
1999; 10 May to 30 September	2,983 nests	Teguh (WWF-Sorong, 2000)
2001; April – August (on-going data collection)	2,561 nests	WWF Sorong, 2001

[1] 1985 data did not mention monitoring date.
[2] No information on monitoring dates or number of monitoring days.
[3] Exact species unknown; unclear whether the data includes 2 olive Ridley turtles.
[4] No detailed number of monitoring days, but assume surveys were conducted between May to September.
[5] Calculated from 25 percents (estimate) of 13,360 nests.
[6] No monitoring activities for the year 1998 and 2000

Table 2. *A summary of leatherback nesting surveys and results along the Jamursba Medi Beach, North Coast of Irian Jaya with adjustments by Dutton et al., 1992.*

Researcher	Survey Period	# of nests	Adjusted # nests	Estimated[1] # Females
Salm *et al.*	Sept 1981	4,000+	7,1432	1,232-1,623
Bhaskar	April-Oct 1984	13,360	13,360	2,303-3,036
Bhaskar	April-Oct 1985	3,000	3,000	6,58-731
Bakarbessy	June-Sept 1993	3,247	4,0913	705-930
Bakarbessy	June-Sept 1994	3,298	4,1553	716-944
Bakarbessy	June-Sept 1995	3,382	4,2283	729-961
Bakarbessy	June-Sept 1996	5,058	6,3733	1,099-1,448
La Muasa	May-August 1997	4,001	4,4814	773-1,018
Teguh	May- Sept 1999	2,983	3,251	560-739
Wamafma	April-August 2001	2,561	2,644	456-601

[1] The average number of nests laid by leatherbacks on Jamursba Medi in 1985 (Bhaskar) an was 4.4 nests per female. This is consistent with estimates for the average number of nests by leatherbacks during a season on beaches in Pacific Mexico which range from 4.4-5.8 nests per female (Sarti et al., unpub. report). The range of the number of females is estimated using these data.
[2] The total number of nests reported during aerial survey, were adjusted to account for loss of nests prior to the survey. Based on data from other surveys on Jamursba Medi, on average 44% of all nests are lost by the end of August.
[3] The total number of nests have been adjusted based on data from Bhaskar's survey from 1984-85 from which it was determined that 26% of the total number of nests laid during the season (April 1st – October 1st) are laid between April and May
[4] Number adjusted from Bhaskar (1984) findings. The percentage of nests laid in April and September is 9% and 3% respectively of the total nests laid during the season

Clutch Size and Hatching Success

Bhaskar conducted a preliminary study on hatching success in 1984. Sporadic survey on the hatching success were also conducted and summarized in Table 3.

Table 3. *Egg Production and hatching data (average number).*

Average number per nest	Bhaskar (1987), N=25	WWF (1994 N=15	WWF (2001), N=136
Eggs	107	109	70
Yoked eggs	72 (67% of total eggs)	72 (66% of total eggs)	45 (64% of the total eggs)
Hatched eggs	31 (43% of yoked eggs)	53 (73% of the yoked eggs)	21 (47% of the yoked eggs)
Hatchlings emerged	25 (80% of hatched eggs)	51 (96% of hatched eggs)	18 (72% of hatched eggs)

A study in 1994 to determine the hatchling success of 32 nests at the three beaches revealed that 12 nests at Wembrak did not hatch. Similarly, of the 25 nests marked for observation in Wembrak five were analyzed and the others were washed away. Detailed information on hatching success is provided in the following pie charts (Fig. 4):

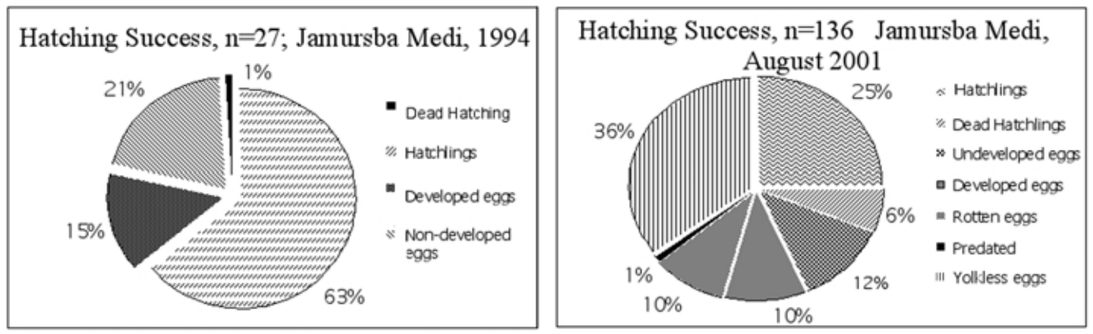


Figure 4. *Pie charts indicating hatching success at Jamursba Medi, 1994 versus 2001 (pie charts read clockwise).*

Other Turtle Species

In addition to the occurrence of leatherbacks, green *(Chelonia mydas)*, hawksbill *(Eretmochelys imbricata)* and olive ridley turtles *(Lepidochelys olivacea)* nest in the area (Table 4). Nesting season of these three species start earlier in a year and slightly overlapped with the nesting of leatherbacks.

Table 4. *Number of other turtle species (nests) since 1993 (Source: KSDA-WWF population monitoring data (1993-1996; 1997; 1999, 2001).*

Species	Number of Nests per Year						
	1993	1994	1995	1996	1997	1999	2001>Aug
Green Turtles	4	11	20	11	7	171	51
Hawksbills	2	8	7	23	—	13	40
Olive Ridleys	4	13	18	29	54	77	227
Flatbacks				0*			

** Originally thought to be 1 nesting flatback, but corrected by C. Limpus at the workshop as a misidentified olive ridley (number not added to 1996, olive ridley count).*

OTHER IMPORTANT NESTING BEACHES

Three other beaches located along the North Coast of Vogelkop are also found to be important nesting habitat for leatherback turtles. War-Mon and Sidey-Wibain are among these beaches that were also included in WWF Reserve proposal in 1987. So far, no conservation measures are being taken at these beaches although some population data have been sparsely collected by WWF and other parties.

War-Mon Beach

War-Mon, a six kilometer beach located halfway between Welos Cape and Wau Village, lies 30 km east of Jamursba Medi. This north facing beach is partly sheltered, composed of dark gray sandy substrate and has a similar dynamic beach structure as Jamursba Medi. The Mon River divides the beach in half, two kilometers to the west and 4.5 km to the east, with the eastern half more favorable to nesting turtles.

Table 5. *Number of Leatherback sea turtle nesting on War-Mon beach.*

Author	No. nests	Average per night
Bhaskar (1984)	676	16
Starbird & Suares (1993)	406	14

Notes: Of the nest counted by Starbird & Suares from Nov. 23 to Dec. 30, Bhaskar counted an additional 336 nests on Jan 1-24, 1984.

Starbird and Suares (1994) carried out a 21 day survey on the eastern 4.5 km War-Mon Beach (Table 5). A total of 101 nesting females were encountered on nightly patrols. Mean carapace length of 101 leatherbacks was 161 cm (range 145-178 cm). Six inter-nesting intervals ranged from 8-10 days (average 9.3 days). The mean distance to waterline was 22 m and to vegetation was 7 m. A total of 406 nests and 74 false crawls were recorded with nesting concentrated on the eastern 2 km of the beach. Villagers were observed collecting eggs for local consumption and for sale at the Wau village market.

Pig predation at War-Mon Beach accounted for approximately 40% of nest disturbance. However, the villages in the vicinity of War-Mon have increased in recent years and villagers around War-Mon regularly hunt wild pigs with snares and spears. Increased hunting has resulted in fewer pigs on War-Mon beach and therefore a lower rate of future predation at Jamursba Medi.

Mubrani-Kaironi & Sidey-Wibain

Mubrani Kaironi Beach (20 km) and Sidey Wibain Beach (18 km) are situated in the North Vogelkop Region (Subdistrict Amberbaken, District Manokwari). These beaches, located off the Pacific Ocean, are being proposed for gazetting as a protected area. Four turtle species (leatherbacks, green turtles, hawksbills and olive ridleys) are found to nest at these beaches during the months of March to June. Of nesters, leatherbacks are the dominant species, and local people report during nesting periods approximately 20-25 nesting turtles come ashore to lay eggs.

Topography of Mubrani and Kaironi beach is low, considerably flat and has a brownish sandy beach. In contrast, Sidey beach has a wide profile (30-60 m), and a stretch of fine and dark sand with plant species such as *Ipomea pescaprae*. Turtle hunting and egg harvests are well known as a source of income in this area. A two-week preliminary survey conducted by WWF-Irian Jaya in collaboration with MAPIA, Cendrawasih University in 1983 recorded ten leatherback nests, 37 green turtle nests, 24 olive ridley nests and four hawksbill nests at these beaches.

EXPLOITATION AND THREATS

Threats to sea turtles are broadly defined as any factor that jeopardizes the survival of turtles and obstructs the recovery of their populations. Threats exist in almost all phases of a turtle's life cycle. The main threats identified for leatherbacks are: adult poaching, egg harvests, feral depredation and incidental take by fisheries.

Adult Turtle Poaching (Commercial Trade)

The harvest of sea turtles and/or their eggs for consumption or commercial use is a significant threat to the species. Removing breeding adults from a population can accelerate the extinction of local stock, and the persistent collection of eggs can cause the reduction of future recruitment. Due to a close traditional connection with leatherbacks, poaching of the adult leatherbacks is never conducted by local villagers (residents of Jamursba Medi beach). However, fishermen from outside the region such as Sorong, Manokwari and North Maluku, poach adult turtles, mostly green and hawksbills, in the surrounding waters and on the beach for market. Fortunately, conservation efforts initiated in 1993 have succeeded in preventing most turtle poaching at Jamursba Medi.

Egg Harvests

Turtle eggs are an important protein source for coastal communities. However, the subsistence use of eggs shifts to commercial use where there are marketing opportunities. Exploitation of turtle eggs on Jamursba Medi beach was intense for a long period of time, mostly by outside fishermen (from Sorong, Manokwari, Biak, and North Maluku). During 1984 and 1985, four to five fishermen boats were observed to visit the beach weekly and loaded 10,000-15,000 eggs per boat. Permission to collect eggs is given by local people through a trade with household necessities, such as sugar, rice, salt, soap, cigarettes, and cooking utensils. During the nesting season, beaches used to become crowded with temporary huts. Fortunately, this activity has declined significantly and even eliminated since intensive beach monitoring was initiated by WWF in 1993.

Feral Predation

WWF preliminary work by Baskar (1985) explored nest predation by wild pigs *(Sus scrofa)* in detail. Having been introduced to the islands of New Guinea long ago, pigs have become a major threat to nesting turtle populations on the north coast of Papua, including Jamursba Medi. Nests located close to the fringe of forests are likely safe from inundation and beach erosion, but are vulnerable to pig predation. In addition to pigs, monitor lizards *(Varanus salvator)* and dogs also forage on nests which have been formerly raided by pigs, and ghost crabs (*Ocypode sp)*, birds (crows, *Corvus orrea*), sea eagles *(Haliaetus leucogaster)*, brahminy kites *(Haliastus indus)*, sharks and fish (primarily threadfin) prey on hatchlings.

Based on the survey of July 1985 (Baskar), an average of 50 nests per night were deposited on Jamursba Medi. At hatching time, 56 days later, there was evidence of only three or four nests remaining. Considering that 17% of the nests were likely to have been inundated, up to 93% of the rest of the nests were destroyed by pigs. The situation at War-Mon Beach is similar to Jamursba Medi.

A short beach survey on Warmamedi beach (May 26-30, 1992) by WWF-Irian Jaya counted 387 leatherbacks nests destroyed by feral pigs (Stark, 1993). Based on Bhaskar's pig predation survey, 25% of the annual clutches laid during the period of April and May are consumed by pigs. Assuming that Warmamedi beach contributes 44% (data 1997) of the total clutches laid on Jamursba Medi, approximately 3,350 clutches were laid during the 1992 breeding season, it is therefore concluded that 100% of the nests were predated during April and May of that year.

The characteristic funnel shaped pit of a destroyed nest by feral pigs may extend up to one meter in depth and two meters across, giving the beaches a pock-marked "war zone" appearance. Local people interviewed stated observations of numerous empty shells lying in and around the excavated nest, which is clear indication that wild pigs are a great cause of egg mortality. In July to Sept 1993, 181 out of 1,300 nests (14%) were found predated by wild pigs. Predation data for other years has not been well documented, and inconsistencies in methodology creates difficulty to quantify exact predation rates.

Incidental Catch by Fisheries

Although the rapid collapse of most leatherback populations was due primarily to egg poaching, the indigenous harvest of adult leatherbacks, the high rate of incidental mortality in fishing gear has accelerated this process.

Facing the Pacific Ocean, the waters off the north coast of Irian Jaya have high potential for pelagic fisheries interactions by both national and foreign fishing fleets. Based on licensing records issued by Department of Fisheries in Sorong, there has been a substantial increase of pelagic fishing activities (for boats less that 30 gross tons) during the last ten years in Northern Papua. The types of fisheries include tuna longline, gillnet, trammel net and some other traditional type of fisheries, trap nets, floating cages with submerged lights (bagan).

The national Economic Exclusive Zone (inclusive of 200 nautical miles from land) exacerbates illegal fishing activities in the vicinity of nesting areas. Fishing activities occur during the eastern monsoon, when the sea surface is calm. This coincides with the nesting season at Jamursba-Medi beach. Thus far, fisheries induced mortality has not been quantified. However, communities living along the north coast and north Islands of Irian Jaya report dead leatherbacks entangled in fishing nets and marine debris.

Habitat Degradation

Nesting success of leatherbacks at Jamursba Medi beach and other sites along the North Coast of Papua area is dependent on the seasonal dynamics (erosion and accretion) of the beaches. The northwest monsoon begins with a three to six day period of windy weather late in August or early September. During this period the sea surface abruptly changes and most parts of the beaches are washed away. From October onwards the sea is constantly rough. By December and January there may be five to ten meters of beach remaining between the high tide mark and the forest, and possibly nothing at all the other stretches. Accretion starts around April each year (coinciding with turtle nesting), and the beach width slowly increases in some cases up to 65 m by late August.

At present, logging activities are not restricted to the southern boundary of the nesting beach, which is gazetted as a limited production forest. The logging activities include lumber harvest and transportation, and the construction of a log pond and base camps. These activities potentially threaten beach structure, change the physical environment, and are a potential threat by offering an increased opportunity for poaching. Logging and log transportation will likely cause upstream erosion of rivers and consequently the degradation of nesting habitats. The use of the beach as an access for harvested lumber and to build log ponds also has a direct impact on nesting turtles as logs have the potential to block beach access.

PROBLEM AREAS AND MANAGEMENT NEEDS

Research Needs for Management

Initial conservation objectives of WWF in Jamursba Medi are aimed to protect the beach from harvests of turtles and their eggs and to propose the area to be designated as a conservation site. Monitoring activities conducted in close collaboration with local communities since 1993 has proved effective in deterring anthropogenic threats (poaching and egg harvest). However, clutch information during beach patrols shows a marked decline of the nesting population. Thus far, no relevant management interventions are identified based on existing data due to:

- Lack of standardized data collection methods (inconsistencies in data gathering);
- Lack of technical knowledge (of turtle biology) among both field and program staff for data analysis and interpretation for management purposes;
- Lack of interest and capacity among national and local scientific agencies to conduct management-related research on sea turtles.

Despite the protection of the beach from direct exploitation, the impacts of other threats (e.g. feral predation, tidal inundation, beach abrasion, and fisheries by catch) on the sustainability of the population are unknown. The fact that other nesting beaches remain unprotected may further contribute to the population decline. Is protecting Jamursba Medi nesting beach enough to keep and maintain the existing leatherback population? This raises questions as to unit management and is crucial to be resolved through specific research projects.

Several important research questions in relation to unit management and *in-situ* management are identified:

- Unit Management:
  - What is the distribution of habitats and what is the population status in those habitats?
  - Is Jamursba Medi nesting a part of an extended nesting population in the Vogelkop Region?
  - Is the protection of Jamursba Medi enough to sustain the overall Papua leatherback turtle population?
- *In-situ* Management:
  - What is the current status of the nesting population (population trend), population dynamics?
  - What are the major threats throughout the region?
  - What is the possible reproductive outputs (clutch size, hatching success) and what degree of factors influence them (quality of habitat, predators, and incidental fishery bycatch)?
  - How to improve the reproductive outputs (semi-natural hatchery experiment, predator control experiment, or interaction of predators and turtles)?

In order to obtain a clear picture of the ecology of Papuan marine turtles and the habitats on which they depend and factors that threaten their sustainability, specific research objectives are identified:

- To determine distribution and structures of sea turtle critical habitats;
- To determine the size of current nesting population in each habitat;
- To determine success of reproductive efforts (clutch size and hatching success) and factors influencing them, and possible intervention to increase the reproductive outputs such as semi natural hatcheries; and
- To identify potential threats and quantify the level of threats to both habitat and nesting population.

SPECIFIC RESEARCH AREAS

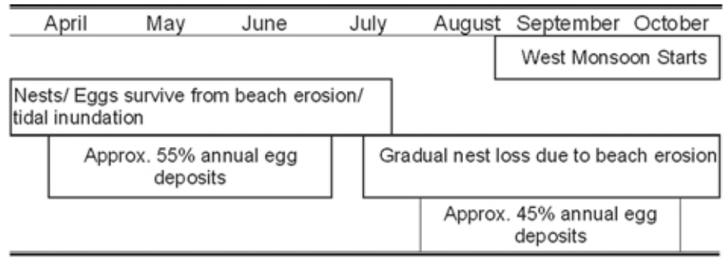
Tidal Inundation and Beach Abrasion

Like most sandy beaches, the Vogelkop beaches are subject to seasonal or storm related erosion and deposition (accretion) cycles. These cycles can lead to nest loss when portions of the beach succumb to change in current direction or velocity. Almost total loss of the beach occurs between high-tide mark and forest edge during the west monsoon (Table 6).

Leatherbacks, unlike green and hawksbill turtles, prefer to nest on the beach zone. Although there is still enough space left on the beach in Batu Rumah, the occurrence of sand walls along the beach is the main barrier for leatherbacks to move up the beach. Wembrak beach is fairly flat, with sand walls especially on the east part (near the perennial stream). Warmamedi lacks sand walls but has a slightly elevated beach. It is certain that a considerable proportion of leatherback nests will be inundated by spring tides, even if the beach is wide during pre-monsoon period.

The incubation period for nests at War-Mon beach average 56 days. Using this average, the majority of nests laid between April and the first week of July would survive inundation, since seasonal erosion (the beginning of the monsoon) gradually starts in late August. But the peak season at Jamursba Medi is June to July. In this case, almost half of the eggs deposited are lost each year by sea inundation/erosion. Study of the seasonal coastline dynamics in relation to nesting densities, distributions and nest loss is needed to justify mitigation (e.g. initiating a hatchery program).

Table 6. *Possible scenario for seasonal nest loss due beach erosion/tidal inundation (assuming that incubation period is 56 –60 days).*



Surprisingly, nesting activities still continue although the beach has virtually disappeared. Approximately five to 10 nests are laid per night in October. It is possible that at least some of the Jamursba-Medi nesters shifted to War-Mon or other eastern beaches. Tagging or genetic marking should be applied to confirm this. On War-Mon beach, the situation is the same but the erosion occurs later in January

Although the best management choice is to protect eggs *in-situ*, under special circumstances, such as seasonal beach erosion and tidal inundation, the removal of eggs is a viable conservation option. This intervention can mitigate threats by reducing hatching success as well as high level of nest loss. Relocation should be done for nests laid in known "high-risk areas" (areas with serious and predictable erosion) to more stable beach zones.

Hatching Failures and Causes

Although there has been no detailed study on the hatching success at different sections of the Jamursba Medi beach, local people confirm low hatching success even nest failure at Wembrak beach. An observation conducted by students in 1994 for 12 marked nests in this area showed zero hatching success.

Previous results indicate that 55% of the annual nests produced survive inundation. Since Wembrak contributes 40-50% of the total clutches laid during this period (April-July), nest failure is another serious threat. Detailed studies of the conditions (quality) of nesting habitats are needed to confirm the cause before specific interventions (e.g. hatcheries) are undertaken.

Feral Predation and Predator Control

Wild pigs are the major predator of turtle eggs in the area. Although the presence of monitoring personnel on the beach may hinder wild pigs on the beach, the vast beach size is still an obstacle. Several methods have been tried to prevent the predation by wild pigs on turtle nests. These efforts include building living fences (made of strong, thorny plants) at the edge of the beach forest, relocating the vulnerable nests located near vegetation to a safe place, building cages around nests, setting fire on the beach at night and animal-traps. Other methods have being applied by a Jakarta-based conservation NGO (Yayasan Alam Lestari) using a three km electric wire fence generated by solar panels along the forest edge. The effectiveness of these methods still needs to be assessed and improved.

Fishery Impacts

Incidental catch by fisheries is widely recognized as a major mortality factors for sea turtles. Although local people occasionally witness dead entangled leatherbacks, no studies have been made to quantify the impacts of fisheries in relation to turtle distribution to promote a "turtle safe" fisheries policy in Indonesia.

MANAGEMENT AND CONSERVATION

Economic Incentives for Local Communities

Local people have shown their support and commitment to WWF effort's to conserve leatherback turtles and their habitats. The beach monitoring members recruited by WWF were elected by their communities. This has resulted in decreased egg harvest and trade of egg harvest rights to outsiders; an indication of real changes. In addition, to grants of personal land property (beaches) are managed by WWF.

However, the fact that poverty is prevalent, economic aspects should be included in the development of conservation program. Community-based conservation is a strategy that seeks to reconcile the dual goals of biodiversity conservation and improved livelihoods for local communities. Many questions need to be explored. For instance:

- In what ways can local people benefit from conservation?
- In what ways can local communities contribute to conservation?

The most direct link is through community-based natural resource management systems that contribute to local livelihoods. Strategies to add value to resources and reduce the negative impact of their use through community management provide clear incentives for conservation with community participation. However, more research is needed to explore links between biological conservation and local livelihood benefits, and under what conditions they work well. Understanding the most important needs of the community, respect of local culture and analysis of the role of sea turtles, as well as understanding other associated nature resources needed to generate family income is necessary.

Thus far, small economic development projects have been supported by WWF (e.g. palm sugar home industries, chili-pepper and vegetable plantations, etc.). However, the integration of an economic component into a conservation plan is needed to both ensure sustainability of the conservation effort. Especially for remote areas where full involvement of the local community is required. A well planned ecotourism program is one option that can be used as a conservation tool as well as a successful community development model. Creating jobs and new environmentally friendly sources of income fitted to each individual community are realistic ways of promoting the conservation not only of sea turtles, but the ecosystem as a whole.

Integrated Management Approach

To ensure the survival of sea turtles and their nesting and foraging habitats, a holistic approach to the sustainable management of coastal resources is required. Land erosion may affect the quality of a nesting beach. Additionally, breeding habitats that usually occur nearby the nesting beach should be protected from any (fishery) activities that might disturb breeding or influence nesting processes. The diversity of threats influencing these habitats requires an integrated management strategy, which can coordinate the activities of many sectors.

Proposed National Park, Jamursba Medi-Tamrau

Jamursba Medi beach remains a proposed Wildlife (Turtle) Sanctuary based on the recommendation letter (No. 522.5/1010, dated November 8, 1994) of the district government of Sorong, Irian Jaya. The proposed site covers an area of 10,000 hectares. Currently, conservation actions in the area are done only with full support of local communities, WWF, and the Nature Conservation Agency, Forestry Department in Sorong. During the project period several achievements have been met:

- Political support gained from district government through the issuance of the recommendation letter (No. 522.5/1010, November 8, 1994) that supports the designation of Jamursba Medi beach as a Turtle Reserve.
- Public recognition gained for demarcation of proposed Jamursba Medi Turtle Reserve.
- Anthropogenic threats (egg harvest and adult poaching) eliminated.
- Fishing activity by local people in the immediate vicinity of the nesting beach reduced.
- Threats by predators reduced.
- Community awareness of the unique characteristics of leatherback species and management issues (i.e. threats to the populations) raised.
- Continuous collection of nesting data.

It is realized that the proposed conservation status for the Jamursba Medi Turtle Reserve restricts the conservation actions of beaches beyond the reserve. Consequently, an appropriate legal status must be issued to address a larger and integrated management status, to include the surrounding landscape (Tamrau Mountain) and coastal areas of North Bird's Head Region. Informal and formal meetings with relevant stakeholders by government institutions and local customary institutions were held to highlight the above mentioned issues. WWF- Irian Jaya II Regional Office held a stakeholder workshop in December 1999 to propose a 465,543.45 ha National Park for the areas including:

- Jamursba-Medi beach (278.75 ha);
- Limited production forest in the southern boundary of the beach (74, 855.50 ha);
- Protected forest in other areas (25,595.30 ha);
- Northern Tamrau Mountain Nature Reserve (351,934.80 ha); and
- Seas (12,515.10 ha).

General objectives of the proposed national park

- To protect and maintain sea turtle nesting populations (especially leatherback species) and habitats from any form of threats.
- To conserve the viability of Jamursba Medi nesting habitat and other important (Bird's Head) Papua terrestrial species and habitats.
- To stimulate active participation of local communities and relevant government institutions in conservation and management programs.
- To facilitate research, training and limited recreational activities that might support management of the area.
- To raise local economies through a promotion of community based management programs in relation with sea turtle and forest conservation.

Currently, a bottom-up planning process (for national park designation) has gained full support from both local government and communities, and legal arrangements with the national government are pending.

LITERATURE CITED

Adipati and Patay. 1984. Investigations on Marine Turtles and Their Nesting Sites on the Beaches of Kepala Burung, Irian Jaya. Cendrawasih University. Jayapura. WWF fellowship Studies.

Ating Sumatri, Djuharsa, E. 1985. Laporan Sementara Pengelolaan Habitat Penyu Belimbing *(Dermochelys coriacea)*, Pantai Jamursba Medi Kepala Burung, Irian Jaya. WWF/IUCN Project 1528 Report

Bakarbessy, J. 1999. Kondisi Penyu Belimbing *(Dermochelys coriacea)* dan Kawasan Pantai Jamursba Medi Kecamatan Sausapor Kabupaten Sorong Propinsi Irian Jaya (Condition of Leatherback Turtle and Jamursba Medi Beach). Research Paper. Balai Konservasi Sumber Daya Alam Irian Jaya II, Sorong. (Bahasa Indonesia).

Dutton, P., A. Soares, J. Bakarbessy, 1999. Paper presented at Sabah ASEAN Sea Turtle Symposium.

Stark, M. 1993. Field Survey of Leatherback nesting beaches in the Bird's Head Region, Irian Jaya, is renewed.

Maturbongs, J.A. 1999. Marine Turtle Nesting in Sorong,Irian Jaya, Indonesia. Marine Turtle Newsletter: Issue No. 87/January 2000.

Nababan, M.G., J. Bakarbessy. 1996. Kondisi Penyu Belimbing *(Dermochelys coriacea)* dan Suaka Margasatwa Pantai Jamursba Medi serta masa depan pengelolaannya. Sub Balai KSDA Irian Jaya Sorong.

Petocz, R.G. 1987. Nature Conservation and Development in Irian Jaya. Pustaka Grafiti, Jakarta.

Rajaar, D.R., 1996; Bio-Ekologi Persarangan Penyu Belimbing di Jamursba Medi, Kecamatan Sausapor, Kabupaten Sorong. Unpublished Thesis. JurusanKehutanan. Fakultas Pertanian. Universitas Cendrawasih. Manokwari. Irian Jaya.

Salm, R.V.; R.G. Petocz and T. Soehartono. 1982. Survey on Coastal Area in Irian Jaya. UNDP/FAO National Park Development Project, WWF Indonesia Programme, Bogor.

Starbird C.H., M. Suares. 1994. Leatherback Sea Turtle Nesting on the North Vogelkop Cosat of Irian Jaya and the Discovery of A Leatherback Sea Turtle Fishery on Kei Kecil Island.

Teguh, H. 2000. Leatherback Turtle *(Dermochelys coriacea)* Nesting in Jamursba-Medi Beach, Irian Jaya. Internal Report-WWF Indonesia-Sahul Bioregion Sorong Field Office, Sorong.

WWF-Indonesia. 1993-1999. Project Brief Profile. Three monthly Report for PKA, Dept. of Forestry.

WWF Indonesia Sahul Bioregion. 2000. Prosiding Lokakarya Penetapan Status Kawasan Konservasi Jamursba-Medi, Kecamatan Sausapor, Kabupaten Sorong, Irian Jaya. Workshop Proceeding. WWF Indonesia-Sahul Bioregion, Jayapura (Bahasa Indonesia).

WWF-KSDA, 1994. Laporan Pembinaan Masyarakat Sekitar Kawasan Jamursba Medi, Kecamatan sausapor, Sorong. Internal WWF report.

WWF-Sorong. 1999. Survai Keanekaragaman Hayati Pantai Peneluran Penyu Jamursba Medi (Survey on Biodiversity of Jamursba Medi Turtle Nesting Beach). Internal Report. WWF Indonesia - Sahul Bioregion, Jayapura. (Bahasa Indonesia).

WORKSHOP DISCUSSION

MR. OPU: Just a comment and a question. I notice you mention about lack of interest and capacity from academics. One of the problems that we have and one of the risks that we take within the Pacific Region, which hasn't been coming up in our meetings, is the political situation of these countries. For example, in Solomon Islands we had some turtle projects going on, but we had to stop them all last year because of the political situation in the Solomon Islands. Also in Fiji, we had some other federal programs with SPREP activities, we can plan it all out but we have the risk of it not working out because of the political situation there. So I was just wondering if that is one of the reasons why you do not have academics going in there.

My question is with regard to adult poaching, by that I guess you mean killing some of the nesting females that come up to nest. How serious is the problem within your project area?

MS. HITIPEUW: First, referring to the lack of interest of the academics is it because of the political situation. Myself, I've been involved in the area for almost ten years first with green turtles in our islands, I found it difficult to get academics interested in doing such a research because normally they've got their own interests in doing something. For instance, at our project site, for the university or fishery faculties to go out there, they need logistical and financial support. So the university focuses on areas close by, and leaves other areas for fishery conservation issues. Normally projects at remote areas are supported by outside institutions.

In regards to poaching, it is still a problem. But I may say on that particular beach, because local people enforce the protection and they really care about the sustainability of the population, I can say that along almost 20 kilometers of the beach the poaching and egg harvest is zero at that particular beach. But in other beaches, for instance, the eastern beach, the poaching and egg harvest is still there. You can confirm it because you can see there is still a lot of turtle meat and eggs sold at market.

DR. MARQUEZ: Do you have you an idea how to improve the hatchling success for the eggs?

MS. HITIPEUW: I was thinking of studies which involve hatchery management techniques. At some parts of the beach, there is not high nesting density (especially in the middle) and so hatchling success is low. But in other parts of the beach, especially in the west part, the nesting density is quite high (almost 45% of the total annual nesting) but hatchling success is still low and people confirm that it is common for there to be no hatching there. So instituting a hatchery could be one of the solutions, moving the eggs. Of course, it has to be confirmed from studies.

DR. MARQUEZ: Maybe to have the hatchery, just to move the eggs of the nest to some more protected areas, that would improve it.

MS. HITIPEUW: Yes, thank you.

Notes on Global Warming

Dr. Colin Limpus

I would like to make a quick comment on temperature because there has been two talks this morning that have picked up on some problems with incubation success. Studies in Eastern Australia are indicating very subtle impacts on incubation of turtle eggs in recent years that are linked to climate. For example, in December 1996 at Raine Island there was a very large nesting concentration of green turtles recorded there with tens of thousands of nesting females for the season. We took a camera crew to Raine Island to film the mass emergence of hatchlings two months after the peak of the nesting season. On arrival, we found there was virtually no hatchling production. We were not prepared for that. Our subsequent assessment of the clutches that were sampled was that there was a zero hatch success. The failure was caused by flooding that followed elevated ground water levels associated with storm surges and high rainfall. In the last six years we have had atypical weather patterns with six summers of very elevated SOI[1] values. This pattern had not occurred in the previous 30 years. The incubation environment has been changed fairly dramatically.

The January-February 1998 summer was the hottest on record. We are all familiar with the coral bleaching that occurred globally that year. At the same time, sand temperatures in the turtle rookeries in Queensland were being pushed up towards the upper limit for incubation of turtle eggs. So I'm not surprised that the Sabah incubation success in 1998 came down. We've just gone through another one of those hot summers in 2001-2002 with again a reduction in hatchling success at South Queensland rookeries.

I suspect that the reduced incubation success rates that have been recorded during these last few years could very well be related to global warming or climate change. It is an issue that should be examined more closely because climate modeling in Southeast Asia and the Western Pacific indicates that these rare hot summer events of recent years are likely to become common events within the next 30 years.

Issues like climate change with temperature change, increased rainfall, and flooding with rising water tables are key factors that are very, very relevant to marine turtle conservation. I suggest that global warming/climate change impacts on marine turtle population dynamics should be an area of focus. If we do not address it, we run the risk of being confronted with a nesting environment that will not be particularly productive for sea turtles.

[1] *Southern Oscillation Index*

Status of Sea Turtle Conservation in Thailand

Mickmin Charuchinda[1] , Somchai Monanunsap, Supot Chantrapornsyl

ABSTRACT

The following paper summarizes the conservation strategies for the four remaining species of sea turtles occurring in Thai waters: the green turtle, the hawksbill turtle, the olive ridley turtle and the leatherback turtle. In the past, sea turtles and their eggs were harvested for commercial purposes, but current population declines have led to increase in conservation initiatives. Conservation projects have been conducted at Phuket Marine Biological Center in the Andaman Sea since 1971, as part of the pilot project for the Queen's Project on sea turtle conservation at Mannai Island, Gulf of Thailand. Recently, organizations such as the National Parks, the Thai Navy and NGO groups have become concerned about sea turtle conservation. Management activities and hatcheries are being developed at several nesting locations. In addition, the Thai government has established laws and regulations to protect sea turtles, and promotes public education campaigns.

INTRODUCTION

Historically, five species of sea turtles have been recorded in Thai waters: the leatherback turtle *(Dermochelys coriacea)*, the green turtle *(Chelonia mydas)*, the hawksbill turtle *(Eretmochelys imbricata)* the olive ridley turtle *(Lepidochelys olivacea)* and the loggerhead turtle *(Caretta caretta)* (Phasuk and Rongmaungsart, 1973). Green and hawksbill turtles are found in the Gulf of Thailand, while olive ridley turtles are the most abundant species along the Andaman Sea Coast. In addition, a small number of leatherback turtles also occur in the Andaman Sea, while the hawksbill turtles are very rare. In the Andaman Sea, green turtles have been found at Similan Island, Phang-nga Province and Tarutau Island, Satune Province. A few loggerhead turtles have been found in the Gulf, but are believed to be extinct from other areas of Thailand.

In the past, sea turtles were hunted for shells and meat, and eggs were commercially harvested. Many nesting beaches were declared as concession areas. However, approximately 20% of the harvested eggs were reincubated in hatcheries, and hatchlings were released to the sea according to an agreement between the government and the concessionaires (Chantrapornsyl, 1992).

Aware of the decline of sea turtle populations, a conservation project was initiated in 1971 by the Phuket Marine Biological Center (PMBC). PMBC established the Sea Turtle Conservation Station at Mannai Island in the Gulf of Thailand, which studies sea turtle biology and protects nesting sites. A few critical nesting beaches have been declared National Parks to protect the animals and their habitats. Similarly, laws and regulations protecting sea turtles have been registered, and public education and conservation campaigns are being provided.

DISTRIBUTION AND NESTING SEASON

Sea turtles are distributed in Thai waters along the coastline and Islands of the Gulf of Thailand and the Andaman Sea. In the Gulf, the most important nesting areas for green and hawksbill turtles are Khram (predominate nesting site), and adjacent Islands located in the inner Gulf, Chonburi Province. There are some Islands along the east coast from Chonburi, Rayong and Trat Province and in the middle Gulf off Chumphon, Surattani and Nakorn-sri-thummarat Provinces where sea turtles are occasionally found. Along the Andaman Coast of Thailand, sea turtle nesting areas are concentrated on the west coast of Phuket and Phang-nga provinces. Mostly olive ridley and a few leatherback turtles are found in these areas. Green and hawksbill turtles are found at the Similan Islands, Surin Islands and Tarutao Islands (Fig. 1).

[1] *Presenting author*

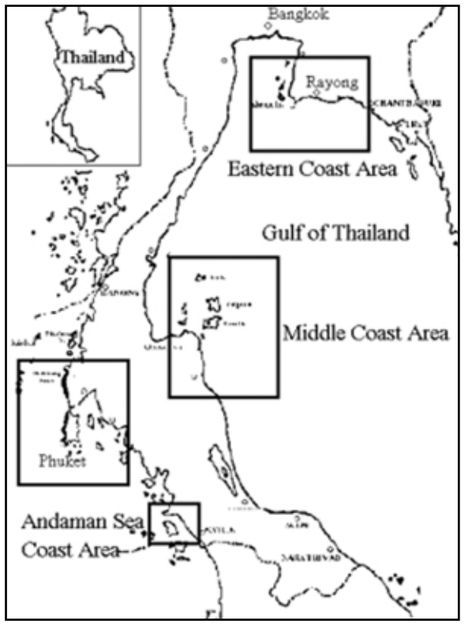


Figure 1. *Map of Thailand with sea turtle nesting areas identified (square areas).*

Sea turtle nesting areas are divided into two difference geographical locations, the Gulf of Thailand and the Andaman Sea. In the Gulf, green and hawksbill turtles lay their eggs all year with peak season from May to August (Charuchinda and Monanunsup, 1998). The populations of green and hawksbill turtles in the Gulf of Thailand have not declined significantly (Fig. 2) since these nesting areas have been protected and controlled by the Department of Fisheries and the Royal Thai Navy since 1950. As these areas are completely protected, very few fishermen or poachers can enter the Island. However, the numerous nesting grounds of the Andaman coast have been negatively impacted by urban expansion, improper fishing techniques and tourism development. Sea turtle conservation at the Andaman coast is more difficult than in the Gulf, and thus these populations have decreased significantly (Fig. 3).

The nesting season of sea turtles along the Andaman Coast occurs from October to March with peak season during November to January. The most abundant nesting turtles along this coast are the olive ridley, with occasional leatherback turtle nesting. Green and hawksbill turtles occur predominantly at the Islands. The famous nesting beaches are Thaimuang Beach and Phrathong Islands, Phang-nga Province; Maikhaw beach, Phuket Province; and Tarutao Island and Adang-Rawi Islands, Satun Province (Fig. 1). Unfortunately, recent tourism development has become a major disturbance to nesting turtles. Consequently, only the National Marine Park areas provide suitable nesting habitat.

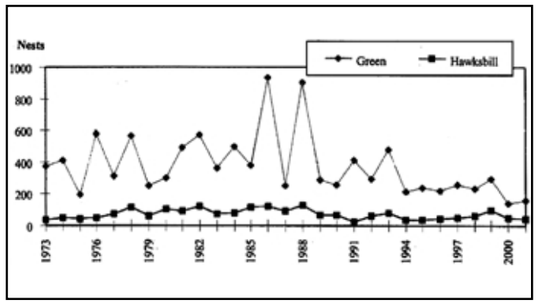


Figure 2. *Number of green and hawksbill turtle nests at Khram Islands, 1973 – 2001.*

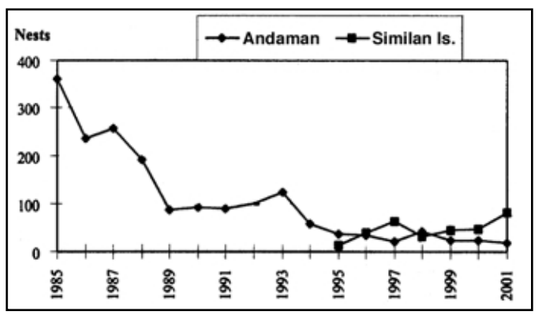


Figure 3. *Number of sea turtle nests at Andaman Sea coast of Thailand, 1985-2001.*

CONSERVATION STRATEGY

Sea turtles in Thailand are currently better protected than in the past. Commercial harvest, sale and consumption of sea turtle meat and products are prohibited. Many laws and regulations have been registered to provide protection (Charuchinda and Chantrapornsyl, 1999). This legislation was officially implemented as follows:

- The Ministry of Agriculture and Cooperative Enactment, 1947. Sea turtles were listed as protected species. Killing sea turtles and/or collecting eggs was prohibited.
- The Fisheries Act, 1972. Commercial fishing within three kilometers of the coastline was prohibited. This legislation was based on findings that sea turtles and their foraging habitats in Thailand are destroyed by shallow water trawling and push netting boats [the incidental capture of sea turtles by trawling was reduced after regulation of fishing gear].
- The Ministry of Commerce Enactment 1979. The export of sea turtles was prohibited.
- The Conservation and Protection of Living Resources Enactment 1992, Act No. 19. The collection, production or sale of sea turtles products is prohibited. In addition, Thailand signed and became a member of the Convention on International Trade on Endangered Species (CITES) in 1983.
- The use of Turtle Excluder Devices (TEDs) in shrimp trawl fisheries was enforced in 1997.

HABITAT PROTECTION

Nesting Beaches

Nesting beach habitat protection has been strengthened due to increased patrolling of beaches. Several agencies, non-government organizations (NGOs) and institutions are involved in this environmental protection. Due to proper coordination, the National Parks and NGOs provide increased manpower at beaches during nesting seasons.

The most important nesting areas in the Gulf of Thailand (where almost 100% of the sea turtles lay their eggs) is under the control of the Royal Thai Navy at Khram Islands. Turtles are thus well protected in this area. Almost 100% of sea turtle eggs are collected, hatched and raised to proper size (three months) before being released to sea.

The Andaman Sea coast conservation program is currently being implemented for olive ridley and leatherback turtles. The Phang-nga Province, Phuket Marine Biological Center, the Thaimaung-Kao Lumpee National Parks, and Coastal Aquaculture Development Center provide authorities to patrol nesting beaches. All turtle eggs are transferred to hatcheries. Hatchlings are reared at the Phuket Marine Biological Center for three months before release. Olive ridley and leatherback turtles lay eggs at three beaches of the Phrathong Islands, Phang-nga Province. In 1997, the PMBC collaborated with the Italian Marine Turtle Research and Conservation (CELON) program to conduct a sea turtle conservation project at the Phrathong Islands. This project includes: surveying nesting sites; education (of students and local communities) to promote awareness; and relocating turtle eggs to hatcheries.

At present most sandy beaches at Phuket are fully developed for tourism. Sea turtle nesting areas remain only at the Sirinarth National Park (Niyang National Park). In this area, the Park authority together with the Phuket NGO, patrol beaches to protect nesting females and their eggs. These eggs are relocated to hatcheries for incubation, and hatchlings crawl to the sea naturally.

Many islands in the Andaman Sea belong to the National Parks, and nesting beaches are patrolled and eggs removed to hatcheries for incubation. Hatchlings are released to the sea immediately after hatching, but in some Islands controlled by the Royal Thai Navy, eggs are incubated in natural conditions *(in-situ)*. These hatchlings are reared for a short period before release.

Foraging Areas

Foraging habitats such as seagrass beds and coral reefs, which are important feeding areas of sea turtles, are protected by law. Certain fishing gear such as push nets and trawls are prohibited in these areas.

Education Program

Information about sea turtle biology and conservation management is provided for public awareness. Educational campaigns depicting the plight of sea turtles are aimed towards local people to promote cooperation for conservation. T-shirts, articles, newspapers, slide shows, radio, television program, posters and exhibitions regarding the sea turtle life history have been widely distributed to improve public knowledge. The most effective program, however, was conducted by the Department of Fisheries and the Royal Thai Navy in cooperation with private agencies. In this instance the public was invited to release baby turtles to the sea. This initiative promoted greater enthusiasm for turtle conservation among the Thai participants who are known for their gentleness and kindness.

CONSERVATION AND MANAGEMENT

Sea turtle conservation activities are conducted by the Department of Fisheries, and the Sea Turtle Conservation Station, Mannai Island. The Department of Fisheries conducts the Queen's Project Sea Turtle Conservation Program. Her Majesty the Queen of Thailand, initiated the Queen's Project by donating private royal property, Ko Mannai Island, Rayong Province, to the Department of Fisheries for use as a research station for sea turtle conservation on August 11, 1979. At this site, sea turtle breeding biology has been studied and future goals are to establish a sea turtle conservation farm. The objectives of the Queen's Project are:

- To propagate and increase the number of sea turtles in Thai waters by means of natural and artificial hatching of sea turtle eggs. Young sea turtle will be reared for a certain period of time then tagged and released to the sea to replenish the natural stock.
- To maintain adult sea turtles as a parent stock for breeding and to safeguard against the disappearance of sea turtles in Thai waters.
- To promote the area as a tourist site to encourage turtle conservation.
- To propose proper conservation measures to the Thai Government in order to develop a decree concerning sea turtle resource management in Thai waters.

Phuket Marine Biological Center

Phuket Marine Biological Center (PMBC) is a research center that belongs to the Department of Fisheries. The marine endangered species conservation program includes sea turtles, with emphasis on olive ridley and leatherback turtles. The eggs are collected from various nesting beaches along the west coast of Thailand and are transferred for incubating at the center. The hatchlings are reared for a few months before being released to the sea, some hatchlings may be reared for longer until they are strong enough for a tagging study. Leatherback turtle hatchlings cannot be successfully reared in captivity, and are released immediately after hatching.

The Department of Fisheries

The Department of Fisheries has five Marine Fisheries Development Centers and thirteen Coastal Aquaculture Development Centers. Most research programs are conducted by the Department of Fisheries, which studies the biology and nesting behavior of sea turtles, both in nature and in captivity. These centers also conduct sea turtle conservation programs by means of collecting eggs, hatching, rearing and releasing the hatchlings to the sea. The department is also actively involved in enforcement of laws and regulations, and implements public education and awareness campaigns. The Department of Fisheries is presently conducting research on sea turtles as follows:

1. **Long-term monitoring:** Data collection to assess population status and enhance hatch rates and sex ratios of hatchlings.
2. **Tagging study:** To study nesting and interesting parameters of female sea turtles, and success of reared hatchling experiments.
3. **Satellite tracking:** To study behavior, feeding grounds and migratory routes.
4. **DNA analysis:** To identify turtle stocks within the country and in the region.

Department of Forestry

The Department of Forestry is authorized to take responsibility for the National Marine Parks throughout the country. Beaches under the authority of the National Marine Parks are strictly patrolled and sea turtle eggs are always removed to a safe place. A few hatchlings are kept and reared for public education.

Sea Turtle Conservation Center (Thai Navy)

In 1950, the Hydrographic Department of The Royal Thai Navy started a sea turtle conservation program, and requested the permission of the Department of Fisheries for concession turtle eggs from Khram Island (Gulf of Thailand) to rear approximately 20% of eggs in hatcheries to be released into the wild. Since 1979, activities by the Air and Coastal Defense Command in collaboration with the Queen's Project released about 4,000 baby turtles a year from Mannai Island, Rayong Province. In 1992, The Royal Thai Navy established the Sea Turtle Conservation Center hatchery to rear eggs, and hatchlings for three months prior to release (Hydrographic Service Department, 1964).

Sriracha Municipality Sea Turtle Aquarium

Sriracha Municipality, Chonburi Province established an outdoor aquarium in 1992 for rehabilitation services. A large number of sea turtles are kept in this Aquarium, some which were caught incidental by fishermen in trawls or gill net. Turtles wounded during fishing operations are cared for by a veterinarian and reared in the outdoor aquarium until ready for release. This activity is under the conservation project of the Department of Fisheries.

LITERATURE CITED

Phasuk B. and S. Rongmuangsart. 1973. Growth studies on the ridley turtle *Lepidochelys olivacea*, in captivity and the effect of food preferences on growth. Res. Bull., Phuket mar. Biol. Cent. 1: 14

Chantrapornsyl, 5. 1992. Artificial Incubation and Embryonic Development of Olive Ridley Turtle Eggs *(Lepidochelys olivacea)*. Phuket Mar. Bid. Cent. Res. Bull. 57: 41-50.

Chantrapornsyl, 5. 1992. Biology and Conservation on Olive Ridley turtle *(Lepidochelys olivacea)* in the Andaman Sea, Southern Thailand. Phuket Mar. Biol. Cent. Res. Bull. 57: 51-66.

Charuchinda M. and S. Monanunsap. 1998. Monitoring Survey on Sea Turtle Nesting in the Inner Gulf of Thailand, 1994-1996. Thai Mar. Fish. Res. Bull., 6:17-25

Charuchinda M. and S. Chantrapornsyl. 1999. Status of Sea Turtle Conservation and Research in Thailand. SEAFDEC MFRDMDIRMIWS-l/99/CR.8

Hydrographic Service Department. 1964. Studies on sea turtle and sea snake program. Bureau of Administration. 31 p. (in Thai)

WORKSHOP DISCUSSION

DR. FITZSIMMONS: What you consider is the biggest threat to the turtle populations in Thailand right now?

MR. CHARUCHINDA: We do not know why the turtles coming to lay eggs have reduced in number. But I think the nesting stock and the foraging population in Thailand is the same stock. Possible nesting turtles are impacted in the foraging grounds and thus are not making it back to the beach. After we satellite tag turtles, they go one of three ways. 50 percent have gone to the east, to Cambodia, Vietnam or cross the South

China Sea to the Sulu Sea. Another direction is towards Malaysia and Singapore. And the rest have stayed around the nesting site. But why they are not making it back to nest I do not know.

DR. MORITZ: I wonder whether bycatch in trawls outside of Thai waters might be an issue.

MR. CHARUCHINDA: In the Thai waters we try to study TEDs after the U.S. law embargo. At that time, we compared the use or non use of TEDs. In the shrimp trawl fishery, we believe the shrimp trawls cannot catch turtles because the shrimp trawl has a small mouth opening of the trawl. But the fish trawl does catch some turtles.

MR. KISOKAU: Are the local communities involved with the turtle conservation? And what are some of the traditional links to turtles in Thailand?

MR. CHARUCHINDA: Yes. They have some festivals in during the Thai New Year. We release a lot of turtles. Not only turtles, but also fish and other things. After they are released, the Department of Fishery gives information about conservation.

MR. SHARMA: There are a number of really good universities in Thailand. Why is it that turtle research has never got into the universities? Are there some restrictions or lack of interests?

MR. CHARUCHINDA: No, I don't know why. Maybe, those who study turtles will be old like the turtle.

MS. PHILIP: You mentioned the Queen's Project, is there any collaboration with the Queen's Project with others?

MR. CHARUCHINDA: Yes, the Queen gave us [the Department of Fishery] this Island and we began research.

Current Sea Turtle Research and Conservation in Taiwan

Dr. I-Jiunn Cheng

INTRODUCTION

There are five species of sea turtle found in Taiwan. They are the green turtle *(Chelonia mydas)*, the hawksbill turtle *(Eretmochelys imbricata)*, the loggerhead turtle *(Caretta caretta)*, the olive ridley turtle *(Lepidochelys olivacea)*, and the leatherback turtle *(Dermochelys coriacea)*. All these species are listed as Endangered and under full protection of wildlife legislation. Among these five species, the green turtle is the most abundant nester in Taiwan.

In spite of their Endangered listing, sea turtles have had an intimate relationship with Chinese culture for thousands of years. The long life span and numerous life-saving legends have made most Chinese in coastal areas believe that this giant creature is the representative of God. Thus, local people prepare turtle shaped offerings for temples made from rice, cake, fruit jellies, and even gold to pray to during the annual lantern festival (which occurs two weeks after Chinese New Year), for peace and prosperity.

Ironically, coastal fishermen harvested sea turtles for their meat, their bones for Chinese medicines, and eggs for profit. Most of the turtles incidentally caught in coastal set-net and driftnet fisheries were slaughtered, or sold to temples as religious icons. Fifty years ago, there were numerous nesting sites distributed on the east and southwest coasts and offshore islands of Taiwan. Now, nesting turtles can only be found on the beaches of PengHu Archipelago (especially the Wan-An Island) and Lanyu Island, Taitung County.

Wan-An Island (23°22'N, 119°30E), approximately 7.17 km² in size is the fourth largest Island in the Penghu Archipelago (Fig. 1). It is located southwest of Taiwan Straits, 18 miles south of the mainland Penghu Island. Lanyu Island (22° 00-05'N, 121° 30-36'E) is 45.7 km² in size, a tropical rainforest island in the Pacific, located 49 miles southeast of Taitung (Fig. 2).

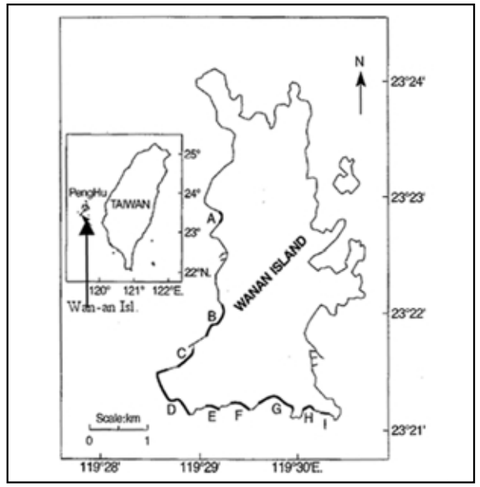


Figure 1. *Map of Wan-An Island, Northwest of Taiwan, with nesting sites (A-I) labeled.*

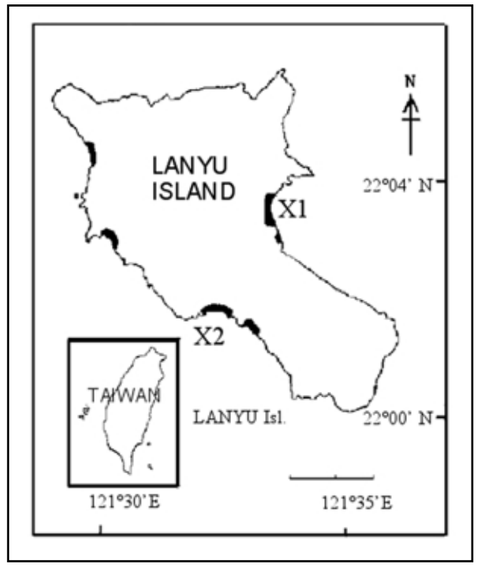


Figure 2. *Lanyu Island, southwest of Taiwan with survey beaches labeled X1 and X2.*

RESEARCH

With support of the Council of Agriculture (COA), a long-term research project on the biology of green turtles was started at Wan-an Island in the summer of 1992. This site was designated as a refuge for nesting green turtles in July 1995. There are six nesting beaches on the island, a total of four km in length and 4.02 km^2 in area (labeled A - I, Fig. 1). The project expanded to Lanyu Island, Taitung County in 1997. At Lanyu, there are two nesting beaches with an area of approximately 0.021 km^2 (labeled X1 and X2, Fig. 2). The nesting beaches on this island are not yet authorized as wildlife refuge sites.

On each island, six environmental parameters and 28 biological parameters were measured. The environmental parameters includes the air temperature and precipitation, area of nesting beaches, the substrata mean grain size, sorting coefficient, and pore water content. The biological parameters were separated into three categories.

1. Parameters related to gravid females: number of nesting females; straight and curved carapace lengths of nesting females; emergence frequency on different beaches; emergence times; temporal variation of nesting activities; nest site; digging times; digging frequency; digging success; nesting times; nesting frequency; nesting success; clutch size; nest depth; and inter-nesting interval.
2. Parameters related to incubated eggs: egg diameter; egg weight; underutilization rate; hatching mortality rate; hatching success; post-hatching mortality; and emergence success.
3. Parameters related to the hatchlings: straight and curved carapace length of hatchlings, and hatchling weight.

Due to manpower limitations, except for air temperature and precipitation, the environmental parameters were measured only once on both islands. The daily air temperature and precipitation were obtained from the Central Weather Bureau. In 1994, 40% of the biological parameters were collected on Wan-an Island, and 70% were collected 1996. On Lanyu Island, all the biological parameters have been collected since 1997. The re-migration intervals were collected on both islands based on the flipper tag records. Results from this study can be seen in Table 1. Statistical analysis showed that the larger and heavier eggs produced larger hatchlings. It was also evident that air temperature can influence the incubation period, the hatching success, and the size (not the weight) of hatchlings.

TAGGING TECHNOLOGY

Research and Conservation Implications

A combination of GIS (Geographic Information System) and GPS (Global Positioning System) technology was used to determine that gravid females prefer nesting sites in the interface zone between the open beach and grassland. From a management point of view, these results, together with the high nest site fidelity of green turtles, suggested that nesting beaches should be safeguarded as much as possible. Permanent building, sand mining, motorcycle racing, and the removal of vegetation should be banned on nesting beaches. The above mentioned technologies combined with satellite telemetry and ultrasonic acoustic telemetry found that inter-nesting gravid turtles spent approximately 50% of their time within five km of the Island in water of less than 20 m depth. This stressed the importance of conserving the coastal ecosystem of the nesting beaches.

Beginning in 1996, long-term self-recording temperature loggers were used to determine the sex ratio of the green turtle hatchlings on Wan-An Island. The results of a two year study indicated that more than 83% of hatchlings were females. The ratio was slanted towards more male hatchlings at the beginning and end of the nesting seasons as a result of lower incubation temperatures at those times. More male hatchlings can also be expected from nests deposited on open beaches. In the past, all nests on open beaches were relocated to either the grassland or interface zone within four hours of deposition.

Table 1. *Nesting Parameter Study Results.*

Parameter Studied	Wan-an Island	Lanyu Island
Air temperature	16°C January to 28°C August	18°C January to 26°C August
Precipitation	0.0mm October to 2,600 mm August	140mm May to 4,000 mm August
Sediment character	moderately sorted, very coarse sand	moderately sorted, very coarse sand
Pore water content	4.3%	5.3%
Nesting season	May to November; peak July and August	June to October
Nesting population size	2 to 19	4 to 11
Female size	97.0 to 101.2 cm SCL; 101.2 to 105 cm CCL	95 to 100.5 cm SCL; 100.5 to 105.4 cm CCL
Re-migration interval	3.6 years	3.3 years
Female emergence/season	2 to 19 times; dug 4 to 22 holes	3 to 10 times; dug 4 to 14 holes
No. nests deposited per season (nesting success %)	2 to 5 (46 - 79%)	1 to 4 (33 - 65%)
Internesting interval	13 to 16 days	10 to 12 days
Average nest depth	64 to 81 cm	58 to 73 cm
Clutch size	87 to 126 eggs	73 to 110 eggs
Incubation period	48.3 to 56.3 days	49.5 to 56.3 days
Hatching success	49 to 87%	53 to 79%
Hatchling size	46.4 to 48.5 mm SCL; 46.6 to 50.7 mm CCL, 21 to 27.1 g	43.9 to 47 mm SCL; 48.9 to 61.8 mm CCL; 21.4 to 27.4

More recent results suggest, that except for inundated nests in the inter-tidal zone, every nest in the open beach does not need to be relocated to produce more male hatchlings.

The geosystem total station study found that most female turtles will climb directly over the first slope after emergence before searching for a nest site, and the beach slopes on both islands were not too steep for emerging turtles. The cone dynamic penetrometer study found that the nesting success on Wan-An Island is only influenced by the substratum compactness 30 cm below the surface. Currently, the light intensity logger is used to determine light pollution on the nesting beach, and the combination of time domain reflectometry moisture measuring Trase System with the temperature logger is used to determine the effect of both sediment temperature and moisture on the incubation period and hatching success. Both studies are still in progress.

FISHERIES BY-CATCH

Fishery by-catch is a serious problem for sea turtle conservation. Historically, little attention has been paid to coastal fisheries operating in areas inhabited by adult and juvenile turtles. From 1991 to 1995, a field survey was conducted consisting of visits to the harbor fishery market, and on-board observations to determine the impact of coastal fisheries on the sea turtle populations.

The results showed that more than 90% of turtles were caught by setnet fishing gears. Although all five species were caught by this method, green turtles were the most abundant turtles incidentally caught, followed by loggerheads and olive ridley turtles. The by-catch rate also increased with fishing effort. Most of the turtle bycatch was sold to temples for "religious release" later. Less than 10% were slaughtered or stuffed for decoration.

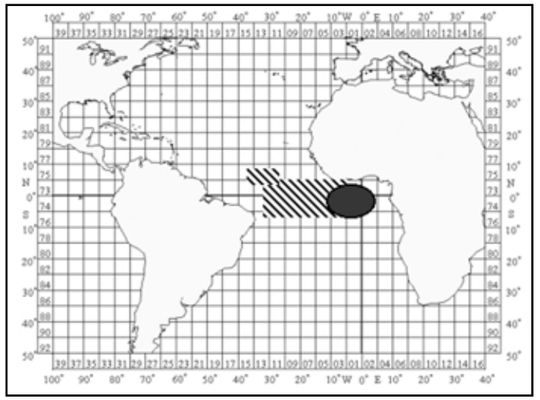


Figure 3. *The long-line Taiwan fishing area (shaded) with observers from 1998 – 2000. The • (black area) denotes the sea turtle by-catch area.*

In 1999 and 2000, an on-board observer program was initiated on the high sea Taiwan long-line fleet to record sea turtle by-catch rates in the tropical Atlantic Ocean. The observation period lasted from December 1998 to February 1999, and again from October to December of 2000. In addition, five long-line fishing vessels were contracted for their logbook recordings. The result indicated that leatherback, olive ridley and loggerhead turtles were caught in the tropical Atlantic Ocean (Fig. 3). A total of 47 turtles were incidentally captured, and 62% were leatherback turtles. The estimated CPUE by species can be seen in Table 2.

Table 2. *Catch per unit effort (CPUE) of sea turtle species during long-line fishery operations in the Atlantic Ocean.*

Species	CPUE (turtles per 1,000 hooks)
Loggerhead	0.327
Leatherback	0.337 - 0.702
Olive ridley	0.16 - 0.324

All captured turtles were either immature or undetermined sex. The mortality rate due to capture was about 23%. These values are in the range of other studies. The high bycatch rate of leatherback and olive ridley turtles might be related to the nesting activities of these species in the area. The fishing areas in 1999 and 2000 were near Gabon in the Gulf of Guinea, the site of the second largest leatherback turtle nesting in the world. In addition, the observation period matched the nesting seasons of both leatherback and olive ridley turtles in the region.

The logbook records revealed that turtle bycatch by longline vessels fishing in the Western Pacific Ocean occurred primarily on the continental shelf, as compared to the tropical Indian Ocean and the South Atlantic Ocean (Fig. 4). Nine turtles were recorded including loggerhead, green and olive ridley turtles. The bycatch CPUE by species was 0.018 turtles per 1,000 hooks for olive ridley turtles, 0.02 turtles for loggerheads, and 0.0615 turtles for green turtles. Again, these values fall in the range of other studies.

SATELLITE TELEMETRY AND CONSERVATION IMPLICATIONS

To understand the migratory patterns of nesting females in the ocean (with the help of George Balazs, U.S. National Marine Fisheries Service), post-nesting females at Wan-an Island have been fitted with satellite transmitters (PTT) since 1994. Between 1994 and 1998, 10 PTTs have been deployed. The migration distance ranged from 193 to 1,909 km, and the migration speed ranged from 1.2 to 2.8 km/h. Turtles spend 95% of their time submerged, and surfaced for short periods of time to breath. The end points or last transmissions are from: the Koshiki Island of Japan, outskirts of Tamshiu Estuary of Taiwan, east coast of Hainan Dao of Mainland China, Qinpeng Dao of Mainland China, Okinawa of Ryuku Islands, Ishigaki-shima of Ryuku Islands, Ho-Lon Town Maio-Li County of Taiwan, and east coast of Pratas Island (Dungsha Island). In addition, a fisherman in the near shore waters of the Philippines found one Inconel tagged turtle and reported it to the conservation officer. He retagged the turtle, and released her to finish her journey.

These results show that turtles that nest at Wan-An Island are distributed widely on the continental shelf east of Mainland China (including the East and South China Sea and the Yellow Sea). In addition, these results strongly suggest that the green turtles of Wan-An Island are a resource that is shared among nations in Northeast Asia, and indicate the importance of nations to exchange information that share critical foraging habitats with green turtles that nest in Taiwan. The importance of opening dialogue and discussing the possibility of joint cooperation with these nations for conservation and research of green turtles is clearly indicated. Populations that nest in these regions can only be recovered if stakeholders from both sides unite to conduct basic biological research, stock estimates and comply with regional and international management regimes.

COMMUNITY PARTICIPATION

The ecological behavior of the green turtles that nest at Wan-An Island has received substantial media attention since the establishment of the refuge site. The number of turtle-watch groups has also increased with the involvement of local people patrolling the beach during summer nights. In the beginning, private industry (I-Mei Foods Corp.) donated money to hire four local villagers to patrol the beach and protect nesting females and hatchlings. The successful launch of this preliminary work has encouraged the PengHu County Government to hire more villagers. Meanwhile, they also adopted a rote system so that more villagers could be hired. With this additional manpower on the beaches, and the development of management programs which encourage local people to be actively involved at the decision-making level, the future of sea turtle conservation in Taiwan is promising.

In 1997, the community participation program for sea turtle conservation was conducted. Results from interviews and questionnaires of tourists, local residents and Wan-An middle and primary school students showed that all the interviewees are well aware of the importance of sea turtle conservation. However, due to the various requirements, simply employing beach patrollers, limited entry to the nesting beaches, and enhancing basic research apparently cannot meet the future needs. Therefore, with help from PengHu County Government, a formal beach training program was carried out to train local villagers in the summer of 1997 and again in 1999. Forty-nine villagers registered for the program and 29 of them (included one 78 year old grandfather), passed the test and became the certified beach patrollers. These people will become the backbone of the management program of the refuge site.

In addition, PengHu County Government also plans to increase its public awareness/education program, and open a dialog with the local residents to create environmentally relevant job opportunities. In this way, ecotourism may, hopefully, flourish on the island. The county government also aims to improve the living conditions of the local people and promote a grassroots movement directed towards self-sufficiency. With the help of a Legislator, the Tourism Bureau decided to invest over one billion NT dollars to build a Green Turtle Ecological Exhibition and Conservation Hall on the Wan-An Island. The building is scheduled for its grand opening for tourists and researchers in the summer of 2002. It is expected that this center will act as a bridge between conservation and the community, as well as a bridge for international cooperation.

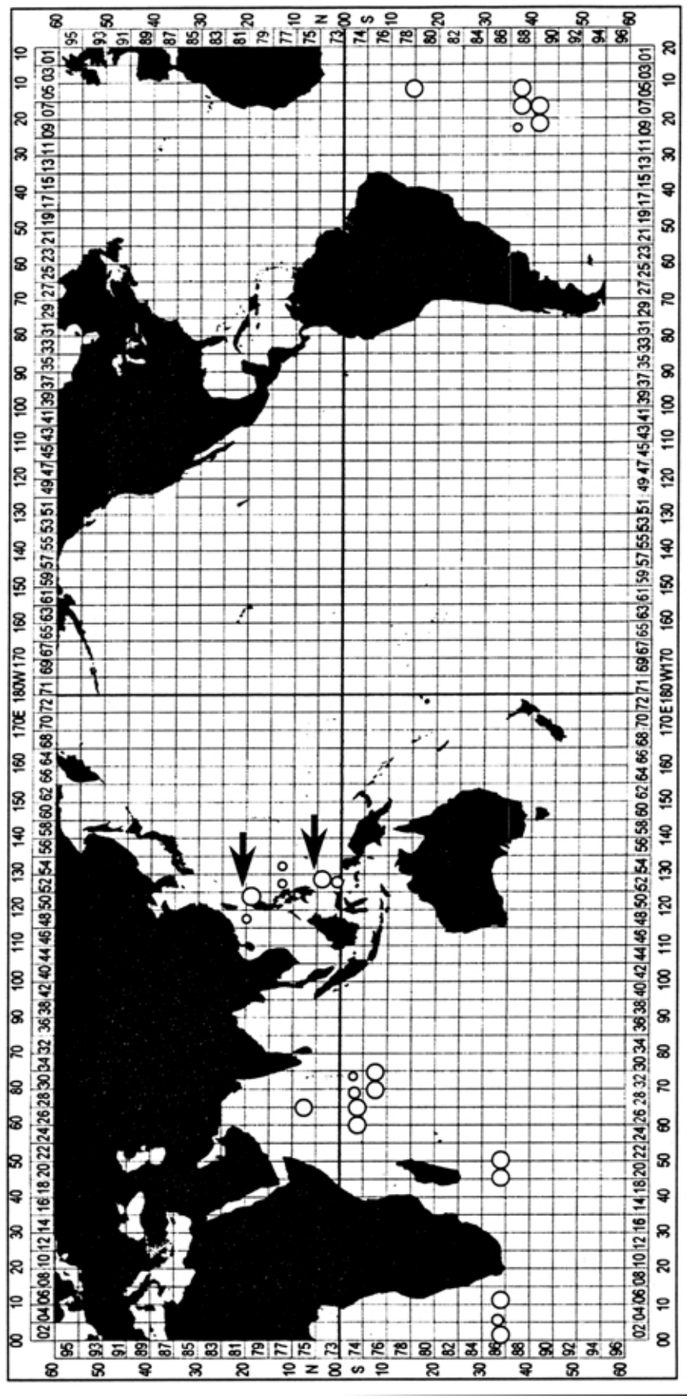


Figure 4. Results from Taiwan long-line fleet log books. The circle areas denote fishing effort, arrows denote site where sea turtles were incidentally caught.

Status of Sea Turtle Conservation in Vietnam

Tran Minh Hien

INTRODUCTION

There are five sea turtle species which occur in Vietnam: the green sea turtle *(Chelonia mydas)*, hawksbill *(Eretmochelys imbricata)*, loggerhead *(Caretta caretta)*, olive ridley *(Lepidochelys olivacea)* and leatherback *(Dermochelys coriacea)*. All five species have been found to feed and/or nest along the coast of Vietnam (Fig. 1): Quang Ninh, Hai Phong, Thanh Hoa, Quang Nam, Da Nang, Quang Ngai, Binh Dinh, Khanh Hoa, Ninh Thuan, and Kien Giang. There have been insufficient sea turtle studies in Vietnam to determine population trends. However, there is no doubt that the population of sea turtles coming to the region has sharply declined and the number of nesting females coming to beaches to lay eggs is also reduced. Sea turtle nesting sites have been found only in few places, mainly on the islands of Con Dao and Phu Quoc, where there is less pressure from human activity. Currently, the population of nesting sea turtles in Vietnam is estimated at about 200 individuals.

THREATS

The main threats to sea turtles in Vietnam are human impacts such as:

- **Over-exploitation of eggs and adults.** In Vietnam, catching sea turtles and collecting turtle eggs for food are common activities of coastal communities where feeding and/or breeding grounds are in close proximity.
- **Habitat destruction and alteration.** Other than natural impacts such as typhoons and beach erosion, the habitat of sea turtles has been destroyed by a series of human activities such as: exploitation of coral reefs, construction of coastal infrastructure and facilities, impacts of tourism, pollution caused by oil spill or discharge of untreated sewage or solid waste. The fundamental factors of habitat destruction are lack of a comprehensive development plan and a national plan for sea turtle conservation.
- **Intensive and destructive fishing methods.** The unregulated fishing industry and advances in fishing technology has resulted in the incidental catch of sea turtles. The use of destructive fishing methods such as explosives, toxic chemicals and electro-fishing has further damaged turtle habitat and impacted populations.
- **Market demand.** There is a high demand for sea turtle products in the market; and green and hawksbill sea turtles have been heavily hunted to supply this demand.
- **Poverty and lack of community participation.** There is a high level of poverty in Vietnam's coastal communities, particularly in the rural areas. Poor infrastructure, inadequate availability of credit, and insufficient access to markets contributes to the exploitation of marine resources. There is a lack in understanding in biodiversity and conservation, and a lack of alternative livelihoods for rural households.
- **Lack of information and education.** There is no management for sea turtles in Vietnam, and no information regarding the ecological characteristics or biological requirements of sea turtles.
- **No financial support.** There is no available government funding for research and/or conservation activities.
- **Lack of regulations and week enforcement.** Sea turtles have been included in the Vietnamese Red Book since 1992. However, there are no provisions in the legislation to provide protection for sea turtles.

Since 1995, WWF has supported sea turtle protection at some nesting sites in Con Dao, and recently (2000) in Nui Chua Nature Reserve. Interest in sea turtle conservation has grown since participation in the Southeast Asian Memorandum of Understanding, signed on September 12, 1997 by the Vietnam government. The government has recently begun to attend meetings and workshops at the national and regional level, and sea turtle conservation issues are gaining support.

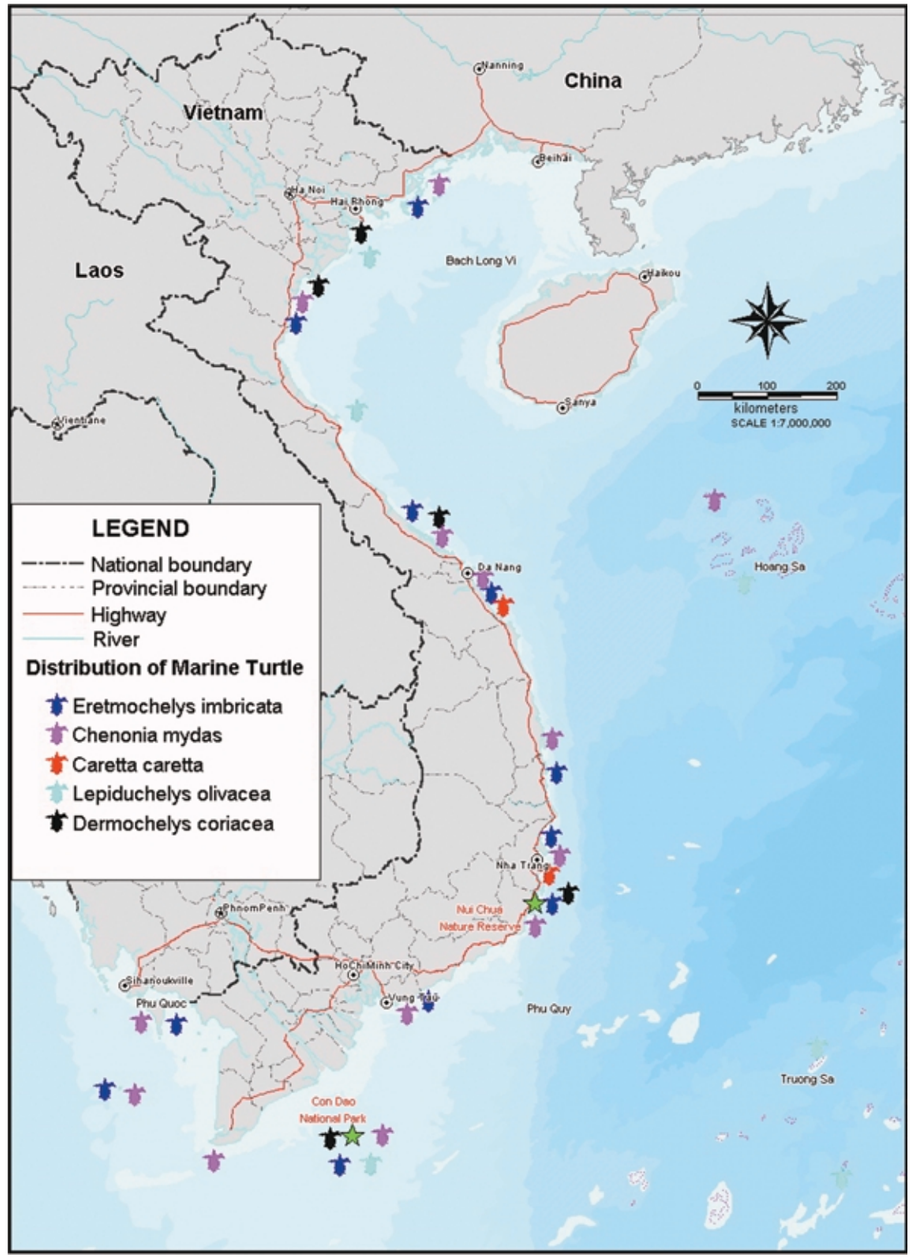


Figure 1. *Distribution of marine turtle occurrences in Vietnam.*

CONSERVATION ACTIVITIES

Con Dao National Park

Con Dao National Park is the most populous nesting sea turtle site in Vietnam. Although there is no specific data on the population trends or rate of decline, anecdotal information from local people (based on reports and interviews) suggest a downward trend in turtle numbers. In 1995, WWF Vietnam initiated the first sea turtle conservation program in the park

Table 1. *Number of nesting green sea turtles at Con Dao National Park.*

Year	No. Turtles	Hatch rate %
1995	295	35
1996	116	74
1997	254	75
1998	217	75
1999	283	80
2000	241	80
2001	290	NA*

*not available

Two species nest in Con Dao, the green sea turtle (predominately) and hawksbills. There are historic records of other species, loggerheads and olive ridley, nesting in the area as well, but there are no recent sightings. Of the 14 beaches at Con Dao National Park, five are monitored for turtle nesting activity. Although nesting does occur at other beaches, lack of funding prevents census studies to be conducted. Of the five monitored beaches, more than 200 female turtles nest each year (Table 1).

The sea turtle conservation activities at Con Dao National Park are focused to protect nesting beaches and hatchlings; provide basic infrastructure and training for national park staff in turtle conservation; research and monitoring; and marine protected area management. The sea turtle rescue program has been effective in mitigating threats to turtle populations. For example, turtle nests that are in danger of erosion, tidal inundation or poaching are transplanted to the hatchery program. The improvement of conservation methods and hatchery techniques by staff over the past five years has resulted in a gradual increase in the number of turtles nesting on beaches and of the hatching success rates. In addition, the research and monitoring program conducts a tagging program to provide a foundation for studies and migration patterns in the future.

WWF - Vietnam's support of activities at Con Dao has provided invaluable contributions to the general knowledge of sea turtles and sea turtle conservation in Vietnam, and has helped to engage local communities in the conservation effort. The continuation of this project represents a major step toward ensuring the conservation of Vietnam's endangered sea turtle species.

Nui Chua Nature Reserve

In 2000, WWF Indochina Programme initiated sea turtle conservation activities in Nui Chua Nature Reserve, Ninh Hai district, Ninh Thuan province. This area is one of the few remaining turtle nesting areas on mainland Vietnam. Three species of turtles nest in this area, the olive ridley, green turtle and hawksbill. Historically, leatherback turtles also nested in this area, but now are only seen in the water on occasion (reference, community interview). There have also been sharp declines in sea turtle populations and in the number of nesting turtles in this area within the last five years. According to local people, tens of turtles used to nest per night, but today only few arrive during peak season.

Monitoring activities from the first nesting season (March to October 2001) revealed green sea turtles emerging 71 times, resulting in 23 nests (21 of which hatched), and a hatchling success rate of 64%. Future project activities will focus on identifying the distribu-

tion of sea turtle populations and the root causes of threats to turtle species at the project site, and to create an appropriate conservation plan to include local community participation. WWF-Indochina hopes to motivate the community to form a volunteer monitoring program to enhance conservation, and an education awareness program.

Future sea turtle conservation activities will be assisted by funding from IUCN Vietnam, WWF Indochina and TRAFFIC Indochina. Con Dao and Nui Chua National Parks have been chosen as three pilot sites for a National Action Plan for sea turtle conservation. The goals of this plan will be to help enforce policies and regulations on sea turtle protection; build capacity to set up effective conservation programs throughout the country; establish a database for the tagging program; and provide a program for environmental education and awareness.

WORKSHOP DISCUSSION

MS. KINAN: Just a quick question about funding, are there government funds available for turtle research in Vietnam?

MS. HIEN: No, no government funds are available. It is very hard to get funds from the government for biodiversity conservation work; not only for marine turtles, but also for other areas like forests.

Sea Turtle Conservation in Palau

Theo Isamu[1] , Mike Guilbeaux[2]

ABSTRACT

In 1994, the Republic of Palau became an independent nation, freely associated with the United States through what is known as the Palau-US Compact of Free Association. Through this process, Palau terminated its Trust Territory ties to the US, its agencies, and programs, relying now on its own internal processes for decision making, policy setting, and program implementation. Some of these processes still involve some level of US-based assistance; however, responsibility for national level, natural resource management, including endangered species protection, has now turned completely to the Palau government. Over recent decades, the national government has faced several challenges in protecting the viability of turtle populations from threats ranging from local exploitation for traditional, subsistence, and commercial use to increasing impacts from tourism and infrastructure development. The recent evolution and involvement of locally-based conservation NGO's create new opportunities for sea turtle management and conservation efforts. Similarly, the enhancement of government programs to improve resource management and environmental protection may prove beneficial. Existing opportunities will be described to illustrate how progress may be made in the conservation of Palau's threatened sea turtle populations. These include policy revisions governing turtle harvesting; the design and implementation of state level or community based conservation initiatives, and educational and awareness programs. Local experiences with these approaches will be described. This paper will also summarize current threats to sea turtle population recovery in Palau, as well as possible alternatives for national conservation strategies, local initiatives for sea turtle protection, and cooperation with local communities.

PRESENTATION

The following presentation is about the past, current and future perspectives of marine turtle conservation in Palau. Palau consists of about 350 islands, 70 of which are inhabited, with a total area of 494 square kilometers including 237,830 square miles of EEZ. It has a total human population of about 19,000 people; a small country spread over a large area. Palau has a traditional matriarchal social structure in which women comprise a strong decision making faction of the society.

Sea turtles species which occur in Palau are hawksbills, green turtles, and some occasional observations of olive ridleys, loggerheads and leatherbacks. Turtle sightings are diffuse on the main islands and more concentrated in the southeast islands where most of the nesting is concentrated. Modern conservation areas were enacted in the early 1960's to set aside marine protected areas. This trend has continued where now there are marine conservation areas in many areas of Palau, some of which relate to the protection of sea turtle nesting sites and foraging habitat.

The women in Palau play a very strong role in regard to sea turtles. They are one of the prime users of sea turtle products (hawksbill shell) and exchange and safeguard turtle products for cultural purposes. Green turtles are harvested by fishermen for meat, but hawksbill are harvested by husbands as requested by their wives to make "women's money," called toluk. This practice continues to the present.

RESEARCH

Research in the past - mostly of headstarting turtles and collecting nesting information - had been conducted by the Micronesian Mariculture Demonstration Center. There is a now a planned state-operated head-start

[1] *Presenting author*
[2] *Abstract author; Community Conservation Network*

program at Merir Island of the Sonsorol State, one of the Southeast Islands close to the Philippines. There has been a satellite tagging of one turtle and routine flipper tagging is a program to be incorporated in the future.

CONSERVATION

Existing laws in Palau regarding sea turtles includes restricted no-take seasons during the nesting season when it is not permitted to collect any female turtles of any species while they are on the beach, including no-take of eggs at the same time. There are size limits for hawksbill turtles at 27 inches in carapace length, and green turtle at about 34 inches. In the future, more stringent conservation laws are anticipated. The Endangered Species Act is applicable to all species of turtles in Palau.

Awareness programs, coordinated by the Palau Conservation Society (funded by R.A.R.E), incorporate children to create posters and brochures about sea turtle issues. Recent conservation actions include awareness workshops to educate the local community. Dr. Nicolas Pilcher of the Community Conservation Network recently presented a workshop directed towards women to focus on integrating traditional practices and other customs in Palau with sea turtle conservation. As women are integral policy and decision makers in Palau, it is important to include and understand women's issues, views and concerns and try to formulate comprehensive and effective regulation.

Palau would like to increase its cooperation and collaboration with other Pacific Island nations (via SPREP) and would like to be incorporated in the Southeast ASEAN MoU to promote sea turtle conservation. Palau is just beginning to treat sea turtles as a management responsibility. With recent reorganization of government departments and apparent declines in populations, sea turtles have become a major issue, and hopefully the country will work to accommodate actions which will assist sea turtle populations to repopulate Palauan waters.

WORKSHOP DISCUSSION

DR. MORITZ: I wonder if you can give us some indication of what is known about current turtle numbers nesting in Palau?

MR. ISAMU: There has not been any consistent detailed work on turtles in Palau. The number of nesting turtles or information on the stocks is not known.

MR. ARTERO: Theo, seeing that Palau received substantial U.S. federal assistance, is there a provision which calls for the total acceptance of the Endangered Species Act of the United States?

MR. ISAMU: When Palau was part of the Pacific Trust in Tahiti, we were a member of CITES. But when we came out from the Pacific Territory Trust and became independent, the agreements that were ratified by U.S. were automatically amended. In regards to federal grants in Palau, R.A.R.E is involved in the educational side of turtle management programs. But in regards to direct management or research studies, we could use U.S. funding for these programs.

MS. KINAN: Just wondering, what can you buy with a turtle dollar?

MR. ISAMU: For the women's money, it depends on how close are you to the ceremonial setting. The husband catches the turtle, and for one to two days of labor, a woman may produce two or three toluk [$, turtle shells], the money might ranges from $100 to $1,000. We are looking to come up with an arrangement to work out with women as to reuse women's money or revolve it around the community, rather than collecting new turtles.

DR. BRODERICK: I wonder if there is a conflict of interest between the women making the turtle dollars and the export of turtle products.

MR. ISAMU: There wide sentiment to stop the sale of turtle shell jewelry so as to not dilute the real meaning of the tradition or context in turtle shells.

Global Status of the Green Turtle *(Chelonia mydas)*: A Summary of the 2001 Status Assessment for the IUCN Red List Programme.

Dr. Jeffrey A. Seminoff

INTRODUCTION

The green turtle *(Chelonia mydas)* is currently listed as *Endangered* by the World Conservation Union (IUCN), with the Mediterranean subpopulation listed as *Critically Endangered* (Hilton-Taylor 2000). In effort to maintain accurate status listings, the IUCN Red List Programme solicits periodic re-evaluations of each Red List species; this report summarizes the findings of the 2001 evaluation of the global green turtle population. Although the IUCN green turtle listing is based on population changes over the last three generations as determined through extrapolations of documented population trends (IUCN 2001), this summary focuses only on recent published information. See Seminoff (2002) for the 3-generation population extrapolations and summaries of current global threats and conservation practices.

RANGE & POPULATION

The green turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Pacific Ocean – eastern, central, western; Indian Ocean – western, northern, eastern; Mediterranean Sea; and Atlantic Ocean – eastern, southern, western). Green turtles are highly migratory and they undertake complex movements and migrations through geographically disparate habitats. Nesting occurs in more than 80 countries worldwide (Hirth 1997). Their movements within the marine environment are less understood but it is believed that green turtles inhabit coastal waters of over 140 countries (Groombridge and Luxmoore 1989).

The primary nesting rookeries (i.e., sites with ≥ 500 nesting females per year) are located at Ascension Island, Australia, Brazil, Comoros Islands, Costa Rica, Ecuador (Galapagos Archipelago), Equatorial Guinea (Bioko Island), Guinea-Bissau (Bijagos Archipelago), Iles Eparses Islands (Tromelin Island, Europa Island), Indonesia, Malaysia, Myanmar, Oman, Philippines, Saudi Arabia, Seychelles Islands, Suriname, and United States (Florida) Lesser nesting areas are located in Angola, Bangladesh, Bikar Atoll, Brazil (Atoll da Rocas), Chagos Archipelago, China, Costa Rica (Pacific), Cuba, Cyprus, Democratic Republic of Yemen, Dominican Republic, d'Entrecasteaux Reef, French Guiana, Ghana, Guyana, India, Iran, Japan, Kenya, Madagascar, Maldives Islands, Mayotte Archipelago, México (Yucatan Peninsula, Michoacán, Revillagigedos Islands), Micronesia, Pakistan, Palmerston Atoll, Papua New Guinea, Primieras Islands, Sao Tome é Principe, Sierra Leone, Solomon Islands, Somalia, Sri Lanka, Taiwan, Tanzania, Thailand, Turkey, Scilly Atoll, United States (Hawaii), Venezuela, and Vietnam. Sporadic nesting occurs in at least 40 additional countries (Groombridge and Luxmoore 1989).

POPULATION TREND ASSESSMENT PROCEDURES

Because reliable data are not available for all sub-populations of green turtles, the present report focuses on 33 Index Sites (Fig. 1, Table 1). These include all of the known major nesting areas for green turtles. Despite considerable overlap at some foraging areas, each is presumed to be genetically distinct (Bowen *et al.* 1992, Bowen 1995). Selection of these sites was based on the assumption that they represent the overall regional population trends and because historic data indicate most were the largest nesting sites in their respective areas, a guideline for assessing widely distributed species (IUCN 2001). In accord with the IUCN definition of "reduction" as a "decline in the number of mature individuals", assessments presented here are based on activity at nesting beaches. Indices of abundance for the present assessment include counts of nesting females, records of adult harvest, hatchling production data, and measures of egg production and harvest. Population trends are determined independently for each Index Site through comparisons of past and present data sets. Because of the high inter-annual variability in magnitude of nesting displayed by green

turtles (Limpus and Nichols 1987, Broderick *et al.* 2001) multiple-year data sets are used whenever available; nevertheless, in some cases single-year data sets are used because they represent the only available information. Past versus present comparisons are based on the assumptions that at each site (A) the mean number of nests/female/season and mean number of eggs/nest remain constant through time, (B) efforts to monitor nesting female activity and egg production are constant through time, and (C) when using egg and/or adult female harvest data, capture effort is consistent during all years for which data are available.

GENERATION LENGTH

The current IUCN Guidelines for Assessing Widely Distributed Species (IUCN 2001) indicate that population trends should be considered over a time interval of 10 years or three generations, whichever is longer. In the case of long-lived sea turtles, the latter criterion is applicable. Generation length is based on the age to maturity plus one half the reproductive longevity (Pianka 1974). Although there appears to be considerable variation in generation length among sea turtle species, it is apparent that all are relatively slow maturing and long-lived (Chaloupka and Musick 1997). Green turtles exhibit particularly slow growth rates, and age to maturity for the species appears to be the longest of any sea turtle (Hirth 1997). Estimates based on age-specific growth suggest green turtles attain sexual maturity at ages ranging from 25 to 50 years (Limpus and Chaloupka 1997, Bjorndal *et al.* 2000, Chaloupka *et al.* in press). With regard to reproductive longevity, estimates range from 17 y to 23 y (Carr *et al.* 1978, Fitzsimmons *et al.* 1995). Data from a pristine green turtle stock in the southern Great Barrier Reef in Australia show a mean reproductive life of 19 y (Chaloupka *et al.* in press). Thus, based on the midpoint in the range of maturity estimates (37.5 y) and reproductive longevity from the undisturbed Australian stock (19 y), a conservative generation length of 47 y (37.5 + 1/2*19) is used for this assessment; however, the actual generation length may approach 60 yrs.

LISTING RECOMMENDATION BASED ON 2001 ASSESSMENT

The green turtle has been a species of global concern for decades, and was previously listed by IUCN as Endangered (Groombridge 1982, Baillie and Groombridge 1996, Hilton-Taylor 2000). The majority of the most important nesting populations of green turtles have declined in the 20th century at substantial rates. Although a few large populations remain, they are vulnerable to exploitation, incidental capture in marine fisheries, habitat loss, and disease. Based on several different population indices, the global green turtle population has declined by 34% to 58% over the last three generations. These estimates are, however, based on a very conservative approach; actual declines may be closer to 70% to 80%. This rate of decline, coupled with impending threats (Table 4), clearly justify *Endangered* status for green turtles under the 2001 Red List Criteria.

RATIONALE FOR THE LISTING

Evaluations of green turtle populations focus on annual nesting activity and egg production at 33 Index Sites distributed globally (Fig. 1). Analysis of historic and recent published accounts indicate extensive population declines in all major ocean basins over the last 141 years (three generations) as a result of overexploitation of eggs and turtles and, to a lesser extent, incidental mortality relating to marine fisheries and degradation of marine and nesting habitats. Population declines of over 50 % have been identified in the eastern and western Atlantic. Declines greater than 80 % have been shown for populations in the eastern Pacific, western Pacific, South East Asia, northern Indian Ocean, western Indian Ocean, and Mediterranean. In all cases declines have occurred in less than three generations indicating that absolute reductions over the entire 3-generation time span (since the year 1860) are much greater.

Information on nesting activity over the last three decades indicates that green turtle nesting populations in Ascension Island, Australia, Brazil (Trindade Island), Comoros Islands, Costa Rica (Tortuguero), Ecuador (Galapagos Islands), Guinea-Bissau, (Bijagos Islands), Malaysia (Sabah), México (Yucatan Peninsula), Oman (Ras al Hadd), Saudi Arabia (Karan Island), Suriname, and the United States (Florida, Hawaii) are currently stable to increasing. However, the statuses of these nesting populations relative to 141 years ago are unknown, and several face substantial threats of mortality through poaching, fisheries impacts, habitat loss, and disease.

Despite increasing conservation attention to green turtles, intentional harvest continues worldwide. Egg collection is ongoing at nesting beaches in the eastern Atlantic (Fretey 1998; 2001), western Atlantic (van Tienen *et al.* 2000), Caribbean (Mangel *et al.* 2001), southern central Pacific (Eckert 1993), eastern Pacific (Alvarado *et al.* 2001), and South East Asia (SPP 2000, WWF 2000). Nesting females continue to be killed in the Caribbean (Fleming 2001, Mandel *et al.* 2001), eastern Atlantic (Fretey 2001), and Indian Ocean (Humphrey and Salm 1996). Of perhaps greatest threat to the stability of existing green turtle stocks is the intentional capture of juveniles and adults at neritic foraging habitats (National Marine Fisheries Service and U. S. Fish and Wildlife Service 1991; 1998). High levels of take are present in the eastern Atlantic (Formia 1999), Caribbean (Lagueux 1998), Indian Ocean (Humphrey and Salm 1996, Andrew Cooke pers. comm. to J. Mortimer), Mediterranean (Kasparek *et al.* 2001), central Pacific (Eckert 1993), eastern Pacific (Seminoff 2000, Gardner and Nichols 2001), and South East Asia (Pilcher 1999, SPP 2000, Limpus *et al.* in press).

Because of slow maturation rates for green turtles, the effects of egg and juvenile mortality have yet to manifest fully at nesting beaches. Although large numbers of females may continue to nest in many areas, such harvests decrease the recruitment and overall abundance of juveniles, thus hindering this age-group's ability to replace aging adults. Declining population trends are exacerbated when harvest is more intense or longer term (Chaloupka 2000), and when nesting females are also exploited.

The genetic substructure of the green turtle regional populations shows distinctive mitochondrial DNA properties for each nesting rookery (Bowen *et al.* 1992). Mitochondrial DNA data suggest that the global matriarchal phylogeny of green turtles has been shaped by ocean basin separations (Bowen *et al.* 1992, Encalada *et al.* 1996) and by natal homing behavior (Meylan *et al.* 1990). The fact that sea turtles exhibit fidelity to their natal beaches suggests that, if populations become extirpated, they may not be replenished over short time frames by the recruitment of turtles from other nesting rookeries. Moreover, because each nesting population is genetically discrete, the loss of even one rookery will represent a decline in genetic diversity and resilience of the species (Bowen 1995).

The loss of ecological function due to depletion of these large, long-lived animals may have serious implications for the maintenance of both marine and terrestrial ecosystems. As large herbivores, green turtles impact seagrass productivity and abundance (Bjorndal 1980, Zieman *et al.* 1984) and continue to represent an essential trophic pathway over expansive coastal marine habitats (Thayer *et al.* 1982; 1984, Valentine and Heck 1999). Through egg deposition on beaches, sea turtles act as biological transporters of nutrients and energy from marine to terrestrial ecosystems (Bouchard and Bjorndal 2000). Thus, as green turtle stocks are depleted we can expect a corresponding breakdown in the health of coastal marine and terrestrial systems (Jackson 1997, Jackson *et al.* 2001).

RECENT DOCUMENTED DECLINES: A REGIONAL PERSPECTIVE

When examining the prevailing population trajectories in each region it is apparent that green turtle populations exhibit different overall trends in different parts of the world (i.e., some areas are doing much better than others). For example, green turtle populations in Australia, western Atlantic and central Pacific are exhibiting encouraging trends: all three populations in Australia are either stable or increasing (Fig. 2c); all but

one nesting population (Venezuela) in the western Atlantic are stable or increasing (Fig. 2h); and the single rookery examined in the central Pacific (Hawaii) is increasing (Fig. 2b). In contrast, populations in South East Asia, northern Indian Ocean, eastern Pacific, western Pacific, and Mediterranean are doing relatively poorly. Among the six rookeries in South East Asia, all but one (Sabah, Malaysia) are declining, and in the northern Indian Ocean all but two (Saudi Arabia, Oman) are declining. Although few rookeries are present in the eastern Pacific (Fig. 2a), western Pacific (Fig. 2b), and Mediterranean (Fig. 2g), declining trajectories are present at all but one (Galapagos Islands). The current IUCN assessment procedures for sea turtles are carried out at the global level (e.g., this report), however, the presence of regional population trends suggests that it may be appropriate to apply the IUCN Red List Criteria at regional levels during future assessment efforts (Gärdenfors *et al.* 2001).

LITERATURE CITED

Al-Merghani, M., J. D. Miller, N. J. Pilcher, and A. Al-Mansi. 2000. The green and hawksbill turtles in the Kingdom of Saudi Arabia: Synopsis of nesting studies 1986-1997. Fauna of Arabia 18: 369-38

Alvarado-Díaz, J., C. Delgado-Trejo, and I. Suazo-Ortuño. 2001. Evaluation of black turtle project in Michoacán, México. Marine Turtle Newsletter 92:4-7.

Asrar, F. F. 1999. Decline of marine turtle nesting populations in Pakistan. Marine Turtle Newsletter 83:13-14.

Baillie, J. and B. Groombridge. 1996. IUCN Red List of Threatened Animals. Gland, Switzerland: IUCN, 368 pp.

Balazs, G. H. 1980. Synopsis of biological data on the green turtle in the Hawaiian Islands. NOAA Tech. Report WFSC-36. 141 pp.

Basson, P., J. Burchard, J. Hardy and A. Price. 1977. Biotopes of the western Arabian Gulf. Aramco, Dhahran, Saudi Arabia. 284 pp.

Basintal, P. and M. Lakim. 1994. Status and management of sea turtles at Turtle Island Park, pp. 139-149. *In:* Proceedings of the First ASEAN Symposium-Workshop on Marine Turtle Conservation, Manila, Philippines 993. Manila: World Wildlife Fund.

Batori, G. 1974. Rapport d'activité. Ile Tromelin. Mimeo, 1-15.

Bhaskar, S. 1984. The status and distribution of sea turtles in India. Proceeding of the Workshop on Sea Turtle Conservation: CMFRI publication. No: 18.

Bjorndal, K. A. 1980. Nutrition and grazing behavior of the green turtle, *Chelonia mydas*. Marine Biology 56:147-154

Bjorndal, K. A., J. A. Wetherall, A. B. Bolten, and J. A. Mortimer. 1999. Twenty-six years of nesting data from Tortuguero, Costa Rica: an encouraging trend. Conservation Biology 13:126-134.

Bjorndal, K. A., A. B. Bolten, and M. Y. Chaloupka. 2000. Green turtle somatic growth model: evidence for density dependence. Ecological Applications 10:269-282.

Bouchard, S. S. and K. A. Bjorndal. 2000. Sea turtles as biological transporters of nutrients and energy from marine to terrestrial systems. Ecology 81:2305-2313.

Bowen, B. W., A. B. Meylan, J. P. Ross, C. J. Limpus, G. H. Balazs, and J. C. Avise. 1992. Global population structure and natural history of the green turtle (*Chelonia mydas*) in terms of matriarchal phylogeny. Evolution 46:865-881.

Bowen, B. W. 1995. Molecular genetic studies of marine turtles, pp. 585-587. *In:* K. A. Bjorndal (ed.), Biology and Conservation of Sea Turtles, revised edition. Smithsonian Institution Press, Washington, D.C.

Broderick, A. C., B. J. Godley, and G. C. Hays. 2001. Trophic status drives inter-annual variability in nesting numbers of marine turtles. Proceedings of the Royal Society 268:1481-1487

Broderick, A. C., B. J. Godley, and G. C. Hayes. 2001. Monitoring and conservation of marine turtles of Ascension Island: a sustainable resource. Interim Report to Foreign and Commonwealth Office Environment Fund for the Overseas Territories. 13 pp.

Bustard, H. R. 1974. Barrier Reef sea turtle populations. Proceedings of the Second International Coral Reef Symposium 1:227-234.

Butynski, T. M. and S. H. Koster. 1989. Marine turtles in Bioko Island (Fernando Poo), Equatorial Guinea: A call for research and conservation. Washington DC: WWF Unpublished Report. 14 pp.

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

Carr, A., A. Meylan, J. Mortimer, K. A. Bjorndal, and T. Carr. 1982. Surveys of sea turtle populations and habitats in the Western Atlantic. U. S. Department or Commerce NOAA Tech Memo. NMFS-SEFC-91. 91 pp.

Catry, P., C. Barbosa, B. Indjai, A. Almeida, B. J. Godley and J. Vié. In review. Biology and conservation of the green turtle (*Chelonia mydas*) nesting at Poilão, Bijagós Archipelago (Guinea-Bissau). Oryx.

Chaloupka, M. 2000. Modelling the sustainability of sea turtle egg harvests in a stochastic environment, pp. 52-54. *In:* F. A. Abreu-Grobois, R. Briseño-Dueñas, R. Márquez-Millan, and L. Sarti-Martinez (comps.), Proceedings of the Eighteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-436.

Chaloupka, M. Y. and J. A. Musick. 1997. Age, Growth, and Population Dynamics, pp. 233-273. *In:* P. L. Lutz and J. A. Musick (eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.

Chaloupka, M. Y., C. J. Limpus, and J. D. Miller. in press. Sea turtle growth dynamics in a spatially disjunct metapopulation. Can. J. Zoo.

Cliffton, K., D. O. Cornejo, and R. S. Felger. 1982. Sea turtles of the Pacific coast of México, pp. 199-209. *In:* K. A. Bjorndal (ed.), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C.,

de Silva, G. S. 1982. The status of sea turtle populations in East Malaysia and the China Sea, pp. 327-337. *In:* K. A. Bjorndal (ed.), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D.C.

Dodd Jr., C. K. 1982. Nesting of the green turtle, *Chelonia mydas* (L.), in Florida: Historic Review and Present Trends. Brimleyana 7:39-54.

Domantay, J. S. 1953. The turtle fisheries of the turtle islands. Bulletin of the Fisheries Society of the Philippines 3,4:3-27.

Eckert, K. A. 1993. The biology and status of marine turtles in the North Pacific Ocean. NMFS Technical Memorandum. NOAA-TM-NMFS-SWFSC-1186. 156 pp.

Eisentraut, M. 1964. Meeresschildkröten an der Küste von Fernando Poo. Natur und Museum 94, 471-475

Encalada, S. E., P. N. Lahanas, K. A. Bjorndal, A. B. Bolten, M. M. Miyamoto, and B. W. Bowen. 1996. Phylogeography and population structure of the Atlantic and Mediterranean green turtle *Chelonia mydas*: a mitochondrial DNA control region sequence assessment. Molecular Ecology 5:473-483.

Fitzsimmons, N. N., A. D. Tucker, and C. J. Limpus. 1995. Long-term breeding histories of male green turtles and fidelity to a breeding ground. Marine Turtle Newsletter 68:2-4.

Fleming, E. H. 2001. Swimming Against the Tide: Recent surveys of Exploitation, Trade, and Management of Marine Turtles in the Northern Caribbean. Traffic North America, Washington D. C. 161 pp.

Formia, A. 1999. Les tortues marines de la Baie de Corisco. Canopee 14:1-2

Frazier, J. 1985. Marine Turtles in the Comoro Archipelago. North-Holland Publishing Company. Amsterdam. 177 pp.

Fretey, J. 1998. Marine turtles of the Atlantic Coast of Africa. UNEP/CMS Publications No. 1. 254 pp.

Fretey, J. 2001. Biology and conservation of marine turtles of the Atlantic Coast of Africa. CMS Technical Series Publication No. 6. UNEP/CMS Secretariat, Bonn, Germany, 429 pp.

Gärdenfors, U., C. Hilton-Taylor, G. M. Mace, and J. P. Rodríguez. 2001. The application of IUCN Red List Criteria at Regional Levels. Conservation Biology 15:1206-1213.

Gardner, S. C. and W. J. Nichols. 2001. Assessment of sea turtle mortality rates in the Bahía Magdalena region, Baja California Sur, México. Chelonian Conservation and Biology.

Geldiay, R. 1987. Marine turtles in Turkey. Council of Europe, Convention of European Wildlife and Natural Habitats. Secretariat Memorandum, Appendix IV, Pp. 10-11. Strasbourg.

Godley, B. J., A. C. Broderick, and G. C. Hays. 2001. Nesting of green turtles (*Chelonia mydas*) at Ascension Island, South Atlantic. Biological Conservation 97:151-158.

Groombridge, B. 1982. The International Union for the Conservation of Nature Amphibia-Reptilia Red Data Book, Part 1. IUCN, Gland.

Groombridge, B. and R. Luxmoore. 1989. The green turtle and hawksbill (Reptilia: Cheloniidae): world status, exploitation and trade.Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Lausanne, Switzerland, 601 pp.

GUIDE. 2001. Status of the Breeding Population of Sea Turtle along the Gujarat Coast, Report - GOI - UNDP Sea Turtle Project, Gujarat Institute of Desert Ecology, Bhuj, Kachchh, Gujarat-India (Techinical report).

Hardjosentono, H. P. 1976. Studi habiat dan pembiakan penyu laut di panti Pangumbahan, Kabupaten Sukabumi. Unpublished report, Kerjasama Fakultas Perikanan, Institut Pertanian Bogor.

Hendrickson, J. R. and E. R. Alfred. 1961. Nesting populations of sea turtles on the east coast of Malaya. Bulletin of the Raffles Museum Singapore 26:190-196.

Hilton-Taylor, C. (compiler) 2000. 2000 IUCN Red List of Threatened Species. IUCN, Gland, Switzerland and Cambridge, UK. xviii + 61pp.

Hirth, H. F. 1968. Report to the governments of Southern Yemen and the Seychelles Islands on the green turtle. Report FAO/UNDP. CTA 2467, Rome. 50 pp.

Hirth, H. F. 1997. Synopsis of the biological data on the green turtle, *Chelonia mydas* (Linnaeus 1758). United States Fish and Wildlife Service Biological Report 97-1. 120 pp.

Hirth, H. F. and S. L. Hollingworth. 1973. Report to the People's Democratic Republic of Yemen. Report FAO/UNDP. TA 3178, Rome. 51 pp.

Horikoshi, K., H. Suganuma, H. Tachikawa, F. Sato, and M. Yamaguchi. 1994. Decline of Ogasawara green turtle nesting population in Japan, pp. 235-236. *In:* K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar (comps.), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351.

Hornell, J. 1927. The turtle fisheries of the Seychelles Islands. H.M. Stationary Office, London. 55 pp.

Hughes, G. R. 1970. The status of sea turtles in South East Africa, 2. Madagascar and the Mascarenes (1) Europa Island. Oceanogr. Res. Inst. Durban, South Africa. Mimeographed. 47 pp.

Humphrey, S. L. and R. V. Salm (eds.). 1996. Status of Sea Turtle Conservation in the Western Indian Ocean. UNEP Regional Seas Reports and Studies No. 165. IUCN/UNEP, Nairobi, Kenya. 162 pp.

Hurtado, M. 1984. Registros de anidación de la tortuga negra, Chelonia mydas, en las Islas Galápagos. Boletín Científico y Técnico 4: 77-106.

Hurtado, M. 2001. Panorámica Regional sobre el Estado de la Conservación de las Tortugas Marinas en el Pacífico Sudeste (Colombia, Chile, Ecuador, Panamá, Perú). Procede de los talleres nacionales organizados por la Comisión Permanente del Pacífico Sur con el apoyo del NMFS/ WWF/ UNEP.

Ibrahim, K. 1993. The status of marine turtle conservation in Peninsular Malaysia, pp. 87-103. *In:* Proceedings of the First ASEAN symposium-workshop on marine turtle conservation. Manila.

IUCN. 2001. Guidelines for assessing taxa with widely distributed or multiple populations against Criterion A. Standards and Petitions sub-committee of the IUCN, June 2001.

Jackson, J. 1997. Reefs since Columbus. Coral Reefs 16 Suppl. S23-33.

Jackson, J. J., M. X. Kirby, W. H. Berger, K. A. Bjorndal, L. W. Botsford, B. J. Bourque, R. H. Bradbury, R. Cooke, J. Erlandson, J. A. Estes, T. P. Hughes, S. Kidwell, C. B. Lange, H. S. Lenihan, J. M. Pandolfi, C. H. Peterson, R. S. Steneck, M. J. Tegner, and R. R. Warner. 2001. Historical overfishing and recent collapse of ecosystems. Science 293:629-638.

Kasparek, M., B. J. Godley, and A. C. Broderick. 2001. Nesting of the green turtle, *Chelonia mydas*, in the Mediterranean: a review of status and conservation needs. Zoology in the Middle East 24:45-74.

King, G. W. 1982. Historical review of the decline of the green turtle and Hawksbill, pp. 183-188. *In:* K. A. Bjorndal (ed.) Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D.C.

Lagueux, C. J. 1998. Marine turtle fishery of Caribbean Nicaragua: Human use patterns and harvest trends. Doctoral Dissertation. University of Florida, Gainesville. 213 pp.

Lebeau, A., G. Biais, J. L. Durand, and B. Gobert. 1983. La tortue verte *Chelonia mydas* (Linne) des iles de Tromelin et d'Europa (Ocean Indien): peuplement et reproduction. Inst. Scient. Techn. Pêches Marit., L Port Réunion. 39 pp.

Legall, J. Y., P. Bosc, D. Chateau, and M Taquet. 1986. Estimation du nombre de tortues vertes femelles adultes *Chelonia mydas* par saison de ponte á Tromelin et Europa (Océan Indien)(1973-1985). Oceanogr. Trop. 21:3-22.

Limoges, B. and M. J. Robillard. 1991. Sea turtles in the Bijagos Archipelago, Guinea-Bissau: nesting ecology, utilization by man and conservation. Report mimeogr. CECI and IUCN, 42 pp.

Limpus, C. J. 1994. Current declines in South East Asian turtle populations, pp. 89-91. *In:* B. A. Schroeder and B. E. Witherington (comps.), Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-341.

Limpus, C. J. and N. Nichols. 1987. The southern oscillation regulates the annual numbers of green turtles (*Chelonia mydas*) breeding around northern Australia. Australian Journal of Wildlife Research 15:157-161.

Limpus, C. J. and M. Chaloupka. 1997. Nonparametric regression modeling of green sea turtle growth rates (southern Great Barrier Reef). Marine Ecology Progress Series 149:23-34.

Limpus, C. J., J. D. Miller, D. J. Limpus, and M. Hamann. in press. The Raine Island green turtle rookery: Y2K update. *In:* Proceedings of the Twentieth Annual Symposium on Sea Turtle Biology and Conservation. March 2000.

Lopez, K. G. 2000. Aspectos reproductivos de la tortuga blanca Chelonia mydas en la playa de Las Coloradas Yucatan. Tésis de Maestria. Cinvestav IPN Unidad Merida. 56 pp.

Mangel, J., S. Troëng, L. Segura, M. Stockmann, A. Ortega, C. Reyes, Z. Hudgson, A. Opazo, L. Fernández, R. Hernández, D. Hussy, M. Ramírez, S. de la Parra, M. Martínez, R. Hajjar, and E. Rankin. 2001. Report on the 2000 Green Turtle Program at Tortuguero, Costa Rica. Unpublished report submitted to Caribbean Conservation Corporation and the Ministry of Environment and Energy of Costa Rica. 58 pp.

Maxwell, F. D. 1911. Reports on inland and sea fisheries in the Thongwa, Myaungmya, and Bassein districts and the turtle banks of the Irrawaddy division. Rangoon. Government Printing Office 57 pp.

Meylan, A. B., B. W. Bowen, and J. C. Avise. 1990. A genetic test of the natal homing versus social facilitation models for green turtle migration. Science 248:724-728.

Meylan, A. M., B. Schroeder, and A. Mosier. 1994. Marine turtle nesting activity in the state of Florida, 1979-1992, p. 83. *In:* K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar (comps.), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351.

Moreira, L. M. P. 2001. Estimativa do número de desovas da tartaruga verde-Aruanã, *Chelonia mydas* (Linnaeus, 1758) (Chelonia, Chelonidae) da Ilha da Trindade, Espírito Santo Brasil. Masters Thesis. Universidade Federal do Espírito Santo.

Moreira, L., C. Baptistotti, J. Scalfone, J. C. Thomé, and A. P. L. S. de Almeida. 1995. Occurrence of *Chelonia mydas* on the Island of Trindade, Brazil. Marine Turtle Newsletter 70:2.

Mortimer, J. A. 1984. Marine turtles in the Republic of the Seychelles: Status and Management. IUCN, Gland, Switzerland. 84pp.

Mortimer, J. A. 1985. Recovery of green turtles on Aldabra. Oryx 19:146-150.

Mortimer, J. A. 1988. Green turtle nesting at Aldabra Atoll: population estimates and trends. Biol. Soc. Wash. Bull. No. 8, pp. 116-128.

Mortimer, J. A. 1990. Marine turtle conservation in Malaysia, pp. 21-24. *In:* T. H. Richardson, J. I. Richardson, and M. Donnelly (comps.), Proceedings of the Tenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-278.

Mortimer, J. A. and A. Carr. 1987. Reproduction and migration of the Ascension Island green turtle (*Chelonia mydas*). Copeia 1987: 103-113.

National Marine Fisheries Service. 2001. Endangered Species Act Section 7 Consultation Biological Opinion. Southwest Region Sustainable Fisheries Division. Long Beach, California, USA.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998. Recovery plan for U.S. Pacific populations of the green turtle (*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, MD. 84 pp.

Ogren, L. H. 1989. Status report of the green turtle, pp. 89-94. *In:* L. Ogren, F. Berry, K. A. Bjorndal, H. Kumpf, R. Mast, G. Medina, H. Reichart, and R. Witham (eds.), Proceedings of the Second Western Atlantic Turtle Symposium. NOAA Tech Memo MMFS-SEFC-226.

Paris, B. and T. Agardy. 1993. La tortue verte et la tortue olive de Ridley de l'Archipel des Bijagos: Identification de leur importance dans le contexte mondial et contribution á proposition de qonage d' une reserve de la Biosphére. Miméogr. 6 pp.

Paris, B. and H. F. Pereira. 1992. As tartarugas marinhas da Guine-Bissau – Ecologia geral e guia para os inventarios. Miniesterio do Desenvolvimento rural e Agricultura, Direccao geral das Florestas e Caca, Babaque, Mimeogr. 27 pp.

Pianka, E. R. 1974. Evolutionary Ecology. New York. Harper and Row. 356 pp.

Pilcher, N. J. 1999. Turtles turned turtle. Asian Geographic 2:56-69.

Pinchon. 1967. *In:* Groombridge, B. and R. Luxmoore. 1989. The green turtle and hawksbill (Reptilia: Cheloniidae): world status, exploitation and trade. Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Lausanne, Switz. 601pp.

Preen, A. R., H. Marsh, I. R. Lawler, R. I. T. Prince, and R. Shepherd. 1997. Distribution and Abundance of Dugongs, Turtles, Dolphins and other Megafauna in Shark Bay, Ningaloo Reef and Exmouth Gulf, Western Australia. Wildlife Research 24: 185-208.

Prince, R. I. T. 2001. The Distribution and abundance of Dugongs and other megavertebrates in Western Australian Coastal Waters Extending Seaward to the 20 Metre Isobath Between North West Cape and the De Grey River Mouth, Western Australia, April 2000. Unpublished report to Environment Australia.

Rene, F. and D. Roos. 1996. The status of sea turtle conservation in French Territories of the Indian Ocean: Isles Eparses, pp. 151-156. *In:* S. L. Humphrey and R. V. Salm (eds.), Status of Sea Turtle Conservation in the Western Indian Ocean. UNEP Regional Seas Reports and Studies No. 165. IUCN/UNEP, Nairobi, Kenya. 162 pp.

Ross, J. P. and M. A. Barwani. 1982. Review of sea turtles in the Arabian area, pp. 372-383. *In:* K. A. Bjorndal (ed.), Biology and conservation of Sea Turtles, Smithsonian Institution Press: Washington, D.C.

Saad, M. A. 1999. Hadramaut coast importance in conservation of endangered green turtle. Marine Sciences Resources Research Center, Aden. Unpublished Report. 8 pp.

Sagip Pawikan Philippines. 2000. Sagip Pawikan: A community-based sea turtle conservation program. Inclusive of proposals and Preliminary Results (IUCN Questionnaire, 2001).

Schulz, J. P. 1982. Status of sea turtle populations nesting in Suriname with notes on sea turtles nesting in Guyana and French Guyana, pp. 435-438. *In:* K. A. Bjorndal (ed.), Biology and Conservation of Sea Turtles, Smithsonian Institution Press: Washington, D.C.

Schulz, J. P. 1984. Turtle conservation strategy in Indonesia. IUCN/WWF Report.

Schulz, J. P. 1987. Status of and trade in *Chelonia mydas* and *Eretmochelys imbricata* in Indonesia. Consultancy report prepared for IUCN Conservation Monitoring Centre.

Seminoff, J. A. 2000. Biology of the East Pacific green turtle, *Chelonia mydas agassizii*, at a temperate foraging habitat in the central Gulf of California, México. Doctoral Dissertation, University of Arizona, Tucson. 249 pp.

Seminoff, J. A. 2002. Global Status of the green sea turtle, *Chelonia mydas*. Report to IUCN Red List Programme, Species Survival Coalition. 83 pp.

Solé, G. 1994. Migration of the *Chelonia mydas* population from Aves Island, pp: 283-286. *In:* K.A. Bjorndal, A. B. Bolten, D. A. Johnson, and P.J. Eliazar (comps.), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-351.

Suganuma, H. 1995. Green turtle research program in Ogasawara. Marine Turtle Newsletter 33:2-3.

Thayer, G. W., D. W. Engel, and K. A. Bjorndal. 1982. Evidence for short-circuiting of the detritus cycle of seagrass beds by the green turtle, *Chelonia mydas* L. Journal of Experimental Marine Biology and Ecology 62:173.

Thayer, G. W., K. A. Bjorndal, J. C. Ogden, S. L. Williams, and J. C. Zieman. 1984. Role of larger herbivores in seagrass communities. Estuaries 7:351.

Thorbjarnarson, J. B., S. G. Platt, and S. T. Khaing. 2000. Sea Turtles in Myanmar: Past and Present. Marine Turtle Newsletter 88:10-11.

Tomas, J., J. Castroviejo, and J. A. Raga. 1999. Sea turtles in the south of Bioko (Equatorial Guinea). Marine Turtle Newsletter 84:4-6.

Valentine, J. F. and K. L. Heck Jr. 1999. Seagrass herbivory: evidence for the continued grazing of marine grasses. Marine Ecology Progress Series 176:291-302.

van Tienen, L. H., W. E. J. Hoekert, P. van Nughteren, and S. Denz. 2000. The sea turtles of Suriname, 1997 – Awareness, pp. 91-92. *In:* F. A. Abreu-Grobois, R. Briseño-Dueñas, R. Márquez-Millan, and L. Sarti-Martinez (comps.), Proceedings of the Eighteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-436.

Weijerman, M., L. van Tienen, A. D. Schouten, and W. E. J. Hoekert. 1998. Sea turtles of Galibi, Suriname, pp.142-144. *In:* R. Byles and Y. Fernandez (comps.), Proceedings of the Sixteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-412.

Wetherall, J. A., G. H. Balazs, R. A. Tokunaga, and M.Y.Y. Yong. 1993. Bycatch of marine turtles in the North Pacific high-seas drift-net fisheries and impacts on the stocks. International North Pacific Fisheries Commission Bull. 53(III):519-538.

World Wildlife Fund. 2000. Preliminary assessment on the status of green turtle nesting population in the Berau Islands, Indonesia. Wallacea, WWF Report. Cited in IUCN Questionnaire filled out by Creusa Hitipeuw, WWF, Indonesia.

Zieman, J. C., R. L. Iverson, and J. C. Ogden. 1984. Herbivory effects on *Thalassia testudinum* leaf growth and nitrogen content. Marine Ecology Progress Series 15:151-158.

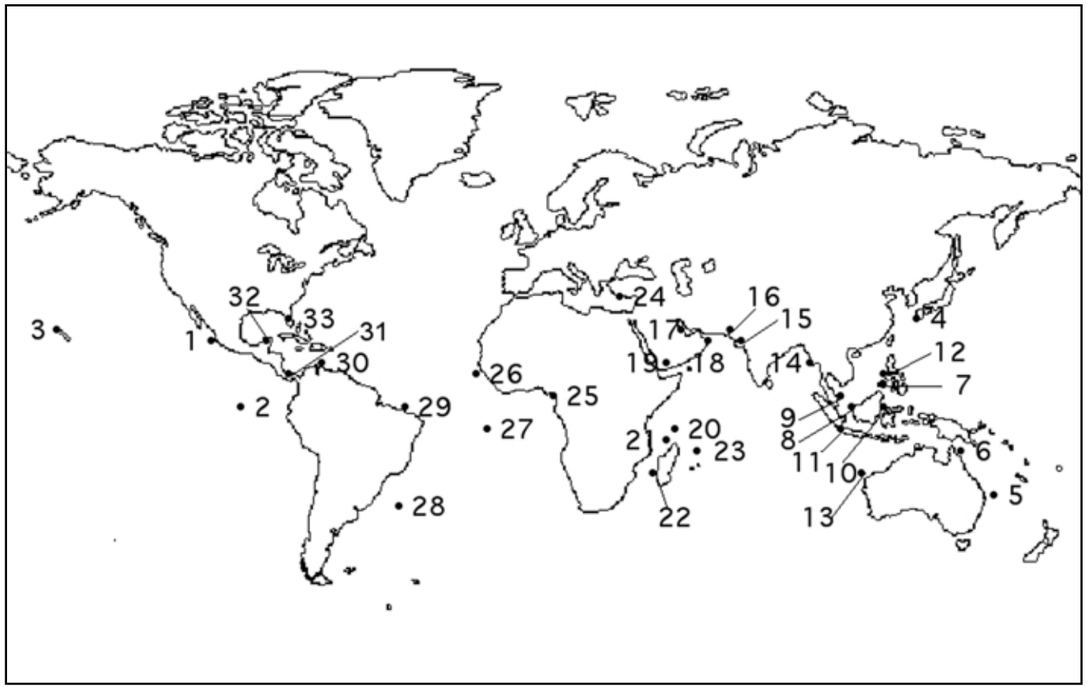


Figure 1. *World map with the geographic locations of the 33 Index Sites used for the 2001 Green Turtle Assessment. See Table 3 for a summary of published size estimates. Figure 2 shows population trends for each site based on published values in Table 2.*

Table 1. Summary of published estimates of Past and Present nesting activity, and population trends for Chelonia mydas at the 29 Index Sites. Data codes include: AN, nesting females; AC, number of nests; FH, nesting females harvested; EH, egg harvest; EP, egg production; HP, hatchlings produced; TC, tally count for high density nesting area. HPS = historic population size (1, 0-1000 females/yr; 2, 1000-5000 females/yr; 3, >5000 females/yr). ALL VALUES ARE BASED ON ANNUAL MEANS UNLESS OTHERWISE STATED.

Index #	Subpopulation	Data type	Past Estimate			Present Estimate		Interval	Trend (% Change)	Citation (Past)	Citation (Present)
			Years	Mean	HPS rank	Years	Mean				
1.	Eastern Pacific Ocean, México (Michoacán)	AN	1970s; 1981-1983	ca.25,000 ;1,271 females	3	1998-2000	484 females	18 y	- 62 to 98%	Cliffton *et al.* 1982; Alvarado *et al.* 2001	Alvarado *et al.* 2001, J. Alvarado pers. comm.
2.	Eastern Pacific Ocean, Ecuador (Galapagos Is.)	AN	1976-1982	ca. 1,400 females	2	2001	ca. 1,400 females	19 y	0%	Hurtado 1984	Hurtado 2001, M. Hurtado pers. comm.
3.	Central Pacific Ocean, United States (Hawaii)	AN	1974-1978	378 females	1	1991-2000	574 females	22 y	+ 44%	Balazs 1980, G. Balazs pers. comm.	Wetherall *et al.* 2000, G. Balazs pers. comm.
4.	Western Pacific Ocean, Japan (Ogasawara Is.)	FH	1920s	1,000-1,800 females	2	1986-1993	45-225 females	70 y	- 77 to 98%	Suganuma 1995	Horikoshi *et al.* 1994
5.	Western Pacific Ocean, Australia (sGBR, Heron Is.)	AN	1965-1969	ca. 400 females	1	1990-1998	562 females	29 y	+ 0 to 40%	Bustard 1974	Limpus *et al.* in press
6.	Western Pacific Ocean, Australia (nGBR, Raine Is.)	TC	1977-1980	50-200 females /night	3	1997-2000	50-1,650 females /night	20 y	- 75% to + >100%	Limpus *et al.* in press	Limpus *et al.* in press
7.	Eastern Indian Ocean, Western Australia	AN	1980	3,000 – 30,000 females	3	2000	3,000 – 30,000 females	20 y	0%	Preen *et al.* 1997	Prince 2001
8.	South East Asia, Malaysia (Sabah) 1	EH	1965-1968	556,278 eggs	2	1983-1986	255,877 eggs ca.	18 y	- 54%	de Silva 1982	de Silva in Groombridge & Luxmoore 1989
8.	South East Asia, Malaysia (Sabah) 2	EH	1983-1986	255,877 eggs	2	1989-1993	540,000 eggs	7 y	- 48%	Groombridge and Luxmoore 1989	Basintal and Lakim 1994

Table 1. Continued

Index #	Subpopulation	Data type	Past Estimate			Present Estimate		Interval	Trend (% Change)	Citation (Past)	Citation (Present)
			Years	Mean	HPS rank	Years	Mean				
8.	South East Asia, Malaysia (Sabah) 3	EH/EP	1989-1993	ca. 540,000 eggs	2	1995-1999	975,480 eggs	6 y	+ 80%	Basintal and Lakim 1994	E. Chan pers. comm.
8.	South East Asia, Malaysia (Sabah) 4	EH/EP	1965-1968	556,278 eggs	2	1995-1999	975,480 eggs	31 y	+ 75%	de Silva 1982	E. Chan pers. comm
9.	South East Asia, Malaysia (Sarawak) 1	EH	1930s	2,000,000 eggs	3	1998-1999	228,618 eggs	40 y	- 89%	de Silva 1969, 1982 King 1982	Limpus 1994, E. Chan, pers. comm.
9.	South East Asia, Malaysia (Sarawak) 2	AN	1949-1953	15,472 females	3	1984-1988	2,074 females	35 y	- 87%	Mortimer, 1990	Mortimer, 1990
10.	South East Asia, Malaysia (Peninsula)	EH	1961	928,900 eggs	2	1993	317,105 eggs	32 y	- 65%	Hendrickson and Alfred 1961	Ibrahim 1993
11.	South East Asia, Indonesia (Derawan (Berau) Is.)	AN	1940s	ca. 36,000; 200 fem/night, peak sea.	3	1984	ca. 4000-5000; 25 fem/night, peak season	50 y	- ≥80%	Schulz 1984	Schulz 1984
12.	South East Asia, Indonesia (Java; Pangumbahan)	EH	1950s	2,500,000 eggs	3	1980s	400,000 eggs	30 y	- 84%	Hardjosentono 1976	Schulz 1987
13.	South East Asia, Philippines (Turtle Is., Taganak)	EH	1951	1,401,450 eggs	2	1985	827,463 eggs	33 y	- 41%	Domantay 1953, Groombridge and Luxmoore 1989	Reyes 1986 in Groombridge and Luxmoore 1989
14.	Eastern Indian Ocean, Myanmar (Thamihla Kyun)	EH	1885-1886	ca. 1,600,000 eggs	3	1999	<250,000 eggs	115 y	- ≥84%	Maxwell 1911	Thorbjarnarson *et al.* 2000
15.	Northern Indian Ocean, India (Gujarat)	AC	1981	866 nests	1	2000	461 nests	19 y	- 53%	Bhaskar 1984	GUIDE 2001
16.	Northern Indian Ocean Pakistan (Hawkes Bay and Sandspit)	AC	1981-1985	1286 nests	1	1994-1997	ca. 600 nests	12 y	-53 %	Khan in Groombridge and Luxmoore 1989	Asrar 1999

Table 1. Continued

Index #	Subpopulation	Data type	Past Estimate			Present Estimate		Interval	Trend (% Change)	Citation (Past)	Citation (Present)
			Years	Mean	HPS rank	Years	Mean				
17.	Northern Indian Ocean, Arabian Gulf (Saudi Arabia, Karan Is)	AN	1970s	500-1000 females	1	1990s	500-1000 females	20 y	0%	Basson *et al.* 1977	Al-Merghani *et al.* 2000
18.	Northern Indian Ocean, Oman (Ras al Hadd)	AN	1977-1979	ca. 6,000 females	3	1988	ca. 6,000 females	9 y	0%	Ross and Barwani 1982	Ross in Groombridge and Luxmoore 1989
19.	Northern Indian Ocean, Peoples Democratic Republic of Yemen (Sharma)	AN	1966, 1972	30-40 fem/night, peak sea.	2	1999	15 females /night, peak season	27 y	- ≥50%	Hirth 1968, Hirth and Hollingworth 1973	Saad 1999 comm.
20.	Western Indian Ocean, Seychelles (Assumption)	AN	ca. 1900	ca. 5000 females	3	1980s	ca. 200 females	80 y	- 96%	Hornell 1927	Mortimer 1984
20.	Western Indian Ocean, Seychelles (Aldabra)	AN	1900s	6,000-8000 females	3	1981-1985	941-1730 females	85 y	- ≥71%	Mortimer 1985	Mortimer 1988
21.	Western Indian Ocean, Comoros Islands	AN	1972-1973	1,850 females	2	2000	5,000 females	27 y	+ 170%	Frazier 1985	Ahamada pers. comm.
22.	Western Indian Ocean, Iles Eparses (Europa Is.)	AN	1970-1971; 1978-1979	4-5,000; 9-18,000 females	1	1973-1985	2,000-11,000 females	7 y	- 90% to + 175%	Hughes 1970; Lebeau *et al.* 1983	Le Gall *et al.* 1986
22.	Western Indian Ocean, Iles Eparses Is. (Europa Is.)	HR	1983-1987	153,000 hatch-lings	1	1990-1994	119,000 hatchlings	7 y	- 22%	Rene and Roos 1996	Rene and Roos 1996
23.	Western Indian Ocean, Iles Eparses (Tromelin)	AN	1973-1974	1,660 females	2	1983-1984	1,958 females	10 y	+ 18%	Batori 1974	Le Gall *et al.* 1986
23.	Western Indian Ocean, Iles Eparses (Tromelin)	HR	1983-1987	427,600 hatch-lings	2	1990-1994	377,000 hatchlings	7 y	- 12%	Rene and Roos 1996	Rene and Roos 1996
24.	Mediterranean Sea, Turkey	AN	1978-1982	1,000 females	2	1990s	115-580 females	8 y	- 42 to 88 %	Geldiay 1987	Kasparek *et al.* 2001

Table 1. Continued

Index #	Subpopulation	Data type	Past Estimate			Present Estimate		Interval	Trend (% Change)	Citation (Past)	Citation (Present)
			Years	Mean	HPS rank	Years	Mean				
25.	Eastern Atlantic Ocean, Equatorial Guinea (Bioko Is.)	AH	1940s	200-300 females /night	1	1980s, 1996/97 -97/98	50-100 fem/night, 1468 nests	40 y	- ≥50%	Eisentraut 1964, Butynski and Koster 1989	Tomas (in prep), Tomas *et al.* 1999
26.	Eastern Atlantic Ocean, Guinea-Bissau (Bijagos Archipelago)	AN	1990-1992	ca. 2000 females	2	2000	ca. 2465 females	8 y	+ 23%	Limoges and Robillard 1991, Paris and Pereira 1992, Paris and Agardy 1993	Catry *et al.* in review
27.	Central Atlantic Ocean, Ascension Is.	AC	1977-1978	5257-10,764 nests	2	1998/99 1999/00 2000/01	13,881; 13,000; 6,500 nests (=11,127 nests)	23 y	+ 3 to 111%	Mortimer and Carr 1987	Godley *et al.* 2001, Broderick *et al.* 2001
28.	Western Atlantic Ocean, Brazil (Trindade Is.)	AN	1981	ca. 3,000 females	2	2000	ca. 3,000 females	19 y	0%	Moreira *et al.* 1995	Moreira 2001
29.	Western Atlantic Ocean, Suriname (Galibi)	AN	1975-1979	1,657 females	2	1983-1987, 1995	1,740, 1,803 females	8 y	+ 5 to 6%	Schulz 1982	Mahadin in Ogren 1989, Weijerman *et al.* 1998
30.	Western Atlantic Ocean, Venezuela (Aves Is.)	AN	1947	150-200 females/ wk	2	1984-1987; 1994	376; 300-500 females/yr	40 y	- ≥50%	Pinchon 1967	Medina and Medina in Ogren 1989; Sole 1994
31.	Western Atlantic Ocean, Costa Rica (Tortuguero)	AN	1971-1975	ca. 25,000 females	3	1992-1996	ca. 58,000 females	21 y	+ 132%	Carr *et al.* 1982, Bjorndal *et al.* 1999	Bjorndal *et al.* 1999
32.	Western Atlantic Ocean, México (Yucatan Peninsula)	AC	1990	247 nests	1	2000	896 nests	10 y	+ 263%	Lopez 2000	Lopez 2000
33.	Western Atlantic Ocean, United States (Florida)	AN	1980	366 females	1	1995-2000	2,278 nests (ca. 759 females)	20 y	+ 107%	Dodd 1982	Meylan *et al.* 1994, B. Witherington per.comm.
	Remainder[1]	AN	1860 - 2001						declining	Groombridge and Luxmoore 1989, Humphrey and Salm 1996, Fretey 2001, Fleming 2001	

[1]*The category entitled Remainder has been included as per the IUCN species assessment guidelines (IUCN 2001). This category is a catchall for the areas that have not been included as Index Sites.*

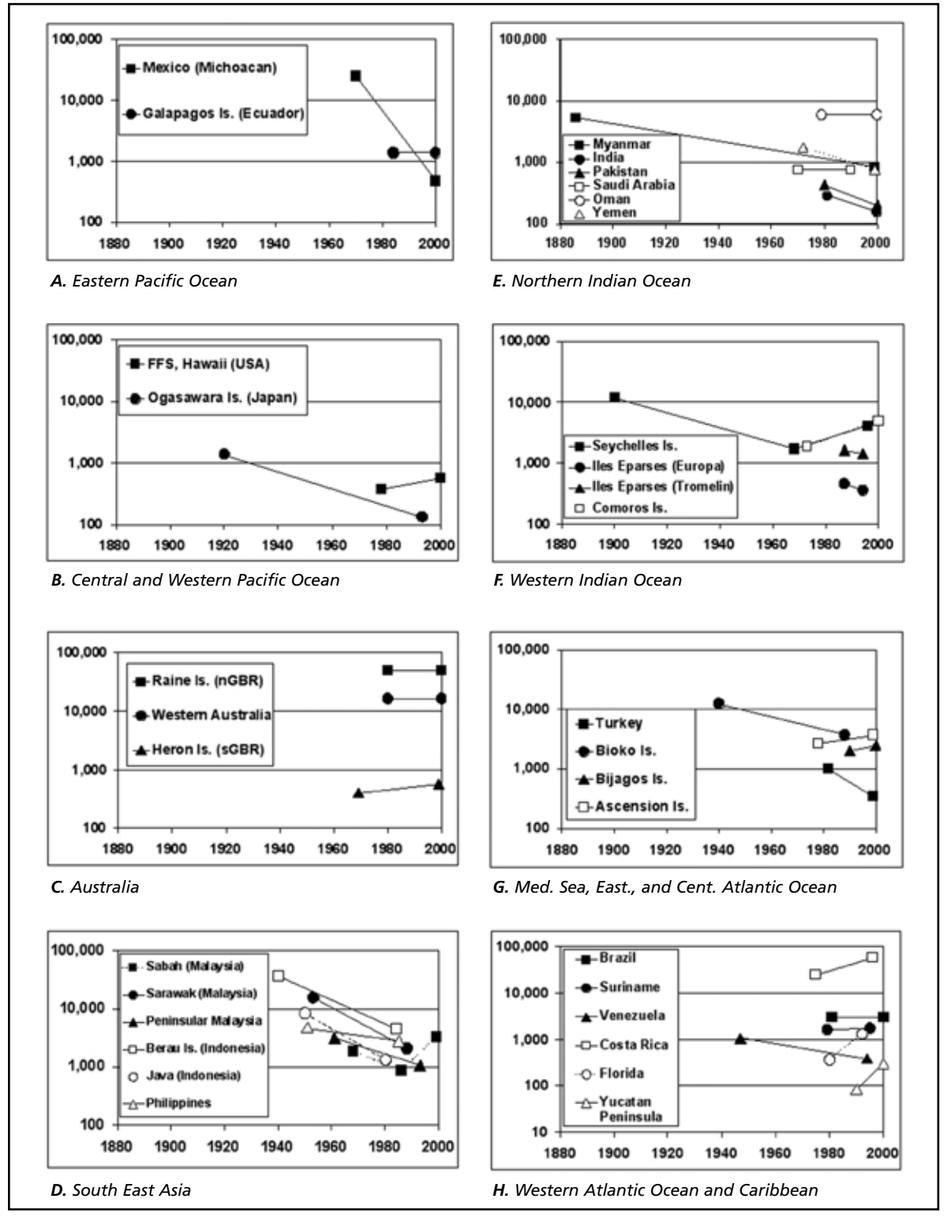


Figure 2. *Population trends for 33 Index Sites used in the 2001 IUCN Green Turtle Assessment organized by region. Trend lines are based on published population estimates listed in Table 1.*

WORKSHOP DISCUSSION

DR. ECKERT: I'm extremely uncomfortable with the use of linear or linear regression back over time where you have no data to anchor the beginning point. I don't think you can do that.

DR. SEMINOFF: I share the skepticism there, absolutely, but --

DR. ECKERT: I mean, you're not even going back a single generation time and yet you're assuming that population is growing or is exhibiting a trend rate. With these 50 year long generation times, you can't even consider that.

DR. SEMINOFF: I would say, you're preaching to the choir, and certainly there are some shaky things there. But these are the criteria that have been established. From my perspective, this is the recipe that I followed and it is very specific about the types of models and the assumptions that are made in constructing these models. So yes, in trying to go back to the year 1860 there has been some shortcomings. But when you're trying to establish long-terms trends, from the IUCN perspective, this is how it's done.

DR. LIMPUS: I'm disappointed that we have such a gap for the South Pacific where there exists a whole series of discreet stocks. The message that comes clearly through the meetings that SPREP has hosted over the years is that the turtle numbers throughout the Pacific Island nations have come down. The one that sticks in my mind, particularly, is French Polynesia. In terms of the last 20 years or so, a 90 percent reduction in nesting numbers. From French Polynesia through to New Caledonia you have a blank, and yet there are very significant populations in those communities. This is an issue that I would urge you to try and focus on in the next draft.

DR. SEMINOFF: Absolutely. Again, more coverage is better, absolutely. In a lot of these smaller areas, there's a lot of missing information out there. The 33 sites that we used at this stage was the first go-around; and agreed, we need more coverage. The problem is that at some of these sites we just don't have a large enough set of information to establish any sort of a publishable trend line to begin with.

MS. DONNELLY: Of the ten sites where populations are increasing and the six where they are stable, is that a recent situation or is that based on going back three generations?

DR. SEMINOFF: Those were published data. So that is just published information. I did not present the information based on extrapolations. Let's take Sabah, for example, where the population in three points in time is 1966, mid 1980s and 1998. Around 1966, the onset of some conservation or acquisition of those islands occurred. The population continued to decline until the mid '80s, but then it started to increase. The 1997 number was higher than the 1960s number, but we're dealing with a shifting baseline there. If you take the declining trend from 1940, you'd actually have a depleted stock. However, with the published information it doesn't appear so. This is something to keep in mind regarding published numbers.

MS. DONNELLY: There's a big difference between depleted and increasing, rather than stable.

DR. SEMINOFF: Absolutely. Yes. If I didn't make that point, let me make that very clear.

DR. LIMPUS: If you take that Sabah starting point and bother to have a look at what is happening in the other nearby long-term datasets, like Sarawak, you'll find that that Sabah point that you start with is, in fact, the bottom of the regional fluctuations that are going on. So that one only point where you have got a gap in time, you've actually picked up at the bottom of the fluctuations. It's not near the top. It's not the middle. It's way down at the bottom of those fluctuations. So you're immediately introducing errors there, and I think we can do better on some of this.

DR. SEMINOFF: Absolutely. The idea is we wanted to look at multi-year datasets as much as possible. With multiple year sets, we can get some better sort of numbers. In that case, it was a smaller temporal interval there that we had to use that number.

MR. PALMA: Just to pick up from what Colin told us, trying to link nearby islands. I think the bottom data that we have for the Sabah Philippines is 1950. I think if you put them together, since the islands are really very near, and I'll be reporting later, you can extend your point of origin for data out to 1950.

DR. SEMINOFF: That's the sort of news I want to hear. This is a work in progress, so I'll be speaking to you afterwards.

MR. PALMA: I was also the one who answered your questionnaire.

DR. SUGANUMA: I'm very sorry, I didn't report to you, but in the last 30 years our nesting numbers of the green turtle is increasing. I'll give you that information.

DR. BRODERICK: The document that you're doing, will you be circulating it around for comment?

DR. SEMINOFF: Absolutely.

DR. BRODERICK: That's a good idea.

DR. MORITZ: If I can say just one comment in closing. It seems because of the time lag here, the information you get is always going to be 20, 30, 40 years out of date because the impacts on the harvest or reversal of the impacts of the harvest have yet to be felt in terms of the adult nesting numbers. So I wonder if there is some way you can actually do a socio-economic analysis. I think what it needs more than an analysis of nesting numbers is a socio-economic analysis, asking what is happening to coastal populations, what regulation is in place and effective. Where is it going to be in 20 or 30 years, and your best guess.

DR. SEMINOFF: The one point, Craig, that I would make, though, is in the case of egg harvest, you have a time lag as far as when it is going is to show up in nesting numbers. But a lot of these sites, you still have harvesting of adult nesting females. So this is real-time.

DR. MORITZ: I think all this needs to be part of a socio-economic analysis.

A Discussion on Regional Databases

Dr. Colin Limpus

PLENARY DISCUSSION

DR. LIMPUS: The question to ask first, is what do we mean by data? What does it mean to have a regional databases? Should it be accessed fairly, freely? What data do we really want to have access to? I tend to feel that the data we want is the aggregated data, not the individual tagging records that research programs might have. But rather, the results from the annual work in terms of the population size, remigration information summarized, annual egg production, etc.

DR. MORITZ: There is a sense that many people see there is a need for this and there's a current impediment in doing the research, because it is, I think the word that was used today was - bulkcanized - and there's a natural reticence for people to share raw data, a work in progress. So perhaps what is being called for is a way to make it easier to establish sharing raw data.

DR. CRAIG: I think for some areas what Colin is talking about is fine, but in a broad area like the South Pacific with all the islands where we have no major institution doing tagging and demographics and so forth, so every little tag recovery is very helpful to get a big picture in those thousands of miles there.

DR. PILCHER: There is also the thought that a lot of people who are just starting out with turtle programs, many of them don't actually realize where their data sets fit into a much, much broader picture. For example, Colin, in your position of having done 30 years of research you are looking at it from a wide viewpoint, you've got a feeling for what is happening in many different parts of the world. Where as many people, possibly in this room, who are spread throughout this region might only just now be getting into this work, and they might not understand what the use is of having data that is shared among groups. The comment the gentleman made about the tag returns is a classic example. I know that several of us in this room have run into people who have said, oh yeah, I've had one of these tags for a while, and never knew what to do with it.

This is one of the things we really need to work on. Explaining and getting the message out why sharing data is important and what use it may have. Because it might not have an immediate visible use to a lot of people in this room, or in small programs spread across this region, and that might be something that we should take the responsibility for; the actually explaining the role of sharing data. I know you've got several talks planned along those lines, but getting that message out to a lot of these smaller programs is quite important.

I know I have discussed with people in small conservation projects, people who have just started out in a little miniature tagging program at their particular nesting site, that never even considered that their data should be out there for the rest of the world to utilize or don't see the need or the use of it.

DR. LIMPUS: I'll play the devil's advocate back to Nick, in that in some of those maps that I showed with the migration data, the nesting distribution data, the bulk of that information came from going to live resources, getting reprints, getting the books and reading and extracting out the summary information.

It may well be that one of the components of talking about a regional database has to be how do we help to identify the data that is already available, the knowledge that already exists and how people can access it. We have a whole library database available on the internet that can help guide people as to which reference to go search for. I certainly appreciate that in some areas the libraries may have difficulty in being able to get copies of Lammergeyeragire (phonetic), the stuff that George Hughes published from South Africa, masses of detailed information on tag recoveries and migration and whatever. It's an obscure journal. It is not well represented in libraries. But there is

a starting point there and it may be one of the components of talking about establishing a regional databases is helping to facilitate access to what we already have.

I would like to take that to the flipside of it, and I was talking over lunch with Rene [R. Marquez] and Suganuma [H. Suganuma] and some of the others that I don't read Spanish. I've got a whole box of publications out of Central America that are in Spanish. From my perspective, it's almost as if it doesn't exist. Yet, there is a wealth of data that is contained in there. There is a huge amount of stuff that has been written in Japanese and I can't read it. The stuff results that is are coming from the French speaking folks out of West Africa and Northern South America and so on, how many of us are reading that literature and getting access to that sort of information?

We shouldn't have to reinvent the wheel to be able to use the information. It is out there, but we cannot access it. How can one facilitate that? In addition, how does a person who is sitting in some remote part of Indonesia who doesn't speak English or Japanese or French or Spanish, how much of the world's literature in marine turtle goes to them? Very little. So therefore, how can we really help them? So I come back to this question of making things accessible. We have got to find a way through it; websites may be part of the answer. I suspect it's going to be a bit more than that.

It is not just a case of, pooling your data. Because in this case, there would be a lot of decoding which would have to happen to explain coding in one's files. We need to ask the question of what regional databases are already in existence, and some are there. Kamarruddin, I'm going to stop at this point. Do you want to make some comments coming from your perspective, coming from a different viewpoint?

DR. IBRAHIM: Actually, I'm representing SEAFDEC, which is based in Malaysia. We are about to create or to develop a database. Actually, we have friends all over in ten countries. More or less we agree to decide what sort of data we want, but the thing is we cannot proceed because of financial constraints. So we have to more or less decided to begin a database, but at the moment we have just stopped there because of the financial problems.

MR. DALZELL: I was just going to ask a question, going back to the sort of comments that Col was making. Has anybody invented, for example, a tagging program that have been done in the Pacific, is it well known in the last 50 years?

DR. LIMPUS: Certainly, the majority of the programs would be documented. So if you took, say, the South Pacific Region Environment Program (SPREP), there would be a paper trail within the SPREP program as to all of the programs that they have initiated. I'm sure if you went through the National Marine Fisheries Service all of the tag dispersal that has gone through George [G. Balazs] to the areas would be there. The same applies in Eastern and Northern Australia in my case. What we wouldn't pick up is a case where you had say a student or an academic from, be it Wales or Utah or somewhere, who has taken a sabbatical and gone out and spent five or six months in some remote area and decided to tag some turtles. Unless they publish it you would never know about it. But certainly, the vast majority of the work I think would be known within the broader regional areas.

The problem comes through time with the attrition of memory. I look across the table at my colleague here from Indonesia. The folks I was interacting with in Indonesia back in the 1980s, to my knowledge, almost none of them that were in the managerial roles or decision making roles are currently involved. Now there is a new, younger generation. There is no guarantee that knowledge is passed down across the generations. We've been fortunate in our part of the world that there has been a few of us that have stuck around for a few decades and have bridged between previous workers and the younger workers that are coming up.

DR. DUTTON: Colin, I've found that some of us youngsters are starting out for instance, PIT tagging leatherbacks. It's fairly new. It took a long time to figure out that the flipper tags do not work for leatherbacks. But there is enough of a group to starting from the ground level. So we've managed to coordinate and maintain a database that is distributed between all the projects, and a lot of that up to this point has been coordinated through our program at National Marine Fisheries Service. So we buy the tags, send them out, train taggers. Most recent example is Papua New Guinea. I went over and worked with them. So at the moment we're sort of starting from the ground level with some new areas, like PIT tagging in leatherbacks. It's fairly containable right now. So we're in a good position to kind of think about what were the pitfalls for some of the past database problems and tag return kind of problems.

MS. COUSINS: I like the comment that was just made about working on turtles for decades. Some of the turtles that you've known that were hatchlings and are now coming back are 20 or 30 years old., I think these turtles are going to outlive our researchers. So it might actually be a really good idea to have a database because I think it's going to be many generations of us that are going to be carrying it forward.

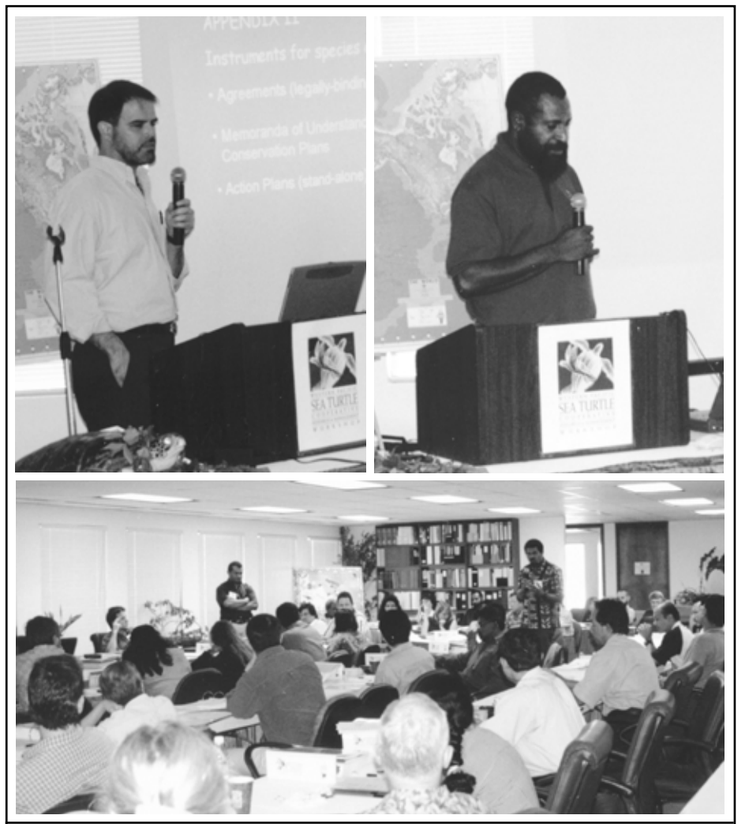
DR. LIMPUS: I would then come back and ask, what guarantee do you have that database is going to be available or usable in 20 years time. I guess I want to be sure that we don't end up putting things in a direction that in the long term can't work. It may. I don't want to cut myself off from the tried and true workable situation with libraries. Libraries have a system of duration that maintains information across hundreds of years. I think that is part of what a database is about. That's what I was getting at. I don't see it as separate. I see it as as the library as the primary place for the repository of information and then how can we link them and know where to go to look to get it. Because I believe that, like you, the animals I tagged as hatchlings 30 years ago, they're going to be around for my grandkids to play with. I might not be; I won't be.

DR. ECKERT: I think certainly we have to have the back up, so to speak, of putting things in the library. But I don't think that necessarily discounts the possibility of also making things available on the internet. Certainly, internet accessibility is probably the limiting factor for anybody that is trying to get this information and they're unable to. But that's the sort of thing as we move into the future that has the possibility of preventing the problems of say duplication of tag numbers, for example.

MR. BALAZ: We've heard a lot about the business of tag duplication. The opposite side of a tag has an address. I've never heard of a duplication of a tag address. Maybe it has happened, but I don't think so. I think we need to be careful that tag numbers aren't duplicated, but you still have the opposite side that has the return address.

DR. MORITZ: I would like to draw this session to a close. Really, the main purpose of this is to start people thinking about this issues. I hope we can come back and revisit it again towards the end of the meeting. Bottom line is that there is a lot of people here with a lot of experience in managing not just their own data, but intersecting with data from other groups around the Pacific or Southeast Asia or wherever. Please just keep this in the back of your minds.

Integrated Management



Top left: Douglas Hykle, CMS
Top right: Job Opu, SPREP
Bottom: Comments from Aisake Batibasaga, Fiji

Approaches for an Integrated Conservation and Development Program in the Philippine Turtle Islands

Jose Angelito M. Palma[1], Felimon G. Romero and Romeo B. Trono

ABSTRACT

In 1996, WWF-Philippines, forged an agreement with the Department of Environment & Natural Resources (DENR) through the Pawikan Conservation Project (PCP) to implement a program through an integrated approach. Since then, WWF-Philippines in collaboration with the PCP has implemented a number of activities towards the realization of this task. An environmental and ecological study was completed. The studies were basis for the formulation of a management plan for protected area declaration and an ecotourism development plan to anticipate effects of future developments. These activities contributed to the enactment of policies for conservation. In August 1999, the Turtle Islands Wildlife Sanctuary was established through Presidential Proclamation No. 171 and DENR Administrative Order 99-31 implementing the Turtle Islands Ecological Destination Development Guidelines was promulgated last July 30, 1999. In the same manner, an intensive social research was undertaken to understand the dynamics of the community for a more active role in conservation. The results of these activities were presented to the community as an imperative process for the formulation of a program for an integrated conservation and development initiative with emphasis on the active participation of all stakeholders. The framework developed identified four major components for implementation namely: enforcement; livelihood; education and health. Initial activities regarding these components are underway with the support of local authorities conservation efforts in the area evolved from a species approach to an integrated and a multi-stakeholder approach. This is regarded as the only alternative to address the long-term conservation needs of the Turtle Islands.

INTRODUCTION

The Turtle Islands have a high conservation value for sea turtles and have been subject to Government control and management since 1948. In 1979, the Government identified the need to establish a specific agency, The Pawikan Conservation Project of the Department of Environment and Natural Resources (DENR), to oversee the conservation of sea turtles in the Philippines. Since 1984, the PCP has been implementing the Government's efforts to conserve turtles in the Turtle Islands, through regulation of egg collection as well as the management of Baguan Island as a strict sanctuary. Substantial work on sea turtle research has been undertaken by the PCP since its creation. In 1991, the GEF Funded Integrated Protected Area System (IPAS) was initiated. The Turtle Islands was chosen as one of the ten priority sites that would benefit from the project, and the project's final aim is to establish the area as protected area. This project is implemented by the DENR through its established Conservation of Priority Protected Area Project (CPPAP) and its NGO counterpart, the NGOs for Integrated Protected Area Inc (NIPA), mainly mandated to facilitate the establishment of the Turtle Islands under the NIPAS. The 1st transfrontier protected areas for sea turtles was also established through the Turtle Islands Heritage Protected Area between the Governments of the Philippines and Malaysia.

WWF-Philippines started to get directly involved in 1996, in collaboration with the DENR, the management authority through the PCP. An agreement was forged by WWF-Philippines and DENR for the implementation of the Turtle Islands Integrated Conservation and Development Project. This report focuses on the activities undertaken by WWF-Philippines in collaboration with the DENR, and highlights the two-pronged approach to conservation, in which biological assessment and community and social assessment are used to formulate a long term integrated conservation plan in collaboration with the stakeholders.

[1] *Presenting author*

MANAGEMENT PLANNING PROCESSES TOWARDS THE INSTITUTIONALIZATION OF CONSERVATION INITIATIVES IN THE PHILIPPINE TURTLE ISLANDS

Due to its high conservation value as an important sea turtle nesting area, a comprehensive management plan has to be developed to address the conservation needs of the area. As an initial activity, baseline data on the resource were undertaken to understand the conservation needs. Through this an extensive research on the resources was undertaken focusing sea turtles and its habitat. Work was done on three primary components, the marine benthic communities, terrestrial flora and fauna and physical characterization of the island. Upon completion of data gathering, an environmental ecological characterization was developed to define the Turtle Islands as a management unit. Another important component of this process continuous monitoring of the above mentioned habitats to detect changes over time and provide the management authority timely information for appropriate response. This is made possible through the establishment of a monitoring scheme along side with the training of concerned people involved in the management of the area.

To facilitate and assist in the planning process a GIS database for the islands is currently being developed starting with the acquisition of a satellite spot map of the area. The development of this data base will ensure that all the information gathered over time through the monitoring scheme can be easily accessed and safeguarded thereby facilitating planning.

The above mentioned activities served as a vital input in the declaring of the Turtle Islands as Wildlife Sanctuary under the National Integrated Protected Areas System (NIPAS) through Presidential Proclamation 171 in August 1999 and the promulgation of the Turtle Islands Ecological Destination Development Guidelines through Department Administrative Order 31-99.

COMMUNITY DEVELOPMENT INITIATIVES

The social analysis and implementation of Integrated Conservation and Development Projects (ICDP) in the Turtle Islands Heritage Protected Area was an effort to understand the socio-economic and political dynamics in island communities with rich yet threatened biodiversity, as is the case in the Turtle Islands. The ICDP has been adopted as an approach to conservation because unless the root causes of poverty are addressed, which are the focal problem of the island communities, unsustainable utilization of marine resources and pressure on the green and hawksbill turtle population will remain high.

The Social and Institutional Assessment of the Turtle Islands is considered the most crucial phase, since this activity is to set the direction towards the implementation of ICDP. Aside from the initial inputs documented by previous KKP involvement in the area, the study is designed to understand the dynamics of the community as well as to provide inputs on how to effect ICDP in the present social setting. This activity is taken in the context of a systematic view of a situation by specifying the cause and effect relationship for the purpose of explaining and predicting. A goal defined in this ICDP framework is to make a protected ecosystem an essential component of the local peoples' economic, cultural and social survival and growth.

The social and institutional analysis has three major components namely: the social analysis, gender analysis and stakeholders analysis. This analysis was undertaken with following goals (Cola 1998):

- To pinpoint development beneficiaries being the users of critical resources;
- To characterize their needs and absorptive capacity; and
- To assist in design and implementation of activities responsive to their needs and absorptive capacity in the context of conservation goals.

As a result of the activity, a program with four major components (livelihood, enforcement, health and education) was identified through a long process of consultations and planning with the community and its leaders. The consultations also become a venue to impart to the communities the results of the ecological studies. The social analysis will become the basis for developing the specific plans for livelihood, information and education, health and protected area management through enforcement activities. The most notable highlight of this initiative is the process of consultation and processing of information that was gathered as basis for community planning in setting the conservation agenda.

INTEGRATED APPROACH TO CONSERVATION

The initiative was able to evolve from the species-focused program into a multi-disciplinary activity. Key to the implementation of ICDP in the area was the relevance and contribution of each of the different activities and initiatives under the program. The integration of undertaking parallel activities on the biological/ecological and social and development concerns will play an important role towards the attainment of ICDP in the area. Of chief importance to the process was the constant feedback of the results to the communities, for the purpose of information as well as validation as a continuing cycle for planning and implementing ICDP. In this particular case, we realized that an integrated approach to conservation was not just a singular event, but rather a long-term process that will take 15 - 20 years before the overall goals can be achieved. The realization of addressing the root causes of these issues confronting the sea turtles and not just focused on sea turtles and its habitat is seen as a milestone in addressing the conservation needs in the area.

CONCLUSION

It is an acknowledged fact there is an urgent need to address conservation issues in the Turtle Islands. Over the past few decades most, if not all, initiatives were focused on a single species, specifically the sea turtles, and their habitats. However, in recent years it has also been realized that, to be effective, conservation needs to go beyond the mere protection of a species and its habitat. The participation of people and communities is as important and critical in determining the fate of the resources one tries to conserve and manage and, ultimately, the only way to sustain conservation over the long term. At this juncture, we have witnessed the evolution of a conservation program from a species-focused to a multi-stakeholder, multi-disciplinary initiative. Conservation is not merely a science but an art that requires striking a creative balance between species and habitats and the different stakeholders that regard the species as their resource.

ACKNOWLEDGEMENTS

We would like to thank DFID and WWF-UK, MacArthur Foundation, and WWF-Philippines for funding the different ICDP components in the Turtle Islands, along with our partners in conservation, the Department of Environment and Natural Resources, specifically colleagues from the Pawikan Conservation Project, Sabah Parks, local partners in the Turtle Islands and most specially the Turtle Islands Team of WWF-Philippines, which has put up so much effort in this undertaking.

LITERATURE CITED

Cola, R. 1998. Social and Institutional Assessment for the Turtle Islands Integrated Conservation and Development Project. Unpub. Report. World Wildlife Fund-Philippines.

WORKSHOP DISCUSSION

DR. MORITZ: I'm curious about the benefits of the ecotourism flowing back to local villagers, and the extent to which that is between the Sabah side and the Philippine side.

MR. PALMA: Actually, there is no ecotourism on the Philippine side right now. Although, when this becomes beneficial to the Philippines, ecotourism might develop. I don't know how feasible it is right now with the kidnappings and all. But we have already developed an ecotourism project based on the Sabah experience. So if ever there can be some developments it can be controlled right away. So, in terms of ecotourism benefiting communities, probably Paul Basintal can answer that because it's on the Sabah side.

MR. BASINTAL: On our side, local communities benefit from employment with tourist and also by working with the operation, these are the only benefits I see at the moment.

Southeast Asia, Memorandum of Understanding: An Overview

Douglas Hykle & Dr. Nicolas Pilcher

PRESENTATION – Douglas Hykle

In my presentation I am going to set the scene and give the context within which the Indian Ocean/Southeast Asian Memorandum of Understanding (MoU) was developed over the last couple of years. The Convention on Migratory Species (CMS), headquartered in Germany, is an intergovernmental treaty that covers all migratory species, but with a fairly important focus on marine turtles. CMS also deals with migratory birds, terrestrial mammals, cetaceans and bats; in fact it has the potential to deal with anything that migrates across international boundaries. Currently there are about 80 countries participating in the Convention and another 16 or so that are also involved and participating in agreements under the Convention.

CMS is one of about half a dozen international conventions concerned with conserving biodiversity. Others include the Convention on Biological Diversity, the Ramsar Convention on Wetlands, and CITES – the Convention on International Trade in Endangered Species.

I would like preface my remarks with a brief description of the differences between CITES and CMS. CITES has a fairly narrow scope of interest, namely regulating international trade in live animals, including sea turtles, as well as their parts and derivatives. Thus CITES' focus is strictly on international trade. CMS is complementary, inasmuch as it focuses on what goes on within a country -- that is, domestic harvesting. It also promotes regional cooperation and collaboration among countries. Taken together, these two conventions are perfectly complementary, and both are needed to cover all aspects of conserving sea turtles.

CMS has three mechanisms or tools for achieving its objectives. The first of these tools is the Convention's provisions for protecting endangered species. It also promotes small scale research projects and there exists a limited budget to fund these. But the main way that the convention works is through the development of regional agreements. There are three types of agreements that can be developed under CMS:

1. Formal agreements, which are legally binding treaties;
2. Less formal arrangements, memoranda of understanding (MoU), that can be concluded among governments; and
3. Free-standing action plans, which are the least. Under CMS there are different types of agreements for quite a wide range of species, ranging from migratory waterbirds to small cetaceans. MoU's exist for some very critically endangered birds, for example, the Siberian Crane.

Legally binding treaties are an option that governments have for promoting conservation. An agreement that is of a legally binding character has the advantage of having "teeth." These are long-lived and tend to outlive the life of governments that conclude them. Normally, they have a financing mechanism built in, and there is some assurance of funding over the long term. A legally-binding treaty also provides for some sort of coordination mechanism, like a secretariat. But there are disadvantages, as well. A legally-binding treaty tends to take a long time to negotiate and conclude, and even once that stage is reached it takes a long time for governments to ratify them because they have to go through a formal procedure with their parliament. Some countries they may consider them too costly to join and implement, while for other countries, the provisions of the agreement might be too stringent or they may choose not to join for political reasons. Another disadvantage is that they are difficult to amend once they have been concluded.

Essentially, a legally binding treaty is an ideal to strive for, but one has to balance the positive attributes with some of the negative aspects associated with them. In the area of sea turtle conservation, there is one legally-binding treaty to date, the Inter-American Sea Turtle Convention (not a CMS Agreement), which has just entered into force last year (2001).

A second type of agreement is the Memorandum of Understanding. This is an innovation of CMS, which first developed a MoU for Siberian cranes about eight years ago. This instrument has proven very effective, and as a result, the knowledge gained has been transferred to the work being done on sea turtles. One of the advantages of MoUs is that they are relatively quick to negotiate and conclude: two or three years. Still a fairly long process, but governments do not need to formally ratify them. Generally speaking, there has been good participation from NGO's in the formulation of these agreements.

Even though they are not legally binding, they do have the potential to attract funding from donor agencies. The most important or attractive feature of the MoU is ease of monitoring progress over time; they are specifically designed in that sense. On the negative side, however, the commitments that governments make to them are not binding. They do not necessarily have financial security or a coordinating body (i.e. Secretariat), and they are not necessarily as effective for getting long-term actions on the ground.

CMS developed a marine turtle MoU for all the countries of West Africa a couple years ago and more recently has developed a similar MoU for the Indian Ocean and Southeast Asia (the "IOSEA MoU"). This agreement covers a very wide geographic region, with potentially at least 40 countries involved. The idea is to have the activities for the whole region coordinated at a subregional level. In relation to what we are discussing this week, I would like to suggest that one potential option is to link the IOSEA MoU with the SPREP programme, or perhaps have Pacific-based activities under an extended MoU be coordinated through SPREP in its coordination role for marine activities in the Region.

PRESENTATION – Dr. Nicolas Pilcher

In my presentation I would like to offer a brief description of how the IOSEA MoU came about and what some of its potentials or limitations are. In 1999 the Second ASEAN Sea Turtle Symposium was held in Kota Kinabalu, which resulted in the Sabah Declaration, calling for a wider regional agreement that spread across countries other than just the ASEAN countries themselves. The Australian government very generously picked up on this, and efforts of other people, and held the first round of intergovernmental negotiations later in the year in Perth, at which time the draft text for the MoU was considered. Meetings reconvened in Kuantan in 2000 and the text for the MoU was finalized. In Manila in 2001, the Conservation and Management Plan was finalized the and there were countries ready to sign the MoU at the conclusion of the meeting. Thus, in June of last year (2001) eight countries signed the MoU. Shortly there-after in July, a ninth country (Vietnam) signed. In a yet to be determined location, most likely in June of 2002, there will be the first meeting of signatory states.

The main components of the MoU itself includes a preamble, with all the "noting this..." and "recognizing that...". One of the important parts of this preamble is that it recognizes all of the efforts that have gone into turtle conservation up to this point, including the ASEAN MoU and the TIPHA arrangements. One of the things that I think is quite important to this group [workshop participants] is towards the end, "noting the desirability of involving other states whose nationals or vessels conduct activities which may affect marine turtles of the region." Thus the MoU basically states that it is interested in having states that are not within the region become a signatory to it if they either affect turtles within the region or could contribute resources. A good examples is that the United States is a signatory to this agreement, and that it is nowhere near the Indian Ocean/Southeast Asian region but is interested in sharing expertise and resources to the conservation of marine turtles in the region.

In the MoU, there are also a number of definitions. These include things such as the species covered under the MoU, their habitats, and their actual range. This is a critical point because the region as delineated extends eastward only to the Torres Strait, and does not include any of the West Pacific waters although this is not to say that the turtles from the West Pacific are not involved within the Southeast Asian region. It also goes on to highlight exactly what is meant by conservation status, something that does not appear in quite a number of other documents. This is useful for governments so that they can pick up on issues such as population dynamics, which indicate if marine turtle populations are maintaining themselves on a long-term basis. It goes on to describe the definition of conservation status, which is extremely useful for those countries which at the moment might not have as much technical input as they might desire. The objective of the MoU is "to protect, conserve, replenish and recover marine turtle populations and their habitats." It is important to note that it is not just marine turtles that needed conserving, but also their habitats. Thus the IOSEA MoU has a very clear and concise objectives to work towards in the next few years.

The MoU continues with action items, calling out for cooperation among nations, the implementation of the conservation and management plan, and when necessary, to review or establish legislation that will promote the conservation of marine turtles and their habitats. Finally, to establish an advisory committee (which has not been established yet) to be determined by the signatory states at their first meeting. Possibly in June 2002, at the first meeting of signatory parties, an advisory committee will be nominated and established. At the same time under these actions, at the first meeting, hopefully there will be discussions on how funding is procured to operate a Secretariat and deciding on ways in which the Secretariat can assist states to carry out their responsibilities under the MoU.

These are the basic principles that guide the MoU. Another important point is in paragraph 2C, "each signatory state will implement within the limits of its jurisdiction… , but also with respect to vessels operating in the region under its flag." This means that if there are, for example, Spanish vessels operating within the Indian Ocean, that they also can become part of this MoU and work with these groups to promote turtle conservation. This might be an avenue through to consider fishing vessels from countries on the Western Pacific rim, but which impact turtles in the Indian Ocean.

What the MoU does not do, is that it does not exclude any country from implementing stronger management and conservation measures than those described in the conservation and management plan. It is very clear under the basic principles of the MoU that this document is a guideline, but by all means countries can go ahead and do a lot more using additional resources should they wish to.

The conservation and management plan is a unique document in that it has six main programs that cover such things as: threats, public awareness, research, etc..., which are then broken down into 24 subprograms, and finally 104 activities. It is the first action oriented component of any international instrument on marine turtles to date. Neither the Inter-American Convention nor the West African MoU have an action oriented conservation and management plan. This is the first one of its kind and should be used as an example. It was developed by representatives from each of the participating countries with input from marine turtle specialist groups [i.e. people like C. Limpus, J. Frasier and J. Mortimer, etc.]; quite a few people with many, many years of experience working towards something that was extremely cohesive.

With regard to limitations, the geographical coverage of the MoU is one of its limitations, for example, the fact that it stops at the Torres Strait. Also, turtle excluder devices (TEDs), which have been identified as a major way to protect marine turtles, are not identified by name. Bycatch reduction devices are discussed, but because there was some sensitivity in some countries in the region about the actual use of the word "TEDs", it was excluded. The MoU does require funding to operate a Secretariat. Funding will always be an issue, but without a motivated Secretariat, someone with the energy and interest to maintain momentum to keep countries interested, I believe the MoU will not go far. In addition, there are some significant language barriers in the region: Arabic, French, English, Malay, Thai, among others, that create their own management problems in terms of communication. Lastly, the MoU was signed at a government level with little or no consultation process with the people on the ground. So whereas the Philippines, for instance, is a signatory, the people that are out on the little islands in remote areas really don't know about it.

Opportunities of the MoU include the point that several states from outside of the region can become signatories. It also promotes the implementation of other bilateral and multi-lateral agreements. For example, some subregion components can put together their own agreements which might help overcome language barriers. And finally, it provides guidance on conservation activities, especially in nations that might not have the technical experience to start with.

In conclusion, in applying the IOSEA MoU to the Western Pacific region, it is important to note that turtles from the Indian Ocean/Southeast Asian region definitely do migrate into West Pacific waters; leatherbacks from Papua, loggerheads from Japan and greens from Australia, among others. There are several land-based activities in Southeast Asia that impact all of the Pacific, for example, solid waste that accumulates in the northeastern part of the Pacific Ocean, and terrestrial runoff from the Philippines or Indonesia that might directly impact the western reaches of the Pacific. In addition, the Indian Ocean/Southeast Asian nations are most likely a source of hatchlings and juveniles to some of these Western Pacific nations. The possibility that turtles hatching, from the Philippines and other Pacific rim countries contribute to Western Pacific populations, should not be discounted.

WORKSHOP DISCUSSION

DR. HAMANN: Two questions, first, have you guys identified any of the potentially problematic foreign fleets that are coming into IOSEA waters; and if so, is there some sort of general strategy that you would use to approach those countries?

DR. PILCHER: At the moment there is some knowledge about some of the tuna fleets that are operating in the Central Indian Ocean region that affect leatherback populations from South Africa. There hasn't been any major work within the Indian Ocean/Southeast Asian MoU towards that. I think the people that really drive a lot of the knowledge side of things of the MoU, have been involved in other things subsequent to the development of the MoU. At this time we are focusing on where the Secretariat gets based which will determine where things get taken from there, but it certainly is under the 104 activities. There is a column where we prioritize some of those issues, although there hasn't been a prioritization exercise. We were hoping that at the first meeting of parties that this sort of an exercise might take place. But it is listed as one of the things that is needed. In fact, there is a section on prioritizing activities.

South Pacific Regional Environmental Program: An Overview

Job Opu

PRESENTATION

In this presentation I hope to give a general overview of SPREP's role and how it can help turtle conservation, both in the Southwest Pacific, and in the Indian Ocean and South China Sea program.

The Southwest Regional Environmental Program, SPREP, is a regional intergovernmental organization, composed of 21 Pacific Island countries, four French and American territories, and four metropolitan countries: France, Australia, New Zealand and United States. SPREP was designed to develop and promote strategic actions to address conservation and environmental issues in the Southwest Pacific region. SPREP reports to the South Pacific Forum and the Secretariat of the Pacific Community. SPREP's strategic action plan and work is directed by member governments which review the program and develop new programs, and endorse its action plans.

SPREP's action plan has five key areas or major programs. The first area of this action plan deals with conservation and biodiversity. This plan includes the Regional Marine Turtle Conservation Program (RMTCP). The RMTCP addresses issues affecting sea turtle survival and coordinates the activities of a network of governments and NGOs to work together to promote conservation and sustainable management of sea turtles. Throughout the years, the original sea turtle conservation program has had various goals and objectives. For example, in 1997 to 2000 the goal was to conserve sea turtles for their cultural, economic and nutritional values for Pacific Island people and for the long-term survival of turtle resources. When the original RMTCP was put together, SPREP's vision with regard to sea turtle conservation, was:

To see a future where generations of Pacific Island people will have choices of how they use and interact with sea turtles. This dream will come true if we take action now to ensure that sea turtle populations recover to become healthy, robust and stable. Sea turtles will fulfill their ecological role and be harvested by Pacific Island people on a sustainable basis to meet their cultural and nutritional needs.

There are four main activities of the original conservation program, the first and foremost is the coordination and operation of the regional marine turtle conservation program network. Each of the 21 Pacific Island countries form a network that is used to address conservation issues within each country. For example, during 1995 Year of the Sea Turtle campaign, turtle conservation was very active in regard to public awareness and education. The RMTCP developed awareness and tagging programs within these countries to be carried out on behalf of the program. The role of the RMTCP is to maintain this network of programs through exchange of information and exchange of technical expertise within this network. It was through this activity that SPC was given the contract to come up with the turtle bycatch report, and it is through this activity that SPREP maintains the original sea turtle database.

The second activity is in-country support for turtle conservation and sustainable use initiatives. Under this activity, SPREP sets limited funds aside for each member country to conduct necessary programs. For example, funds to conduct educational awareness or tagging programs. The third activity is to produce resource material (educational awareness material), and supply member countries with tags and tag applicators. The fourth aspect of the RMTCP is to review the program every three to four years. The entire conservation program is reviewed to outline activities, and identify how address the turtle conservation issues in the following four years. The next regional marine turtle conservation program is scheduled for October 2002.

WORKSHOP DISCUSSION

MR. ISAMU: How much money are you giving to the member countries? Just a question of funding, how does one apply for funding and how much is available?

MR. OPU: The process for applying for the funds is very simple. NGO communities or anybody within the country can apply for the funds. What they need to do is put together a proposal and get the SPREP focal points, it's just the way Department of Environment or Department of Fisheries or Department of Foreign Affairs in each of the countries will endorse this proposal. When it comes over to SPREP, we look at it and send out funds. Unfortunately, we have only $40,000 U.S. annually that must be distributed throughout the South Pacific region. Five to ten thousand U.S. dollars is average per request, but they usually receive maybe four or five thousand U.S. dollars.

DR. CRAIG: One project that I think would be really worth considering is perhaps the pivotal role of Fiji in the green turtle biology. We heard there are tags recoveries from American Samoa, French Polynesia, Cook Islands and Australia; turtles going to foraging pastures in Fiji. Maybe at this next meeting we could develop a project that wasn't just to help Fiji, but elevate it to a regional issue that we could all tackle.

MR. OPU: Your representative that comes to the meeting at SPREP is welcome to bring this point up. As I said, we would like to have issues presented to us from each of the countries.

DR. CRAIG: At this upcoming October meeting or prior to it?

MR. JOB: Probably during the October meeting. But we can start discussing it prior to the meeting.

DR. CRAIG: One other, in my report I have an old SPREP tagging map, 1993. I'm wondering, have there been increases to that in the SPREP database that I need to be aware of?

MR. JOB: The last updated maps are of 1999. So yes, there are some maps around.

DR. MORITZ: What are the longer-running intergovernmental agreements trying to do with marine turtle issue, what things you think have worked and what things haven't worked.

MR. OPU: I think in 1995 the Year of the Sea Turtle Campaign, the network started then. In 1995 everybody was excited and everyone wanted to go out and do something about turtles. But as the years progressed, each country had different things to look at and then after that they did not show the same interest that they did in 1995. My problem is trying to revive the network again. I've been sending out letters. But I think since I've started working with SPREP in the last year, only six or seven countries have got back to me, I have heard nothing from the rest of the network.

DR. MORITZ: To follow up on that, given the pivotal nature of SPREP in the region, is there anything you think this group or the Council can do to reenergize the system.

MR. OPU: I will need some time to think this over - because all I can see is money.

MR. BALAZS: The last RMTCP meeting was in Fiji and Sue Miller, who worked for SPREP at that time, was supposed to have written a report of that meeting. We have reports for all the meetings since 1989, but we do not have one for the last meeting, nor do we have the results of the strategic planning session that was held in October 1996, when the vision statement was drafted. I know this is before your time, Job, but is there any chance that any of those documents can be salvaged and put out? So that there is some record that the meeting were held?

MR. OPU: I have been trying to locate these reports and have not had any success so far. I've talked to Sue and she said it was on the computers or something, but the computer has crashed since then. I'm still trying to look for whatever written reports she might have in a box somewhere.

MR. BALAZS: The strategic planning session held after that was facilitated at some great expense by a gentleman named Barry from New Zealand. It seems to me that the note taking for that meeting was probably pretty substantial. A lot of people had different notebooks. That might be worth pursuing. Again, Sue might be able to provide some information on where it is at and maybe someone else at SPREP. I recall that there were people from SPREP at the hotel taking notes, more than just Sue. It is very depressing for all the participants who contributed and done so well in our opinions, and then not have anything come out of it. I really do think that, even that vision statement, the only reason it persisted to today is that I was so intrigued by it that I wrote it down word for word. I wrote it down in my notebook and I think that might be the only reason we still have that documentation still today.

MR. OPU: I've been in touch by my director to get a draft report of the last regional meeting before this meeting comes up in October. I'll try my best to salvage it somewhere.

MS. LEBERER: I just have one thing to add. In our case in Guam, the point of contact is Guam Environmental Protection Agency. In the past they have not informed us of SPREP meetings. If you still send things to them, could you please also send things to our agency [Guam DAWR] as well so that we also are aware of the things that are happening.

DR. MORITZ: Perhaps in SPREP's defense, I would point out that it would seem that it's up to the participating nations to have their act together.

Interpretation of the U.S. ESA Sea Turtle Recovery Plans

Kathy Cousins

PRESENTATION

The U.S. Endangered Species Act, abbreviated ESA, provides a mechanism for listing species as either 'Endangered' or 'Threatened'. Endangered means any species that is in danger of extinction throughout all or a significant portion of its range. Threatened is any species that is likely to become Endangered within the foreseeable future throughout all or a significant portion of its range. Relative to the Pacific, the hawksbill and leatherback turtles are listed as Endangered under the U.S. Endangered Species Act in 1973. The green turtle, loggerhead and olive ridley turtles were listed as Threatened in 1978, except for the breeding population of olive ridleys in the Pacific Mexico, which were listed as Endangered.

The ESA calls for the development and implementation of a recovery plan for the conservation and survival of a listed species. The recovery plans include site-specific management actions necessary for conservation and survival. Criteria, which when met, would result in down listing, which means taking a species from an endangered status to a threatened status or delisting (e.g. the removal of the species from the endangered species list).

In accordance with listing criteria, an estimate of the time and funds required to carry out the conservation actions are required. The recovery plans provide a roadmap to species conservation and recovery in the United States. The recovery plans for U.S. Pacific sea turtle populations were prepared by a 12 member recovery team, and this team is still active today. They were assisted by 40 technical advisors. The people who contributed to the plans represented a diverse group of constituents.

The six Pacific sea turtle recovery plans were issued in 1998, jointly by the U.S. National Marine Fisheries Service and the U.S. Fish and Wildlife Service. These agencies share the jurisdiction for sea turtles in the United States. In short, the U.S. Fish and Wildlife Service (USFWS) takes responsibility primarily when species are at breeding beaches, and the U.S. National Marine Fisheries Service (NMFS) takes responsibility when they are in marine waters. There are six plans, one for each of the listed species. A theme that seems to run throughout the recovery plans, in general, is the poor status of the sea turtle populations and our limited understanding of the baseline population numbers, habitat and the magnitude of the threats.

As everyone is aware at this meeting, sea turtle populations do not appear to be doing so well, and there are large gaps in information. Nest counts and turtle censuses are difficult to quantify, and the total number of breeding adults to a large extent is still unknown for many breeding beaches. Further, we do not really understand the age class structure or composition of the population. While we can indicate a trend, there are still a lot of unknowns that need to be understood.

The U.S. operates under the Endangered Species Act, which directs the federal agencies, the USFWS and NMFS, to use the best available science to list species they believe are endangered or threatened and then develop recovery plans. Specifically, Section 410 of the Endangered Species Act directs the Secretary of Commerce (i.e., NMFS) and the Secretary of the Interior (i.e., USFWS) to develop and implement the plans for the species listed to enhance recovery plans development and implementation, and recommend measures that accomplish the goals of a recovery plan. The agencies are instructed to do these by points, and are instructed to diversify areas of expertise represented on a recovery team. They are instructed to develop multiple species plans where possible, and the U.S. did this by preparing six different sea turtle plans. In the recovery plans they are to try to minimize the social and economic impacts of the recovery actions. They are instructed

to involve representatives of all affected groups and stakeholders. In general, the recovery of species is supposed to be a very transparent process. Furthermore, the agencies are instructed to develop the recovery plans within two and a half years after the final listing of a species.

For the six Pacific sea turtle recovery plans, there are a total of ten delisting criteria. These delisting criteria change between the species. For example, for the Pacific leatherback turtle to be considered for delisting, a priority one task criteria that must be met is to eliminate take (i.e., injury or mortality) in international waters. Another criteria to delist sea turtle species is that the number of FENA, defined as females estimated to nest annually, must "average 5,000 females per stock nesting annually over a six year period, or a biological reasonable estimate based on the goal of maintaining a sustainable population."

The ESA also calls for a review of all species identified on the list once every five years to determine whether a species should be removed from the list or receive a change in status. Unfortunately, there are no review time frames in place for a recovery plan although Congress requires a report every two years on a species' status and the implementation of its recovery plan.

Furthermore, each recovery plan must include an implementation schedule or an action plan that lists each recovery plan task, task priority, cost and time to complete the identified task. Recovery tasks should be assigned priorities of one through three based on the established priority system. For instance, all priority-one action items are actions that must be taken to prevent extinction or to identify those actions necessary to prevent extinction. Priority-two actions in the plans are actions that must be taken to prevent a significant decline in the population numbers, habitat quality or other significant negative habitat impacts short of extinction. Priority-three are all other actions necessary to provide for full recovery of the species.

The implementation of a recovery plan is to be accomplished through the means that "will provide for a timely recovery of the species while minimizing social and economic impacts." The USFWS and the NMFS are directed to involve all affected interests in the recovery plan implementation process through the development of a participation plan. A participation plan should involve all appropriate agencies and affected interests in a mutually developed strategy to implement one or more of the specifically designated recovery actions and participation plans should ensure that a feasible strategy is developed for all affected interests while providing realistic and timely recovery of the species.

WORKSHOP DISCUSSION

MR. BALAZS: Just to clarify, are you aware that there was a participation plan workshop held with a number of the Pacific Islands from U.S. flagged areas?

MS. COUSINS: When was that?

MR. BALAZS: August of '98.

MS. COUSINS: Was there a report?

MR. BALAZS: Well, the workshop was held by the regional office and I'm sure there was some documentation of it.

MS. COUSINS: No, I wasn't aware, thank you. The point I was trying to make is that there is a mechanism in the U.S. Endangered Species Act to encourage participation plans to be developed and that the recovery team members are still active and they could start the participation plan process. So maybe this might be one avenue that this group might want to go and make recommendations that we start that type of process.

DR. CRAIG: I would like to support that. It's been many years now since the recovery plans were prepared and we've heard of a few activities that are going on, however none in our region. So any kind of action that this group here could take to help move that process forward, to learn, for example, what Fish & Wildlife programs are slated, and so forth, any leverage that we could use would be helpful to us.

MS. COUSINS: Thank you very much.

MR. BALAZS: I have here, it was sent to me a couple years ago, a draft recovery plan for marine turtles in Australia and I was just wondering if any of our Australian colleagues can tell us if this was ever finalized as a recovery plan. I thought it was quite good.

DR. DOBBS: It's a still in draft form.

MR. BALAZS: So the U.S. isn't quite as slow.

DR. DOBBS: No, the political process over there is the same as you have here. We're hoping this year it will be finished.

MR. BALAZS: It's not dead, then?

DR. DOBBS: No, it's not dead.

DR. MARQUEZ: Just a comment. In Mexico and Central America the olive ridley are increasing, I think all Central America and Mexico.

MS. COUSINS: I think that is good news.

DR. MORITZ: I have one question, either you can answer or maybe Scott can address it. The requirements for delisting are very severe, but things like "eliminating" take is simply not achievable. Perhaps having 5,000 annual nesters in each stock is not achievable. Can some progress be made on reporting back on a stock-by-stock basis rather than dealing with the entire Pacific populations for the species?

DR. ECKERT: To come up with criteria we wanted something quantifiable and recovery plans in the past were notoriously vague about such things. So the discussion that transpired among the recovery team over a course of three meetings or so was how to set a number to aim for. You notice we gave ourselves a very sneaky little caveat in there, and that caveat is or some other value that is biologically realistic. We did not say politically realistic. We did not say geopolitical realistic. We say biologically realistic. The bottom line with these recovery plans is the team was all very unified with this, is that biology controls recovery, not politics. So if you only have 20 turtles in your stock and you had 10,000 in that stock 150 years ago, then you need to be striving for that kind of recovery before you can consider it recovered, and we were very firm about that particular aspect.

The 5,000 number came from looking at the major stocks around the region with the data we had in 1996, which is when we were doing these plans, and say, okay, what are some of these larger stocks, about how many nesting females are there, how many nesting females would need to be there to prevent a series of events from wiping out that stock. So for example, say they have hurricanes or typhoons pass through French Frigate Shoals a couple years running, would a group of 5,000 females and their subsequent supporting population size out there be enough to keep that population alive after some very serious events. That's why we picked the number of 5,000, it seemed realistic based on what we knew for stocks.

Remember, stock boundaries are also biologically an issue, that 5,000 could actually represent the entire Eastern Pacific leatherback population. It could represent the entire Western Pacific population, depending on what you put your stock boundaries on. That is something we didn't wrestle with at all, and I think the DNA types in the room are going to have to struggle with that a little bit, is what do you define as a stock. That's where that whole discussion came from.

DR. MORITZ: I guess my follow up question is, do you have the capacity to downlist individual stocks as you go along.

DR. ECKERT: Sure. Absolutely. Endangered Species Act allows for regionally important stocks to be managed separately. Absolutely. In fact, that is why we did a separate plan for the East Pacific green turtle. East Pacific green turtle is not, by most standards, a separate

species. In fact, by many standards, it's not considered even a subspecies. And that was something we wrestled with quite a bit as well. However, because it's a regionally important and unique population of the green turtle we wrote a whole separate plan for it. And the ESA allows for a regional kind of management, but I am not sure about delisting on a regional basis.

MS. COUSINS: From what I understand, when they listed the species under the Endangered Species Act they didn't list them stock by stock, they listed them as a species and therefore for delisting or downlisting you would have to consider it as a species, which means all stocks.

DR. ECKERT: No, absolutely not. You can downlist a stock, after all we have green turtle populations that are some are listed as endangered and some are listed as threatened. Same thing with the olive ridley. The olive ridley was listed as endangered in Mexico and threatened is Costa Rica. So you can take individual stocks and categorize their listing status. What I don't know about is the next big step to delisting.

MR. BALAZS: That's not a realm of the recovery team, to do delisting.

DR. ECKERT: That's right. It's the management authorities that are responsible for making those judgments. The team is to act as an advisory capacity to the management agencies. In fact, the management agencies are not required to necessarily accept those recommendations.

MR. BALAZS: I just wanted to clarify one thing. What we recently found out, is that the team is still on paper, a team. Usually teams, once they finish the plans, are disbanded and done. But although we are still a team on paper, we are not an active team. The team has not been asked to be active and the team has not had any resources to be active.

MS. COUSINS: Maybe this group will ask you to be active as a team again. Thank you very much.

Closing Remarks

Kitty Simonds and Craig Moritz at the Luau on the final night.

Closing Remarks

Dr. Craig Moritz & Kitty Simonds

WORKSHOP SUMMARY – Dr. Craig Moritz

Thank you all for your persistence and contributions. What I want to talk about briefly is to revisit the role of the Council as it has emerged during this meeting and then talk a little bit about one thing I think we've overlooked; the socio-economic dimension. Also I would like to sort through communication strategies, priority setting, and summarize the gist of some of the important things we brought out during this meeting.

I want to emphasize that the information coming from the various working groups, supporting documents, and the outcomes of this meeting are not recommendations to the Council per se. But what we have done is provide advice to their Scientific and Statistical Committee (SSC), who will then make recommendations through the formal Council process. So we need to bear that in mind.

First, I would like to congratulate the Council. This is a world first, bringing together turtle biologists on this scope, to work with people who manage fisheries and bycatch. This was really quite extraordinary and quite exemplary for other Councils to follow. Again, formally I would like to extend my thanks to the Council, Irene and all the people who supported us while we were here. That said, the job is far from done.

One issue that was raised specifically is that there are other fishery Councils in the Pacific that could to some extent adopt this role or take on this interest in marine sea turtles, particularly those on the west coast of the U.S.A. where there are shared issues in terms of turtle bycatch with the fleets they regulate. We have tried to keep focused throughout this meeting on the connection between their business, which is managing fishing fleets, and endangerment - and we hope the eventual recovery - of the turtle stocks that connect with them.

On the other hand, this meeting was explicitly aimed to promote the flow of information between the many turtle researchers, agencies, NGOs and local government institutions that have a role in marine turtle protection, research and conservation. This need for liaison will obviously continue. But I think what has emerged, as we have discussed where the current initiatives are over the region, is that the Council can do more than just liaise with these groups. They can really promote the exchange of information among these groups, as well as between them and the Council. So what has emerged, I think, is a very important role for the Council in liaison and promoting the exchange of information in the region.

One thing that complements this issue that has been underplayed, is to the extent that we are dealing with bycatch, harvest on the beach, etc., we are very much dealing with the symptom of the problem, not the cause. Both the cause of the problem and the possible solution lies with the people, particularly with coastal communities, their cultures, their economic conditions and their population size.

What I would like to suggest is that all these things we have been focusing on, harvest, habitat and bycatch, are a direct consequence of what is happening at the human population level. Yet, we've barely discussed this. It has been pointed out by a number of people that there has been dramatic growth in coastal populations throughout the region. In some areas this is having a direct impact on subsistence harvesting, for example, of turtles and eggs. But there are also some areas in the Pacific, particularly the more remote areas, that are depopulating, and they provide opportunities for turtle conservation.

There is a ton of data out there on demographics of communities throughout the Pacific. I don't believe it has ever been directly connected on a geographic scale of what is happening to turtle stocks and impacts on turtles. I would like to suggest this as a research area that the Council could promote. There are many agencies that can follow through with this. Perhaps the Council can work with SPREP, with CMS and so on, to

try to promote this sort of research. I welcome some feedback on that idea before I go any further.

DR. PILCHER: I agree entirely. I would like to bring it to everybody's attention that there is currently a program of exactly that going on globally. It's called the Global International Waters Assessment. It's a GEF-funded project based out of Sweden. They have a website. I'm sure if you search under GIWA you'll find this on the web. The purpose of GIWA is to look at human populations and changes in coastal demographics over a period of time. They are not only looking at past and present, but also trying to come up with a future scenario. Most of this is aimed at determining what is going to be the effect of coastal populations, etc. on international waters. But the data are going to be the exact same data that would be required by something like this. They have 56 regions in the world, or sub regions, which are being looked at on a different scale by groups of biologists, but at the same time by anthropologists and others of differing expertise.

I've been involved on the South China Sea region, but I know there is a plan to have one of those workshops held soon in the South Pacific region. I think SPREP has been given the contract to actually do this. I'm not sure who will be organizing it. But certainly, this is important and maybe the Council could play the role of linking between the turtle things and GIWA. Point being, if it is already there, no point doing it all over again.

Continuing on, throughout this meeting we heard some bad news and also some good news for turtle stocks. The point being that there is some good news out there and it is an important message to get out to the fishery communities and people dealing with indigenous habits. With proper management, particularly if you identify threats and act on them, there is hope. If we focus too strongly on the bad news (which is important because the news has to get out) then there is just despondency and despair and we would never make any progress. So, particularly for people whose income we impact, they need to know that with correct management and changes in practices, in the long term, the situation can be reversed.

The timing and the possibility of change seems enormous, depending on which stock, which species, recruitment rates, age of reproduction and so on. We are not going to see too many "quick fixes," or anything as spectacular as the East Pacific olive ridley recovery. We are not going to see anything happen that quickly in Malaysian leatherbacks, for example. But the message needs to get out that it's not all doom and gloom.

We talked a lot at this meeting about the need for communication and liaison. Indeed, this meeting is one of those things. We've talked about where we are with databases, we are aware of the database at SPREP that needs to be brought up to date. There are substantial databases sitting at Queensland National Parks and Wildlife Service, U.S. National Marine Fisheries Service and so on. CMS under the Bonn Convention has funding (at the moment) to develop the GIS-based system, which I imagine will work something like a distributive database, where you can click on a single point of mapping and go to it. Behind the GIS system will be the database still controlled by the individual research programs. People will be able to submit data to that directly or it will feed off individual databases through a common data format. The details are still being worked out, but it is very encouraging.

The point I want to make is that we have different constituents and many different types of information. The CMS thing may be brilliant for turtle researchers, as is Cturtle.org. There are terrific datasets out there for turtle researchers and we're working to bring them together in some way. But we need to bear in mind that there are simple or slightly different needs for managers, policy-makers or for the general community. My guess is that they would find most useful, not the individual tag return data or growth data or recapture data, but the derivatives from those data which compiles information in terms of stock boundaries, breeding and feeding ranges, or nesting beach trends. To be able to click on a feeding ground or a nesting area to see what stocks are there, what their range is, what their trend might be, and so on, and to have that information updated regularly would be highly valuable. The need for this came come up in working group after working group after working group here at this meeting.

At the community level, however, they may want different information. Possibly regarding the health of turtle populations, education materials, lesson plans, basic turtle life history information, threats and/or success stories. Maybe an individual fisherman has tagged a turtle and would like to know where the turtle has end up, that sort of feedback is necessary and was discussed this morning in terms of getting fishers engaged in the research process. How we target different types of information to different types of people needs to be thought about.

This workshop was an example of the obvious need for networking. It's not possible for the Council to solve the problems we have talked about here, nor should it. There are a variety of institutions which can help play a role that is relevant to the turtles that intersect with the U.S. fishery fleet. These different groups have different types of information or capabilities. The exercise we went through at various stages during this meeting was a way to try and focus the needs that we see across the region, which are incredibly diverse and difficult to achieve. Things that are in many cases specifically relevant to this Council, but other things that may help them to enhance the work being done by others. We identified many ways in which the Council could facilitate action, in some cases perhaps undertake or fund research, or work with other relevant institutions to promote the sort of research aimed at the recovery of the stocks.

What we are trying to achieve, is the recovery and delisting of the turtle stocks which intersect with fisheries. We have outlined the priority stocks and areas in terms of data deficiencies. We've discussed opportunities, and in my mind, the biggest one is the connection that the Council and its collaborators (like SPC) provide to the fishing industry. They have a unique role of facilitation, but not overlapping and duplicating work being done, in these other multi-national/multi-agency groups.

I want to run down the list of priority actions. With respect to liaison and communication, what emerged, particularly from the community empowerment working group, and based on the comment that Paul Dalzell made at the very start of this meeting [that the Council is in this game for the long haul, that the main turtle stocks are not going to recover in the next five years], the need for a turtle biologist on the staff at Council in a long-term continuing position.

One point, however, that was made very clear is that you cannot vest all this activity in a single person. It has to be an institutional commitment, bearing in mind that the long haul they have is basically fishery-turtle interaction. Meetings like this are a terrific means to advise them of what is happening in the turtle world, but to interpret those results is going to need continuing action. This person might work to provide advice, or if they don't have it, go and get it to give to the advisory Council. In particular, a networking function, and in some cases direct assistance function for things happening around the region, particularly in relation to data.

As we've seen various slides from workshops throughout the region here at this meeting, two faces have cropped up again and again, George Balazs and Colin Limpus. I think it's also true to say that they do this largely in donated time and on the back of full-time jobs elsewhere. We acknowledge these efforts here today! I should add they are not alone. There are others in this room that have played this role, as well, but they need help. The things we are asking to have done here are yet more demand on time and capacity.

There is a need in SPREP for assistance. Job Opu has been quite open about this. The Council needs to

connect up with these groups who need assistance. What I'm suggesting is that we need someone to network between the Council, NMFS, Fish and Wildlife, SPREP, CMS and the Indian Ocean group to collect data, and to help sorting through the data needed for databases. This person would work to get the right people together, and provide support to get products out.

Directly out of the Community Empowerment working group, was a call for a consultant, or shorter-term position to work on a specific project to review existing measures, develop strategies, assist in in-country training, and assess gaps. In this way, the Council could work directly with those various nations and organizations to help. With this comes the bigger issue, and obviously a much more difficult one to tackle, and that is the gaps in knowledge. I don't know how many "person-years" of effort we have in this room trying to build this knowledge, but it is obviously huge.

Surveys of nesting and feeding populations, stock identification, assessment of sea turtle mortality, development and promotion of mitigation measures, bycatch and harvest, and the one I mentioned previously, what are the socio-economic drivers of harvest and threats to the turtle populations? I should point out this is not just about getting the data, but gathered in such a format that data can be rigorously evaluated and when possible put into exclusive models to build our understanding on the dynamics of the population.

We have made terrific progress at this meeting and I am grateful to those of you who did not push their particular population, because this was really about setting priorities. To summarize, we talked about the target audience and effective sharing of information focused on the needs of particular types of people: fishermen, coastal villages, scientists, etc. We discussed the need to promote post-graduate education and try to build internal capacity at higher levels of government administration and universities to address not only turtle biology, but also things that connect with turtle biology. We discussed liaison and communication at length. One idea that seemed to gain support was to have an annual workshop. A workshop focused on this year's data, what is happening in the population, and when possible, combined with modeling and projections. Finally, there is a lot of "in kind" support that the Council can provide through their expertise, particularly with fisheries. It may be that prioritized projects from this meeting can go through the Council process to secure funding for particular initiatives, and that is, of course, what we all hope.

Closing Address

Kitty Simonds

First, we should congratulate Professor Craig Moritz for the excellent chairmanship of this meeting! We can all appreciate why he was selected as the chair for this event.

We are pleased with the outcome of this workshop. Thanks to all of you for accepting our invitation to come here to Honolulu to share your turtle expertise, scientific, and community knowledge.

The completion of this meeting accelerates a new phase for the Western Pacific Council. We will be working with the U.S. government to gain active support for the workshop recommendations. This is an area where the Council has a lot of experience. We have maintained a strong presence in international fishery management for several years, including service on U.S. delegations to world fishery meetings in Europe and Asia. We have already begun discussions with colleagues in other related federal agencies and the Congress is pursuing federal money for turtle research and conservation in Hawaii and elsewhere in the Central and Western Pacific region.

Please continue to advance the dialog stimulated by this workshop. The Council welcomes any suggestions you may have on conserving Pacific sea turtles. We will refer to the points raised here in our continuing deliberation at international fishery meetings and with members and staff of the Congress with responsibilities for these areas.

Hopefully, the Council's role will lead to success in expediting measures you have recommended to protect turtles. We at the Council plan to make this workshop a regular meeting, perhaps annually, and will continue to draw active participation from the Western and Central Pacific. This conference has excited us with the possibilities for saving turtles and safeguarding our fisheries, as balanced sources of life for the future of the planet we share.

E kuahui like I ka hana.
Pūpūkāhi I holomua.
'A' ohe hana nui ke alu 'ia.
- Hawaiian Proverbs

Let everybody pitch in and work together.
Unite in order to progress.
No task is too big when done together.

Appendices

Appendix I:
Workshop Agenda

Western Pacific Region Fishery Management Council Office, Honolulu, Hawaii, February 5 – 8, 2002

Day 1 – Tuesday, February 5th

08:00 – 09:00

1. Introductions - Welcome
   - A. Western Pacific Fishery Management Council — Paul Dalzell
   - B. Workshop Introduction — Irene Kinan
   - C. Workshop Chair — Craig Moritz

09:00

2. Region/Area Summaries
   - A. Central Pacific
     - i. Hawaii & U.S. Territories — George Balazs
     - ii. CNMI — Richard Seman
     - iii. America Samoa — Ruth Utzurrum
     - iv. Guam — Veronica Cummings
   - B. Western Pacific
     - i. Malaysia — Hock-Chark Liew
     - ii. Philippines — Renato Cruz
     - iii. Indonesia — Agus Dermawan

BREAK 11:00 – 11:30

- C. Japan - Loggerhead turtle, *Caretta caretta* — Hiroyuki Suganuma
- D. Australia - Great Barrier Reef World Heritage Area — Kirstin Dobbs
- E. Western Pacific – The Western Pacific Region Summary — Colin Limpus
- F. Mexico - Population Status, *Dermochelys coriacea* — Laura Sarti

LUNCH 13:00 – 14:30

(Captains meet with Chair)

14:30

3. Defining Management Units — P. Dutton/D. Broderick/N. Fitzsimmons
4. Progress on Regional Databases — Colin Limpus

15:30 – 17:30

5. Break into Working Groups
   - i. Conservation Methods
   - ii. Community Empowerment
   - iii. Gaps

Day 2 – Wednesday, February 6th

08:00

6. Community Awareness
   - A. Bringing Cultures Together — Mark Hamann
   - B. Vanuatu Community Programs — George Petro
   - C. Pawikan Conservation Project — Renato Cruz
   - D. Fiji Community Programs — Etika Rupeni
   - E. Malaysia - Partnerships in Turtle Conservation — Dionysius Sharma

7. Fisheries & Fishermen
   - A. Western Pacific Fisheries — Deirdre Brogan
   - B. Turtle-Fishery Interactions & Fishermen — Carolyn Robins

BREAK 10:00 – 10:30

10:30 – 12:30

8. Working Groups Continue....

LUNCH 12:30 – 14:00

14:00 – 15:30

9. Working Groups Continue....

BREAK 15:30 – 16:00

16:00 – 17:30

10. Working Groups Report — Team Captains

Day 3 – Thursday, February 7th

08:00

11. New Research/ Current Information
    - A. Papua New Guinea — Myriam Philip
    - B. Solomon Islands — John Pita
    - C. Malaysia – SEAFDEC — Kamarruddin Ibrahim
    - D. Malaysia – Sabah Turtle Islands Park — Paul Basintal
    - E. Papua – Jamurba-Medi, Bird's Peninsula — Creusa Hitipeuw

Day 3, Cont…

BREAK 10:00 – 10:30

- F. Thailand — Mickmin Charuchinda
- G. Taiwan — I-Jiunn Cheng
- H. Vietnam — Tran Minh Hien
- I. Palau — Theo Isamu
- J. Global Chelonian Assessment — Jeffrey Seminoff

LUNCH 12:30 – 14:00

14:00 – 15:20

12. Integrated Management
    - A. Philippine-Sabah Turtle Islands Experience — Joel Palma
    - B. Indian Ocean, Southeast Asian MoU — N. Pilcher/ D. Hykle
    - C. SPREP – Marine Turtle Conservation Program — Job Opu
    - D. U.S. ESA Sea Turtle Recovery Plans — Kathy Cousins

15:30 – 17:00 (or later)

13. Break into Working Groups... — Team Captains
    - i. Standardized Data Collection
    - ii. Regional Action Plans

Day 4 – Friday, February 8th

08:00 – 10:00

14. Working Groups Continue — Team Captains

BREAK 10:00 – 10:30

10:30 – 12:30

15. Working Groups Report — Team Captains
16. Priorities for Stocks in the Western Pacific — Colin Limpus

LUNCH 12:30 – 13:30

13:30

17. Summary of Action Items — Craig Moritz
18. Closing Statements — Kitty Simonds

Appendix II:
Workshop Participants

Chair	Craig Moritz, Ph.D. – University of California, Berkeley
Team Captains	Christofer Boggs, Milani Chaloupka, Peter Dutton, Scott Eckert, Mark Hamann, Colin Limpus, Nicolas Pilcher, Laura Sarti Martinez
Coordinator	Irene Kinan

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Appendix III:
WORKING GROUP REPORTS

Conservation Methods Working Group

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Any discussion of sea turtle conservation methods or activities must first consider the threats that conservation activities hope to mitigate. It is ineffective to apply conservation actions to symptoms; rather these actions must address root causes of population decline. Given this perception, the group chose to characterize the primary, or most serious threats to turtles in the region, and the conservation methods that are best applied to those threats.

Note: The following list and descriptions are not intended to be comprehensive, nor intended to describe in detail the conservation actions to be undertaken. Such information is readily available from other sources [e.g. K. L. Eckert, K. A. Bjorndal, F. A. Abreu-Grobois and M. Donnelly (eds.). 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.; and the six U.S. ESA Pacific Sea Turtle Recovery Plans].

GREEN TURTLES

Primary Threats

- Over-harvest of adults and eggs
- Scientific management of conservation programs are often jeopardized by political considerations

Primary threats - Green turtles	Conservation needs
Egg over-harvest	Implement control over harvests to sustainable levels (develop harvest models)
Over-harvest of turtles	Implement control over harvests to sustainable levels (develop harvest models)
Fisheries (e.g. trawls, gillnets,hook and line, longline fisheries, fish corral)	Mitigation (TED[1], tending gillnets and appropriate mesh size, handling techniques, time/area closures), new technology to reduce bycatch
Destructive fishing (explosives, poisons, others)	Enforcement and education
Data deficiencies (stock boundaries, stock size)	Identify nesting areas/key index areas, genetic stock identification research
Marine debris	Reduce sources of marine debris, enforce MARPOL[2] provisions internationally
Disease (fibropapilloma)	Research and monitoring in currently disease free areas

[1] *Turtle Exclusion Device*
[2] *The International Convention for the Prevention of Pollution from Ships*

LEATHERBACK TURTLES

Primary Threats

- The status of Western Pacific leatherback populations are poorly understood
- Over harvest of eggs
- Predation by feral animals (dogs and pigs)
- Mortality of leatherbacks in pelagic fisheries

High Priority Needs – Leatherback Turtles

- Establish key index nesting
- Establish standardized census or beach monitoring programs
- Standardized data recording

Primary threats – Leatherback turtles	Conservation needs
Egg over-harvest	Implement control over harvests to sustainable levels (develop harvest models)
Feral predation on nests	Control programs (poison baiting, fencing off nests), hatcheries
Low hatching success	Enhance hatching success rate (hatcheries, management of nesting grounds, relocation of eggs)
Fisheries (e.g. gillnets, longline fisheries)	Mitigation (tending gillnets and appropriate mesh size, handling techniques, time/area closures), new technology to reduce bycatch
Data deficiencies (stock boundaries, stock size)	Identify nesting areas/key index areas, genetic stock identification research
Marine debris	Reduce sources of marine debris, enforce MARPOL provisions internationally

HAWKSBILL TURTLES

Primary Threats

- Over-harvest of adults and eggs
- Distinct lack of understanding on population status in the region

High Priority Needs

- Establish annual surveys
- Identify key nesting index beaches

Primary threats – Hawksbill turtles	Conservation needs
Egg over-harvest	Implement control over harvests to sustainable levels (develop harvest models)
Over-harvest of turtles for tortoise shell and meat, ornaments	Implement control over harvests to sustainable levels (harvest models)
Fisheries (e.g. trawls, gillnets, hook and line, longline fisheries)	Mitigation (TEDs, tending gillnets and appropriate mesh size, handling techniques, time/area closures)
Coral reef destruction	Coral reef protection from anthropogenic effects and Marine Protected Areas
Data deficiencies (stock boundaries, stock size)	Identify nesting areas/key index areas, genetic stock identification research

LOGGERHEAD TURTLES

Primary Threats

- Low breeding populations: currently there are probably less than 2,000 loggerheads nesting annually throughout the entire Pacific
- Commercial fishery related bycatch:
  - Pelagic longline fisheries in the North Pacific
  - Prawn trawling in the coastal waters of Australia and Papua New Guinea
  - Subsurface pound nets in Japan
  - Coastal gill nets in Mexico (Baja, California)
- Coastal development

High Priority Needs

- Information on the high seas developmental habitats of the Australian stock
- Investigate possible mortality in the large longline fishing activities off South America

Primary threats – Loggerhead turtles	Conservation needs
Fisheries (e.g. trawls, gillnets, hook and line, longline fisheries)	Mitigation (TEDs, tending gillnets and appropriate mesh size, handling techniques, time/area closures)
Loss of nesting habitat	Protection of nesting habitat
Data deficiencies (stock boundaries, stock size)	Identify nesting areas/key index areas, genetic stock identification research

OLIVE RIDLEY TURTLES

- Eastern Pacific olive ridley stocks seem generally to be recovering, however, Western Pacific stocks warrant concern.

Primary threats – Olive Ridley Turtles	Conservation needs
Egg over-harvest	Implement control over harvests to sustainable levels (develop harvest models)
Over-harvest of turtles	Implement control over harvests to sustainable levels (develop harvest models)
Coastal fisheries (e.g. trawls, gillnets, hook and line, longline fisheries)	Mitigation (TEDs, tending gillnets and appropriate mesh size, handling techniques, time/area closures)
Data deficiencies (stock boundaries, stock size)	Identify nesting areas/key index areas, genetic stock identification research

COMMON THREATS AND ISSUES

Common threats (all species)	Solutions
Habitat degradation	Identify key/critical habitats, implement protection for habitats
Data deficiencies	Identify nesting areas/key index areas, genetic stock identification research
Lack of international collaboration and initiatives, and lack of resources and coordination	Development of international conservation initiatives and linkages to other regional bodies and commissions
Lack of education and public awareness	Raise awareness of the serious danger of regional loss of turtle populations
Loss of ecosystem function	Education and Marine Protected Areas

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The results from this working group suggest a lack in the overall reporting of community-based conservation programs and knowledge of the function of conservation groups in the region. The group identified a need for coordination in the Western Pacific Region so programs can collaborate and design appropriate education materials (based on target audience), distribute essential information to communities/programs in need, and design incentive programs for conservation for coastal communities. It was found that a comprehensive survey to inventory all community-based conservation initiatives is needed, as is information regarding the types of fisheries in the entire Pacific Region, with emphasis to those which potentially interact with sea turtles.

In regards to Communities:

- Coordinate the Western Pacific Region so programs can collaborate and design appropriate education materials (based on target audience), distribute essential information to communities/programs in need, and design incentive programs for conservation for coastal communities.
- A comprehensive survey to inventory all community-based conservation initiatives is needed. Existing organizations may be utilized and referenced and that such an agency (e.g. SPREP[1], SEAFDEC[2], ASEAN[3], or other) act as an umbrella agency for the implementation of recommendations. The inventory should include:
  - Establishment of a database of contacts
  - Create Summary profiles of programs/initiatives
  - Identify and prioritize program needs constant with the long-term conservation goals of the region
  - Coordinate community conservation activities with biological experts
  - Analysis of successes and failures of programs
  - Identification of gaps and program needs
  - Submit recommendations for implementation of community-based programs

In regards to fisheries/fishermen:

- Compile all information regarding the types of fisheries in the entire Pacific Region, with emphasis to those which potentially interact with sea turtles.
- Design educational video/written material for fishermen. Information should include:
  - Sea turtle biology, life history and migration
  - Information must be general
  - Information must be presented/produced in several languages (e.g. target audience)
  - Basic handling techniques (species identification, resuscitation, etc.)
- Promote cooperation of fishing industry in research by incorporating fishermen in the scientific effort. This should include information on:
  - How to collect essential information
  - Where/how the information is utilized (feedback)
  - Emphasis on the importance of logbooks (e.g. important for other species in addition to sea turtles).

[1] *South Pacific Regional Environment Programme*
[2] *Southeast Asian fisheries Development Center*
[3] *Association of Southeast Asian Nations*

Gaps In Research/Information Working Group

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This working group initially identified 103 gaps in information and/or research during their time together. Point being, had they had more time, the list would have continued to grow. From this list, the team captain directed the grouping and prioritization of items. Participants of this working group then took things one step further, and discussed methods to address these itemized gaps. For example, it was agreed upon that there exists a lack in information and data reporting. Thus the development of a web based database was discussed to facilitate the exchange of this information. The following 23 items is the list of solutions developed to address gaps in research and/or information.

- "Year of the Turtle 200?" - time to renew this theme from the SPREP 1995 Year of the Turtle campaign. An anniversary of the campaign could be used to "jump start" a series of activities including aerial surveys, satellite tracking, population census, community involvement/awareness, and other coordinated programs.

- Establish a web based Meta-database (a database of databases). Possibly coordinated/managed by the Council or another similar agency.

- Aerial surveys to assess undocumented nesting sites, followed by ground truthing (specifically for leatherback turtles, but also for other species).
- Genetic sampling as part of fishing vessel observer programs, integrated with tagging programs of sea turtles for all fishing fleets.

- Continued assessments of sea turtle take in pelagic fisheries.

- Continued efforts in development of by-catch mitigation methods.

- Captive rearing and release experiments using modern tagging technology.

- Satellite tracking program expanded across sites. Emphasis in the Central Pacific (Fiji, Vanuatu, New Caledonia, Solomon Islands) to identify foraging areas and migratory routes to foraging habitats.

- Radio-telemetry programs to identify foraging grounds and habitat usage.

- Funding sources to support local economic alternatives to sea turtle products.

- Human population forecasts to assess potential impact on local sea turtle stocks.

- Enhanced capacity building in:
  - capture-mark-recapture programs for demographic parameter estimation
  - methodology for age estimation
  - laparoscopy, ultrasound - gonad interpretation
  - sampling methodologies (genetics, census surveys, biological parameters)
  - necropsy

Regional Action Plans Working Group

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The Regional Action Plans Working Group looked at three broad areas: the U.S. Sea Turtle Recovery Plans, communication linkages, and institutional strengthening.

In regards to "U.S. ESA Sea Turtle Recovery Plans[4]":

- Support the implementation of recovery plans in the Western Pacific Region, such as funding reports on implementation of the Recovery Plan actions by contacting lead agencies (i.e., U.S. Fish and Wildlife Service, U.S. Department of State, and the National Marine Fisheries Service) to request that funding be disbursed to individual Departments and/or action be taken to implement the Recovery Plans.
- Convene one or more international workshops on the U.S. Recovery Plans, their implementation progress, and identifying mechanisms through which other countries could participate or develop similar plans, or contribute in any way towards the common goal. Highlight enforcement options and promote implementation of enforcement actions, and update and clarify how agencies can implement the Recovery Plans.

In regards to "Improving Communication Linkages":

- Facilitate the exchange of information (meta-database). To include people working in the field, programs in place, and legal instruments:
  - Take stock of what happens beyond SPREP: Determine what programs exist, to what level they are being implemented, and identify gaps in where programs are needed.
  - Develop information packets for nations and managers on turtle programs, international instruments, research, and general info on IOSEA MoU[5] and RMTCP[6].
  - Facilitate flow of critical information, ensuring Secretariats disseminate information in a timely manner (possibly through web list serves such as www.indonesiaturtles, *Cturtle*[7], and others).
  - Assist with website development and maintenance, uploading of information from other programs within the region, and disseminate short notes as to the presence of the data, and/or media releases.
  - Identify stakeholders and different levels of government and involve them in implementation of sea turtle conservation measures.
  - Develop two-way communication between the sea turtle community and other projects, bodies, and fisheries (e.g. U.S., Japanese, Chinese, Taiwanese, Korean etc. fleets).
  - Coordinate development and monitoring of Marine Protected Areas (MPAs) which have sea turtles and their habitats as a key target components, possibly through coordination with existing coral reef initiatives.
  - Convene workshops on by-catch mitigation methods and other technology.

Note: Caution in relying on an individual person to facilitate data exchange – ensure there is either a range of people or an institutional position to ensure longevity of the program

[4] *Recovery Plans are required for all species listed under the U.S. Endangered Species Act.*
[5] *Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia.*
[6] *SPREP's Regional Marine Turtle Conservation Program*
[7] *The Archie Carr Center for Sea Turtle Research at the University of Florida*

In regards to "Institutional Strengthening":

- There is a need to:
  - Assess the needs of and mechanisms for institutional strengthening for the community, country and regional levels.
  - Identify the linkages between the Western Pacific and adjacent regions.
  - Set realistic targets of what can actually be accomplished in a pre-determined period of time at a National level.
  - Identify performance indicators within and among regional instruments.
  - Identify research projects which can act as a rallying point so all members can focus attention on turtles (e.g. stock movements, pelagic phases, habitat use).

- Support capacity building by providing access to scholarships for local post-doctoral, doctoral or master students to carry out studies (anthropological surveys, scientific/genetic approach, etc.). This will require promoting sea turtle research and conservation studies as national priorities.

Standardized Data Collection Methods Working Groups

The "Standardized Data Collection" working groups were designed for the benefit of workshop participants to coordinate research activities and data collection methods in their respective programs. The focus was not specifically on the development of "action items," but to discuss technical and scientific issues and build consensus on standardized methods of data collection. Experts in the field of Aquatic research and nesting habitats led discussions.

Standardized Methods: Beaches Working Group

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There is a wealth of material (publications, manuals, video footage) on techniques used for conservation and research of sea turtles on nesting beaches. There is a need, however, for dissemination of material and more importantly in-country, hands-on approach to ensure standardization of different techniques to promote uniform data collection and reciprocal exchange of information within the region. This working group was used as a forum for discussion on technical issues/questions/problems and exchange of experiences and information regarding use of techniques. Discussion focused on the following specific topics:

- Stock assessments in the Western Pacific is a major "gap" in research:
  - Document techniques and strategies utilized by various programs to assess nesting stocks and biological parameters.
    - ~ Establishing index sites for intense monitoring effective to:
      - » Establish biological parameters (such as clutch frequency and hatchling success)
      - » Periodic ground surveys to count nests
      - » Aerial surveys to identify undocumented nesting beaches and record levels of nesting activities for the regional stocks.
  - Genetic sampling should be incorporated into routine nesting monitoring protocols; genetic studies and telemetry used in conjunction with tagging can be used to determine stock boundaries in order to designate representative index beaches.

- Census data exchanged for Papua New Guinea leatherback turtles and East Pacific leatherback turtles to establish a regional strategy for future nesting monitoring.

- Hatcheries: advantages and disadvantages, techniques for different species. The importance of determining and using *in-situ* nest protocol for hatching and sex ratio hatchling success.
  - Hatcheries most valuable where poaching and predation is high.

- Tagging: an extensive discussion was held on advantages and disadvantages of tagging, and technical questions were addressed.
  - Need for each program to identify objectives of tagging effort (e.g. long-term, short-term, etc.) and cost-effectiveness, logistical feasibility in order to design appropriate approach, tag type, tag technique, or whether to do tagging at all.
  - Recommended standard for leatherback turtles is to place flipper tags on rear flippers.
  - Use of Passive Integrated Transponders (PIT) recommended for a long-term durable internal tag in combination with metal flipper tags. Potential problems with PITs were discussed. General reasons for PIT "loss" were attributed mainly due to:
    - ~ Poor scanning technique (PIT is there, but not detected properly). Adequate training is important.
    - ~ Scanner malfunction. Commonly due to low battery (scanner functions, but power too low to efficiently detect PIT).
    - ~ Incompatibility of equipment (encrypted tags not detected by different manufacturer)
    - ~ Failure to insert PIT correctly (e.g. PIT falls out of needle before insertion)
    - ~ Malfunction of PIT (rare, but has been observed).

- Other techniques applicable to nesting beaches were discussed.
  - Genetic sampling (blood, tissue)
  - Necropsy
  - Laparoscopy
  - Hatchery design

Further Reading:

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, 235 pp.

Standardized Methods: Aquatic Habitats Working Group

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Sea turtles spend over 99% of their lives at sea and are important components of a healthy marine ecosystem. To understand the demographics of an entire sea turtle population, including males and juveniles, research must be done in aquatic and foraging habitats. Moreover, knowledge of the aquatic demographics is essential for understanding population status, and for improving response time where populations are declining.

Why do we need to understand aquatic habitats?

- Sea turtles spend most of their lives in the sea.
- Sea turtles are important participants of a healthy marine ecosystem.
  - Hawksbill turtles - spongivore: maintain coral/sponge balance in reef ecosystems
  - Green turtles - herbivores maintain coral/algae balance, and stimulate healthy seagrass meadows
  - Leatherback turtles - Top predators of cnidarans (i.e. jelly fish).
- To understand population status.
- To improve reaction time to respond to declining populations.

What is important/essential to studying aquatic habitats?

- Understanding how habitats are utilized by sea turtles:
  - Foraging
  - Transit
  - Refugia
  - Inter-nesting
  - Resting (e.g. back reef areas for green turtles)

Why are these habitats important and what factors are important in these habitats?

- Food quality and quantity
- Water quality/temperature
- Refuge
- Isolation
- Depth

How do we determine habitat use by sea turtles?

- Sample the foraging population:
  - Mark/Identify
    - ~ Tagging
    - ~ DNA identification
  - Aerial Surveys: to identify "hotspots." Critical factor: "observability" (e.g. how well turtles are found will dictate survey design)
  - Aquatic Surveys: critical factor is survey design

Techniques:

- Instruments - what they can tell us and how do they work?
  - Satellite tags; radio tags; Time Depth Recorders (TDR's)
    - ~ Drag effect vs. swimming efficiency needs to be considered

- Capturing turtles:
  - Netting: types and how to work them
  - Lavage and other means to understand feeding/foraging

Data Analysis:

- GIS and mapping systems
- Home range and habitat use analysis
  - Kernal method, or Minimum Convex Polygon (MCP)
- Argos: how to process and understand Argos data

Further Reading:

Nat Fraser. 2001. Management and Conservation Goals for Marine Turtles. In: Marine Turtle Conservation in the Wider Caribbean Region: A Dialogue for Effective Regional Management. MTSG 2001. pp 69.

Involving Fishermen in Research

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This working group considered the research opportunities arising from fishery interactions as well as the need for mitigation. Fishermen should be integrated into the research effort, and tagging programs should be developed that include fishermen to gather information on population size and high-sea demographic structure. Experience has shown that fishermen can been instrumental in developing successful mitigation measures and should be actively encouraged to develop their own sea turtle mitigation measures. In addition, incentives for fishermen to report sea turtle interactions should be explored to obtain better reporting of interactions, without the risk of prejudicial retribution.

- Primary sources of fishing mortality identified (e.g. threats):
  - Purse seines. Fishing around Fishery Aggregation Devices (FADs) with purse seines catches sea turtles, mostly alive and in excellent condition. The mortality risk is turtles dropping on deck and cracking carapace, or being eaten by the crew. With correct handling and motivation by the crew, sea turtles can be returned to sea alive almost 100% of time. Removal from the nets is already a crew priority because turtles passing through the power block will break machinery. Guidelines on handling purse seine caught turtles have been developed for the ETPO[8]. These could be adapted and disseminated to purse seiners in the WCPO[9].

  - Gillnets. Driftnetting on the high seas has ceased, although there are still drift nets used in EEZs that may be serious sources of continued mortality. The banning of high seas gear a decade ago may soon result in the appearance of more sea turtles at nesting beaches (if there has been a lag effect on the turtle populations resulting from drift net mortality). Inshore, small-scale gill nets may be a problem for hardshell species in some areas, but in EEZs drift gillnetting can hit turtles badly, especially leatherback turtles. Some data indicate 80% of drift net caught turtles die.
  - Fish traps. Buoy lines for fish traps kill turtles in Australia and elsewhere. Buoyed, bottom-weighted ropes form loops which catch turtles, as documented in Western Australia and Tasmanian fisheries.
  - Recreational angling. Recreational anglers catch of sea turtles in Hawaii, along the U.S. Gulf and Atlantic coast, and probably around the world. Lines can tangle or hook turtles. Probable cumulative large impact to sea turtles and the least well recognized source of mortality.

  - Longline fishing. Longline impacts on turtles by changing depth of sets, and night versus day sets needs to be assessed. The majority of the longline effort in the Pacific stems from Japanese, Taiwanese, and Korean fleets, plus expanding fleets in other Pacific Islands and southeastern Asian countries. More logbook and observer data on the style of longline fishing is needed. Principle question is how many sea turtles are caught by longliners in Pacific? The Secretariat of the Pacific Community (SPC) study suggests relatively low interaction rates. High-end estimates about 0.1 turtles/1,000 hooks for

[8] *European Trade Promotion Organization*
[9] *Western Central Pacific Ocean*

Asian fleets would indicate interactions of between 12,000-20,000 per year. Important to note that these numbers represent catches and not mortalities.
- Other gears. A wide variety of other gear types used mostly in coastal waters, at shallow fishing depths, where turtles have a good chance of survival, but where many cultures are eager to consume the turtles, which might otherwise be released alive. This can be a problem in longline fisheries as well.

• Accurate level of sea turtle catch in central and western Pacific must be assessed (e.g. high priority needs):
- Increased observer deployment on fishing vessels
- Estimates of population size so that numbers caught and/or killed can be expressed in terms of population size to determine impacts
- Tagging and genetic sampling to be done by fishermen
- Need to disseminate pole biopsy instrumentation for large turtles that cannot be landed on board
- Population size and stock boundaries are essential to determine impacts of fishery takes/mortalities
- Quantify fishing hooks (size/shape/type) to mortality
- Develop de-hooking and hook cutting devices
- Bring turtle by-catch to the attention of the Forum Fisheries Committee and the Purse Seine Treaty consultation

• Integrating fishermen in the research effort:
- Develop tagging programs that include fishermen (to gather population size and structure)
- Additional information that fishermen can collect include:
  ~ Sex and size measurements
  ~ Photographs for identification
- Encourage fishermen to develop their own turtle mitigation measures. Note the success of seabird mitigation measures developed by fishermen: tori lines, blue-dyed bait, strategic offal discards, and TEDs.

• Incentives for fishermen to report sea turtle interactions:
- Education and outreach programs
- Feedback to fishermen concerning interactions
- Provide good outreach material to fishermen
- Port presence and port sampling (retired fishermen may be good to use as port samplers)
- Gifts such as hats, shirts and mugs to promote goodwill and interest
- Monetary incentives (cash awards)

• Methods to study fishery induced mortality: (methods currently under debate)
- Pop-up satellite tags
- Conventional tags
- Satellite tagging

• Mitigation methods:
- Degradable hooks versus standard hooks
• What lessons have been learned by the TED importation embargo on commercial shrimp fisheries?
- TEDs resulted in a catch improvement by removing large objects (by-catch) from shrimp trawls which crushed shrimps in the trawl cod end. CSIRO[10] study comparing U.S. versus Australia on TEDs.

General Consensus by all Working Groups

(not prioritized)

• Greatest information gaps occur in stock assessments and in aquatic habitats (especially in the Central and Southern Pacific Region).

• Primary source of mortality and threat to sea turtles is by harvest of adults and eggs.

• Promote international efforts to get fishermen involved to tag turtles, and collect genetic samples, by-catch and high seas stock information.

• Incidental by-catch must be quantified in all fisheries that impact sea turtles.

• A lack exists in the overall reporting of information.

• Indigenous cultural harvest must be quantified.

• Aerial surveys are needed to assess undocumented nesting sites for leatherbacks.

• A central database (Meta DBMS) or website is needed for the Pacific Region.

• Satellite tracking projects to be expanded.

• U.S. ESA Recovery Plans need to be implemented and task progress assessed.

• Coordination is needed in the Western Pacific Region to facilitate the exchange of information and collaboration between programs (especially in regards to community conservation programs).

• Convene technical workshop related to by-catch mitigation, research methodologies (standardized techniques), and community conservation.

• "In kind" and monetary support for programs in need.

[10] *Commonwealth of Scientific and Industrial Research Organization*

Appendix IV:
Supplemental Papers

Rapidly Approaching Extinction: Sea Turtles in the Central South Pacific

Dr. Peter Craig

INTRODUCTION

Hawksbill and green sea turtle populations in the central South Pacific are in jeopardy. The 1998 Recovery Plan Team (RPT) for the Pacific found that hawksbills are "rapidly approaching extinction" (NMFS and USFWS 1998). The RPT was surprised and appalled at how few hawksbills are left in areas of once-high abundance. They concluded that the status of this species is clearly of the highest concern for the Pacific and it was recommended that immediate actions be taken to prevent its extinction. The RPT further found that green turtles in the Pacific (outside Hawaii) have seriously declined and should probably be classified as 'endangered' rather than 'threatened'.

Given this dire outlook, what do we know about sea turtles in the central South Pacific? Although the general answer is 'very little', this paper summarizes some relatively new migration data, and identifies two threats that are increasing in intensity.

Interconnected Islands

It is well established that sea turtles migrate between nesting and feeding areas, often separated by large distances, but such information in the South Pacific is rudimentary because the region is geographically large and contains thousands of islands. For post-nesting green turtles, fin-clip tagging data reveal extensive migrations across the South Pacific (Fig. 1).

More recent studies by NMFS (G. Balazs) and the Dept. Marine & Wildlife Resources (American Samoa) used satellite telemetry to track post-nesting greens at Rose Atoll in American Samoa. Six turtles migrated directly to Fiji, while another migrated in the opposite direction to French Polynesia (Fig 2.). These data indicate important linkages between Fiji, American Samoa and French Polynesia. An additional green turtle was tracked from the Cook Islands to Fiji in 2000 (G. Balazs, pers. comm.).

For those turtles tagged in the central South Pacific (i.e., French Polynesia, Cooks, American Samoa), 96% of the 26 recovered turtles migrated westward after nesting, which suggests a common pattern of turtle utilization of the region. Over half of these turtles (62%) were recovered in Fiji. It may be that islands to the east of Fiji lack significant quantities of seagrass for the green turtles to eat, so the turtles return after nesting to areas like Fiji which have major seagrass beds.

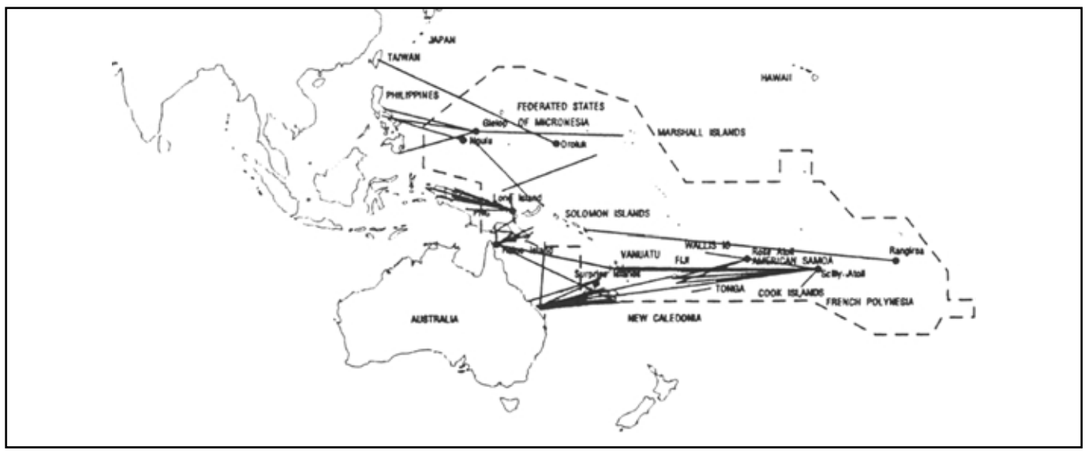

Figure 1. *Recapture locations of tagged green turtles(SPREP 1993).*

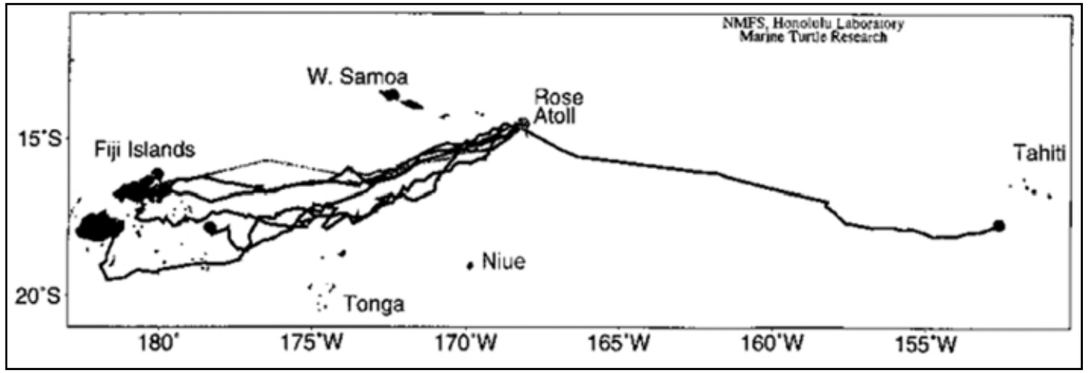

Figure 2. *Migration routes of seven green turtles after nesting at Rose Atoll.*

As clearly illustrated by these migration patterns where turtles nest in one country and feed in another, recovery efforts are politically complex, but it is essential to bridge the gap between countries dealing with the same stock of turtles. A coordinated research and recovery plan is needed that encompasses both endpoints of the turtles' migration. For hawksbills, limited information on local movements is available (e.g., Grant *et al.* 1995, Utzurrum pers. comm.), but migration patterns in the region are unknown.

INCREASING THREATS

As outlined in the Recovery Plan, there are many threats to sea turtle populations in the Pacific region, but direct and indirect impacts by humans (e.g. harvest of turtles and eggs, bycatch in fisheries) are among the most serious problems.

Expanding Human Population

It appears likely that human population pressure on the environment will continue to increase due to the rapid human growth occurring across the South Pacific (Craig 1995). For example, American Samoa is currently growing at an annual rate of 2.1%, which means that about 1,200 additional people are added to their small islands each year (Fig. 3; Craig *et al.* 2000).

A similar increase is projected for the Pacific region as a whole (Melanesia, Micronesia, Polynesia), despite emigration and projected declines in growth rate (SPC, 2000). The Pacific population of about 7.1 million people in 1998 is expected to double over the next 50 years (Fig. 4). That amounts to approximately 170,000 additional people per year in the region.

Figure 3. *Human population growth in American Samoa.*

Figure 4. *Population projection for the Pacific region (SPC, 2000).*

Because most Pacific islands are small and have limited natural resources, it seems probable that human growth pressures will translate into increased impacts to turtles, both directly (subsistence harvest) and indirectly (removal of turtle nesting habitats by coastal development and sand mining, bycatch in fisheries).

Bycatch in longline fishery

A new issue in American Samoa is the potential bycatch of turtles in the developing longline fishery for pelagic fishes, primarily albacore. Pelagic catches have increased rapidly in the past several years (Fig. 5). Turtles have been caught on this longline gear, but the rate of turtle bycatch is not known. While this fishery may seem small and localized, it still represents about 9,000,000 hooks being set annually around the islands (WPRFMC 2001). Given that hawksbills are "rapidly approaching extinction", it is important to quantify what impact this fishery is having on endangered sea turtles.

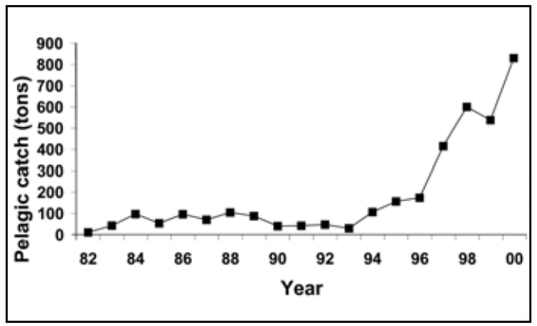

Figure 5. *Longline catches in A. Samoa (WPRFMC, 2000)*

REGIONAL NEEDS

In addition to the information needs outlined in the Recovery Plan, such as the need to collect basic biological data on turtles in the region and the need to improve public awareness of turtle conservation issues, several additional considerations are:

- **Regional plans.** It is essential to develop a coordinated research and conservation plan that directly connects the island countries that manage the same stock of turtles along different points of the turtle's migratory pathway.
- **Protection of Fiji's seagrass beds.** Fiji's seagrass beds are a regionally significant resource for green sea turtles that may well be providing foraging habitat for over half of the adult greens in the central South Pacific. These foraging areas should be delineated and protected.
- **Bycatch.** Given the endangered status of sea turtles in the region, their bycatch and mortality rates in South Pacific fisheries needs to be quantified.
- **Satellite telemetry studies.** Satellite telemetry has proven to be a highly successful means to collect valuable data that appeal to scientists, managers and the public. This technique convincingly links islands that share the same turtle stocks because the exact migration pathway can be seen, and the technique lends itself to publicity opportunities (see 'turtle contest' example). A 10-year program should be implemented whereby a team would tag 3 turtles each year in a different South Pacific country.
- **Coral Reef Initiative (CRI).** The national and international CRI process, which is a high-profile and funded effort to protect coral reef ecosystems in the US and worldwide, largely overlooks the role of sea turtles as a component of the coral reef ecosystem (which is broadly defined to include seagrass areas). This should be remedied. Similarly, turtle nesting and foraging areas need to be considered when designating 20% of US coral reefs as Marine Protected Areas, as recommended by the President's Coral Reef Task Force.
- **Recovery Plans.** The 1998 U.S. ESA Recovery Plans need to be implemented.

LITERATURE CITED

Craig P. 1995. Are tropical near shore fisheries manageable in view of projected population increases? Biol. Pap. 1. In Proc S Pac Comm-Forum Fish Agency regional inshore management workshop. New Caledonia.

Craig P, and 14 co-authors. 2000. Impacts of rapid population growth in American Samoa: a call for action. Rept. by Governor's Task Force on Population Growth. Pago Pago, American Samoa. 30p.

Grant G, P Craig, G Balazs. 1997. Notes on juvenile hawksbill & green turtles in A. Samoa. Pac. Sci. 51:48-53.

NMFS and USFWS (National Marine Fisheries Service and US Fish and Wildlife Service). 1998. Recovery plans for the US Pacific populations of the hawksbill *(Eretmochelys imbricata)* and green turtles *(Chelonia mydas)*. NMFS, Silver Spring, MD.

SPC (Secretariat of the Pacific Community). 2000. 6 billion people. Demography/Population Programme, Secretariat of the Pacific Community, New Caledonia. 20p. (www.spc.int/demog/)

SPREP (South Pacific Regional Environmental Programme). 1993. Report of the 3rd meeting of the Regional Marine Turtle Conservation Programme. Apia, Samoa.

WPRFMC (Western Pacific Regional Fishery Management Council). 2001. Press Release.

WPRFMC (Western Pacific Regional Fishery Management Council). 2002. Pelagic Fisheries of the Western Pacific Region: 2000 Annual Report. (in press).

Sea Turtle Recovery Plan for the CNMI

Richard Seman

The Division of Fish and Wildlife (DFW) under the Department of Lands and Natural Resources (DLNR) is the government agency tasked with the responsibility to conserve, develop, manage, and protect the wildlife and fishery resources of the Commonwealth of the Northern Mariana Islands (CNMI). As such, DFW has been performing the following tasks for the protection of sea turtles within its waters.

- **Year-round monitoring of nesting sites:** the division's law enforcement unit conduct routine patrol of the islands shoreline areas and are always on the lookout for possible nesting at known nesting sites. Whenever a nesting is discovered, the division's turtle coordinator is immediately informed. The coordinator is then required to conduct night monitoring throughout the nesting period;

- **Shoreline Assessment:** DFW has performed three comprehensive shoreline assessments of sea turtles during the last two years. With the assistance of NMFS, DFW personnel have completed assessments on the islands of Rota, Tinian, and Saipan. The division is now gearing up to conduct additional assessments in the other remote northern islands. Preliminary findings indicated that there are an estimated 1000 to 2000 sea turtles foraging in the assessed islands.

- **Enforcement Actions:** DFW continues to strengthen its enforcement program by increasing and expanding its monitoring and patrolling activities. In addition, the enforcement unit is receiving effective enforcement training and equipment. In addition, adequate funding has been identified for the procurement of a 22' enforcement vessel that will be utilized in its monitoring efforts.

- **Public Education and Outreach Program:** the division has a dedicated staff responsible for the development and dissemination of relevant information to the general public. However, the division has been focusing most of its efforts toward the primary and secondary schools throughout the Commonwealth. The division conducts at least 2 school visitations each week on a regular basis. The division normally brings mounted turtles, confiscated turtle jewelry, posters, and brochures during these visitations. The division has also conducted presentations on other local environmental workshops, garment factory orientations, and other social events.

In one of our more critical issues, the division has taken an active role in pursuing the special request of the indigenous Carolinians for the limited harvest of sea turtles for cultural and religious purpose. The re-establishment of the value of sea turtles to its younger generations will bring respect to the species, which in turn will have significant conservation advantages. Knowing the cultural value of sea turtles will positively discourage indiscriminate harvest.

The Carolinian Culture with Sea Turtles In the Northern Mariana Islands

Larry Ilo

PREFACE

The Saipanese Carolinians of the Commonwealth of the Northern Mariana Islands (CNMI) migrated from the outer islands of Yap and Chuuk states in the Federated States of Micronesia. It is difficult to unravel all aspects of the Carolinian culture regarding sea turtles because many of the elders have died and have buried valuable information with them.

However, there did exist a Carolinian cultural practice regarding the harvest of sea turtles, which continued to the early 1970s. The re-opening of the traditional navigation system from the island of Yap to Saipan by traditional navigator, Repanglug and his brothers, has prompted the need to reopen traditional sea turtle harvest. This traditional navigation of the canoe was further expanded when another famous traditional navigator, Mao Piailug[1], came to Saipan bringing with him a sea turtle for the annual San Isidro Fiesta.

The Carolinian sea turtle harvest ceased when the Northern Mariana Islands became a U.S. commonwealth in 1978 and federal statutes, such as the Endangered Species Act, became applicable. As a result, it has tremendously affected the Carolinians sea turtle traditional harvesting practices. Carolinians in the Commonwealth of the Northern Mariana Islands have been trying for many years to preserve their culture with the sea turtle, and have urged the federal government to be considerate and re-instate this cultural practice.

THE CAROLINIANS

The Carolinians in the CNMI, who live predominantly on Saipan, consider themselves experts and knowledgeable in the traditional or unconventional navigation practice. Unfortunately, they are having difficulties to exercise their skills due to the application of federal prohibitions. Carolinians sailing inter-island and in the open ocean using solar bodies in the sky, wind, ocean swells and ocean currents for navigation. A life at and of the sea has made the Carolinian people dependent on ocean resources for their survival. Sea turtles are one of those ocean resources that have become a source for subsistence. Some Carolinians believe that young men have become handicapped in knowledge regarding sea turtles because training and traditional education is no longer being offered to teach them how to harvest and thus preserve the species for continual multiplication and future use.

Unlike land resources where cultivation and harvest can be claimed as individual ownership, Carolinians do not recognize ownership of marine resources; such as sea turtles. However, Carolinians in their own traditional governance administer seasonal harvesting of sea turtle for ceremonial feasts.

The Carolinians would like to reiterate their request to the federal government for the legal harvest of at least five turtles per year for cultural events. Cultural functions that are practiced with sea turtles include:

1. **Wedding Ceremonial—** This infers traditional marriage and religious marriage incorporating cultural practice with a sea turtle recipe.
2. "**Pwo**" **Ceremonial—** Reflects the installation of a traditional navigator called "Paliw" that has completed all traditional navigational skills on land and at sea sailing a canoe by himself using non-conventional instruments.
3. **Special Ceremony—** This infers a cultural event for occasional visit from other important places.

SEA TURTLE USE

Green sea turtles and hawksbill turtle occur at CNMI. The traditional use of these species includes:

- Hawksbill Turtle, "Wongemaaw" — The Carolinians rarely eat this because of strong and intolerable odors and that some have gotten sick from the consumption

[1] *Mao Piailug is renown for his special assistance in the reestablishment of the Hawaiian traditional navigation system by navigating the Hawaiian sailing canoe, "Hukalea," from French Polynesia to Hawaii and other Pacific islands*

of this particular turtle. However, because of its carapace thickness and strength, it is used for jewelry "schowar"shield, and fishing. It is also used during burial ceremonies.

- Green Turtle, "Wongemangusch Mool". — The green turtle is referred to as Wongemangusch Mool because of its fragile scutes. The green turtle is used in most cultural harvest and consumption.

Turtle Eggs

Turtle eggs are also important in cultural practice. The eggs of a green sea turtle are reserved for children, infants, elders, and the sick to provide additional nourishment and potency. There is a strong belief that eggs cure some illnesses.

Sea Turtle Ceremonial Dish

Carolinians have a unique method to prepare sea turtles for the ceremonial meal. A Carolinian chief is always served first during any ceremonial gatherings. The sea turtle carapace is the container used to cook and serve the food. In the carapace, mixtures of meat, fat and intestinal parts along with the blood is placed on the fire and prepared as a stew or "sapiyéér towlap." A separate dish is prepared for the remainder of the participants in the ceremony. Visitors are welcomed to join in.

Steps in preparing ceremonial sea turtle dish include:

1. A pit is dug on the beach or any designated site just big enough to prevent the turtle carapace from tipping over when it starts boiling and cooking.
2. The front and hind flippers are removed and the blood is collected and passed around for people to drink. Carolinian cultural belief that the blood of the sea turtle bonds two human beings and purifies their souls. After the removal of front and hind flippers, the sea turtle carapace is filled with intestinal parts, meat and fat and placed into the pit.
3. The top of the sea turtle carapace is covered with palm leaves, and burnable materials that are added to create more heat to cook the entire contents of the carapace.
4. After this steaming process, the turtle is opened and the contents of the carapace are carefully removed. At this time, the contents are ready to be served.

Sea Turtles and Healing Remedies

The use of sea turtles in Carolinian cultural healing dates back to the days of early migration to the Marianas by the ancestors. These oral histories regarding sea turtle healing remedies have been taught from generation to generation. Prior to 1976, healing practices were not written, but learned orally.

One healing remedy, which utilizes turtles, involves cooking preparation. During a feast, after the removal of the edible contents of the carapace, the remaining bottom settlements, the "Schalulpal Wong," is scooped up and served to sick individuals with asthma problem. Fat from a turtle is also used as a traditional healing remedy. Turtle fat is used to make oil (tikka) similar to coconut oil. This oil in turn is applied to scratches, minor wounds, and injuries from a broken bone, bone dislocation, or muscle pain.

CONSERVATION

Carolinians understand that harvesting sea turtles, as a resource would be based only on consumption needs, as over harvesting would only result in stock depletion. One common method of conservation is harvesting at different locations to allow restocking. The Carolinian term "Pilipil" (harvesting nesting turtles on land) is believed to be the best conservation method because it deals only with those that crawled up to nest and occurs only during seasons. However, most researchers have concluded that this may not be the best conservation method as it reduces the numbers of mature turtles that are contributing to the population growth.

CONCLUSION

Sea turtle harvest and egg poaching will remain a problem throughout the Marianas. Since sea turtles, which forage in the CNMI area are a shared resource with other western regions in the Pacific, dealing with these problems will require tremendous effort.

Due to the restrictive regulations in the CNMI, cultural traditions are no longer practiced openly and this has created a lack of understanding among the younger Carolinians. It is critical that a limited take of sea turtles be permitted so that younger generations are able to understand the special and unique aspect of the sea turtles to their culture. By reestablishing the cultural use of sea turtles, the Carolinian community believes that greater respect of the species achieved.

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The Marine Turtles of Mexico: An Update

René Márquez-M.[1], Miguel A. Carrasco-A. and María del C. Jiménez

INTRODUCTION

Marine turtles have been a traditional food for coastal villagers in tropical and sub-tropical regions throughout the world. When the use of turtles was for subsistence purposes, population balances remained constant. However, the problem for some species began when by-products of commercial exploitation were dedicated for export (Márquez, 1996).

In Mexico, turtles have been used since pre-Spaniard time, but during the decade of the 1950's they became a domestic resource for many communities (Márquez, 1996). Starting in the mid 1960's, the exploitation of some species was increased to such a degree that by 1968 Mexico alone contributed more than 80% of the total production to the world market (nearly 14,500 tons). This trade was mainly of *Lepidochelys olivacea* (olive ridleys). This level of exploitation was not sustainable and stocks collapsed. By 1971-1972, a moratorium of harvest was decreed. In 1973 the capture reopened, but for exclusive quotas. Unfortunately, these regulations were not enforced, illegal exploitation continued, and populations continued to diminish. In consequence, by June 1, 1990 a total ban was decreed for all turtle species in Mexico (DOF, 1990). This ban continues to the present day.

Marine turtles in all developmental phases are vulnerable to natural predation and direct commercial capture. They are caught incidentally during fishery activities and are affected by environmental deterioration caused by tourist, urban development, highway construction, industrial waste, garbage and debris.

THE NATIONAL PROGRAM

The first official marine turtle activities (in 1962) were field surveys of fishing ports and nesting beaches carried out by researchers of the Instituto Nacional de Investigación Biológico Pesquera (Solórzano, 1963). In 1963, work started at the "Centro Quelonicultor", of Isla Mujeres, Quintana Roo, Mexico. Green sea turtle, *Chelonia mydas*, eggs were collected and incubated in an artificial beach setting. At the time, these turtles were part of a fishery export to Florida, USA (Márquez, 1994). In 1964, the "Section of Herpetology" was established and investigations were formalized. By 1966, the "Program of Investigation, Conservation and Tagging of Marine Turtles" was organized and turtle camps were initiated.

Since 1966, marine turtle conservation activities have increased by the National Fisheries Institute (INP) and by 1978 marine turtles were included in the Bi-National Program MEXUS-Gulf, receiving support of the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). During the 1980's, the Mexican State Universities, governmental entities and NGO's joined efforts and assisted in the recovery of turtle species. Fishermen also played an important role in project development and conservation of the species. Currently, more than 40 turtle camps are established every year (Briceño-D. and Abreu-G., 1994; Márquez-M., 1996).

Between 2001 and 2006, research activities and beach protection (turtle camps) that were once carried out by INP, will pass to the Environment Secretary and Natural Resources (SEMARNAT). However, the turtle camps are currently directed by the Direction of Wildlife, and there is some discrepancy as to who will conduct future research investigations. The National Program (up to 2001) defines the following topics for turtle conservation:

1. **Investigation and conservation –** To be carried out at the fishing ports, feeding and breeding grounds, and establishment of turtle camps at the most important beaches. Initially the turtle camps were created for beach protection, but have developed to collect baseline biological information. Information collected includes: the number of spawned nests to evaluate population size; nesting frequency; hatchling survival; natural predation; and mortality due to nest poaching.

[1] *Submitting author*

2. **Tagging –** Tagging turtles began in 1966 with stainless steel tags. To date, more than 100,000 tags have been applied. As of 1980, electronic "PIT-tags" have been used in the Kemp´s ridley, *Lepidochelys kempi*, and more recently in the leatherback, Dermochelys coriacea. Supported by the joint program between México and the United States, the use of pit-tags has helped to define and evaluate tag loss (an important factor in calculating fecundity, nesting frequency and mortality). In addition, tracking sea turtles by satellite, radio tags and recently with magnetic wire (Kemp´s ridley hatchlings) has helped to identify the migratory characteristics and geographical distribution of nesting populations.

3. **Captive rearing –** In most countries, "confinement with conservationist interest" is utilized. However, it is understood that the retention of hatchlings for one or two weeks does not improve its capacity for survival. Hatchlings retained for exhibition purposes, are frequently the weak or sick. Captive rearing activities are recommended only when it is a part of a clearly defined program, with a solid budget backing.

4. **Education** - Parallel to the previous tasks, education activities are developed for the coastal communities. Scientists and camp technicians provide lectures on conservation work, show videos, and involve students in competition drawings and games. Frequently, primary school students are invited to take part during the releasing of hatchlings. Universities and social societies take part in conservation work, and organizing brigades to visit communities of the region to promote active participation in conservation programs. In many cases, communities that depended on the exploitation of marine turtles are presented with alternative occupations to increase their economic revenues without further exploitation of turtles.

Government campaigns are promoted at the national level directed towards the elimination of egg consumption and derived turtle products. Campaigns try to raise public conscience about the necessity of protecting these species. These campaigns are carried out using mass communication like: news papers, radio, television, cinema, direct chats to fishermen, exhibitions in fairs, museums, and aquariums. In addition, environmental education projects are developed for university students, societies and the State fisheries offices. Every year, the "Inter-University Meeting" is organized where research and investigation advances, and conservation and education are presented.

5. **By-catch** - The Turtle Program intervenes in meetings and discussions, and gives opinions on regulations for the use of the TED's (turtle excluder devises), in particular during "appropriate use" training sessions. The shrimp fishery is one of the least selective fisheries, approximately for each ton of captured shrimp nine other species are extracted, of which 80 to 90% are considered commercially worthless. Inside this catch can be: marine turtles, snappers, groupers, shads, sardines, grunts, trout, drums, soles, sharks, lines, crabs, conks, clams, octopi, squids, jelly fishes, sea fans and sea stars. Marine turtles are captured frequently, and the stress and anoxia that they suffer during the capture can be a significant cause of mortality. It is widely accepted that the correct use of TED's can reduce the incidental capture of turtle species in the shrimp fishery.

In the United States, the controversy on the incidental capture of marine turtles by shrimp vessels began several decades ago. The calculations made by NMFS in 1983 for their Atlantic region indicated an annual capture, by an estimated fleet of 17,200 boats operating beyond the two fathoms, of approximately 47,970 turtles. Of this volume, it was considered that 11,180 died by drowning (Henwood and Stuntz, 1987). To reduce this capture, NMFS personnel gathered information and experience from fishermen and initiated studies to develop a device that allowed for the release of turtles, with the minimum possible damage and at the same time without reducing the volume of the captured shrimp (Weber *et al.*, 1995). On April 1, 1993, the mandatory use of TED's began in the Atlantic coast (Márquez-M., 1994), and April 1, 1996 TED's were adopted for the Pacific Ocean.

6. **National Committee for the Protection and Conservation of Marine Turtles** - A Presidential Ordinance, December 2, 1993, created the "Inter-Secretariat Commission for the Protection and Conservation of the Marine Turtles." In coordination with the functions of an advisory Committee, the objectives of the ordinance are to pursue and support to the activities related to handling, investigation and conservation of the marine turtles and to favor the use of funds dedicated to these activities. This Committee established a national strategy plan using the model developed by a group of marine turtle experts attributed to the International Union for the Conservation of Nature.

7. **Convention for the Protection and Conservation of the Marine Turtles in the Western Hemisphere** - Recognizing the regional distribution of marine turtles that live in American waters, their vulnerability to different fishing gears and the modifications of their habitat, it was considered necessary to develop an international campaign through the signature of a hemispheric convention in order to safeguard and increase populations, conserve biodiversity and future possibilities for sustainable harvest. This convention includes commitments and obligations for signatory countries, with objectives of achieving the above named goals. To give pursuit and to support activities of the Convention, the creation of a scientific-technical-advisory body was suggested. However the operation, activities and the funds for this advisory body has not been defined.

RESULTS

As of 2001, the National Program has been working 37 years without interruption as a department of the INP; a considerable public administration achievement. During this time, a group of investigators have promoted investigation and conservation activities using the turtle camps established in 1966. Due to the continuity of this work, some populations are showing signs of recovery. It is believed that otherwise these populations would have been extirpated. Throughout the years, interest in marine turtles has increased, contributing the presidential initiative for the foundation of the "Mexican Center of the Turtle" located in Mazunte, Oaxaca. This Center is near the most important nesting beach for the Pacific olive ridley turtle at La Escobilla beach.

At the same time, collaborative activities were developed with foreign institutions, such as the U.S. Fish and Wildlife Service at Rancho Nuevo, Tamaulipas in 1978. This collaboration propitiated a great improvement in the investigation and preservation of the Kemp´s ridley *(L. kempii)*. As a result of these combined activities, the population has multiplied extraordinarily from 1987 of 740 nests to more than 6,000 in 2000 (Fig. 1). The work area was extended (Márquez *et al.*, 2001) to three main camps, installed in the coast of Tamaulipas and Veracruz.

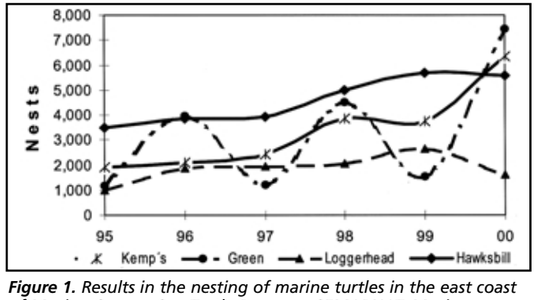

Figure 1. *Results in the nesting of marine turtles in the east coast of Mexico. Source: Sea Turtle Program, SEMARNAT, Mexico.*

In the 1960's, the green turtle *(Chelonia mydas)*, hawksbill *(Eretmochelys imbricata)* and loggerhead *(Caretta caretta)* were not considered in danger of extinction, however, the activities of the Program included them. Beginning with low intensity, the programs for these species increased support by the middle of the 1970´s. The conservation programs at the turtle camps have resulted in a continuous increase in populations of green and hawksbill turtles (Fig. 1).

By 1967, conservation activities were promoted by the Turtle Program at several Pacific Ocean beaches. These collaborated to formulate technical bases that instituted the ordinance of the "Total Ban of Marine Turtles" (of 1972-1973 and June 1, 1990). As a result of the protection work and its prohibitions, the population of *Lepidochelys olivacea* at La Escobilla beach, Oaxaca has multiplied extraordinarily between 1987 of 57,000 nests and 2001 to more than one million (Fig. 2). This population is considered at present to not be in danger of extinction. Olive ridley's at other beaches of the Pacific coast have also shown slight increases. It is clear, that where protection has been developed with certain continuity, a positive answer is observed. A special case at Ixtapilla beach in Michoacán recently discovered more than 10,000 nests per year; which shows a great potential for the species. This beach is considered third in importance after La Escobilla and Morro Ayuta in Oaxaca.

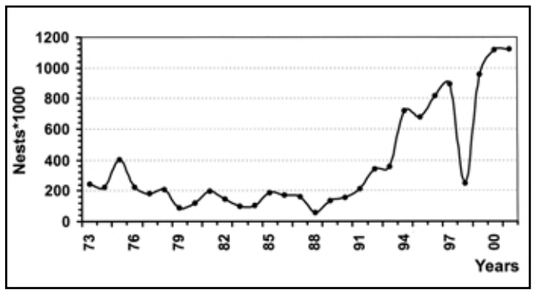

Figure 2. *Results of the nesting of L. olivacea, in La Escobilla, Oaxaca. The year 2001 is preliminary, Source Mexican Center of the Turtle, SEMARNAT.*

The National Program of Investigation of Marine Turtles (PNITM) is the most extensive and productive, with more than 40 camps organized annually at nesting beaches encompassing more than 500 km of costs. Approximately 300,000 olive ridley females come ashore to nest, averaging more than 1.5 million nests and 150 million eggs, of which 20 to 30 million hatchlings are produced each year in Mexico.

CONCLUSIONS

Marine turtle's *Endangered* status is a result of over exploitation and miss handling of critical ecosystems. For recovery, it is important to strengthen protection programs, investigation activities, handling, conservation and education, guided toward the development of new alternatives for these valuable resources. The Turtle Program in Mexico was developed at the national level which facilitated instituting changes, resulting in increases of some populations. In this way, authorities were allowed to emit administration opinions for turtle species and allowed for discussions and negotiations at the national and international jurisdictional framework.

Many populations of marine turtles in Mexico continue to deteriorate due to lack of support and development of conservation activities, however, in some areas there has been positive increases in the number of nests laid (Kemp´s and olive ridley, hawksbill and green turtles). Unfortunately, the situation is uncertain for other species (leatherback and black turtle). Greater financial support and reliable monitoring is necessary to identify the status of these populations and to define appropriate strategies for recovery. Information obtained from coordinators of turtle camps indicate that poaching continues and therefore it is necessary for drastic and efficient measures to avoid population collapse.

LITERATURE CITED

Briseño-D., R. y F.A. Abreu-G. 1994. Bitmar's survey of sea turtle nesting beaches is part of new approaches to conservation in Mexico. Pages 198-201 in K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar, compilers. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation, March 1994, Hilton Head, South Carolina. NOAA Technical Memorandum NMFS-SEFSC-351.

DOF. 1990. Acuerdo por el que se establece veda total para todas las especies y subespecies de tortugas marinas en aguas de jurisdicción nacional de los litorales del Océano Pacífico, Golfo de México y Mar Caribe. Diario Oficial de la Federación. México. Mayo 31, pp.:21-22.

Henwood T.A. y W.E. Stuntz. 1987. Analysis of sea turtle capture and mortalities during commercial shrimp trawling. Fishery Bulletin. 89:813-817.

Márquez-M., R. 1994. Synopsis of Biological data on the Kemp´s ridley turtle, *Lepidochelys kempi* (Garman, 1880). NOAA Technical Mem., NMFS-SEFSC-343, 91pp.

Márquez-M., R. 1996. Las tortugas marinas y nuestro tiempo. Fondo de Cultura Económica, México. 197 pp.

Márquez-M., R., G. Nodarse y S. Elizalde. 1991. La cría de la tortuga blanca *Chelonia mydas*, en la Granja de la Isla de Gran Caimán Antillas Mayores. I. Generalidades. Archelon, 1(2):5-8.

Márquez-M., R., G. Nodarse y S. Elizalde. 1992. La cría de la tortuga blanca *Chelonia mydas*, en la Granja de la Isla de Gran Caimán Antillas Mayores. II. Aspectos Técnicos. Archelon, 1(3):1-5.

Márquez-M., P. Burchfield, M. Carrasco, C. Jiménez, J. Díaz, M. Garduño, A. Leo, J. Peña, R. Bravo y E. González. 2001. Actualización sobre la anidación de la tortuga lora en México., Noticiero de Tortugas Marinas. 92:2-4.

Shaver, D.J. 2000. Summary North Padre Island Kemp´s ridley Project and Texas Sea Turtle Nesting and Stranding. Report for: Kemp's ridley Working Group Meeting. October 25-26, 2000. Brownsville, Tx., 7pp.

Solórzano-P., A. 1963. Tortuga marina. Datos sobre su biología y cultivo. Prospección acerca de las tortugas marinas de México. INP (re-ed. 1990). Doc. Trab. 11(18):1-26

Webber, M., D. Crouse, R. Irvin and S. Ludicello. 1995. Delay and Denial. A political history of sea turtles and shrimp fishing. Center for Marine Education. 46pp.

Regional Research Strategy for Sustainable Utilization of *Eretmochelys imbricata*[1]

Dr. Colin Limpus

INTRODUCTION

At the global level, the hawksbill turtle, *Eretmochelys imbricata*, has suffered substantial declines in populations. Some of the past large nesting populations, like that of Playa Chirique in Panama, are approaching extinction. Today there are few remaining countries with large nesting aggregations. Even with the substantial reduction in populations, the species is still actively hunted throughout much of its range for its eggs and meat as food, for its thick keratinised scales (bekko/tortoise shell) or for souvenirs (polished carapace or stuffed turtle). The conservation status for this species is very discouraging.

Within the international conservation arena, a management goal for species. such as *E. imbricata* can be sustainably utilized. At the present time this is not being achieved with this species, largely because of the paucity of understanding of its biology. This is often compounded by misinformation contained in "local knowledge" concerning the species and the lack of precision in many past "scientific" studies. This was obvious at the Marine Turtle Specialist International Workshop in Nagoya 1992, where there was disagreement on such basic biological parameters as: Is *E. imbricata* migratory? What is its age at maturity? How often does it breed? What is the size of the individual populations? Is the species comprised of discrete stocks?

Given the declining populations and the poor biological understanding of the species, the common response of people concerned with its conservation is to call for a total ban on commercial utilization of *E. imbricata*. If there is to be an alternate option to this "preservation" of the species, given the poor conservation status of the species and the continuing pressure from the bekko industry to harvest it, there is an urgent need for planned research to provide the specific biological data needed for formulating realistic management of *E. imbricata* populations in terms of ecological, sustainable utilization.

RESEARCH STRATEGY

The following is a summary of the essential components of a regional research program to provide such data.

1. DEFINE THE BREEDING SITES (rookeries):
   - map the distribution of rookeries;
   - define the duration of the breeding season; and
   - quantify population size by rookery.

2. IDENTIFY THE BREEDING UNITS (stocks) WITHIN EACH BREEDING UNIT: by use of tagging studies and population genetic studies.
   - define the rookeries within a breeding unit;
   - define the feeding area (migration) distribution for each breeding unit; and
   - identify sources of anthropogenic mortality within the breeding unit.

3. AT THE ROOKERIES CENSUS THE NESTING POPULATION:
   - use total tagging census at selected rookeries; and
   - sample other rookeries using an index of population size.

4. QUANTIFY RECRUITMENT, SURVIVORSHIP/MORTALITY, FECUNDITY, AGE FOR EACH PHASE (breeding adults, eggs, hatchlings):
   - use whole season studies of a representative tagged population(s);
   - minimum of 5 year study; and
   - visual examination of the ovary can be used to identify long-term breeding history of a turtle.

5. MONITOR HATCHLING SEX RATIO
   - measure pivotal temperature;

[1] *Paper first presented at the Hawksbill Turtle Conservation Specialist International Workshop in Tokyo, Japan. March 25-26, 1993. Submitted to these proceedings as a reference paper for standardized research techniques.*

- describe temperature profiles of rookery(s); and
- sample hatchlings for sex ratio at selected sites/times.

6. IN THE FEEDING AREAS, DESCRIBE FEEDING AREA POPULATION STRUCTURE:
   - use representative tagged populations at replicate study sites;
   - quantify size class distribution;
   - visual examination of gonads provides data for determining:
     - sex ratio;
     - adult / immature ratio;
     - proportion of adults breeding in any one year; and
     - proportion of adults that are new recruits to the breeding population.

7. QUANTIFY ANNUAL RECRUITMENT, SURVIVORSHIP, AGE CLASSES
   - use mark and recapture study;
   - minimum of 5 years study;
   - quantify growth rates and estimate age structure; and
   - visual examination of gonads can provide data for determining proportion of adults that are new recruits to the breeding population.

8. DEFINE THE PELAGIC LIFE PHASE (difficult to measure):
   - define temporal and spatial distribution; and
   - quantify recruitment and survivorship.

9. ASSESS REGIONAL SIGNIFICANCE OF TURTLE POPULATION:
   - wildlife values;
   - cultural values;
   - traditional harvest;
   - commercial harvest; and
   - ecotourism.

10. QUANTIFY ANTHROPOGENIC MORTALITIES:
    - census harvests, incidental catch and other sources of mortality throughout the region;
    - quantify size, sex and maturity of turtles killed.

11. ANALYZE INTEGRATED DATA FOR WHOLE BREEDING UNIT:
    - predictive population models; and
    - determine usage on the basis of cultural priorities and sustainable utilization principles.

LOGISTIC CONSTRAINTS

The following is a summary of logistic constraints that need to be considered when planning for an Eretmochelys imbricata population dynamics research project that is to have a high probability of delivering good quality results.

1. The total research program could be developed as a single integrated study or through the coordination of a number of smaller studies. If the latter were the case then maintaining unity of purpose and comparability of data must be addressed in the planning.

2. Because of the potential for feeding areas to be widely separated from the nesting beaches, the research project must of necessity encompass a large geographical region. Suggested study regions include:
   - Caribbean Sea,
   - Coral Sea and Arafura Sea, and
   - West Indian Ocean.

3. Given that time and money are limited for these studies, it is imperative that the maximum data obtainable be gathered wherever possible.
   - use a team of diversely skilled researchers;
   - apply recent advances in research methodology:
     - Assessment of sex and reproductive condition:
       - » hormone assay (sex data),
       - » ultrasound scans (sex and limited reproductive condition data), and
       - » laparoscopy (most comprehensive potential for supplying sex and reproductive condition data).
   - radio tracking and telemetric data gathering; and
   - computerized databases and models.

4. A study site should provide sufficient numbers of turtles for the study to ensure rigorous statistical analysis of the data obtained.
   - most populations are seriously depleted;
   - intensively harvested populations may be unsuitable for supporting some types of long-term study; and
   - select study sites on a regional basis rather than on an individual country basis.

5. Long term study design, conducted over several years.
   - Minimum of 5 years recommended for both nesting and feeding area studies.
   - Considerable savings in time and resources can be made by supporting suitable studies that have already commenced. While new study sites may need to be established, several suitable studies are already in progress and could produce better results with increased funding support, for example:
     - Comprehensive nesting studies addressing population dynamics:
       - » Antigua (Dr. Jim Richardson, University of Georgia),
       - » Seychelles (Dr. Jean Mortimer, University of Florida),
       - » Queensland (Dr. Cohn Limpus & Dr. Jeffery Miller Queensland Department of Environment and Heritage), and
       - » Western Australia (Dr. Bob Prince, Western Australian Department of Conservation and Land Management).
     - Feeding area mark/recapture studies addressing population dynamics:
       - » Queensland (Dr. Cohn Limpus & Dr. Jeffrey Miller, Queensland Department of Environment and Heritage), and
       - » Northern Territory (Hick Guinea, Northern Territory University).
   - Fisheries catch statistics;
   - Population genetics of hawksbill turtles:
     - Indo-Pacific (Dr. Craig Moritz, University of Queensland), and
     - Caribbean (Dr. Brian Howen, University of Florida).

6. When a tagged population is established, there needs to be a high probability that the tagged turtles will be available for study during subsequent visits to the study site.
   - Long term tagging studies for mark/recapture studies are not viable in areas where turtles are actively hunted or subjected to other high levels of anthropogenic mortalities.
   - In tagging studies, the tag design should be selected to maximize long-term tag retention and reduce tag loss:.
     - Titanium or Inconel 625 turtle tags are recommended for use with *Eretmochelys imbricata*.

7. For international acceptance of the results of the studies:
   - research needs to be scientifically rigorous;
   - research program should be open to inspection by the international scientific and conservation community; and
   - results need to be published in international scientific journals to ensure peer review!

This paper considers only those aspects related to gathering biological data necessary for developing models applicable to planning for sustainable utilization of the species. It does not address the harvest and trade methods, political issues or legislation that would need to be addressed if these models were to be used in establishing an internationally accepted trade in *E. imbricata* products!

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