



WESTERN PACIFIC
SEA TURTLE
*Cooperative Research
& Management Workshop*

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PROCEEDINGS OF THE



WESTERN PACIFIC SEA TURTLE

Cooperative Research & Management Workshop

**VOLUME I: May 17–21, 2004
West Pacific Leatherback and
Southwest Pacific Hawksbill Sea Turtles**

Coordinated and Edited by Irene Kinan

Sponsored by



WESTERN PACIFIC
REGIONAL FISHERY
MANAGEMENT COUNCIL

1164 Bishop Street, Suite 1400
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To provide a forum to gather and exchange information, promote collaboration, and maintain momentum for research, conservation and management of Pacific sea turtle populations

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Editors' Note

The papers presented at the workshop and contained in these proceedings have been edited and formatted for consistency, 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.



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PREFACE

This volume of papers is a record of the Second Western Pacific Sea Turtle Cooperative Research and Management Workshop which convened in Honolulu, Hawaii sponsored by the Western Pacific Regional Fishery Management Council (WPRFMC). The focus of these proceedings is on west Pacific leatherback and southwest Pacific hawksbill sea turtles.

Sea turtles are long-lived species which migrate vast distances across ocean basins, living successively in varying life stages on the high seas, and within the Exclusive Economic Zones (EEZ) and coastal habitats of numerous Pacific nations. Consequently, a collaborative and integrated approach to management and conservation between nations is essential for the recovery of depleted sea turtle populations. 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.

The WPRFMC is the federal authority for fisheries in the U.S. EEZ of the western Pacific and has extensive experience in international management of highly migratory and shared marine resources. Under the 1996 Magnuson-Stevens Act, the WPRFMC is dedicated to ecosystem-based conservation, protection of essential fish habitat, and sustainable fishery management, and in 2002 expanded its focus of international fishery management to include sea turtle conservation.

In 2002, the WPRFMC convened the first Western Pacific Sea Turtle Cooperative Research and Management Workshop to exchange scientific information, gather an update on the status of population trends, and help build consensus for a regional approach towards research and conservation (Kinan, 2002). Through this dialogue, the WPRFMC focused on the most efficient use of its resources to aid in the recovery of depleted Pacific sea turtle populations. Since implementing a turtle conservation program, the WPRFMC, in collaboration with the National Marine Fisheries Service (NMFS), has helped foster essential research and conservation throughout the central and western Pacific.

The WPRFMC convened a series of workshops which together comprise the Second Western Pacific Sea Turtle Cooperative Research & Management Workshop to continue this momentum. The focus of these workshops were on west Pacific leatherback and southwest Pacific hawksbill sea turtles (May 17-21, 2004), and north Pacific loggerhead sea turtles (March 2-4, 2005).

These proceedings contain the 19 presentations or submitted papers, results from plenary sessions and/or working groups, and recommendations for future research from the leatherback and hawksbill sea turtle workshop (volume 1). The proceedings for the north Pacific loggerhead sea turtle workshop will follow in 2006 (volume 2). Discussion following oral presentations is included at the end of each paper. Additionally, in 2003/04 five conservation projects focusing on loggerhead and leatherback sea turtles were supported by the WPRFMC and implemented by local community-based Non-governmental Organizations (NGOs). These workshops thus provided a forum for project leaders to report on the results and findings of their first year. The final project reports to the WPRFMC are also contained within these proceedings.

Leatherback Workshop

The leatherback sea turtle workshop provided an opportunity to convene a consortium of leatherback researchers from the western Pacific region to gather and exchange information, promote collaboration, and build consensus for continued leatherback turtle research and conservation. Twenty-five stakeholders primarily from Papua Indonesia, Papua New Guinea, the Solomon Islands, Vanuatu, Japan, and the United States reported on the most current population trends, identified previously unknown nesting beaches, and reviewed current conservation and management efforts of the west Pacific leatherback turtle stock. Working groups identified the most current anthropogenic threats to nesting beaches and foraging grounds, and identified areas to focus additional research efforts. Primary investigators, in collaboration with regional experts, reviewed data gathering techniques, results from the 2003/04 field season, and worked to standardize research methodologies.



Leatherback turtle workshop, group photo. From left to right, top to bottom: Tetsuya Kawashima, Rodney Galama, Scott Benson, Tina Fahy, Liu Chi-Chao, Yoshi Matsuzawa, George Petro, Hiroyuki Suganuma, Jeanne Mortimer, Hideki Nakano, Ken MacKay, Levi Ambio, Karol Kisokau, Tomo Eguchi, Vagi Rei, Irene Kinan, George Balazs, Anne Trevor, Taro Takeshita, Kitty Simonds, Creusa Hitipeuw, Peter Dutton, John Pita, John Senego, and Heidi Gjertsen. Not pictured: Jacob Bakarbossy, Mike McCoy, and Milani Chaloupka.

Hawksbill Workshop

Participants at the hawksbill sea turtle workshop reviewed and exchanged information on a hawksbill sea turtle stochastic simulation model commissioned by the WPRFMC. The workshop: 1) introduced the model to eleven hawksbill turtle experts and/or conservation managers; 2) explained and demonstrated the interactive stochastic modeling approach; 3) enabled the workshop participants to review inputs and model assumptions incorporated in the model; 4) enabled the workshop participants to interact with the model to collectively explore model assumptions and data inputs; and 5) reviewed expected population responses to risk factors effecting the long-term viability of the southwestern Pacific hawksbill sea turtle stock. Each participant was provided with the model on a CD with supporting documentation and a User Guide on how to run the model and set up various scenarios.



ACKNOWLEDGMENTS

The Western Pacific Regional Fishery Management Council would like to thank the participants for their presentations and papers prepared for the meeting. Without the dedication of our participants, this meeting would not have been possible. The Council expresses its sincerest gratitude to its Turtle Advisory Committee: Mr. George Balazs, Dr. Jeff Polovina, Dr. Peter Dutton, Dr. Colin Limpus, Dr. Milani Chaloupka, Dr. Nick Pilcher, Dr. Naoki Kamezaki, and Ms. Laura Sarti for their thoughts, ideas and insights, and whose expertise and leadership we could not do without. Finally, the Council would like to thank the National Marine Fisheries Service for involvement and support of these workshops, of the Council's turtle program, and for sharing in the vision of cooperative research and integrated sea turtle management.



TABLE OF CONTENTS

PREFACE	i
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	v
INTRODUCTION	1
RESULTS AND RECOMMENDATIONS	7

LEATHERBACK WORKSHOP

Introduction

Western Pacific Leatherback Turtle Working Group: "Why We Are Gathered Here Today"

Peter Dutton	13
--------------------	----

Papua, Indonesia

Leatherback Turtle Conservation at War-mon Beach, Papua-Indonesia

Julianus Thebu & Creusa Hitipeuw	19
--	----

Community-based Management of Leatherback Turtles Residing in Kei Islands,
Papua-Indonesia: Reducing Mortality Due to Traditional Hunting Practices

Julius Lawalata & Creusa Hitepeuw	25
---	----

Leatherback Turtle Management of Feral Pig Predation in Indonesia

Hiriouki Suganuma	37
-------------------------	----

Research on the Mitigation and Conservation of Sea Turtles by the
Fishery Research Agency of Japan

Hideki Nakano	39
---------------------	----

Papua New Guinea

Leatherback Turtle Nesting Demographics: Identified Through
Migratory Movements and Aerial Census in Papua New Guinea

Scott Benson	43
--------------------	----

The History of Leatherback Conservation in Papua New Guinea:
The Local Government's Perspective

Vagi Rei.....	47
---------------	----

The Community-based Conservation and Monitoring of Leatherback Turtles at
Kamiali Wildlife Management Area, Morobe Province, Papua New Guinea

Karol Kisokau & Levi Ambio	51
----------------------------------	----

Huon Coast Leatherback Turtle Network, Papua New Guinea

John Sengo.....	59
-----------------	----

Commercial Fisheries-Sea Turtle Interactions in Papua New Guinea: Mitigation and Outreach Program, a Joint Project of NOAA Fisheries and National Fisheries Authority Mike McCoy	61
Solomon Islands & Vanuatu	
Leatherback Turtles in the Solomon Islands John Pita	67
The Tetapare Descendents Conservation Project, Solomon Islands Kenneth MacKay	69
Leatherback Turtles in Vanuatu George Petro	73
Data Management	
Regional Turtle Research and Tagging Database System (TREDs) Anne Trevor	79
HAWKSBILL WORKSHOP	
Summary of Hawksbill Turtle Stochastic Simulation Model Milani Chaloupka	85
Hawksbill Turtles in Brazil Neca Marcovaldi	91
Hawksbill Turtles in the Indian Ocean Jeanne Mortimer	97
Hawksbill Turtles in the Solomon Islands Damien Broderick & John Pita	101
Hawksbill Turtles in Indonesia Hiroyuki Suganuma	103
APPENDICES	
Appendix I: Leatherback Turtle Threat Matrix	105
Appendix II: Leatherback Turtle Nesting Beach Catalogue	107
Appendix III: Hawksbill Turtle Threat Matrix	111
Appendix IV: Hawksbill Turtle Workshop Agenda	113
Appendix V: Leatherback Turtle Workshop Agenda	115
Appendix VI: Participants List – All Attendees	117

INTRODUCTION

Irene Kinan, *Turtle Program Coordinator, WPRFMC*

In some creation myths, the sea turtle is the animal upon 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. However, sea turtles have also been exploited for their meat, eggs, shell, leather, and oil for centuries. The negative effects of this unregulated adult and egg harvest, along with impacts from habitat degradation, coastal construction, commercial trade and mortalities through incidental capture in coastal and pelagic fisheries, have accelerated the decline of sea turtle populations. Today, all sea turtle populations are listed as either threatened or endangered under the U.S. Endangered Species Act (ESA)¹.

Sea turtles migrate vast distances across ocean basins, living complex life histories within pelagic, coastal and beach habitats of numerous Pacific nations. Given that sea turtles are a shared international resource, their management requires cooperation across the Pacific region in a manner which considers their entire life history. The Western Pacific Regional Fishery Management Council (WPRFMC) is the federal authority for fisheries in the U.S. waters of the Western Pacific (1.5 million square miles) and is committed to ecosystem-based management. In collaboration with numerous agencies throughout the Pacific, the WPRFMC and its partners are leading a Pacific-wide effort to recover endangered sea turtle populations. To date, the WPRFMC's management program consists of a suite of measures that include sea turtle conservation projects and actions that promote responsible and sustainable longline fisheries.

The Sea Turtle Conservation Program

Of the sea turtle species of concern in the Pacific Ocean, west Pacific leatherback and north Pacific loggerhead turtles are captured most frequently by the Hawaii-based longline fishery, and also have populations in general decline. For this reason, these two stocks have been the focus of the WPRFMC's conservation measures. Recognizing that recovery of sea turtle populations must focus on more than just fishery mitigation, the WPRFMC instituted a conservation program to address anthro-

pogenic and environmental impacts at critical life stages, namely at nesting beaches and coastal foraging habitats.

Five measures were recommended to the WPRFMC by its Turtle Advisory Committee² which are considered to hold great scientific merit and high conservation value³. They include: leatherback turtle nesting beach management and monitoring projects at War-mon Beach (Papua, Indonesia), the Kamiali Wildlife Conservation Area (Papua New Guinea), and support of loggerhead turtle nesting beach projects in Japan. In addition, conservation measures emphasize the reduction of direct harvest and incidental capture of turtles in coastal foraging habitats. These projects include protection of adults and sub-adults leatherback turtles through education and outreach initiatives at the Kei Islands (western Papua, Indonesia), and the reduction of incidental capture of juvenile loggerhead turtles in the halibut gillnet fishery of Magdalena Bay (Baja California, Mexico).

All projects are grassroots, community-based efforts because the WPRFMC believes that by empowering local communities to manage their resources, the foundation is laid for long-term sea turtle conservation initiatives. Furthermore, the information gathered by these programs combined with data from NMFS supported satellite deployments, aerial surveys, and genetic research will help better define sea turtle population dynamics of the Pacific to promote both effective conservation and sustainable fishery management policy.

One of the WPRFMC's greatest strengths, however, is as a liaison and facilitator for progress for fishery management and conservation in the region. To promote collaboration and information exchange, the WPRFMC continues to convene numerous workshops and provides assistance to international sea turtle meetings (including, but not limited to, the Annual Sea Turtle Symposia and IOSEA MoU)⁴. The WPRFMC has also taken the lead to support and coordinate five international agencies⁵ in the rehabilitation of SPREP's turtle tagging database through the development of a Regional Turtle Tagging and Research Database System⁶.

¹ All sea turtles that occur in U.S. waters are listed as either endangered or threatened under the Endangered Species Act (ESA). Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and hawksbill (*Eretmochelys imbricata*) sea turtles are listed as endangered. Loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and olive ridley (*Lepidochelys olivacea*) sea turtles are listed as threatened, except for breeding colony populations of green turtles in Florida and on the Pacific coast of Mexico and breeding colony populations of olive ridleys on the Pacific coast of Mexico which are listed as endangered.

² The TAC is comprised of eight world-renowned sea turtle biologists and scientists: Mr. George Balazs, Dr. Peter Dutton, Dr. Jeffrey Polovina, Dr. Colin Limpus, Dr. Milani Chaloupka, Dr. Naoki Kamezaki, Ms. Laura Sarti Martinez, and Dr. Nicolas Pilcher.

This regional database was recommended by the participants at the first Sea Turtle Workshop of 2002 as a critical step in understanding the population status and trends of Pacific sea turtles (Kinan, 2002); information and updates of this effort are also contained within these proceedings.

Sustainable Fisheries

For the WPRFMC, however, conservation projects are not the only means to offset fishery impacts on sea turtle populations. In April 2004, after almost five years of regulatory changes⁷, the swordfish component of the Hawaii-based longline fishery was reopened based on the implementation of new circle hook technologies⁸ that have been found to significantly reduce interactions of pelagic longline gear with sea turtles (Watson et al., 2004). These management measures have successfully reduced sea turtle interactions, nearly eliminating them for three of the four impacted species (WPRFMC, 2004). Additionally, research to identify methods to mitigate seabird interactions has led to the development of measures (e.g., side-setting) that can be almost 100 percent effective at avoiding seabird bycatch (Gilman et al., 2003). The WPRFMC works to transfer this “best practice” methodology to the international longline fleets of the Pacific Ocean through international workshops, meetings, Fishers Forums and gear mitigation experiments designed to reduce protected species interactions in the pelagic environment.

The WPRFMC hopes that by sharing its ecosystem-based style of management, other agencies may recognize the

benefits of integrating both sea turtle conservation (or other fishery specific conservation measures) and appropriate “best practice” gear technology into their fishery management regime. As many countries in the Pacific have expanding longline fleets, the challenge is to find a way to unite these fisheries to identify and implement cost-effective bycatch solutions. To accomplish this goal, the WPRFMC actively works to engage foreign countries in discussions or to elicit their active collaboration in fishing gear experiments. The success of these international and multi-agency collaborations has recently been realized in Ecuador where experimental research with circle hooks has identified that a 63 to 93 percent reduction in mortality rates between the tuna fishery and sea turtles is achievable (Largacha et al., 2005).

In conclusion, environmentally responsible pelagic longline fishing continues to be at the forefront of fishery management objectives, and the WPRFMC’s turtle program is dedicated to maintain, expand, and foster international collaboration to promote Pacific sea turtle recovery. In the future, the WPRFMC plans to maintain its core program while expanding community-based nesting beach monitoring programs to other key leatherback nesting beaches in Papua New Guinea and the Solomon Islands to help maximize hatchling production. The WPRFMC convened this second international forum to exchange scientific information, update the status of west Pacific leatherback population trends, review the progress of conservation projects, promote collaboration, and maintain momentum for continued research, conservation and management in the central and western Pacific.

³ “It is important to note that numbers don’t always tell the whole story in the world of conservation projects. Projects can and do often have high spin-off value in regards to raising public awareness, education, and providing multiplier affects that generate other worthwhile actions including the establishment of valuable and collaborative working relationships. The number of turtles theoretically saved should be viewed in context with the establishment of positive, but unquantifiable, working relationships which are essential towards integrated management efforts of shared international marine resources to achieve recovery of sea turtle species.” (Balazs, pers. comm.)

⁴ Indian Ocean and South East Asian Marine Turtle Memorandum of Understanding

⁵ Database steering committee includes: South Pacific Regional Environmental Program (SPREP), Secretariat of the Pacific Community (SPC), ASEAN-SEAFDEC, Queensland Parks Authority, NMFS, and WPRFMC.

⁶ The database is expected to reach completion by mid 2006, and will be available to all turtle programs operating in the Pacific Islands and ASEAN countries (approx. 30 member countries in total).

⁷ In response to litigation in 1999, the Council and NMFS implemented significant changes to the management of the Hawaii-based longline industry to reduce sea turtle interactions (WPRFMC 2003). In summary, between 2001 and 2003, the swordfish (shallow-set) component was closed and the fishery became an exclusively a deep-set, tuna-targeting fishery with mandatory gear modifications, time/area closures, and 20% fishery observer coverage for the fleet.

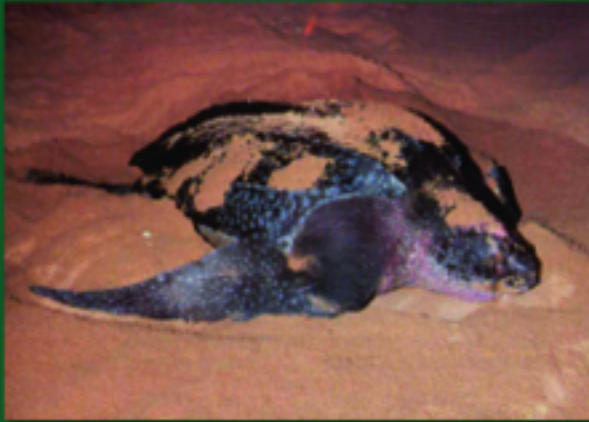
⁸ These technologies, 18/0 circle hooks in combination with mackerel-type bait, greatly reduce interaction rates by 92% and 67% for loggerhead and leatherback sea turtles, respectively (Watson et al., 2004). Furthermore, circle hooks result in less lethal mouth hookings (versus throat or ingested hookings) thus promoting greater turtle survivorship. Additional safeguards for the Hawaii-based longline fishery include: dehooking devices, limits on the allowable number of turtle interactions, fishery effort capped at 50% of the historical average (2,125 sets), and 100% observer coverage is required on all vessels targeting swordfish (WPRFMC 2004).

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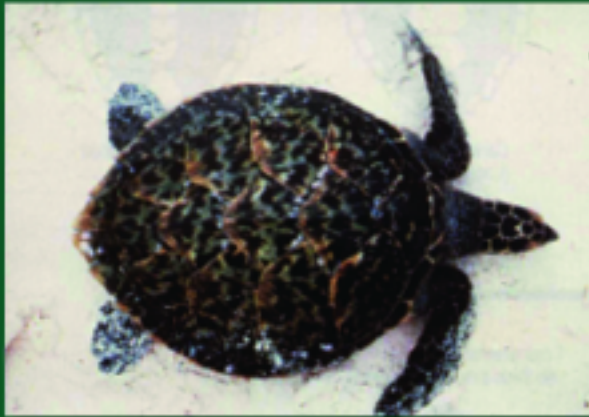
Indo-Pacific Marine Turtles



Dermochelys coriacea (Leatherback turtle)



Lepidochelys olivacea (Olive ridley turtle)



Eretmochelys imbricata (Hawksbill turtle)



Caretta caretta (Loggerhead turtle)



Natator depressus (Flatback turtle)



Chelonia mydas (Green turtle)

The six marine turtle species occurring in the Pacific Ocean. Not pictured is the subpopulation of the Eastern Pacific "black" sea turtle, *Chelonia agassizii* (Photo Source: Dr. Colin Limpus).



Results & Recommendations

Recommendations developed from the workshops will be used to help direct essential research, conservation and recovery efforts, and assist with future management decisions of the WPRFMC (and hopefully other stakeholders) regarding west Pacific leatherback and southwest Pacific hawksbill sea turtles.

Leatherback Workshop Results

The leatherback workshop was the first of its kind to convene researchers and resource managers from the four countries in the western Pacific/Melanesian area that have nesting leatherbacks: Indonesia (Papua), Papua New Guinea (PNG), Solomon Islands and Vanuatu. It also provided a great opportunity for the Council to convene the primary investigators from the three leatherback programs implemented during the 2003/04 nesting season (Warmon Beach, Papua; Kei Islands, Papua; and Kamiali, PNG). The workshop was led by Dr. Peter Dutton (NMFS/SWFSC), and was organized to provide a comprehensive overview of all the leatherback research projects currently being conducted in the western Pacific region.

In total, 14 presentations were given at the workshop. Dutton laid the groundwork with the first presentation, giving an overview of the background and history of leatherback research in the region. He was followed by Scott Benson who provided the most recent, and comprehensive summary of known leatherback migratory movements in the Pacific, as well as the results of an aerial survey conducted January 2004 in PNG that identified additional leatherback nesting beaches. Presentations followed by project leaders of Papua, PNG, the Solomon Islands and Vanuatu who gave detailed presentations of leatherback nesting trends in their respective countries. These presentations added considerable new information, filling previous gaps in the knowledge of nesting in these countries. Additional information which expressed continued regional efforts to aid in the recovery of turtle species was provided by The Fishery Agency of Japan, the South Pacific Regional Environmental Program (SPREP), NMFS (contractor), and Canada-South Pacific Ocean Development Program (C-SPOD).

Upon conclusion of the presentations, the workshop was transformed into a working group where participants developed a threat matrix for leatherbacks in the western Pacific region (Appendix 1). This matrix will be used by NMFS as necessary to help update the 1998 ESA

Leatherback Turtle Recovery Plan. Additionally, to develop future priorities for research and conservation, project leaders from all four countries had the unique opportunity to share unpublished agency reports (gray literature) and compile their raw data to acquire a summary of the best available leatherback data in the region. This information was utilized to inventory and catalogue all known leatherback nesting beaches in the region, the number of approximate nests (or number of females nesting) at each site, a relative measure of the quality of the data (excellent, poor, fair, incomplete), and a complete list of specific threats occurring at each site (Appendix 2).

In summary, twenty-four nesting sites were identified, of which nineteen were previously unknown, or poorly described (Table 1). Papua Indonesia remains the largest and best studied rookery, with three beaches at Jamursba Medi containing the bulk of the nesting, and War-mon Beach having greater nesting activity than previously thought possible. The Solomon Islands is more important than previously believed, with scattered nesting reported from several sites in the western province of Isabel. Although large scale egg harvest has been eliminated at key rookeries like Jamursba-Medi, Papua and conservation efforts to reduce subsistence harvest of eggs is underway in Kamaili, PNG and War-mon Beach, Papua, predation and natural beach erosion continue to suppress hatchling production throughout the region. In addition, competing economic activities, such as logging and mining, threaten to compromise vital nesting habitats in numerous areas.

Table 1. Summary of identified nesting beaches catalogued at the leatherback workshop.

Country	No. Beaches Catalogued	No. Beaches Monitored (to date)	No. Beaches Unmonitored
Papua	6	2	4
PNG	6	1	5
Solomon Isl.	10	4	6
Vanuatu	2	1	1

Workshop participants agreed that immediate opportunities exist to enact conservation measures through community-based initiatives on the nesting beaches to dramatically increase hatchling production. This is also a priority that has been highlighted in a recent regional

Action Plan for leatherback turtles in the Pacific Ocean (Worldfish Center, 2004). The Council is therefore reserving funding to support leatherback turtle conservation efforts in PNG, the Solomon Islands, and/or Vanuatu based on the results of a three-year, leatherback turtle strategic action plan (currently under development through collaboration with Dr. Peter Dutton, SWFSC).

As a result of this workshop, a paper has been compiled and submitted for publication in the upcoming special leatherback issue of *Chelonian Conservation and Biology* (2005). Although data are still incomplete, it is estimated there may be a minimum of 2,000 females nesting annually among these four countries (Dutton et al., in press), which is larger than previous reports, and provides a valuable update to the most recent global population assessment published by Spotila et al. (1996).

The workshop concluded with a day of informal clinics. Researchers from the various programs reviewed data collection methods, raw data from the 2003/04 field season, and acquired data analysis assistance. The programs in this region (with the exception of those in Indonesia lead by WWF) are still in their infancy compared to the long-term programs of the east Pacific or Atlantic. Regardless, personnel and communities are motivated and dedicated to collect the best possible data. Dutton and other NMFS staff provided classroom style education in turtle monitoring and research techniques: information which will enhance and facilitate data collection protocol during upcoming nesting seasons. It was identified that programs are proficient in tagging and measuring turtles, however, there has been a lack in emphasis to count and manage nests. Overall, project leaders acquired new knowledge to better manage their nesting beaches and left the workshop empowered.

Leatherback Workshop Recommendations

Results and recommendations from this workshop will be used to generate a three-year action plan for leatherback research in the west Pacific/Melanesian region. Additional recommendations included:

- PIT⁹ tag scanners and standardized data collection sheets supplied to all programs;
- All programs encouraged to double tag all turtles (PIT and flipper);
- All programs encouraged to tag during peak nesting periods and monitor nesting activity (tracks) during non-peak periods; and
- All programs should continue to tag, but redirect emphasis towards data collection methods to better identify nesting periodicity and the number of nests per season.

It was further recommended that a regional organization, or network, be established to address the specific needs of the west Pacific leatherback stock. This network should include research and conservation methods, and involve the community, researchers, and resource managers. It was concluded that a Melanesian turtle meeting be held in the Solomon Islands to continue momentum to build local capacity for research and conservation, maintain and expand the leatherback network, and focus on education and awareness (of all turtle species) and research methods (of leatherbacks)¹⁰.

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⁹ Passive Integrated Tags

¹⁰ The Solomon Islands sea turtle workshop convened October 28 to November 4, 2004 with the support of WWF-Pacific, SPREP, C-SPOD, and the WPRFMC.

WorldFish Center, Penang, Malaysia. Pp.1-24. Complete Proceedings to be published by the WorldFish Center and University of Hawaii in 2005.

Hawksbill Workshop Results

A stochastic simulation model for the southwestern Pacific hawksbill sea turtle stock was commissioned by the Council to foster better insight into regional population dynamics. The model was designed to support evaluation of the effects of competing mortality risks on stock abundance, and of the design of conservation policies to protect this stock. Dr. Milani Chaloupka directed the workshop and provided the bulk of presentation material. An explanation of the stochastic simulation model was provided and how information was utilized to build and explore assumptions, functions and competing risk factors affecting the viability of the hawksbill metapopulation in the southwest Pacific. Data and population demographics used to build the model came from the Australian rookeries of Milman and Heron Islands, and Sabah parks in Malaysia. The hawksbill stock in the southwest Pacific region appears to be in general decline with numerous population threats; however, evidence of increasing population size has been documented at protected nesting beaches.

In summary, although excellent and comprehensive data does exist for some model parameters, the model is based on limited empirical data. Foraging ground abundance, harvest and subsistence take, incidental take in fisheries, and density dependence effects are generally unknown. The most complete biological information exists for hatchlings, subadults and adults. Recruitment for hawksbill turtles from the pelagic environment is at about 3 to 5 years of age (approximately 35 cm) and maturity is achieved between 25 to 30 years of age after recruitment (thus average age to maturity is between 30 to 35 years of age). Results from the simulation model suggests a population size of approximately three million hawksbill turtles in the Southwest Pacific region, with the primary stock (~10 percent) originating from the Milman rookery in Australia.

Additional presentations were provided by hawksbill turtle specialists who were in attendance to review and

critique the model. Maria “Neca” Marcovaldi provided a summary of hawksbill turtles in Brazil and results of over 20 years of research and conservation activities by Projecto-TAMAR. To date, a network of 20 stations and associated conservation and monitoring activities protect all sea turtles and their eggs along approximately 1,100 km of coastline. Coastal fishing villages are fully integrated into the program with fishermen and local villagers comprising the majority of TAMAR’s staff. Studies since the 1990 demonstrate an increasing, but fluctuating trend in the number of Brazilian hawksbills.

Dr. Jeanne Mortimer gave a presentation on the status, trends, threats and available data of hawksbill turtles in the Indian Ocean, and a detailed analysis of hawksbills in the Seychelles based on long-term studies at Cousins and Aride Islands (since 1970 and 1976 respectively). Mortimer provided excellent information on the historical export and exploitation of hawksbill turtles in the region (at least 81,700 turtles harvested between 1894 - 1982), and expressed an important take-home message: nesting beach management works! Although there has been an overall decrease (25%) of the hawksbill population in the Seychelles, at protected sites 142 percent population increase has been achieved versus 60 percent decrease at unprotected sites.

Damien Broderick and John Pita gave a joint presentation on hawksbills status in the Solomon Islands indicating that adult harvest remains a significant threat in the area. They expressed an urgent need to implement monitoring and intensive conservation activities. Pita presented information supporting the Arnavon islands to be a significant hawksbill rookery in the Solomon Islands; the most recent survey in 2000 estimated that 270 female hawksbills laid 785 nests. Broderick concluded that the historic commercial harvest in the Solomon’s was unsustainable (over 10,000 turtles harvested) and that current subsistence harvesting is probably limiting recovery. This was further supported by data comparing rookeries at Milman Island in Australia versus the Arnavons. At Milman, there are a high proportion of experienced breeders with shorter remigration intervals (2-3 yrs) and larger clutches, whereas in the Arnavons, there are

a low proportion of experience breeders, longer remigration intervals (5-7 yrs) and smaller clutches. Additionally, it would appear that there are still many hawksbill turtle mysteries in the Southwest Pacific. For example, Broderick stated that there is a genetic stock of hawksbills (comprising approximately 40 percent) which forage at Heron Island, Australia, but the nesting stock of these turtles has yet to be identified. Furthermore, it is unclear where the Milman hawksbill nesting population migrates to forage.

Dr. Hiroyuki Suganuma gave a brief overview of hawksbill turtles in Indonesia. He reported that between 1961-1987, the hawksbill Bekko shell trade from Indonesia to Japan resulted in over 7,000 turtles harvested per year. Of the 474 islands or sites surveyed by Suganuma and his staff, only eight had over 100 nests. Available information suggests that egg harvest remains a significant threat in the region.

A portion of the workshop was dedicated to reviewing anthropogenic threats to nesting beaches and foraging grounds, and building a threat matrix for hawksbills in the region (Appendix 3). This information will be used by NMFS and the sea turtle recovery team when they work to review and update the 1998 ESA Hawksbill Turtle Recovery Plan. Through the discussion generated by the threat matrix, and exploratory use of the model by participants, recommendations were generated by the workshop participants.

Hawksbill Workshop Recommendations

Through discussion, workshop participants provided the following suggestions:

- Density dependence and environmental variability are the most subjective parameters in the model, thus it was emphasized that future research activities focus on these parameters.
- Hawksbill turtles show a unique characteristic in that subadults that have not reached adult size have the capacity to breed. For example, the entire breeding population is threatened by direct harvest in the Solomon Islands, therefore managers (or model users) need the ability to manipulate the model to address this threat directly.

- Through dialogue it was determined that results from hawksbill turtle studies which was comprised of nesting and foraging ground work in Great Barrier Reef waters were lacking. This data is integral to the model and to the greater understanding of hawksbill turtle population dynamics. It was recommended that the Council's Turtle Advisory Committee (TAC) send a letter to the director of the Australia Environmental Protection Agency to draw attention to the international relevance and importance of this work to encourage its publishing.
- Laparoscopy data is crucial to strengthening population demography and the value of the model. The workshop recommends and encourages laparoscopy work throughout the region.
- Participants recommend that the Council's TAC write to SPC to ask them to collect turtle genetic samples of species encountered during fishery operations.
- The importance of Sabah Parks, Malaysia was recognized as a significant hawksbill rookery in the region. However, beach management practices appear to be outdated and not in the best interest of hatchlings. Participants suggested that Sabah Parks consider changing their nesting beach practices to increase hawksbill population size in the region (i.e., encourage shading of nests, eliminate hatcheries and encourage in-situ nesting, and allow hatchlings to enter the water in a more natural, unstructured way).
- Of turtles captured in the foraging grounds of Heron Islands, approximately 40 percent are of an unknown nesting stock. Given the significant size of this undocumented stock, it was recommended that efforts be made to identify the source of this stock (perhaps through aerial surveys).
- Fish Aggregating Devices (FAD's) were discussed as an important and increasing entanglement threat to hawksbill turtles. A quantification of FAD impacts in the region is suggested.

LEATHERBACK WORKSHOP





Introduction

Western Pacific Leatherback Working Group: “Why We Are Gathered Here Today”

Dr. Peter Dutton, NOAA Fisheries, Southwest Fisheries Science Center

This is a monumental occasion in terms of getting everyone we have been collaborating with together in the same room. In fact, I would like to pronounce this officially the very First Western Pacific Leatherback Working Group!

I will start by providing some background on what we've been up to for the last few years in regards to leatherback turtle research, and what we want to achieve at this workshop. Our working group extends beyond just the groups represented here in Honolulu. Recently, leatherbacks have been placed on the map, globally, in terms of global institutions. For example, the United Nations FAO is having a technical consultation and leatherback conservation is one of the highest priorities, largely as a result of the community level work that you [the group gathered here today] are all involved in. High levels of government have become involved, including groups such as the Far Seas Fishery Agency of Japan. But the community level projects that this working group is involved with at nesting beaches and foraging grounds in Papua Indonesia (Fig.1), Papua New Guinea (PNG; Fig. 2), Solomon Islands and Vanuatu are the backbone of conservation in the region. The network we are building and working to expand, at the grassroots level, is the front line of conservation for leatherback turtles in the region.

This network is extending globally, both at the regional government level and internationally. The message I want to convey to everyone in PNG, Papua, Solomon Islands, and Vanuatu is that you have the world's attention as to western Pacific leatherback turtles.

There is an opportunity for support and interest in what needs to be done to recover and maintain populations. There is a broad range of interest from sustainable use, local use, fisheries that are interested in not catching turtles, but catch them as bycatch, and also people who just want to



Figure 1. Papua Indonesia leatherback turtle conservation team.



Figure 2. PNG leatherback turtle conservation team.

save turtles because they like to have them around. So whatever the reason, the world is focusing attention on Pacific leatherbacks. It is up to us these next few days to start to define what needs to happen to accelerate the pace for conservation and recovery. Our challenge for this workshop is to assess where we are and where we need to go, and to continue to build the networks to make it happen.

Research Background

How did we end up getting involved in the western Pacific? Originally, the first signs that leatherbacks were in trouble came from work in Mexico. Laura Sarti, who unfortunately could not be here today, had been monitoring leatherbacks for a number of years and noticed a catastrophic decline in that population (Fig. 3). Similar to what happened in Malaysia in the '70s and '80s (Fig. 4). The leatherback population went from some of the largest in the world to basically collapsing.

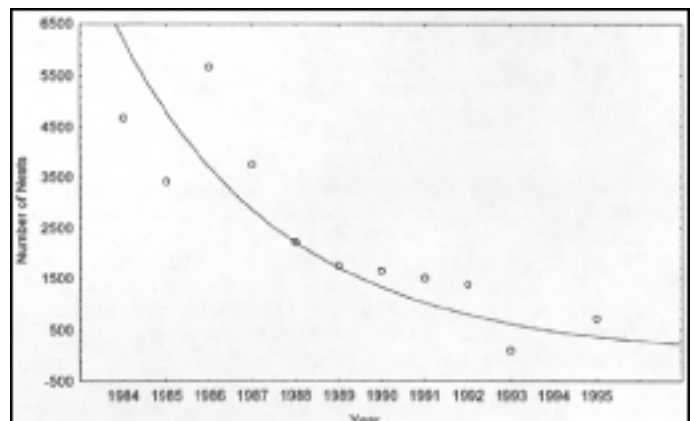


Figure 3. Leatherback turtle nesting trends in Mexico (Sarti et al., 1996).

Similar monitoring projects were started at nesting beaches in Costa Rica (Fig. 5). Again, a catastrophic decline in numbers. This became a big concern. So we started to wonder how many leatherbacks are really left in the Pacific? One area we knew the least about at the time was the area in Papua (formerly known as Irian Jaya) where large numbers of turtles were reported, but very little information existed.

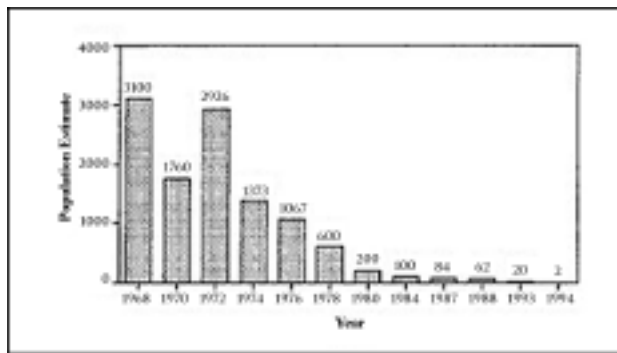


Figure 4. Terengannu, Malaysia leatherback turtle nesting trends (Spotila et al., 1996).

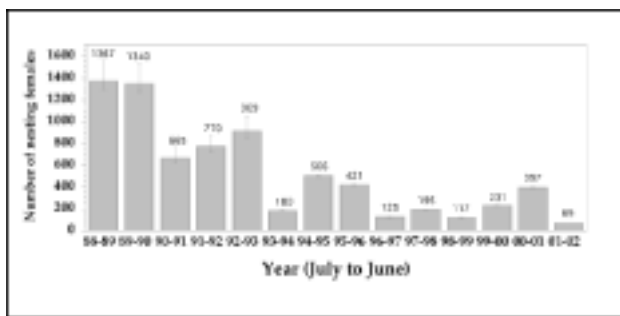


Figure 5. Costa Rica leatherback turtle nesting trends (Spotila et al., 2000, and http://www.leatherback.org/lasbaulscosta-ric/Las_BaulasProjectHistory.html).

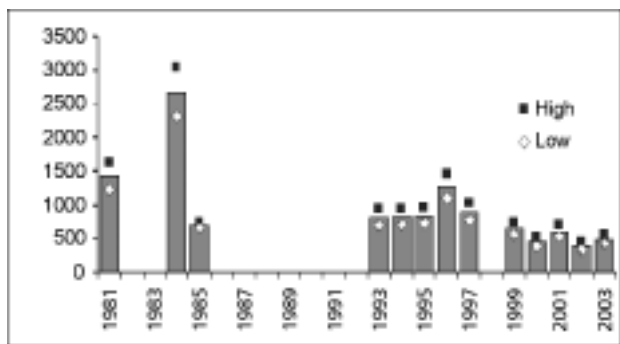


Figure 6. Leatherback turtle nesting trends at Jamursba-Medi, Papua (Hitipeuw, unpublished).

Since then, of course, a project has been initiated, led by World Wildlife Fund-Indonesia (WWF-Indo) and Creusa “Tetha” Hitipeuw, but big gaps of data still exist. There was once believed to be many, many turtles, possibly hundreds, maybe on the order of 1,000 turtles nesting per year, but now appear to be fewer. At just one beach in Papua, at the highest density beach, it too looks like the numbers have declined (Fig. 6). But there are questions about whether a population collapse has happened, as we’ve seen at the other populations in the Pacific. This gives us hope for now, that it hasn’t collapsed yet. We still have time to work with this population before it gets to the critical numbers expressed in the eastern Pacific.

The question remains, however, how many leatherbacks are there? You would think we would know by now, but people are still arguing this point. One of the questions that came out of the early work in Mexico was that maybe the populations didn’t really collapse, maybe they just moved somewhere up the coast and we’re not looking in the right place. In 1995, an aerial survey was initiated, and has continued every year since, to answer this question (Fig. 7).



Figure 7. Aerial survey route in Mexico designed to cover all five primary nesting beaches.

The answer to the question is, no. Aerial surveys every year along the whole coast of Mexico, Central America, and Panama have not revealed that nesting populations have relocated. A new nesting area was identified next to a previously known beach, but it only accounted for about 100 females a year. This didn’t explain the huge loss in numbers. However, with intensive monitoring at all index areas, every night during the nesting season, people are on the beach counting nests, protecting nests and tagging females. Add to this annual aerial surveys, we have a really good idea of the numbers of turtles nesting each year for the eastern Pacific.

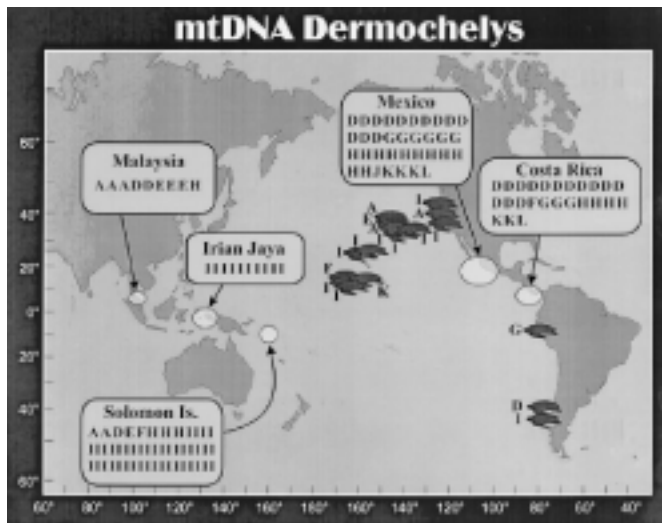


Figure 8. Genetic results of sampled leatherback turtles (Dutton et al., 1999 and unpublished data).

For the western Pacific, we don't really know with certainty whether there are any beaches out there that have not been discovered. However, we've begun moving in the direction needed to implement census techniques that are needed to get reliable estimates, such as aerial surveys.

What was responsible for the collapse in the eastern Pacific? Some believe that U.S. based fisheries here in Hawaii and off the coast of California were to blame. Therefore, in 1994 an observer program was initiated that documented bycatch of leatherbacks. But where are those turtles originating from? We assumed they were coming from Mexico and the eastern Pacific. So we began looking at the genetics to try to figure out if that was the case. This was the first time we had any idea that something different was going on than what we had assumed.

Turtles sampled from the north Pacific and samples from stranded turtles along the west Coast of the U.S. represent the genotypes or haplotypes of the various nesting populations (Fig. 8). The populations that make up the western Pacific stocks, that's PNG, Solomon Islands, Papua and Malaysia, are very different from the eastern Pacific. The stocks are distinct, but within the nesting regions they make up one genetic metapopulation.

The eastern Pacific nesting populations in Costa Rica and Mexico are genetically one stock. We use this information to figure out where these animals are coming from. What was really surprising was that all but one of the turtles that have been sampled to date all came from the western Pacific. At the time, this was a big surprise.

The next phase was try to catch animals at foraging areas in Monterey Bay, California and put satellite transmitters on them to see if indeed animals there are migrating to the western Pacific, which is where they should be going, if indeed that's where they're from. We figured out how to capture and put transmitters on with a harness system (Fig. 9). Indeed some of the early tracks went across to the other side of the Pacific.



Figure 9. Satellite transmitting turtles off of California.



Figure 10. Satellite transmitter training in Papua.



Figure 11. Satellite transmitting turtles in PNG.

This was the first time we realized that to manage leatherbacks at their foraging areas in the north Pacific, we need to turn our attention to the western Pacific, rather than to the eastern Pacific. But we really needed to figure out what was going on, how many turtles there were, what the status and trends of those populations are, and start working together. This is the background of how we ended up going across the Pacific to work with the local communities of Papua and PNG (Fig. 10).

It's been a wonderful partnership. We now have expert researchers in both Papua and PNG who can deploy satellite transmitters and are partners in this research (Fig. 11). We've deployed over 20 transmitters in PNG and Papua. In addition, our Japanese colleagues have also deployed a couple of transmitters in Papua.

The resulting data has proven very interesting, and the pattern has generally held up. The animals that were tagged at foraging areas of Monterey Bay generally tend to go towards the western Pacific. The female turtles tagged after nesting in Papua, migrate out and enter the North Equatorial highway enroute to foraging areas of the west coast of the U.S. In PNG, the females are migrating south. This mirrors the eastern Pacific, where again, turtles migrate south post-nesting. The genetic map therefore fits very nicely. In the north Pacific we are dealing with the Papua nesting stock. In the south Pacific, we

are dealing with the PNG and the eastern Pacific stocks. Of course, these are only females. Most of the animals that have been tagged are females, we know very little about males or juveniles.

This summarizes the challenges of leatherback conservation. Leatherback turtles range throughout the ocean and it is the reason we have reached out across the Pacific. Nations have gotten together and are realizing these migratory animals are in fact bringing us together. Currently there are a couple of active transmitters, ones that were deployed in Monterey Bay last year, and a few that were deployed on the nesting beaches in Papua. Currently those tracks are meeting just below Hawaii. So it is appropriate that we meet here in Hawaii, too.

Priorities for Management

Recently a meeting was held in Bellagio, Italy (Conservation of Pacific Sea Turtles, November 17-22, 2003; WorldFish Center, 2004). One of the priority calls was to protect all nesting beaches, starting with those of Pacific leatherbacks, and recommended a massive mobilization effort to protect the remaining leatherback nesting sites around the Pacific (Fig. 12). The goal, of course, is to protect every possible nest to ensure maximum hatchling production that can sustain the recovery of the depleted populations. Of course, there are issues of in-water and the high seas. But if we can't protect the foundation of those populations and do everything we can to secure nesting beaches, then everything else becomes moot.

The Leatherback Working Group

This is why we are gathered here today, to focus and make this a proper working group. One of the things we will do at this workshop is figure out how many turtles there are in these four countries of the west Pacific. All of you have been working really hard during this past nesting season [2003/04], so this is a good opportunity to look at the data and see what questions remain to help better design and implement research for the next nesting season. We need to make sure that methods are standardized, including PIT tagging, and to learn how to better manage databases. We also need to talk about aerial and ground surveys, and how to identify potential nesting areas we don't yet know about. Another objective

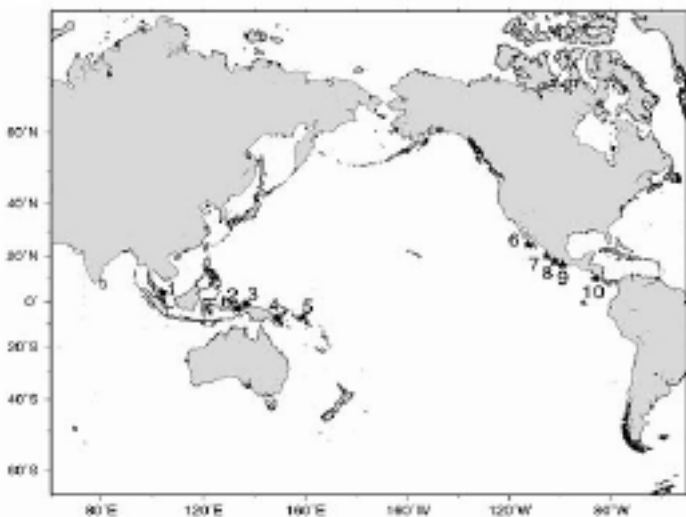


Figure 12. The ten leatherback nesting areas of the Pacific Ocean – priority conservation areas.

will be to coordinate conservation activities with the various entities, NGOs and government resource managers, that are here and interested in beach protection to help identify needs and develop proposals.

The goal and focus of this workshop are to keep our sites on long-term monitoring and protection; to generate reliable population estimates for the western Pacific stock in the same way that we have for the eastern Pacific to determine abundance and trends; and finally, to acknowledge the effective conservation measures that are being implemented, and make this a good interactive, focused working group.

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Papua, Indonesia

Leatherback Conservation at Warmon Beach, Papua-Indonesia: November 2003-October 2004¹

Julianus Thebu and Creusa "Tetha" Hitipeuw², WWF- Indonesia

Background

The region of the north Vogelkop coast of Papua, Indonesia supports possibly the last large nesting aggregation of the leatherback turtle in the Pacific Ocean. The importance of War-mon beach as nesting habitat for leatherback turtles was identified in early 1984 when a consultant (hired by WWF-Indo) started an intensive fieldwork program in Jamursba Medi, Bird's Head Peninsula, Papua, Indonesia. With lessons learned from a decade of field activities at Jamursba Medi, and technical as well as funding support from the Western Pacific Regional Fishery Management Council and NOAA Fisheries, WWF-Indonesia was able to start the field conservation project at War-mon beach as part of the larger framework of conserving Pacific leatherback turtles. The project is currently working on decreasing human induced threats to the population, such as egg harvests and habitat conversion, and quantifying the nesting population dynamics at this previously unmonitored and unmanaged key leatherback nesting beach.

Introduction

Surveys conducted in the 1990s (Bhaskar, 1985; Suarez et al., 2000) revealed a different leatherback turtle nesting

season at War-mon beach (winter) versus other sites in Papua, including Jamursba Medi (summer). This may ecologically imply that there are separate breeding colonies utilizing different nesting and/or foraging habitats. If this is the case, different management regimes are required and management-related research, especially on migration and foraging ecology, is also needed to better understand this particular population. Currently, information on the population size of leatherback turtles utilizing War-mon beach, its migration route, and its connection with the Jamursba Medi population does not exist.

War-mon beach lies about 30 km east of Jamursba Medi and extends six kilometers halfway between Welos Cape and Wau Villages (Fig. 1). The beach faces northeast and experiences extreme weather conditions during the late January monsoon season. It is divided roughly in half on each side of the Mon River mouth, 2 km to the west of the river and 4.5 km to the east of the river. The eastern beach is further separated into four segments by one perennial stream and the two dry streambeds, and is more favored by nesting turtles. The leatherback turtle nesting season runs October through September with peak nesting in December to March.

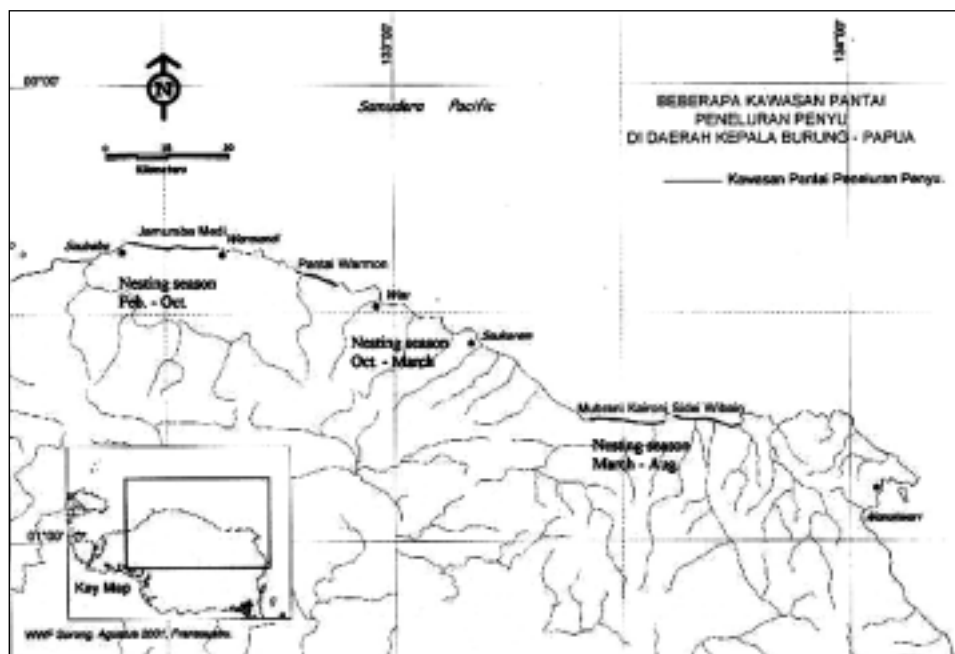


Figure 1. Bird's Head region, north Vogelkop coast of Papua, Indonesia.

¹ Final Report to Western Pacific Fishery Management Council: A Contract of NA03NMF4110017

² Presenting author

Project Activities

WWF-Indonesia aims to conserve Pacific leatherback turtles through habitat protection by using an effective co-management regime. The program's objectives will be achieved through greater understanding of the status, threats, and critical habitats of Papuan leatherbacks, as well as promoting community participation in conservation activities.

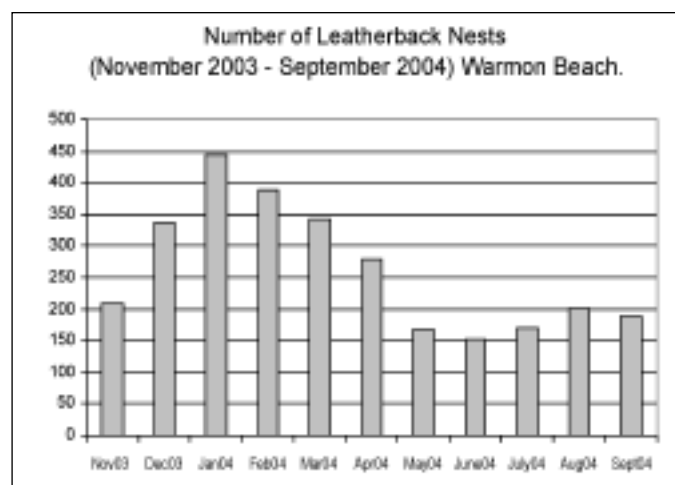


Figure 1. Total number of nests laid per month during the 2003/04 nesting season at Warmon Beach.

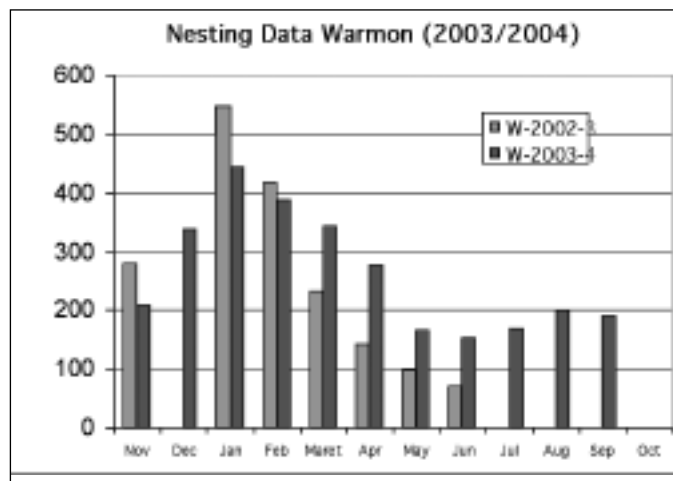


Figure 2. Comparison of nest counts in War-mon beach for two nesting seasons, 2002/2003 and 2003/2004.

Project Objectives

The objectives are protection of nesting beaches, nesting leatherbacks and their nests in War-mon Beach through a community-based patrol and monitoring program, and

other relevant initiatives that demonstrate the benefits of conservation towards improving the people's quality of life.

To protect nesting beaches and the nests of leatherbacks from human-based threats, two major activities are conducted by the War-mon project. These include: community based patrol and beach monitoring, and community consultations aimed at gaining local people's support for leatherback conservation.

Beach Patrol and Monitoring Activities

Standardized techniques for data collection and recording were applied by the project. A team of three monitoring personnel conducted the daily/nightly patrol along the 4 km length of War-mon beach. Teams recorded new nests and crawls, and took note on disturbances and threats to nests, such as animal depredation and beach erosion (Table 1 and Fig. 2). For comparative purposes, Figure 2 is included for a graphical representation of the nesting season between the first pilot study of 2002/03 and this second year of monitoring 2003/04.

Table 1. Number of nests laid, predated and/or inundated by wave activity between November 2003 to September 2004.

Month	Nest Counts	Depredated nests			Inundated Nests
		Pigs	Dogs	Lizards	
November 2003	208	12	11	0	62
December 2003	338	19	21	0	56
January 2004	445	31	15	0	75
February 2004	389	24	11	0	62
March 2004	343	0	0	0	23
April 2004	278	19	26	0	4
May 2004	167	15	18	0	14
June 2004	152	0	0	0	0
July 2004	170	64	0	0	0
August 2004	202	168	12	0	0
September 2004	189	17	22	0	14
TOTAL	2,881	369	136	0	310

Based on the data collected and the monthly distribution of clutches, it is evident that leatherback turtles nesting at War-mon and Jamursba Medi beaches have different nesting seasons (Fig. 3). However, population estimates from past census should be interpreted with caution, since it is clear that War-mon is a sizable rookery that has been overlooked in the past. This first complete, year-round census at War-mon beach in 2003/04 found

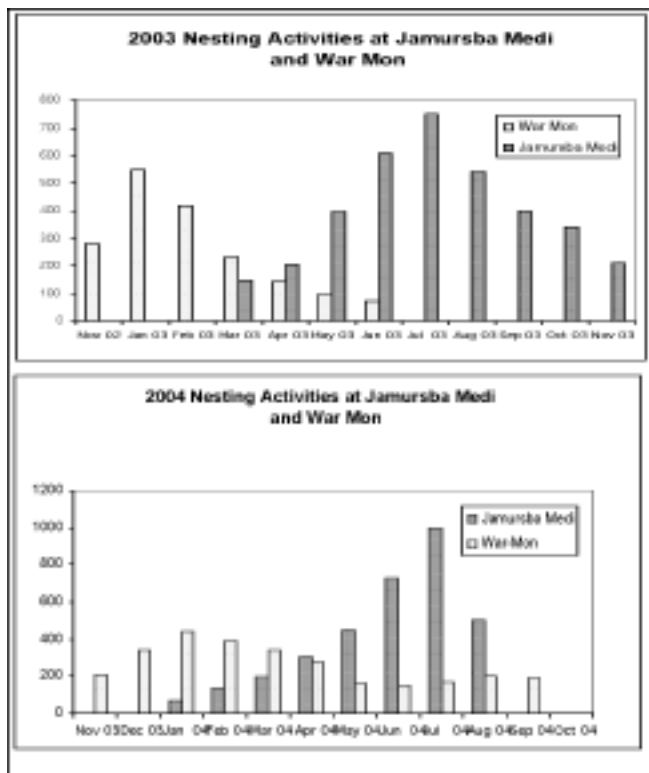


Figure 3. Monthly distribution of leatherback turtle clutches between Jamursba Medi and War-mon beaches.

almost comparable number of nests laid in War-mon as at Jamursba Medi (Fig. 3). It is unclear whether this represents a recent demographic shift, or if there has always been this level of nesting in War-mon beach. Further work is needed to determine whether Papuan leatherbacks consists of two distinct populations.

Due to community resistance, PIT tags (which would assist in quantifying the number of nesting turtles) were not applied during this reporting period at War-mon beach. Tagging activity is perceived to have resulted in a decrease of the nesting population at Jamursba Medi. This situation made the field team decide to suspend the use of PIT tags and instead conducted intensive awareness building consultations (workshops) to gain support for future tagging. However, one scanner was provided to the monitoring team to scan any encountered female leatherback turtles to detect whether any Jamursba Medi turtles (which are PIT tagged) may also nest at War-mon, especially during the Jamursba Medi peak season of June and July. No PIT tagged turtles were observed during this period.

Intensive PIT tagging is required (in War-mon) to acquire information on the use of War-mon beach by Jamursba Medi turtles and vice versa. Therefore, consultations with villagers to discuss tagging were initiated in April 2004, and intensive individual and group consultations were again conducted in August. There are pros and cons among village members regarding the impact of PIT tag application. Despite general acceptance by communities including the village leader and landowners, negative intervention by certain party members spread negative comments regarding tagging impacts and discouraged the community's support of PIT tagging. At the Customary Council meeting in November 2004, additional information was provided to community to explain the importance of tagging and satellite tracking (Fig. 4). At this meeting, it was agreed through a written agreement (between WWF and the local community) to allow satellite tracking work to ensue in early February 2005. Part of the agreement is to provide a deployment tax of 500,000 Rupiahs per turtle (approximately 10 turtles will be deployed with transmitters). Funds will be used for village development proposes.



Figure 4. Tetha showing children the migratory tracks of leatherback turtles on computer.

Management Related Activities

Management issues that influence nesting activities and hatching success were assessed during monitoring activities to design strategies for intervention. The following aspects were recorded:

Egg Predation

Of nests laid, 18% were plundered. Existing data revealed that 13% of egg predation came from pigs in the night, and 5% from domestic dogs during the daytime which prey upon freshly laid eggs. Starbird and Suarez (1994) reported that egg predation by pigs at War-mon beach exceeds 40%. However, during the 2003/04 nesting season it was felt that nightly beach patrol operations

prevented egg depredation by pigs at night, especially for the smaller beach stretch. Additionally, anecdotal information suggests that harvest of pigs by the local community has resulted in fewer pigs and an overall lower rate of predation³. To maintain patrol operations, it was determined that field facilities be improved. Reconstruction of the existing station will be implemented before the next nesting season begins.

Nests Inundation

The north eastern monsoon severely determines beach dynamics. During this nesting season, it started two months earlier than normal (in December). The unusual and unpredictable monsoon occurring at the start of the nesting season created difficulties in conducting intervention activities to save threatened nests from beach erosion or inundation. This was due to the inability to select suitable relocation sites.

Intervention trial

As an experiment, ten nests that had the potential to be doomed from inundation (based on previous observations of the tide line) were relocated to a safer location close to its original site, but above the high tide mark. The relocation took place immediately after egg-lay, with careful handling. However, these relocated nests were washed away by the unpredicted tidal flood and resulted in no hatching. The unusual and unpredictable tide conditions made it impossible to continue egg relocation for the rest of the season due to difficulties in selecting suitable sites. During this monitoring period, about 10% of the recorded nests were washed away. Therefore, additional research is necessary to characterize the beach profile and monsoon dynamics to allow for better site selection in the future.

Community Consultations and Livelihood Support Initiatives

Based on consultations with the local community, income generation activity was identified as an important intervention when the protection of nesting beach is concerned. The beach patrol that was carried out by a small group of villagers (some of whom are relatives of

the landowner), brought twofold benefits. First was provision of temporary employment for the village members. Second, there was a substantial decrease in egg poaching by outsiders, since permits for egg collection is usually allowed for a fee by landowners. Currently, three more additional monitoring personnel have been recruited for the 2004/05 nesting season. In this way, more community members will be involved. However, further arrangements need to be considered. This part of the local empowerment process has been postponed until the coming months in order to synchronize with other empowerment activities of WWF (from a different funding source) in Jamursba Medi. It is recognized that this empowering process may take some time for acceptance by local communities.

The absence of transportation at this remote area was identified as the major obstacle for any economic development. Hence, a startup activity has been proposed by the communities to help them resolve the transportation problem; such as long-boat and two 40-HP engines that can be used as 'vehicles' to speed up the empowering process regarding livelihood development. The same initiative has also been applied at Jamursba Medi. In addition, the community is currently constructing their church building and has asked for material support from the project. The response to this request may provide opportunity for the conservation project to show its concern for and participate in community activities.

Workplan for November 2004 to Oct 2005

- Beach monitoring (including hands-on training on PIT tagging application)
- Preliminary assessment of beach quality and the dynamics to protect nests from being washed away or predated upon
- Implement management intervention such as relocation of vulnerable eggs (includes training and implementation)
- Satellite tracking
- Livelihood support and community involvement activities

³ An increase in the human population and a consequent increase in protein needs of the community have induced a high rate of pig hunting activities (with snare and spear)

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Community Based Management of Leatherback Turtles Residing in Kei Islands: Reducing Mortality Due to Traditional Hunting Practices¹

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Introduction

The leatherback turtle has a large cultural significance to local customary groups in Kei Islands of Maluku, Indonesia (Figs. 1 and 2). It has served as a sacred component of the diet for villagers for many generations. Local communities assume that, because of its traditional role in their culture, the leatherbacks will always reside in their surrounding waters and never go extinct. Prior information by Starbird and Suarez (1996) suggests that approximately 100 adult (male or female) leatherbacks are hunted in the Kei Islands foraging grounds during the annual season of November to February. Considering the critically endangered status of Pacific leatherbacks due to various hazards, including incidental catch by fisheries, the threat from the traditional/subsistence hunting should be understood and alleviated if possible. This measure, being addressed in this project, together with reduction of by-catch and egg poaching at nesting beaches (see final report for Warmon beach), will contribute to recovery efforts. WWF-Indonesia recognizes the importance of addressing the direct hunting of leatherbacks in addition to protection of major nesting

beaches in Papua, in order to significantly contribute to the recovery efforts of the species in the Pacific region. Funding support from the US Western Pacific Regional Fishery Management Council and technical support from NOAA-NMFS, Southwest Fisheries Science Center has enabled WWF-Indonesia to address this important issue and has set the groundwork in the Kei islands by assigning a local community organization to lead this effort.

PROJECT OBJECTIVES

This project was initiated in October 2003 with the main objective to 'Reduce mortality of leatherback turtles at their foraging grounds due to traditional hunting practice.' The main challenge of this conservation initiative was to change perceptions of Kei island villagers of the fate of the species, and their existing global status level, and to promote significant contributions to recovery actions. To encourage acceptance and participation of target communities, it was crucial for the project to consider the role of socio-cultural values as they relate to hunting practices, including the relevant indigenous institutional arrangement, and to apply strong communication strategies.



Figure 1. The Kei Islands, Papua, Indonesia.

¹ Final project report submitted to the WPRFMC; A Contract of NA03NMF4110017

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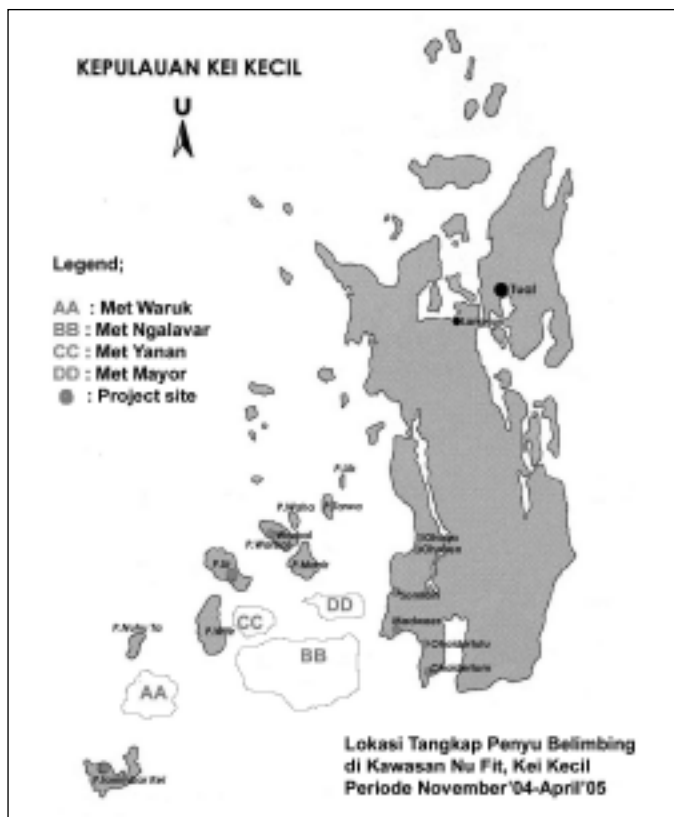


Figure 2. The islands which comprise the Kei Kecil Islands of Papua, Indonesia. The project sites are denoted, as well as approximate hunting location of customary hunting clans during November 2004 to April 2005.

To achieve the conservation objective, three major components of the project were identified as follows:

- Awareness and Education - including dissemination of indigenous and modern scientific knowledge (research results) for different target groups in all villages with customary law related to leatherback.
- Livelihood support - as trade-off for participation by the indigenous community in conservation activities. This fits the message of the ancestor's blessing: a reward to save leatherbacks.
- Promote sustainable harvest - regulated in the Nu Fit Customary Law and supported by relevant government regulations.

These three components were implemented through community organization and empowerment approaches, including community consultations and field observations.

PROJECT ACTIVITIES

A socio-cultural assessment of the hunting communities was conducted prior to the development of the project work plan. This first year's activities were focused on conservation awareness program (intensive consultations and outreach activities) and needs assessment for relevant livelihood support at nine major hunting villages: Ohoidertom, Ohoidertutu, Madwaer, Ohoiren, Somlain, Ohaira, Warbar, Ur, Tanimbar Kei. These activities were conducted during the hunting season November to March. The latter component was meant to gain the local trust and fuel the awareness process. Continuous assessments were also conducted through intensive community organizing activities for a better understanding on the background of the practices and the existing values associated with hunting. This allowed WWF to design an appropriate approach to address the conservation issues and integrate these into the existing customary institutional frameworks. Along with these activities, capacity building activities such as training to draft village regulations and proposal writing (in response to immediate needs from the communities) were also conducted. Finally, WWF has succeeded in facilitating a clan meeting to discuss the issues related to natural resource management and regulations on hunting activities covering 13 items which were summarized in a call of action to be followed by a small customary committee.

Socio-cultural Assessment

Careful assessment of the local socio-cultural and economic perspectives in relation to leatherback hunting was conducted at the beginning of the project period. These activities were aimed to design the best approach to address conservation issues and adaptation of the local customary institutional frameworks. Based on the initial findings, the following strategies were developed:

- Awareness program on the status of the Leatherback turtles (socio-cultural perceptions versus bio-ecological perceptions).
- Revitalization of existing customary framework to stimulate sustainable use of natural resources (in general) and leatherback hunting (in particular). A unique opportunity was used on policy to decentralize mandates in managing natural resources.
- Economic related activities to gain support and trust of conservation initiatives in line with the ultimate goal of the project. For example, focusing the community that

hunting or community hold mandates for decision making is that of the customary group federation Nu Fit.

Harvest Monitoring

This initiative was conducted as a starting point for project activities to be used as a baseline (harvest level) for measuring the achievement of the project, as well to gain information that will be useful for the communication component of the project. In addition to hiring village personnel to collect the data, recent issues and relevant factors contributing to hunting and opportunities for (conservation) intervention were also identified and are being used for developing strategies for the project. Nine local villagers from nine villages Ohoidertom, Ohoidertutu, Madwaer, Ohoiren, Somlain, Ohoira, Warbar, Ur, Tanimbar Kei were hired to collect data on the catches (numbers, location, size, sex, effort, and hunter identity). During the period of November 2003- March 2004, 23 leatherbacks were recorded harvested (Table 1). The harsh and unusual weather conditions during the winter period is possibly the main reasons to hunt leatherbacks as substitute to fish, shellfish or shrimps.

During the monitoring period August to October 2004, an additional six leatherbacks were caught. Of these turtles captured, one was caught by a group in Ohoidertutu and was served to participants during a large catholic youth meeting in August. Another individual was caught by a villager who stays in town. Two leatherbacks were incidentally caught in fishing net (gill-net), and slaughtered for consumption (in Warbal and Ohoira). Additionally, one individual was found stranded on the beach.

Intensive interactions of project personnel with villagers of the nine villages through consultations (regarding leatherback conservation) and hunting monitoring likely discouraged additional hunting activities in the current season. In general, leatherbacks of smaller size were recorded during this period (and confirmed by local people as common case). This indicates that the Kei islands provide a possible developmental habitat for these leatherbacks. In addition, field staff observed significant occurrence of small white starfish (Ophioroidea) in the stomach contents of slaughtered female leatherbacks. Multiple foraging habitats of leatherback turtles was recently identified by satellite tracking in the Birdhead area of Papua which pinpoints the possible relationship between the foraging population of Kei Islands and the breeding population in Papua. However, more DNA sampling as well as satellite tracking and other relevant studies are required to validate such hypothesis.

The following are the identified factors that influence the degree of hunting:

- Hunting activity is related to cycles of economic activities (beginning of crop planting season, fishing, seashells and sea cucumber wading), social activities (church related events) and the climate (rainy season), which are also varied among villages.
- More hunting occurred when the hunting area is more accessible e.g. people of the village of Somlain sighted leatherbacks in the water nearby in January; 'locally' perceived as: 'they offered themselves (sacrifice) to be caught.' The same happened in the village of Ohoidertom in 2000, enabling villagers to catch seven leatherbacks at once, and in more populated villages (e.g. Ohoidertutu),
- Less hunting was observed in the island villages: Tanimbar Kei, Ur, Warbal. The reasons for this are: busy with economic generated activities, hard to find leatherbacks nowadays, and insufficient facilities.

Community Consultations

Community consultation activities have been the nature of overall implementation of the project. The purpose of the consultations was to elaborate the project components into more specific, well-targeted activities including strategies to communicate leatherback conservation issues. This was done as a highly sensitive customary issue associated with leatherback hunting practice requiring a thorough analysis to develop relevant activities to avoid community conflicts and failures at the beginning due to local sensitivities. This is termed a 'socialization conservation project', whereby identification of communication messages and tools, as well as approaches to address conservation issues that may conflict with local practices were conducted through intensive consultations with different individuals or groups. Based on assessment findings, intensive consultations were focused on six major villages on the mainland of Kei Kecil where the highest hunting incidence or the most influential in customary decision-making existed. Villages on the other three smaller islands were difficult to access during the north-western monsoon (stormy weather), but were visited and consulted with at the later stage of project term when progress in term of local acceptance was gained from the six mainland villages.

Table 1. Summary of Leatherback turtle harvest in the Kei Islands: November 2003 – October 2004.

Hunting Village	Sex	width CCL(cm)	length CCL (cm)	Hunting Location	Date	Notes
Somlaine	female male male female	43 112 120 111	52 135 145 124	Lt.Somlaine Lt.Somlaine Lt.Somlaine Lt.Somlaine	20 Nov' 03 16 Jan'04 18 Jan'04 3 Jan'04 Jan' & Feb' 04	3 hunted; additional information from other villages report that actually 10 may have been harvested
Ohoidertom*	male female female male male male	80 86 75 90 107	110 120 123 145 153	Met Waruk Met Waruk Met Waruk Met Waruk Met Waruk	19 Nov'03 23 Nov'03 23 Nov'03 23 Nov'03 23 Nov'03 Feb' 04	
Madwaer	female female male female	80 87	145 170	Met Vait Met Yanan	22 Nov'03 2 Oct'03 Jan' 04 Oct' 04	Stranded rotten on The beach
Ohoidertutu*	female female female female female 2 females 2 males male female female	86 80 91 110 113	187 160 125 155 157	Depan P.Witir Depan P.Witir Met Vait Depan P.Witir Met Mayor Depan P.Witir Depan P.Witir	19 Nov'03 19 Nov'03 19 Nov'03 19 Nov'03 20 Nov'03 Jan' 04 Feb' 04 29 Aug' 04 25 Oct' 04 Sept' 04	Village feast purposes For catholic youth feast By Ohoidertutu people in town
UR	female				Feb' 04	
Warbal	male				Sept' 03	Entangled in coastal gillnet
Ohoira	female				Oct' 03	Entangled in coastal gillnet

* Ohoidertutu and Ohiodertom are the villages with the highest human population.

Community Outreach and Awareness

The general local belief that leatherback turtles constitute a sacred diet and are incarnations of people's ancestors contributes to the perception that leatherback populations are naturally sustainable. This belief is widely held by the community members across ages and education levels. Good hunting at one village encouraged other villages to hunt more. Limited access to new information is one of the reasons this behavior persists. However, new information regarding the endangered status of leatherbacks obviously contradicts this local belief/knowledge (derived from old legend), and hence the information needs to be carefully disseminated and communicated. In addition, the fact that role model individuals within the communities hold similar perceptions regarding the long lasting occurrence of leatherbacks in Kei Islands seems to provide a barrier (contra-opinion) to communicate the conservation issues during informal meetings. This group of key figures therefore, is a priority target for communication in the near future.

The premise of the following legend (Fig. 3) is that:

- Leatherbacks comprise the sacred diet of ancestral villagers, the Nu Fit people;
- The Seven ridges of a leatherback's carapace represent the 'core' 7 hunting villages;
- Leatherbacks are the binding factor for Kei people;
- Their distribution represents the traditional use right; and
- Their position as "sacred diet" is verified in that when hunted, the species turns its body upside down, thus "offering" itself for harvest.

The consultation and assessment activities provided critical inputs on developing communication material and tools. Additional topics that specific communities were interested in were also identified. For example, people in Ohioiren village are interested in the cultural aspect of the leatherbacks and their hunting practices, while those in Ohoidertutu and Ohoidertom villages are keen to know about the ecological aspects of the species, including the optional hunting site when they do not occur in Kei waters. Furthermore, village meetings are suggested to be the most effective way to communicate with villagers, as hunting leatherback is considered a communal right.

Village Meetings

Based on the informal discussions/consultations conducted prior to village meetings, the message "the fate of the Pacific Leatherbacks that are under threat to extinction" was chosen as main issue for discussion during village meetings. This was meant to trigger local response towards a different perception based on the findings from research and monitoring efforts throughout the Pacific region. Included in the discussion were certain behaviors of the species that are locally persisted as 'being ordered.'

As agreed with the community, village meetings were mostly conducted on Sundays to allow the participation of larger community groups. During this reporting period, meetings at the six mainland villages and three island villages were completed. The meetings were attended by village members from different ages and sexes, with an average of 80 villagers in each village excluding children (Fig. 4). The movie presentations were made at night, and this turned out to be entertaining as most villages do not have access to television broadcast. Documentation taken during the meeting was later represented in Power Point at the end of the video show, to wrap up the days meeting.



Figure 3. Leatherback (Tabob) oral history of the Kei Islands, ancestral Nu Fit people.



Figure 4. Community meetings

Main topics of discussion in these meetings were:

- The reasons why leatherback turtles in the Pacific region need serious protection.
- Various efforts taken worldwide to protect leatherback turtles, ranging from beach protection and bycatch mitigation to efforts to identify the most effective way to protect the species from extinction.
- The importance of involving Kei Communities (Nu Fit People) in leatherback protection efforts.
- How the conservation funds for leatherback turtles are generated and how can it be used as part of the global protection effort.

Various interests were expressed during these meetings, however, important highlights or expectations towards the project were noted, such as:

- Need for a monitoring post at each village to discourage hunting activities.
- Need to formulate village regulations on natural resource use, including hunting regulations. A pilot study is expected to be done in Ohoidertom and Ohoidertutu which happen to be the major hunting villages.
- Facilitate a larger meeting among Nu Fit People, proposed by the customary leaders, to discuss the possibility to develop joint hunting regulations among the hunting villages.
- Facilitate a satellite tracking project such as that being done in Papua (with NOAA-SWFSC), the site which is believed as the origins of leatherbacks in Kei. Local

villagers are keen to be directly involved in this activity. There was, nevertheless, an expectation raised that the tracking results should serve to prove the living legend of the leatherback. On the other hand, project personnel foresee that involvement of foreign researchers will encourage the reduction of hunting rate in the next season .

Media Development and Communication Center

Relevant audio visual media related to turtle conservation was presented. Several documentary films on leatherbacks such as the one taken from Jamursba Medi of Papua, and the Jurassic Journey were used to expose the conservation efforts on leatherbacks conducted by other scientists and traditional communities. Such exposure to the local communities was done in order to show that leatherbacks also occur in other waters, that large scale efforts are being taken to save the species from extinction, and that other traditional communities such as those in Papua and Papua New Guinea are also involved. The information that was disseminated during this period, mainly during the village meetings included:

- The threats to leatherback turtles, its current population status, and both the national and international protection status.
- Information directed to change the common (mis) perception that associates the presence of NGOs with provision of direct funding to communities, and explanation on how the conservation funds are generated and used.
- Recent government policy on village autonomy, opportunities to self manage the natural resources including leatherbacks, and the critical steps to set up village regulations.
- Booklets to provide balanced information on both local and global perspectives of the leatherbacks were distributed to villagers.

Field Station

The field station was intended as a work space for the team during the field organizing activities. However, delivery of conservation messages in the early project implementation phase was often encountered with other conflicting issues raised by outsiders or local communi-

ties residing in the district town. It was then determined that the physical presence of the project team among the communities was required not only for conducting the field work, but to gain the local trust and to respond to certain emerging issues. Construction of the field station was well-accepted by the local communities. Land was rented and construction was done by the local people. Currently the field station serves for village meetings, clan meetings, and training purposes (Fig. 5). In the future, the field station is expected to function as an education and communication center for the Nu Fit people, where information on the management and sustainable use of natural resources (e.g., agriculture, fishing, and marketing) will be made available.



Figure 5. The Kei Islands field station.

Customary Institutions Empowerment

A series of informal discussions with key persons in each village were conducted to discuss existing customary institutions and the relevant mechanisms to deliver communal decisions about natural resource management and common property, including leatherback turtles. Several points below were key findings that were identified and verified during the clan meeting, and are being considered as regulations regarding leatherback hunting and management of other natural resources:

- Leatherback turtles were once a power symbol of the Clan Madwaer (in the past known as Reli Badangmas). As a living legendary heritage, it is nowadays passed on to the Clan Somlain. Internal conflicts between

villages under the two clans are often difficult to resolve. This fact needs to be considered in order to avoid a deadlock or creation of new conflicts when conservation issues and leatherback hunting management (as being a common property, and a power symbol) are raised among the Nu Fit communities that possess the rights for leatherback hunting. However, the exclusive communal hunting rights of these communities make them different from other clan groups in Kei islands. Management of leatherbacks as common resources can be used as a tool to re-unite/revitalize the customary based inter-relationships among all villagers within the clan.

- Awareness on leatherback conservation and initiation of community-based management are effective only through series of public consultations. It should be started with smallest kinfolk groups and link up to the village level communal decision-making forum or higher customary institutions. In addition, the information should cover larger natural resource management issues of interest to the general public. In this context, leatherback turtles can be used as a tool to generate communal decisions on wider natural resource management.
- The efforts for institutional capacity building at the village level, on how to deal with the management and use of natural regulations and mechanisms, should be used as a starting point. The recent government decentralization policy authorized the local government to manage the natural resources, and allow for its further decentralization to the lowest administration at the village. This encourages the local community to take the responsibility to manage their own resources, which simultaneously provides opportunities to revitalize the customary institutions and its decision making mechanisms.
- The traditional management system called *sasi* has frequently proved effective to manage certain communal valuable commodities and to prevent over-utilization. In certain villages, village regulations on area-time closures of valuable commodities are well documented to function. However, application of such village level *sasi* has the potential be problematic in relation to communal properties that commonly belong to a group of villages, like leatherbacks or other marine resources.

In general, three different perceptions regarding the existence of leatherbacks need to be considered in any management intervention. In communicating conservation messages to individual communities, at least one dominant issue that might be perceived differently among the community groups should be highlighted. Currently, the project is able to define the dominant different perceptions on leatherbacks by certain villages, as follows:

- Madwaer villagers consider the leatherbacks to be their Ancestors, locally called *Ub*, and they have a higher tendency to conserve the leatherbacks, as they are related to self-identity. The living legend says that leatherbacks used to be reared at this village;
- Ohoidertutu villagers considered the leatherbacks as the symbol of sea tenure, locally named *Tad*, and the loss of the leatherbacks or disappearance of the species will give ways for government to intercede on behalf of the village's traditional ownership rights of waters.

When measures of leatherback conservation are acceptable by only one village, there is doubt whether the other villages will do the same. This presents the challenge for the project to facilitate a meeting for the overall Nu Fit people to discuss a collective decision. The existing information on the 'blood relationship' among villages can help bridge the communication barriers between the communities at either individual or group level. This is needed to find out why individual communities are willing to eliminate hunting, whether it is for preserving the cultural existence of the people, or other reasons.

Village Regulation Training

The recent implementation of village autonomy, which authorizes the village administration to manage its local resources for village revenues, provides the opportunity for addressing leatherback conservation, as the area where this species occurred was generally accepted as local sea tenure. Continuous presence of leatherbacks in surrounding waters legitimizes the boundaries of traditional use zones.

The importance of village regulations as an instrument to manage natural resources, including leatherback turtles, was agreed by most communities. The project provided technical and logistical support to conduct training on village regulation drafting for 19 village leaders from six mainland villages. The training was facilitated by an expert on local community empowerment who is familiar with the society and cultures of Kei Islands. Similar

training for the other three island villages will be conducted in the next project period. The village regulations regarding leatherback hunting were used as an example of the draft regulation with considerations of both the customary and legal aspects.

Clan Meeting

Following the above stated training, a clan meeting was held at the same venue and was attended by 24 participants representing formal and informal leaders from all hunting villages. The meeting was of high interest to the communities, as shown by the presence of the customary leaders (Raja). Such a meeting had not occurred for almost 100 years. The major agenda of the meeting was the management of resources within the Nu Fit traditional Sea Tenure and management of leatherback hunting. The main materials discussed during the meeting were the sample village regulations on leatherback hunting drafted in the previous training, and some awareness materials on regulatory framework for leatherback hunting according to the 'original' rules and its purposes. The purpose was the "call for thirteen actions," and a small committee consisting of local leaders assigned to implement the related actions was established during the clan meeting. It was agreed that in the coming project period, WWF will provide technical assistance and logistical support for the committee.

Livelihood support Activities

To most traditional communities, introduction of new initiatives or projects is more acceptable when it entails immediate economic benefits to the people. Therefore, the conservation program was designed to encourage local participation in conservation actions that simultaneously maintain positive traditional values. Economic driven activities were introduced to fuel and gain local trust and accelerate the empowerment process. In the case of conserving the most endangered turtles in the Pacific region, livelihood support can be perceived as trade-off for the indigenous communities' contribution towards the species conservation at the global scale. This fits the ancestor's message of rewarding the saving of leatherbacks, which by tradition, is held by community members.

During the first three months of the projects' implementation, the need for a quick economic fix intervention was obvious to significantly reduce leatherback hunting; especially for those dense-villages or those that possess the local mandate for customary related decision-making.

Informal discussions on possible economic interventions took place soon after assessments of common needs of each individual village. The intervention is expected to trigger community's willingness to quit their traditional practices, as part of the recovery processes for the leatherback population. The major constraint to economic development in the area is the lack of transport facilities, especially to access the nearest market in the district town. Intervention in this particular sector is crucial as a trade-off when a group of leatherback hunting villages is expected to stop hunting. However, the intervention was held down for financial sustainability reasons, as follows:

- Consult other parties (e.g., the local government) for possible subsidy.
- Need a better understanding on whether the economic intervention will lead to the expected behavioral change, i.e., eliminate or reduce leatherback hunting.
- Continuity of project funding.

The possible interventions identified by village to be further analyzed and prioritized in the coming stage [2004/05 field season] include:

- Ohoiren: improvement of management, quality and marketing for home industry production (bamboo craft and 'knives')
- Ohoidertutu: training to increase the quality of craft products (rug carpet)
- Madwaer: improved skills in the dry-land agriculture production, management, and marketing of products
- Ur and Tanimbar Kei: improved processing quality and marketing of salted fish
- Warbal and Tanimbar Kei: sea cucumber farming
- Somlain and Ohoira: water supply facilities
- Madwaer: fishing nets (for fishermen groups)

WORKPLAN FOR NOVEMBER 2004 to OCTOBER 2005

Recent progress of the project, recommendations and a call for action resulted from the Clan Meeting that should be followed up with in the up-coming future activities of the project. Intensive consultation/facilitation to the small clan committees and awareness will be the major part of project activities. Some livelihood support intervention will also be implemented based on

the current findings. In addition, the positive response from the community to date provides an opportunity to further engage local people in research to further understanding of the basic biology of this species, critical to conservation and management issues. Future proposed activities for this project include:

1) Continue Harvest Monitoring:

- Identification and recruitment of monitoring personnel by the clan committee
- Training on data and sample collection techniques
- Implementation of monitoring activities
- Regular evaluation (on techniques and results) at the end of the hunting period

2) Capacity Building: Community empowerment, organizing and outreach:

- Conduct Training for developing village regulation at the three island villages
- Provide technical assistance during the development process of village regulations in all hunting villages
- Provide technical assistance and logistic support of the development process of clan (customary-wide) hunting regulation
- Provide technical assistance and logistic support for the clan committee
- Provide technical assistance and logistic support the second clan meeting to finalize hunting regulation draft, public consultation process
- Provide technical support for documenting Socio-history of Nu Fit Custom
- Facilitate cross-visit of community members to Papua (Jamursba Medi, during peak nesting seasons) or other sites.

3) Community Outreach:

- Finalize, print and distribute booklets (Local belief versus International Concern)
- Process documentation of project activities for awareness campaign in Kei Islands in general, and communicate lessons learned for magnification at other sites
- Promote and support cultural event in conjunction with the proposed satellite tracking activities

4) Policy advocacy:

- Conduct dialogue/consultations with legislative members on the adoption of Nu Fit (customary) regulations into the formal district policy framework

5) Livelihood support activities:

- Provide training for home production and management of salted fish, agro-business (all villages)
- Support water supply (urgent needs) in Somlain, Ohoira, and Madwaer

May 2005 Project Update

This section summarizes some of the progress which has occurred since convening the Leatherback Workshop in May 2004 which has been realized during the project's 2004/05 winter field season.

A number of behavioral changes have been documented due to the project's interventions in regards to the number of active hunting villages and the number of people who are no longer involved in hunting activities. Although progress is still far from complete and it is too early to celebrate success in reducing leatherback harvest rates at the Kei Islands, recent results and changes in community behavior provide encouragement and clear direction of for future interventions. For example, the project plans to build on these preliminary successes, conduct intensive community consultations in Ohoidertutu (a village which undertook intensive harvesting), and promote local activities during hunting seasons that involve young people (such as the Nu Fit Festival), satellite tracking and livelihood related activities) to provide alternatives to joining the hunt. The strengthening of local (clan) mechanism to regulate hunting based on the best available scientific knowledge is a primary target to ensure long-term conservation actions. The size of the foraging population and foraging ecology are important and critical research areas which will provide the necessary information to support management and customary hunting regulation. In the meantime, working with individual villages and individuals within a village is critical towards the communal and customary decision making process.

As of May 2005, progress includes:

- The presence of field station in Ohoiren village and support from the village leader to implement the

awareness program has resulted in no hunting from Ohoiren villagers. The closest village, Ohoira, where the sub-district town is located, has also had zero hunting effort. The new sub-district leader was involved in the awareness raising process and is promoting the occurrence of leatherback turtles in Nu Fit as a potential asset for marine tourism.

- 15 young villagers at Ohoiren, who used to be hunters, are currently more interested in discussing possible income generating activities.
- A group of Ohoiren women refused to eat leatherback meat at a church event in Somlain village. They protested the hunting activity that took place for this event and accused the village of ignoring awareness efforts by the project.
- Five active hunters (three from Somlain and two from Madwaer) refused to be involved in hunting activities during this project period. According to interviews, they understand the need for local protection to conserve leatherback turtles to maintain their cultural identity. Four of these five ex-hunters received training in village regulation and resource management workshops.
- Five individuals from the Renfaan family in Madwaer village decided not to be involved in hunting activities conducted by this hunting group, and supported the call from the village head and a community leader (Raja Magrib) to not undertake hunting activities. Intensive organizing and livelihood support activity enhanced more support for the conservation initiative. The project believes that intensive organizing and livelihood support activities will enhance more support for the conservation initiative.
- Two groups of hunters from Ur village chose not be involved in hunting activities during the 2004/05 winter season, and expressed their understanding of local protection to maintain their cultural identity and stressed the value of leatherback turtles.
- The only hunter which remains in Warbal village (from Rahakbau family) has decided to give up hunting and focus instead on developing income generating activities with help from the project. Furthermore, Warbal villagers expressed that they are not interested in consuming leatherback turtles.

- Three individual hunters from Ohoidertom village have decided to give up hunting activities due to the presence of the project and as a result of awareness raising activities. They expressed understanding of the advantages of having the project develop the Nu Fit (Hunting Village Clan) area. Villagers of Ohoidertom suggested that intensive hunting in Ohoidertutu village should be resolved through the customary leaders and another small field station in Ohoidertutu to discourage hunting while formal customary mechanisms are pursued.
- The village of Tanimbar-Kei has not performed leatherback hunting for the last ten years. Since this village is also a member of Nu Fit, they support customary regulation as crucial to the long-term conservation of leatherback turtles. At present, villagers have requested assistance from the project to address reef conservation issues in their coastal waters.

References

Suárez, A. and C.H. Starbird. 1996. "Subsistence hunting of leatherback turtles, *Dermochelys coriacea*, in the Kei Islands, Indonesia." *Chelonian Conservation and Biology* 2(2):190-195.

Questions?

MR. McCOY: I didn't do the math, but with the number of inhabitants in the village, and the numbers and sizes of turtles caught, is there any estimation of the contribution to the local diet that turtles represent; big, large, medium?

We understand the cultural significance, the spiritual significance, perhaps. But in terms of real contribution to the diet, is there any way to make any ballpark guesses in talking about how peoples' nutrition is and how important this is?

MS. HITIPEUW: We tried to quantify that, to see if leatherback meat is a significant source of protein to people. We realize that for this particular village, they like to eat them because it's been a tradition for a long time. Even if it's not there, the problem would be that the same amount, kind of thing. But in other villages, except for these seven, eight or nine villages, nobody eats the meat.

MR. McCOY: Within these villages, when people from a particular village get the turtle, does it enter into any kind of commerce, selling to a different village or anything? Or is it strictly noncommercial, never sold –

MS. HITIPEUW: Right, it's noncommercial. You are not allowed to sell. It's just for local consumption.

DR. DUTTON: Do you get a sense from the communities whether they perceive there to be fewer turtles? Or it always been there's always been the same amount of turtles?

MS. HITIPEUW: It's fewer. Some people also think maybe the currents bring turtles closer to the village, but it is less in terms of frequency than seems to be 10 to 20 years ago.

MS. BENSON: Did they mention anything about the size? That they were bigger in the past than they are now?

MS. HITIPEUW: No. But when we measured one leatherback as 58 centimeters, they said it is common.

DR. GJERTSEN: Tetha, you mentioned the leatherback is a symbol of unity amongst the villages. Have the villages seen any decline in unity?

MS. HITIPEUW: That's a good question. The symbol of unity, that is something that can be approached too. The history, legend, of these customary groups is based on that. This is something that came across during discussion with the customary leaders. This is something they are concerned about. Through this project, we have a biologist for the information, and people who are working on the grassroots level, in which this political mind is supposed to be. We are leading the process and try to make sure that we obtain this information.

MR. MacKAY: Tetha, are there any other areas where there is suggestion that there may also be feeding areas?

MS. HITIPEUW: That's a good question. But we only know about this area because I was born in this particular place so I only know this particular area. But that would be very good thing to be researched in the future.

MR. McCOY: Since this is very sociologically based, one of the questions they had, they would like to know, is where turtles go when they leave. In other places, some places I've been associated with and talk to me, they have no concept of migration of species. None. When the species disappears, they turn into a ghost or something, and then they come back. But they don't know they're going, and whatever. One of the things that is so amazing, is you're able to show the people conclusively where the turtles are going, where they're coming back, even in the days of just bringing back metal tags. This tag was found in the Philippines, this tag was found in Taiwan, this tag was found here. What is your sense for people's beliefs of migration in general, whether it's birds or turtles or whatever?

MS. HITIPEUW: In this particular area, they believe that they are residents of the areas. But in Papua one time tags were put on the turtles and then suddenly all the turtles disappeared. People felt that researchers must have done something because people believed that the leatherback is just sitting around the area. Again, the power of the map is necessary to show people where turtles are going. The map carries with it a really powerful message.

DR. DUTTON: Maybe KK or Vagi might have some comments because I think there was a similar experience in PNG when we first got results from satellite telemetry, and how that changed the traditional concept.

MR. LEVI: My community believes the same as Tetha. We believe that the turtles belongs to the coast, only for us. The first time when we attached and deployed the satellite tag device, Karol and I went back to the village with the maps. We showed the maps to the people in the village. Now they realize that the turtle doesn't belong to Lababia, it's everywhere. People seem to understand, we don't own these anymore. They are free. They only come to the beach and go back. So now, everybody is trying to put every effort into presenting it this way.

MR. REI: When we conducted a meeting together with the village people and there was one of the elders that got up and said, since you guys came in, you started putting the PIT tags and the metal tags, you brought blood on the sand and we have began to realize that the next nesting season the number have declined. We are blaming you guys for doing this work, which has affected the turtle population.

So Scott and I, we thought seriously about it, that in applying the metal tags we had to find a spot in the turtle where we wouldn't cause too much damage to the body in terms of bleeding. So now we tag in hind flipper in the soft part. We did that this past nesting season and everybody said, I think that's a good place to put it because it's not bleeding. So we are sort of keeping our fingers crossed that the next season the numbers might increase.

MR. BENSON: Whether it's related or not, doesn't matter.

MR. BALAZS: I just wonder if the common people in these villages, if they really believe, even when they see the maps, that the turtles are really migrating. Do you think they really believe it? And secondly, if they do believe it, then how disruptive – or how impacting is this on a whole series of hundreds of years of traditional belief that suddenly fractures from this? Do we have insight on that at all? It's got to be something.

MS. HITIPEUW: One of the things related to the legend from Papua, tell them, inform them that the conservation took place in Papua as well, then it might be related to that, the legend said so. That's the things that can be connected.

MR. BALAZS: Connect those that can, and minimize those that like Monterey Bay, which probably has no tradition.

DR. DUTTON: But we are trying to learn the techniques they use for catching the leatherbacks so we can get more efficient.

MR. BALAZS: Well, some of you may know that some years ago Colin Limpus was working up in DeMerland (phonetic), with people there. They believed that the loggerhead

turtle that they caught reproduced under the ocean. He went there and told them about this place, and they didn't really believe it until he obtained travel for them and had some of the village leaders go down and actually show them the turtles on the beach, and the eggs. There was a video made of this on Australian TV. Then the elders went back and said, yes, I've seen for myself that the loggerhead turtle doesn't reproduce under the ocean as we thought, because there was no nesting in the area where they harpooned them. But again, how impacting that was on their belief? Certainly, it carried accurate scientific information back, and the need for conservation. But I guess traditional beliefs can unfold and evolve.

MR. BENSON: But I would also say that last year when I was visiting in PNG, that the local folks there have a drama program that they go out to different villages to promote awareness and conservation, and so forth. They integrated the new information with the satellite telemetry results into their program. So, Mr. Turtle, you go over to North America, Mr. Turtle, you go this way, and go that way, incorporating that new information into the program, and it was pretty cool.

MR. BALAZS: Sometimes that can go backwards, and it has for years between Fiji and French Polynesia where the greens nest substantially and then migrate back to the foraging grounds in Fiji. And rather than enhancing conservation, it's been a competition of, well, if we don't eat them here, those Tahitians are going to eat them over there. The Tahitians say, if we don't get them over here, they're going to be killed by the Fijians and the Tongans too.

MR. BENSON: I think actually in this one, it was kind of like they were talking about that they were over harvested on the beach, so don't come back.

MR. BALAZS: It can be very complex issues, that's the only point I'm trying to make. Very complex.

Leatherback Turtle Management of Feral Pig Predation in Indonesia

Hirokyu Sukanuma, Everlasting Nature of Asia

The primary leatherback turtle rookery in the Bird's Head Peninsula of Papua Province is Jamursba-Medi which consists of four beaches, Wembrak, Batu Rumah, Lapon and Warmamed. Together these beaches measure approximately 18km in length and are located about 150km from Sorong, Papua (or six hours to reach by boat).

Jamursba-Medi was surveyed initially by Dr. Bhaskar in the 1980's. He estimated at the time 13,000 leatherback nests, and subsequently reported egg predation by feral pigs in 1985 (Bhaskar, 1985). In 1993, local people banned egg collection and nesting beach monitoring began supported by the Department of Forest in Sorong and WWF-Indonesia. In 1999, financial support was temporally terminated, and monitoring was thus continued in 2000 by Everlasting Nature of Asia and Indonesia Sea Turtle Research Center (Director Akil Yusuf). These four organizations now co-operate to undertake leatherback turtle conservation and management activities at Jamursba-Medi. Currently, seven guards are hired by Everlasting Nature of Asia to monitor nesting activities every day throughout the year (Fig. 1).



Figure 1. Monitoring guards and their families.

Nesting occurs through the year (October to March) in Jamursba-Medi with peak season from June to July. Based on available data, it would appear that nesting trends have gradually decreased over time (Fig. 2).

A small pilot study to measure hatching success was conducted in 1999 and 2001 (Table 1). Subsequently, in 2004 monitors began a more rigorous investigation to quantify hatchling success at Jamursba-Medi beaches.

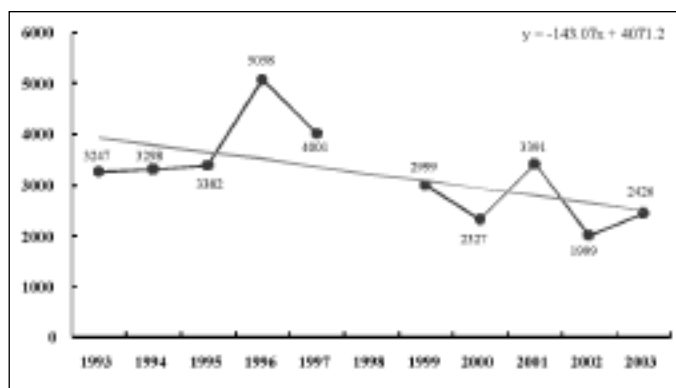


Figure 2. Leatherback turtle nesting trends at Jamursba-Medi.

Table 1. Results of pilot study to quantify hatching success rates.

Year	Number of nests	Hatchling success (%)
1999	7	77.1
2001	15	58.1

It was determined that egg predation by feral pigs was the most serious problem in Jamursba-Medi (Fig. 3). In 1999, the predation rate was 63.3% (n=2,651). Therefore two sets of electric fences were established to prevent pig predation, and placed where nesting density is the highest. In March 2001, a fence was constructed 1.7km between Sujoe River and Suwen River behind Warmamed beach. The second fence was established July 2002, at Lapon beach 2.2km behind the entire beach (Fig. 4). The wires of the fence have electrical currents of 800 to 4,500 volt and 0.2 ampere conducted by a transformer of 8,000 volts. The batteries are charged by solar panels. In general, the egg predation rate has drastically decreased since establishment of the electric fences from 63.3% to 7.1% (Table 2).

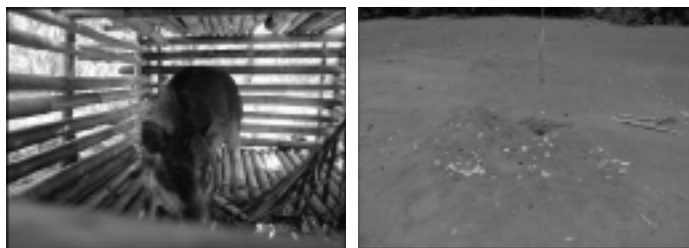


Figure 3. Pig predators and evidence of a predated nest (right).

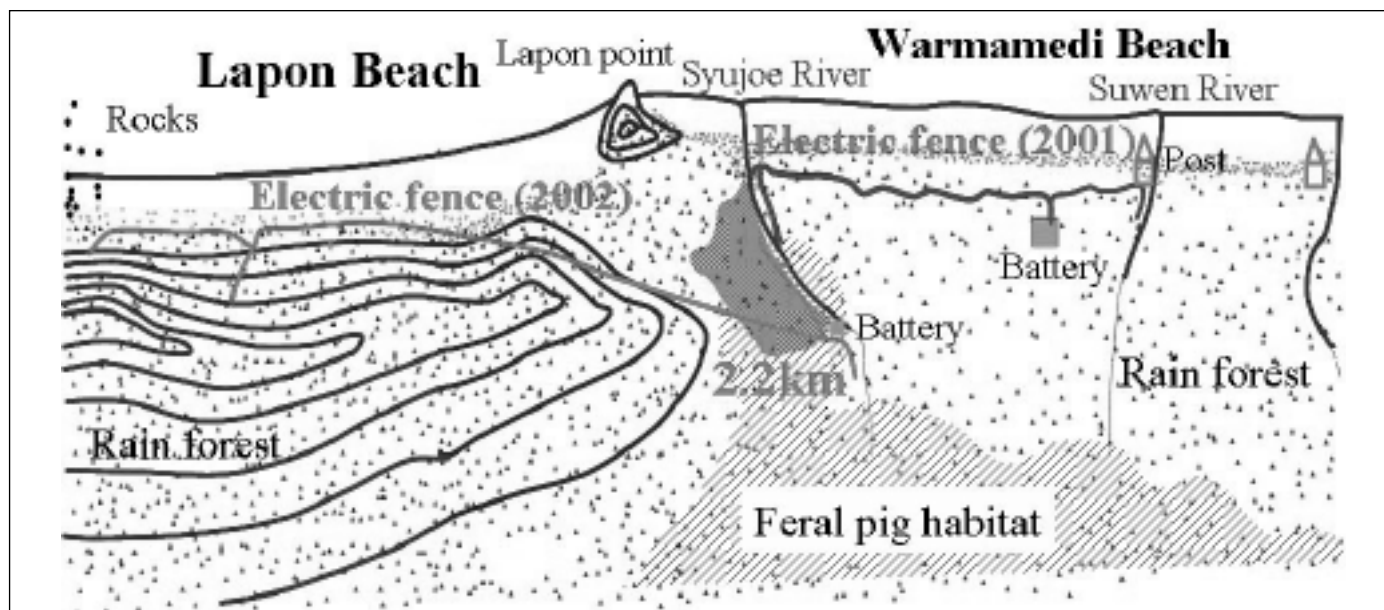


Figure 4. Placement of electric fences.

**Table 2. Egg predation rate
by feral pigs**

September	1999	63.3%
July	2001	24.0%
July	2002	17.5%
September	2002	11.2%
September	2003	7.1%

Reference

Bhaskar, S. 1985. Management and research of marine turtle nesting sites in the north Vogelkop coast of Irian Jaya, Indonesia. WWF Publication.

Research on the Mitigation and Conservation of Sea Turtles by the Fisheries Research Agency, Japan

Dr. Hideki Nakano, National Research Institute of Far Seas Fisheries

Sea turtles are revered in Japan, and numerous stories and legends exist that depicts their importance in Japanese culture (Fig. 1). The activities of the National Research Institute of Far Seas Fisheries, in collaboration with the Seikai National Research Institute, work to reduce interactions between fisheries and sea turtles. Projects include monitoring bycatch from tuna fisheries, conducting experiments to mitigate sea turtle bycatch, deploying satellite telemetry to understand migratory capabilities of turtles to better manage fisheries, and conduct experiments with modified trap nets to reduce interactions in trap net fisheries.

Urashima-taro is a fisherman who saved a sea turtle being mistreated by children. The sea turtle brought him to an underwater palace where the princess of the palace welcomed him, served him to a nice dinner and dancing. It was so nice he forgot to go home and much time goes by. The turtle finally takes him home, and the princess gives him a treasure box. When he opens the box he suddenly becomes an old man because he had spent quite a long time at the underwater palace.



Figure 1. An old Japanese turtle legend, called Urashima-taro, a very famous tale that everyone knows and depicts that the Japanese are very familiar with and love sea turtles (<http://web-japan.org/kidsworld/folk/urashimataro/urashima.html>).

Satellite Tracking Research

Satellite tracking studies are conducted at sea during research cruises and have provided an understanding of the migration route of loggerhead turtles. In 2002, seven turtles were released at sea, both subadults and adults. Resulting tracking routes provided evidence of turtles migrating through the Sea of Japan and also related to the Kuroshio Ocean Current¹.

Fishery Research

The Fisheries Research Agency in collaboration with Hokkaido University are conducting fishery experiments using the circle hook in hopes to reduce the incidental interactions of turtles with longline gear. In some experiments, circle hooks have been found to reduce bycatch rates and produce better survivorship due to the location of the hooking (i.e., hooked in the mouth versus the throat). Although the bycatch rates in this study did not decline between the conventional Japanese style tuna

hook and the circle hooks tested (Fig. 2), circle hooks were effective in reducing the proportion of turtles hooked in the mouth and also reduced the proportion of those hooked in the throat (Fig. 3). This improved the survivorship of captured sea turtles.

Another study compared bait types between mackerel and squid bait, and also compared blue-dyed bait and normal bait. There was no difference between catch rates of blue-dyed bait compared to normal bait for sea turtles, however, mackerel bait dramatically declined the catch of the sea turtles compared with squid bait (Fig. 4).

This coming year the goal will be to conduct experiments using a variety of sized circle hooks (e.g., bigger hooks). In addition, future experiments, with the cooperation of the Tokyo Ocean University, will explore a new idea using horizontal longline gear. Horizontal gear sits deeper than normal gear and is more sensitive to hook depth and target species by use of mid-water floats to better position the gear in the water column.

¹ Satellite tracking data was not authorized to be published in this document.



Figure 2. Hooks used during longline fishery experiments. Traditional Japanese style J hook (left), circle hook (right).

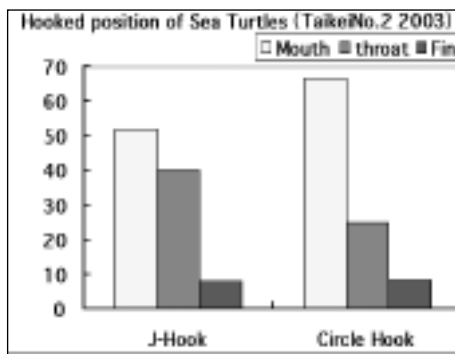


Figure 3. The hooking position of J versus Circle hooks.

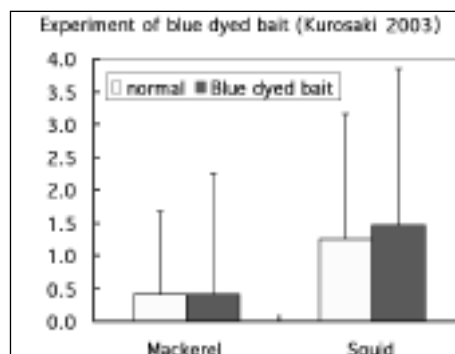


Figure 4. Results of bait type and blue dyed experiments.

Leatherback Research

The Agency works in collaboration with NGO's (see Suganuma's report pg. 37) and supports leatherback turtle satellite tracking research, as well as the protection of leatherback sea turtle nesting beaches in west Papua, Indonesia. In 2004, two leatherback turtles were transmitted from Papua. One did not transmit, but the other is still tracking and is currently off the Kona Coast of Hawaii. Additionally, future goals are to promote stock enhancement for leatherback, loggerhead, green and hawksbill sea turtles in collaboration with the Japan Aquaculture Association (JASFA).

Education and International Activities

The Fisheries Research Agency is dedicated to provide education to fishermen, such as species I.D. sheets, release manual for sea turtles (Fig. 5; translated to Chinese and to Korean), and education videos. The Agency is also cooperates in international meetings such as the SEASTART, Kyoto University; World Tuna Longline Fishery Conference, Tokyo (August 2003 - where the bycatch of longline fisheries was discussed and a resolution was made on the bycatch issue); ASEAN-SEAFDEC on Sea Turtles (Kuala Lumpur, September 2003); the World Fish Center, Conservation of Sea Turtles in the Pacific Ocean Conference in Bellagio (Italy, November 2003); the FAO Expert Consultation held in Rome (March 2004); and the FAO Inter-Governmental Consultation in Bangkok (November 2004).

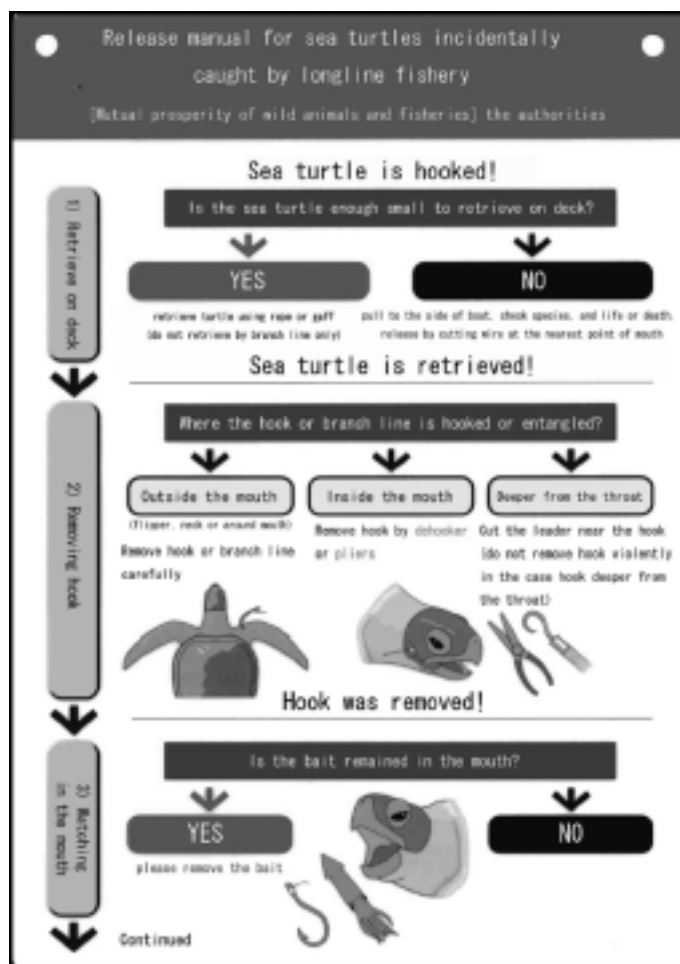


Figure 5. Turtle release guidelines provided to fishers.

Questions?

MR. McCOY: Is there a terminology difference between the description of the J hook and the circle hook? Circle hook is common knowledge circle hook, but traditional Japanese longline hook and what the U.S. swordfish fishermen use as the J hook is different. It's much different. When you use the J hook terminology, the U.S. uses a much longer, really straight shaft, used for hooking the swordfish in the bill. It's not your kind of hook. Your hook is sort of in between what Americans call a J hook. Is that taken into account?

DR. NAKANO: Yes. Maybe we should use the conventional U.S. J hook, too.

MR. McCOY: But you don't want to change to that, so don't worry about it.

DR. NAKANO: In Japan, we call this the sleeping (phonetic) hook. That means the top is here, on the inside. Our terminology, this is a circle hook.

MR. McCOY: It's offset or straight?

DR. NAKANO: We use both, sometimes the offset and sometimes just straight. We use both.

MR. BENSON: Are similar hooks used in the U.S. fishery more circular than that?

MR. McCOY: Yes, there's actually a very specific specification.

DR. NAKANO: Anyway, this year we also used Japanese style circle hook, also U.S. circle hook. The next experiment, with the cooperation of the Tokyo Ocean University, will also test horizontal longline gear.

DR. SWIMMER: I have a question about the experiments with the turtles. Do you know the size of the circle hook that you tested?

DR. NAKANO: I think the Japanese normal size we say is 36. I think it is about 12 centimeters.

DR. SWIMMER: Do you have a sample of the hook that you used?

DR. NAKANO: Right now, I'm sorry, I don't. I didn't bring it. But it is much, much smaller than the U.S. uses. I think the 18/0 is too big for us.

MR. McCOY: In the area you are fishing, specifically, is it swordfishing grounds, tuna grounds? What is the target?

DR. NAKANO: Mainly swordfish and shark fishing ground. Not tuna.

MR. BALAZS: I was especially impressed with the satellite tracking that showed a nesting loggerhead spinning out right off into the east, right into pelagic habitat. The longline fishery and the former squid driftnet fishery did capture a number of adult turtles hundreds of miles from land, suggesting that pelagic habitat is indeed a regular habitat for adult post-nesters as opposed to some of the coastal shallower area up towards Korea. So that is very important tracking, in my opinion. What nesting beach in Japan was that released from?

DR. NAKANO: Omaezaki. There is a population at Omaezaki studied by the Sea Turtle Association of Japan, many of the sea turtles go into the East China Sea. I think that is interesting that some of the nesters go to the east.

MR. BALAZS: Go right into pelagic habitat contrary to what you would normally think. Very exciting. I like that.

DR. NAKANO: Thank you.

MR. McCOY: Another question. We're discussing longline, all the activities on longline. But there are also purse seine fisheries in the region. Are you looking at anything in terms of education, maybe not experiments, but just in education for purse seiners on how to reduce turtle interactions?

DR. NAKANO: We haven't done anything yet with purse seiners because there are few observations of sea turtle bycatch, more problems exist with the longliners. But of course, we have some observer program on the purse seine fisheries to document any bycatch which might occur.



Papua New Guinea

Leatherback Turtle Nesting Demographics: Identified Through Migratory Movements and Aerial Census in Papua New Guinea

Scott Benson, NOAA Fisheries

This presentation will focus specifically on the work in Papua New Guinea (PNG) and provide a brief synopsis regarding the movement patterns of leatherbacks from this area and provide some preliminary information collected during a pilot aerial survey in January 2004.

Satellite Transmitters

Among the priorities of the Sea Turtle Research Program at the National Marine Fisheries Service/Southwest Fisheries Science Center (NMFS/SWFSC) is to determine the movement patterns of leatherback turtles and identify stock ranges. We began leatherback telemetry work on invitation from our friends, Karol Kisokau and Vagi Rei, in PNG to look at the movement patterns of leatherbacks in 2001. We used a variety of techniques to do this, including the use of ARGOS linked satellite transmitters (Fig. 1). Some transmitters were designed to acquire location data only, and others have provided additional information about diving behavior. Most recently, we've begun using pop-up archival satellite transmitters as a means of assessing mortality.



Figure 1. Applying satellite tags in PNG.

We experienced success with our telemetry project during our first two trips to PNG in 2001 and 2003. The beach at the Kamiali Wildlife Management Area (WMA) is one of the highest density nesting areas in PNG for leatherback turtles, and telemetry data showed that the Huon Gulf is a very important place for leatherbacks. Resulting satellite tracks provided information of turtles exhibiting behaviors of high and low site fidelity, as well as information about previously unknown nesting sites in places outside of the Kamiali WMA such as Woodlark Island and the Huon Peninsula (Benson et al., in press, Fig. 2).

Aerial Survey

In January 2004, an aerial survey was conducted with a fixed-wing twin engine aircraft. The primary goals were to locate significant leatherback nesting (>200 nests) outside of the Gulf of Huon and explore if aerial surveys are a feasible means to gather nesting information in the region. This was a collaborative effort between NMFS, the PNG Department of Environment and Conservation (Vagi Rei), local conservation groups (KICDG and the Huon Coast Leatherback Network) and Laura Sarti (from SEMARNAT, Mexico). Laura was the technical advisor because she's flown many similar surveys in Mexico. Over 1,800 miles were covered in seven days (almost 41 hours of flying) at an altitude of about 200 feet (Fig. 3). It was challenging, especially logistically, but it was a worthwhile endeavor that should be continued at the higher density areas.

Crews from KICDG and Huon Coast Leatherback Network provided support on the ground to calibrate results of the aerial survey by estimating the number of nests that may have been missed by the aerial observers (i.e., a source of error). This required some training by Laura (Fig. 4), and illustrated some of the potential biases for error that could be associated in this dataset. The three primary sources of error include: 1) the number of nests prior to the aerial survey that were no longer visible; 2) the number of nests present (and recorded by the ground teams), but missed by the aerial observers; and 3) the number of nesting events that occurred after the aerial survey. By developing estimates for these three sources of error, one can calculate the total number of nests in the area that was surveyed.

Beaches were surveyed from the PNG/Indonesian border, to about Popondetta (Fig. 5). Additional beaches were surveyed on the east side of the large D'entrecasteaux Islands (Goodenough, Fergusson, and Normanby), and the entire New Britain Island coastline (Fig. 5).

Results of aerial counts combined with derived coefficients of detection error 2 (the number of nests present but missed by the aerial observers) indicated that total nestings were 559 (Benson et al., in press). Over 71 percent of nests were found along the Huon Gulf coast. Within the Huon Gulf region, only 29 percent of nests were recorded outside of the two index beaches at Kamiali WMA (2.6 miles) and Maus Bang (3.4 miles, Fig. 6). The Kamiali and Maus Bang sites (monitored by KICDG and the Huon Coast Leatherback Turtle

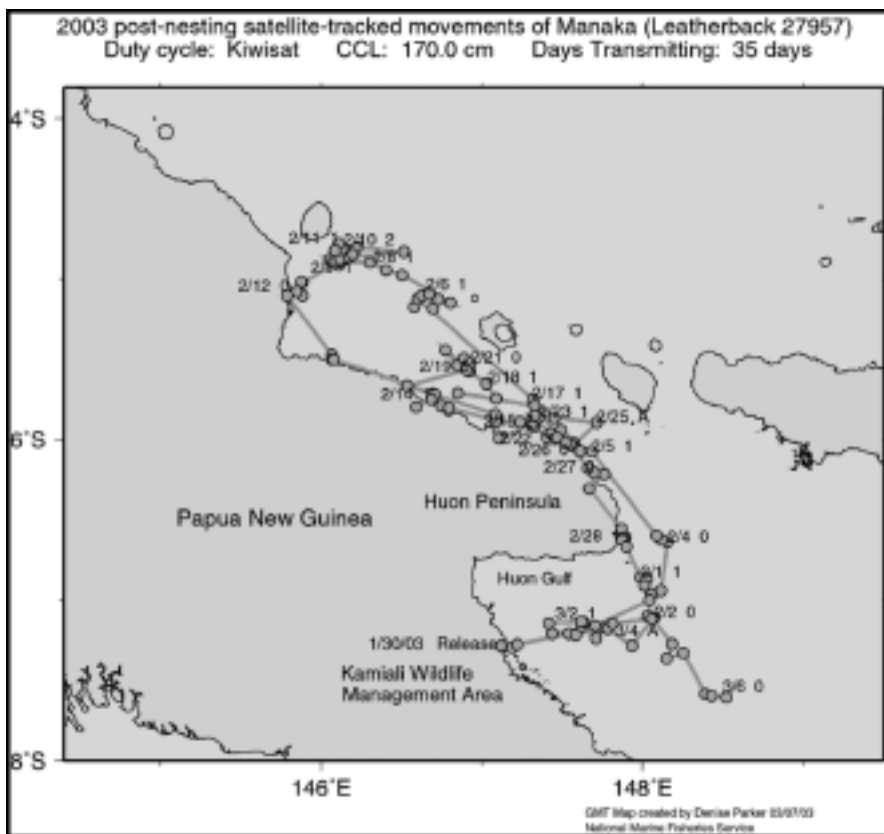


Figure 2. Re-nesting in previously 'unknown' locations to the north (Benson et al., in press).



Figure 3. View from the air during aerial survey.



Figure 4. Laura Sarti providing training regarding nest identification.



Figure 5. Location of NMFS aerial survey of PNG (highlighted in yellow), during 41 hours of flying, covering 1,800 miles (map courtesy of www.bugbog.com).

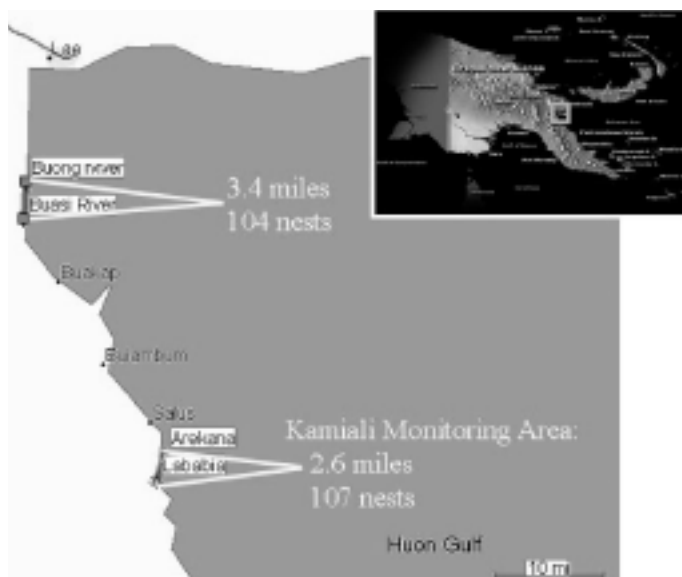


Figure 6. Location of two nesting beach index sites in PNG.

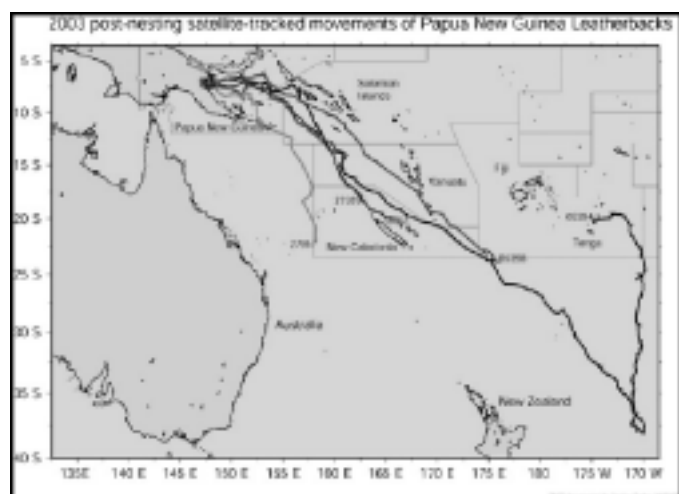
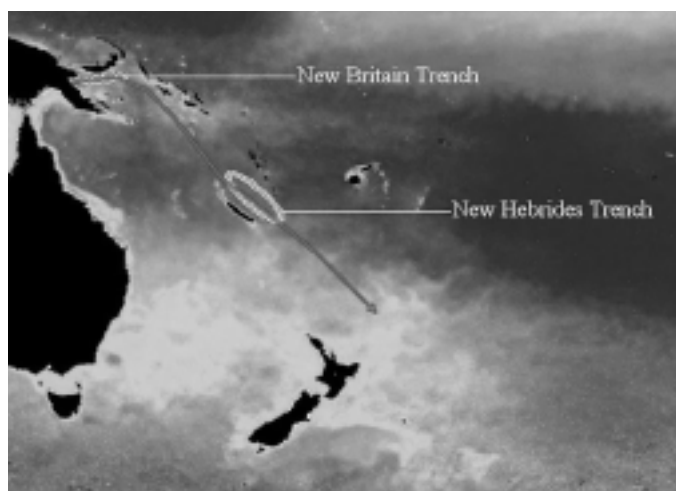


Figure 7. Post nesting migratory movements of five PNG leatherbacks (Benson et al., in press).



Network) will function as index beaches for calibration of future aerial surveys in PNG. New Britain Island had 67 total nests counted, 26 on the north coast and 41 on the south coast. Although the nest count at New Britain Island wasn't large, the results merit a more thorough examination of these nesting beaches by foot patrol.

During the aerial survey, researchers got a chance to interview lots of folks in various places about occurrence of leatherback turtles. Information suggests that surveys be conducted during different seasons of the year at different places due to complex weather patterns that occur in PNG. For example, a dry season on one side of an island may be wet season on the other side. Dry season, wet season, what does a turtle care? The difference is that beach erosion is happening at different seasons of the year. So during the wet season, there is much greater wave activity and sand is being removed from the beach. During the dry season, it's the opposite, sand is being deposited. This will have an impact on nesting and the presence of nests visible from the air.

Post-Nesting Migratory Routes

Leatherback turtles monitored by attached satellite transmitters migrated south from PNG, post-nesting (Benson et al., in press, Fig. 7). They appeared to be utilizing some interesting features along the way such as the New Britain Trench, and the New Hebrides Trench (Fig. 8). Some animals passed between Australia and New Caledonia, but most moved over the New Hebrides Trench, between New Caledonia and Vanuatu, enroute to the Southern Transition Zone, an area of greater productivity in the high latitude waters adjacent to Australia and New Zealand.

Clearly, effective conservation of leatherback species will require broad international cooperation between the U.S., high-seas fisheries, and western Pacific nesting sites. Personally, I've really enjoyed working with the teams in PNG and Indonesia and look forward to doing more in the future. We still have lots of work to do together, but the work is enjoyable and interesting and I would like to thank you all very much.

Figure 8. Oceanic features leatherback turtles might be using during post-nesting migrations.

Reference

Benson, S.R., K.M. Kisokau, L. Ambio, V. Rei, P.H. Dutton, and D. Parker. In press. Beach use, inter-nesting movement, and migration of leatherback turtles, *Dermochelys coriacea*, nesting on the north coast of Papua New Guinea. *Chelonian Conservation and Biology*.

Questions?

MR. MacKAY: This is a general question, but you showed these catastrophic declines in a number of the beaches. Can you give us a little snapshot of what has happened in the Atlantic? Because the suggestion is that there is some considerable cause for hope.

DR. DUTTON: Yes, there is. It's a totally opposite picture in the Atlantic. I would say just about every population that is monitored has increased dramatically in the last five, six, seven, eight years or so. There are many more beaches there, and I'd say there were probably more turtles there to start with, but some of the longer running projects that I have had the good fortune to be involved with, was in Surinam, and more recently, the last 15 years or so, at a project in St. Croix. St. Croix was a very, very small, intensively monitored population. Every nest was saved and produced hatchlings. We had about 10 or 15 turtles nesting each year, for about 10 years. We were saving every nest, putting out thousands of hatchlings, as opposed to just a few that survived before the interventions. We were at it for 10 years or so and were wondering, why do we do this, we only get a handful of turtles coming back.

Then after about 14 years, all of a sudden the population started increasing exponentially. It's really one of the success stories that is well documented.

Even though it's one small population that has been monitored intensively, it serves as a good index population. Those datasets don't exist for all populations, but I think it's a good representation of what's going on in the Atlantic.

To answer your question, this gives me a lot of hope. I never would have thought, having been through that experience of going every night along the beach, seeing one turtle come up and maybe going two or three nights without seeing any turtles, and doing that for many years. At the same time, in the '80s, going to Mexico and seeing hundreds of turtles coming up and saying, boy, wouldn't it be great if we could get to that in the Caribbean. I never thought I would be in Mexico 10 years later wondering where the turtles were, and again, seeing one or two turtles come up, and then in contrast the Caribbean has seen a dramatic increase.

So we know beach conservation works. There is a complex set of environmental factors, but there is hope. The lesson is that these are long-lived animals. They take probably around nine, ten to fourteen years to mature. That is what we saw in St. Croix, for example. It took that amount of time before those hatchlings, grew up and came back. The genetics have actually shown that some of the new turtles that are nesting are the daughters of some of the old-timers. So I think there is hope but it's a waiting game. It requires commitment, and we are committing to long-term monitoring and protection to get those same sort of results.

The History of Leatherback Conservation in Papua New Guinea: The Local Government's Perspective

Vagi Rei, *Department of Environment and Conservation*

Papua New Guinea (PNG) occupies the eastern half of the Main New Guinea Island of Papua (Fig. 1). There is a human population of about four to five million, and a land boundary of about 460,000 square kilometers, with approximately 3.2 million square kilometers of sea which includes the archipelago, territorial seas and the Exclusive Economic Zone (EEZ).

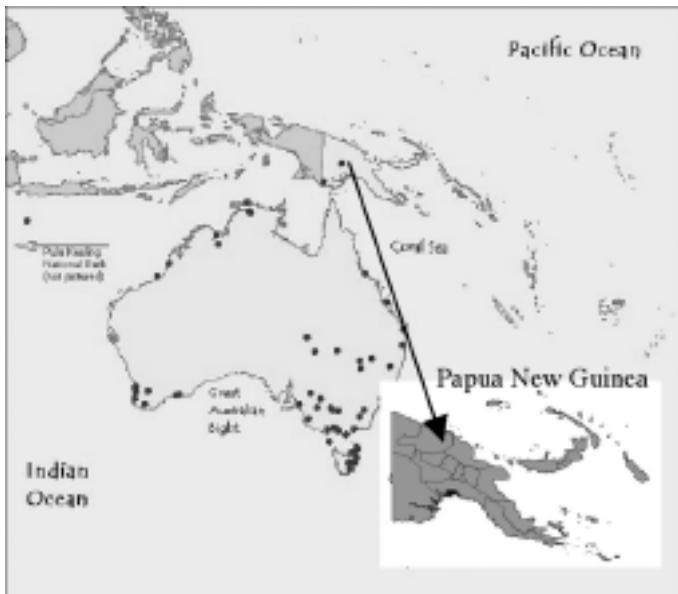


Figure 1. Papua New Guinea

The Department of Environment and Conservation (DEC) is the government agency in PNG with the authority to manage marine resources. DEC's mission statement is to ensure that natural and physical resources are managed to sustain environmental quality and human wellbeing. We have five national goals, and the fourth one states "PNG's natural resources and environment should be conserved and used for collective benefit and should be replenished for future generation." Marine turtles are protected under PNG's Fauna Protection & Control Act of 1978 and listed under CITES Appendix II. This presentation is the official Government status of leatherback turtles in PNG.

Leatherback turtles are identified by the local people as "bikpela tru na igat kil long baksait bilong em," which means "very big turtle that has ridges on the back." They don't know the name, but this is how they describe it.

Most people do not eat leatherbacks, but the eggs are considered to be very, very good to eat. The occurrence of leatherbacks was first reported in the 1970's by Sylvia Spring along the north coast of PNG and the main islands (Bougainville, New Britain, New Ireland & Admiralty Islands).

The first turtle research project began in 1970 with funding by UNDP-GEF and was conducted by Dr. Colin Limpus, Bridgitte Hudson and Sylvia Spring. This project promoted turtle conservation through mapping the distribution and abundance of turtle species, documented the cultural value and subsistence use of turtles, and provided education on turtle biology. It focused on all six species and was concentrated in the south and eastern region, and the New Guinea areas.

Since 1982, the turtle research, tagging and monitoring responsibilities were undertaken by DEC, but these were mainly ad hoc activities. The program was initially supplemented by the South Pacific Regional Environmental Program (SPREP), but funding came to a standstill in 1992. For the last seven years, DEC has been struggling to get the turtle program back on track. In 1999, Karol Kisokau from the Village Development Trust (VDT) - who was the environmental coordinator at the time - invited DEC officials to have a look at leatherback turtles at Kamiali. This was followed by the necropsy workshop, by Dr. Thierry Work (US Geological Survey). With continued dialogue between Job Opu (SPREP) and Dr. Peter Dutton (National Marine Fishery Service, Southwest Fishery Science Center), DEC was able to get assistance to conduct a leatherback turtle program.

The bulk of leatherback research, telemetry and tagging in PNG has been conducted at Kamiali Wildlife Management Area (see Kisokau, this publication pg. 51). Kamiali is a protected area and proposed as a Ramsar site. DEC and other stakeholders are working to get it passed through Parliament, and have it endorsed as a Ramsar site during the leatherback nesting season (it has taken four years of data to convince top management to declare this area a protected zone). In addition, there is a lot of fishery activity that takes place in the waters of the Huon gulf. So one strategy under consideration is to close the Solomon Sea and tell fishers to go into the Bismarck Sea to do all their fishing during the leatherback nesting season, or implement a seasonal closure.



Figure 2. PIT tagging training.



Figure 3. Scanning training.



Figure 4. Community consultations/workshops.

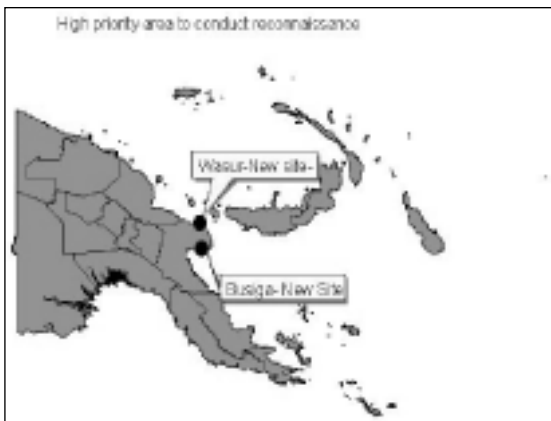


Figure 5. New nesting sites identified by community workshop that may potentially have a summer nesting period.

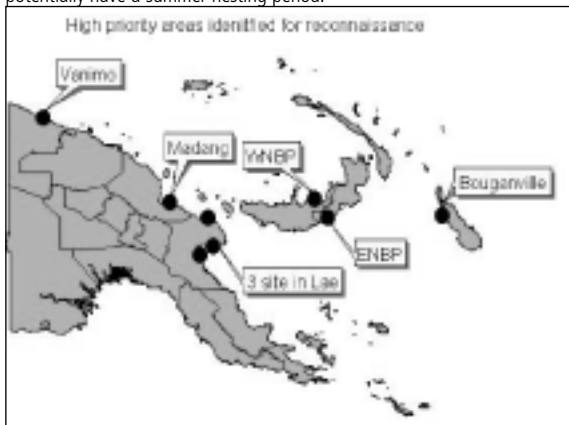


Figure 6. New potential nesting sites identified by the January 2004 aerial survey.

In 2001, the program at Kamiali began in collaboration with the VDT, DEC, and NMFS. Thirty-nine Leatherback turtles were tagged and 10 satellite devices were deployed. The Marine Conservation Action Fund provided a small grant of \$5,000 USD to get five officers from DEC and selected locals from the Kamiali Wildlife Management Area trained during this project (Figs. 2 and 3). Training was focused on turtle tagging, PIT tags and scanners, PAT tags, satellite tracking devices, and genetic sampling (blood and skin). DEC has also trained about 16 local villages, of which four are now working on the leatherback turtle research.

In 2000, DEC received some funding from SPREP to run the first network workshop which involved 14 villages within the Huon Gulf itself (see Senego's paper, this publication). We brought local communities together and discussed how best to protect the leatherback turtle along the whole coast (Fig. 4). The objectives were to form a network and get all the nesting beaches protected. We also engaged nonmembers (members with non-nesting beaches), and all members were given the task to inform their village people.

Follow-up workshops were held in 2002 and the beginning of 2004. All members came. The objective was to develop a project proposal and to get the network members to participate effectively concerning leatherback turtle conservation within the Huon Gulf coast. We also began a reconnaissance of the northern coast (Madang, Morobe, New Britain) to try identify new nesting sites. The initial ground reconnaissance was conducted in preparation for NMFS 2004 aerial survey. For example, the people in Wasur and Busiga tell us that they have a turtle population that nests in June, July and August (Fig. 5). However, turtles at Kamiali nest October to March. So the possibility exists that there may be another population in PNG that has a summer nesting season similar to the Indonesian population.

In January 2004, DEC was privileged to be apart of NMFS aerial survey that was geared to look for beaches with significant leatherback nesting outside of the Gulf of Huon (see Benson, this publication pg. 43). This aerial survey identified about eight sites and three sites in particular (Lae, Madang, and Vanimo) of high priority to revisit to confirm nesting. Vanimo also appears to be another area that has a summer nesting population (Fig. 6). In the future we would like to extend aerial surveys to cover New Ireland, Lihir.

In conclusion, I would like to acknowledge the following people: Dr. Colin Limpus, Silvia Spring, Bryget Hudson, Dr. Peter Dutton, Scott Benson, Dr. Thierry Work (USGS), Job Opu (SPREP), Karol Kisokau (KICDG), John Sengo (VDT), John Joseph (MPF), Levi Ambio (KICDG), and the people of Kamiali WMA. Thank you very much.

Questions?

MS. KINAN: I have a quick question. You said you want to protect the Huon coast from fishing and move the fishers up to a different area at different times of the year. Do you have any information if they are in fact interacting with turtles when they are fishing?

MR. REI: That is something that we'll discuss with the National Fisheries Authority (NFA). There are observers onboard the vessels, but they just record "turtles." They are not able to identify which turtles. There is a heavy presence of trawlers within the area as well. We have three and half years of data to present to the fisheries to support the need to conserve the area. We have the satellite tracks that show they use the area, and because of the migratory route that the turtle takes to come to nest and then go back again, we suspect leatherbacks are being caught as bycatch, but we don't have that information yet.

MS. KINAN: So you know there are interactions, but you don't know how much or what species?

MR. REI: Yes.

MR. BENSON: Now, some of the areas along the coast there, including Kamiali, already have some special status in terms of being protected waters? Or at least being traditional fishing areas, where traditional fishing is only taking place in there. Is that right?

MR. REI: Yes.

MR. BENSON: But are you aware of any incursions of other more modernized, mechanized ships or other ships from other countries using those waters illegally?

MR. REI: I'm unable to say much on that. I do not have information to actually confirm that. But, yes, the area is heavily used by ships coming in, mostly because they have to go around and come back to Lae. So the area is used by most of the coastal ships.

MR. McCOY: I can elaborate a little bit. I'll talk tomorrow about the fishery interaction situation in PNG. But just to point out, in the context of what Vagi said, it is a very complex situation. It's not just a question of telling a few fishing boats, you can't fish here, please go fish there until the season is over. It basically has to do with the structure of

the fisheries, the longline fishery is a fresh fish fishery. The distances involved to the places where they can export their fresh catch are very, very limited.

Off loading in Lae is very limited. The flights out of Lae are very limited. So as he says, a lot of the boats take the catch back to Moresby, which means going around to peninsula. Or they transship and one boat out of the fleet takes the catch back every so often. To push them into the Bismarck Sea is a whole different hill of beans.

From an economic standpoint, it's not something they can adjust to, because there is no air freight capacity out of there, the costs are much higher. So they have to really do some serious thinking about coordinating this type of stuff, maybe get an alternative site, or someplace, where a plane could land and pick up their catch in that area during the year. From what I know of PNG fisheries, it's going to be a complex issue. Some of the people who are involved in that fishery have a lot of clout. It's not to be denied. It's a valuable export fishery for PNG.



The Community-Based Conservation and Monitoring of Leatherback Turtles (*Dermochelys coriacea*) at Kamiali Wildlife Management Area, Morobe Province, Papua New Guinea¹

Karol M. Kisokau and Levi Ambio, Kamiali Integrated Conservation Development Group

INTRODUCTION

The greatest density of nesting leatherback turtles in Papua New Guinea (PNG) occurs along the Huon Peninsula of Morobe Province. The monitoring of leatherback turtles at Kamiali, PNG began first by the Village Development Trust (VDT) in 1998-99 and since 2002 by the Kamiali Integrated Conservation Development Group (KICDG). With technical support from NOAA Fisheries, Southwest Fishery Science Center (SWFSC) and funding support from the Western Pacific Regional Fishery Management Council (WPRFMC), KICDG has been able to implement a grassroots, community-based nesting beach monitoring and protection program. The goals of this project are to gather population demographic information and maximize leatherback hatchling production by reducing population level impacts from egg and turtle poaching at this key leatherback nesting beach in PNG.

Legislation Pertaining Marine Conservation in Papua New Guinea

The use of habitat protection as a means of conserving wildlife began with the declaration of PNG's first Wildlife Management Area (WMA) in 1974. The Department of Environment and Conservation is the government agency mandated or responsible to administer legislation directly related to species conservation, particularly the International Trade on Fauna and Flora Act of 1983, the Crocodile Trade Protection Act of 1982, and the establishment of protected areas through the Conservation Areas Act of 1992, National Parks Act of 1982, and the Fauna Protection and Control Act of 1982.

Conservation of PNG's natural resources and environment, including marine ecosystems, is enshrined in the Fourth Goal of the country's Constitution. The principle legislative acts listed below are relevant to marine resources, environment, conservation and protection of PNG's rich flora and fauna.

- Fauna (Protection and Conservation) Act, 1982
- Crocodile Trade (Protection) Act, 1982

- Fisheries (Torres Strait Protected Zone) Act, 1984
- National Seas Act, 1977
- Prevention of the Pollution of the Seas Act, 1981
- Dumping of Wastes at Sea Act, 1981
- Conservation Areas Act, 1992
- Environmental Planning Act, 1978
- Natural Parks Act, 1982
- Fisheries Management Act, 1998
- Land Act, 1996
- Whaling Act, 1974

Although there is no specific legislation targeting marine conservation, some of the acts mentioned above can be used to protect marine species and ecosystems. In particular, the Fauna and Control Act of 1982 declares protection of dugong and leatherback turtles.

Another important government agency with jurisdiction over marine species is the National Fisheries Authority (NFA). The Fisheries Management Act of 1998 is mandated to manage all fisheries in PNG, specifically by using licenses for commercial fishing operation (foreign and national) and establishing management rules for some key commercial species. The Act is aimed at managing fishery resources in PNG's 200-mile Exclusive Economic Zone, which was declared under National Seas Act of 1977.

The NFA was created to ensure that PNG's fisheries and living aquatic resources are efficiently used within the limits of sustainable yields and managed in a manner that maximized the long-term economic and social benefits to PNG and its people.

Kamiali Integrated Conservation Development Group

The Kamiali Integrated Conservation Development Group (KIDCG) is an end result of a process that concluded with the designation of Kamiali as a Wildlife Management Area (KWMA), following strong NGO history in the area, beginning with the Village Development Trust (VDT).

¹ Final project report to the WPRFMC: AContract of NA03NMF4110017

VDT is an indigenous NGO that has been working in Papua New Guinea and throughout the South Pacific since 1990. It has become recognized as a leader in the fields of eco-forestry and conservation, and its work has evolved over this time to include a series of courses and workshops, professional field support services, educational aids, and model projects that emphasize an integrated approach to the issues of conservation awareness, environmental protection, and the practical sustainable development of village resources. The VDT's mission is to empower and support village communities to manage their resources in ways that promote self reliance and that are environmentally, economically and socially sustainable.

In 1992, the VDT commenced a series of conservation and eco-forestry awareness initiatives with the village residents of Lababia, located 60 km south of Lae on the Huon Gulf. The VDT eventually received the financial support of AusAID and WWF-South Pacific Programme to expand early activities. To date, Lababia is the only one of five villages in the area that has opted for sustainable small-scale development instead of signing contracts with large industrial logging operators. In 1995 the community and the VDT undertook to have the 47,000 hectare area surrounding Lababia declared a Wildlife Management Area (WMA) under the PNG Fauna Protection Control Act. This marked the beginning of a new phase of the VDT's work with partner organizations to demonstrate to villagers and others the environmental and economic benefits of taking an integrated approach to the issues of development and conservation. Through this undertaking came the formal adoption of the name "Kamiali Integrated Conservation And Development (ICAD) Project." The WMA was finally gazetted late in 1996 and the last three years have witnessed a number of accomplishments at Kamiali. Much of this has been supported by funding from the World Bank under its Social and Rural Development Action Program and from the Swedish Society For Nature Conservation.

Sprouting from ICAD and the VDT, KICDG was established by select members of the Kamiali community to focus specifically on the conservation and sustainable management of leatherback sea turtle resources at Kamiali WMA. The WPRFMC, in collaboration with Dr. Peter Dutton (SWFSC, in the capacity of scientific and technical advisor), has contracted with KICDG to conduct leatherback sea turtle nesting beach conservation and management work at Kamiali WMA.

History of Leatherback Turtle Research in Kamiali WMA

Past studies undertaken by the PNG University of Technology in Labu and Sipaia (villages in close proximity to Lae City) were basic attempts to recognize the relative importance (or presence) of leatherback turtles in the region. These studies were focused primarily on generating awareness and identifying the nesting beaches of the species, but they helped to lay the groundwork to develop future community-based management strategies to protect and conserve the species. Over the past few years, the Kamiali leatherback turtle conservation project has lured a consortium of multi-national agencies and NGO's to conduct research and develop management tools. The agencies which have been involved in the program include:

- South Pacific Regional Environment Program (SPREP)
- Village Development Trust (VDT)
- Wetland International-Oceania, Canberra, - Ramsar Site

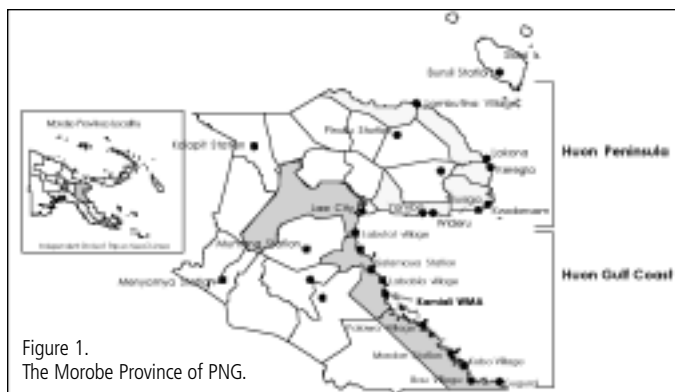


Figure 1.
The Morobe Province of PNG.



Fig. 2 The Kamiali Wildlife Management Area of the Huon coast. The 2km leatherback monitoring site is depicted (area between green circles).

- NOAA Fisheries, Southwest Fishery Science Center (SWFSC)
- Western Pacific Regional Fishery Management Council (WPRFMC)
- Geological & Marine Survey, Honolulu (USGS)
- Government of PNG, Department of Environment & Conservation (DEC)
- UNDP Global Environment Facility Small Grant Program
- New Zealand Overseas Development Agency

During the 2003/04 nesting season, funding from donors (WPRFMC) and resource scientists (SWFSC) have played important roles in empowering the Kamiali parabiologists (trained community members in turtle research) and scientists from private, government and NGO agencies to undertake studies to understand leatherbacks population dynamics in PNG.

Kamiali Wildlife Management Area

Of the wildlife management areas in PNG, Kamiali in Morobe Province is a relatively small-protected area (47,000ha) that includes areas of sea and coastal wetlands including leatherback turtle nesting beaches. The leatherback study site is located on the north of Nasau Bay within the KWMA. The nesting beach is about 11 km long. The sampling plot measures 2km in length and is 1 km from the Kamiali Village. Figure 1 shows the location of the KWMA within the Huon Gulf coast of the Morobe Province, PNG. Figure 2 depicts the 2 km study area of KWMA.

The Nesting Beach

The Kamiali nesting beach is on the northern part of Nasau Bay, on the opposite side of the Kamiali Guest House, within the KWMA. The KWMA has a total length of 11km, including non-nesting sites along the beach, and consists of approximately 8km of beach that leatherback turtles use for laying eggs. The sampling and monitoring activities during the 2003/04 season were carried out on a 2km stretch starting from the village eastward.

The beach has black grayish colored sand and has narrow beach vegetation along the beachfront. Bordered at the back is a large wetland ecosystem. The beach surface sometimes changes from fine smooth to coarse, often with logs due to the sea current changes during the high tide period. These phenomena affect the leatherback turtle nesting site preferences. Larger pebbles, debris, and logs cover the usual nesting areas after the tide has resided. However, if oviposition is urgent the turtle will sometimes crawl over the logs and coarse surface. See Figure 3 for large pebbles deposited on the beach. The normal surface of nesting beaches is shown in Figure 4.



Figure 3: Large pebbles caused by sea current during high tide on the nesting beach.



Figure 4: Normal Surface for Nesting beaches.

Research Objectives

This study conducted by KICDG has been implemented to analyze the long term trends of the leatherback turtle nesting population occurring in the KWMA. This final report, however, depicts only a snapshot of one component of a much larger effort that includes SWFSC supported activities of satellite telemetry, genetic sampling and aerial surveys. There were two components to leatherback turtle monitoring activities at Kamiali during the November 2003 to February 2004 nesting season. Studies are ongoing multi-year collaborations between SWFSC, WPRFMC, DEC, and KICDG. The first component was undertaken by KICDG and the second by SWFSC:

1. Nesting beach management, census and monitoring to:
 - quantify the nesting population during the nesting season; and
 - determine the clutch size and emergence success of hatchlings from a select number of nests.
2. SWFSC and its allies in collaboration with KICDG deployed satellite telemetry, collected genetic samples, and conducted aerial surveys to better understand migratory routes and foraging ecology, identify nesting habitats, and obtain population stock information to assist in developing international management and conservation strategies for leatherback turtles occurring in PNG.

Kamiali Community Support for Leatherback Turtle Protection

Traditionally, only men collect turtle eggs. Eggs are harvested for food and used in special occasions. Turtles are rarely killed for meat, however, over the past generation timeline, it has become quite obvious to some that the turtle population has declined “drastically” since the 1960’s.

In 2002, some community representatives attended a leatherback turtle workshop held at the Kamiali Guest House. They emotionally expressed their “wrongs” and were very sympathetic to see that one turtle was killed by a bushman from an inland village. A number of villagers mentioned not seeing any nesting female turtles on their beaches at Boansing village for over the past four years (this abandonment of a nesting beach may imply that these nesting females belonged to an individual population stock).

Initially, the community agreed to set aside one km of the nesting beach for no harvesting of eggs and meat. With

continuous awareness and educational workshops in 2002, the community became more aware of species plight and they resolved to extend the existing no-take zone to 2 km. At a community meeting October 2003, the Kamiali community declared a moratorium banning villagers and outsiders from harvesting eggs and meat for the entire 2003/04 nesting season in the no-take 2 km zone and also within the whole of Kamiali WMA.

METHODS AND MATERIALS

The community-based monitoring and research activities consist of the following components and with prescribed methods used to acquire field data/information on the population dynamics of the leatherback turtles:

Community Parabiologists/Rangers Training

Turtle research and monitoring are conducted by trained community members called parabiologists. All parabiologists attend training workshops and hands-on field practical demonstrations held to illustrate the application of methods used in turtle population census and monitoring. Additionally, invitations have been extended to universities, research institutions, conservation oriented NGOs and individuals to participate at workshops to learn about the latest state of the art in leatherback turtle research techniques (Fig. 5). The parabiologists are trained with the following skills:

- carrying out field monitoring activities and tagging turtles;
- taking exact measurements;
- adopting appropriate behaviour towards the turtle (handling of torches);
- collecting data on data sheets;
- checking turtles for wounds, ectoparasites and health assessment;
- collecting tissue samples; and
- using of microchip gun and how to implant PIT tags.



Figure 5. Community leatherback turtle awareness workshop at Kamiali village with Scott Benson (NMFS) providing educational information.

Experienced field parabiologists become field assistants, and are provided with additionally information to train and lead parabiologists. There are two major clans, which are each represented by a field research assistant. The field research assistants report to the field research coordinator (Levi Ambio). Each research assistant is trained with basic skills and knowledge to help parabiologists in collecting and recording of data/information into the field data sheets.

Quantification of the Nesting Female Population

The two clans rotate on a weekly basis to collect field data and information on nesting female turtles in the 2 km sampling plot. Parabiologists count egg-laying female turtles, but not those that come up and go back to the sea without laying eggs. Each night of the nesting season, eight parabiologists are deployed to monitor the nesting females starting from 2000 hours to 0500 hours each night for the four months of the nesting period.

Data collection protocol is adopted for Kamiali from the Queensland Marine Turtle Research Program. Data collection includes information on nesting behavior, tags applied and measurements obtained, as well as environmental variables such as weather and sea state.

Emergence Success of Hatchlings

Determining the clutch size and emergence success of hatchlings provides data and information fundamental to the conservation and management of the species. Ten nesting burrows were identified after the oviposition. These nests were marked with cross-like tags planted next to the nest towards the bush written with the turtle tag numbers, nesting and emergence dates.

When hatchling tracks were located, the date was noted and also the date of digging. The parabiologists record information on: empty shells; live hatchlings in the burrows; dead hatchlings in the burrows; unhatched eggs; undeveloped eggs; predated eggs; and the depth of the nests. No data were taken of the sizes and weights of the eggs due to lack of appropriate equipments such as calipers and balances.

Kamiali Community Participation in Leatherback Turtle Protection

The Kamiali Community were advised, informed and consulted on what the leatherback turtle-monitoring program is doing at community forums held every Sunday after church service. Also, community workshops and awareness activities by theatre groups were carried out to educate and make the community understand why the research is being undertaken (Fig. 6). The community shared their traditional knowledge and experiences on the leatherback turtles at these meetings. They expressed their concern on the decline of the nesting population.



Figure 6. Community workshop, education and outreach activities.

Table 1. Total Number of Nesting Females per Month during the Nesting Period in 2km of the Kamiali Wildlife Management Area.

Nesting Period (Year)	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1999-2000 ^a			14	28			42
2000-2001 ^b			27	21	7		55
2001-2002 ^c			13	25	3		41
2002-2003 ^c		10	32	8	6		56
2003-2004 ^c		6	36	17	11	1	71
Total		16	122	99	27	1	265

^a Monitoring concentrated to 1km

^b Monitoring extended in 2000 to 2km

^c Monitoring to 2km

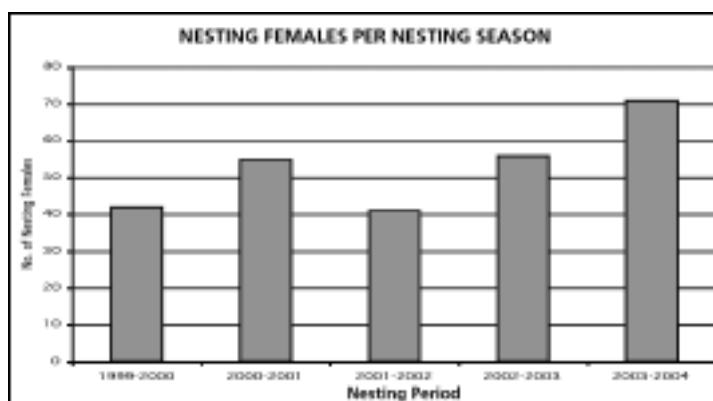


Figure 7. Total Number of nesting females per nesting season from 1999-2004 at Kamiali WMA.

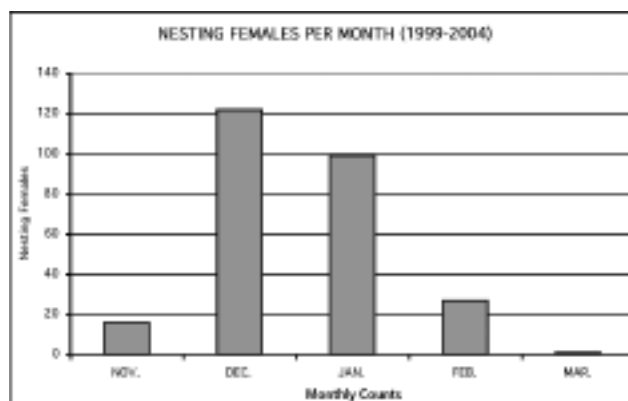


Figure 8. Number of nesting females at Kamiali WMA per month during the nesting season from

Table 2. Minimum Data set for clutch size, hatchling and emergence success².

Tag #	Pit Tag #	Hatchlings, Eggs & Egg Counts										Total No.Eggs ¹
		Date Laid	Date Emerged	Date Dug	Empty Shells	Live. Hatchl	Dead Hatchl.	Unhatch. Eggs	Undev. Eggs	Predated Eggs	Nest Depth	
190597	8	211203	190204	230204	30	4	20	43	38	-	2.31	97
20925	31	180104	180304	150304	17	0	5	2	11	-	2.31	24
19102	11	141203	120204	170204	51	3	5	1	2	-	2.31	60
19057	-	141203	120204	140204	97	3	1	2	6	-	2.31	103
19111	-	291203	270204	290204	81	5	2	13	11	-	2.31	101
20430	-	151203	130204	130304	37	0	3	20	26	-	2.31	63
20925	-	291203	270204	290204	76	4	0	8	23	-	2.31	90
20355	-	090104		130304	57	15	5	3	10	-	2.31	80
19064	-	131203	110204	130204	79	4	2	11	23	-	2.31	96
20908	-	180104	150304	180304	54	1	7	3	10	-	2.31	55
Total					579	34	50	106	160	-	-	610

¹ does not include undeveloped eggs

² The Council's Turtle Advisory Committee has recommended that this experiment be repeated and that technical assistance be provided to the project to help them better quantify hatch success rates.

RESULTS

Counts of Nesting Female Population

The number of nesting females per nesting season were collected beginning in 1999. This information, however, may not be complete, particularly for the early nesting seasons (1999-2001). In 2002, greater emphasis was applied to data collection to quantify the number of nesting females. The total number of nesting females tagged in the 2km study site at Kamiali WMA per month, per nesting period is tabulated in Table 1. Between 1999 and 2004, an average of 53 leatherback turtles nested at Kamiali WMA per nesting season (Fig. 7).

The peak nesting period is during the month of December. Nesting increases rapidly from November to the highest peak in December, and gradually declines towards February. The cumulative total number of nesting females per month per nesting season is illustrated by Figure 8.

Interesting Periodicity

From population counts, the inter-nesting periodicity of two leatherback turtles was determined. Resulting data indicates that turtles return to nest about every 11 days and lay on average five clutches during a nesting season.

Clutch Size and Hatchling Success

A subsample of 10 nests was used to determine clutch size and hatchling success of leatherback turtles (Table 2). This data will provide important information towards conservation and future sustainable management of the species. These efforts represent the first attempt to ever conduct such work by parabiologists at Kamiali. Information obtained is valuable, however, methods need to be refined and standardized, and results based on the small sample size are preliminary at best.

Clutch Size

The clutch size was determined by the number of eggs laid into the nest, excluding yolkless or undeveloped eggs. Using this method of calculation, 61 eggs was the mean number of eggs laid (excluding the number of undeveloped eggs).

Hatchling Success

Hatchling success refers to the number of hatchlings that hatch out of their egg shells (equals the number of empty shells in the nest). The calculated value for the hatchling success was about 24.79 percent.

Emergence Success

Emergence success refers to the number of hatchlings that reach the beach surface (equals the number of empty egg shells minus the number of dead hatchlings remaining in the nest chamber). The calculated value of the emergence success was about 5 percent. This is a very low success rate or mortality rate is very high at the embryonic stage.

DISCUSSION

In summary, 71 female leatherback turtles nested in the 2km monitoring area of the KWMA during the November 2003 to February 2004 nesting season, with peak nesting activity occurring in December and January. Turtles return to nest about every 11 days and lay approximately five clutches per season. It would appear that there has been a slight improvement in nesting numbers between 1999 and 2004 (see Fig.7). However, this may be due to increased capacity and effort/attention by the parabiologists, improvements in monitoring techniques over time, or it could be caused by an increase in recruitment into the breeding stock; although data to support this theory is currently lacking. To acquire a true assessment of nesting trends, additional and continued research is needed both at KWMA and other key nesting areas of the Huon coast.

This project represents the first time a community-based leatherback nesting beach monitoring program was implemented in PNG. Although it is difficult to quantify the number of turtles or nests conserved by these efforts, the education acquired by the community and the declaration of a harvest moratorium, that banned the killing of female turtles and the harvest of eggs in the 2km monitoring area, undoubtedly provided benefits to the leatherback population³. There is a “learning curve” associated with community-based programs which means that projects are slow to start and must progress

³ According to Dr. Limpus of the Council's Turtle Advisory Committee, “If villagers have indeed stopped eating eggs and there is a moratorium on eating eggs, on a section of the coast (however large), this is happening in a place where harvest was once the norm. This is a positive thing that has been achieved, regardless if efforts are quantifiable. The project needs to be encouraged to quantify some index of these conservation efforts, but I'm hearing very positive things out of this project compared to what I heard some years ago about 100 percent of the eggs were being eaten by the villagers simply because they walked past them on a daily basis.”

via incremental steps, but the positive benefits achieved by the increased awareness level and community-based management regime are invaluable stepping stones to long-term conservation efforts. In this context, the project met a critical component of its performance measure by the implementation and maintenance of an unprecedented harvest moratorium .

The workshops conducted by KICDG provided tremendous impacts on the community's attitude towards leatherback turtles. These workshops dramatized the life history of leatherbacks and were performed by the village youth theatre group (see Fig. 6). This was the time when the community fully realized why so much work is being put into leatherback research activities and the turtle's endangered global status. Additionally, research parabiologists and rangers greatly improved their monitoring skills and abilities over the 2003-04 nesting season with regard to data collection. Researchers became proficient in many capacities including assisting NMFS SWFSC to deploy satellite telemetry equipment, perform necropsies and collect genetic samples for analysis.

To maintain benefits that have been achieved to date, the education and awareness activities should be continued and supported.

Through community consultations, it has been determined that protection and conservation of endangered leatherback turtles at Kamiali has much to do with the politics of resource owners. In this context, incentives are necessary. Conservation can be achieved with the full support and participation of the community if there are incentives to improve the villager's quality of life. Incentives are paramount to the survival of the leatherback species in PNG and may include the building of a resource center, help with school projects, funds for school fees and church materials, or implementation of small eco-enterprises such as ecotourism.

Acknowledgements

The community-based monitoring of the endangered species leatherback turtle could not have been possible without funding from the WPRFMC. We sincerely and greatly appreciate the WPRFMC's decision to approve financial support for this important project, and special thanks to Irene Kinan (Project Monitor) of WPRFMC for

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Huon Coast Leatherback Turtle Network, Papua New Guinea

John Senego, Huon Coast Leatherback Turtle Network

The Huon Coast Leatherback Turtle Network in Papua New Guinea (PNG) was developed to address general threats to marine ecosystems, provide awareness and education to local communities, and integrate local people in conservation activities. The Network originated from partnerships with the Village Development Trust (VDT), the South Pacific Regional Environmental Program (SPREP), the Department of Environment and Conservation (DEC), the Kamiali Integrated Conservation Development Group (KICDG), collaboration with NOAA Fisheries, Southwest Fishery Science Center (SWFSC), and is interested in future partnerships with the World Wildlife Fund. The Network currently encompasses villages of the Huon Coast including Lae City, Yambo, Lababia, Labutale, and Gugumi villages (Fig. 1).

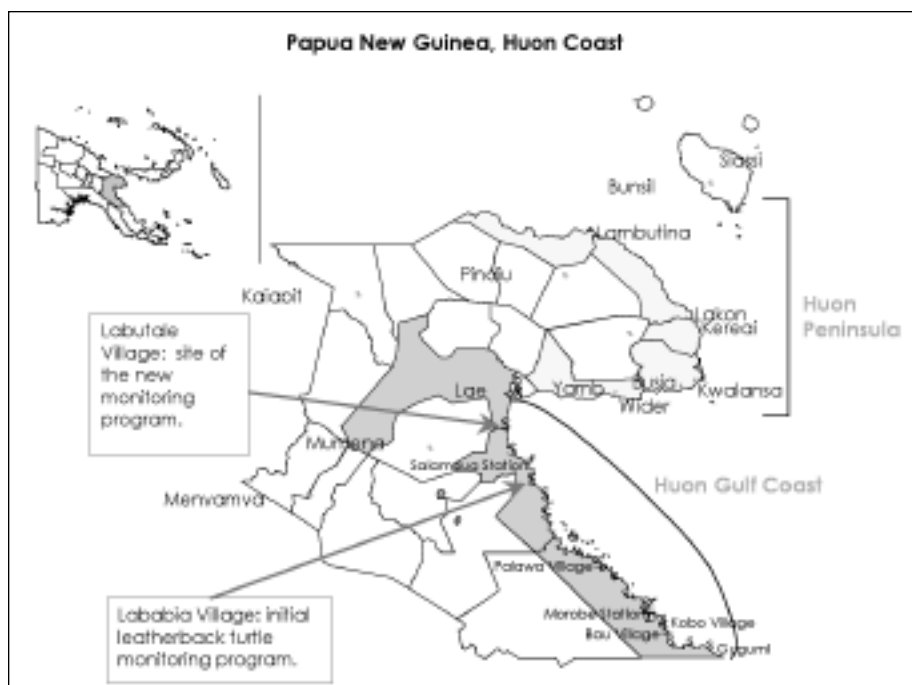


Figure 1. Huon Coast Leatherback Turtle Network Project Sites in Labutale and Lababia villages.

The Network works to increase capacity for long-term conservation and promote local ownership for the conservation of leatherback resources. Network goals are to explore economic opportunities to promote long-term conservation of leatherback turtles. The Network also works to address other threats to the marine environment, such as reef harvest for lime (which is a component that goes along with the beetle nut chewing).

The Network was established in 2001, following the first meeting in 2000. Previous to 2001, awareness generating activities were conducted by SPREP in partnership with VDT (at the time under leadership of Karol Kisokau). In April 2002, a leatherback turtle meeting was held. Committee members were elected including a president, secretary, coordinators, and advisors.

In PNG, there are two local level government areas: Salamaua and Morobe. Paiawa village is in the Morobe local level government area and in November 2002 the Network funded a major awareness raising program. This awareness “road show” took 10 days beginning from Paiawa (Fig. 3) and extended to Labutale villages (Fig. 4).



Figure 2. Huon Coast Leatherback Turtle Network members.



Figure 3. Paiawa people watching the video tape on leatherback turtle biology and conservation.



Figure 4. Headmaster (The Hunter) of Labutale community school speaking to the children. (left)
Workshop at Labutale village. Levi Ambio (KICDG) explaining the leatherback life cycle to the school children. (right)



Figure 5. Laukanu theatre group performing the story of fishing expeditions to catch green and hawksbill turtles.

The Network visited Salas (phonetic) village because these villagers are notorious for reef and turtle harvest. They are inlanders, not coastal people, and do not have the same cultural relationship with the marine environment and turtles. They were told that harvesting turtles is very bad, and many fights have ensued. But this did not deter the Network, and members traveled on to Salamaua, Buakap and Awasa Busama villages where they spoke with school children during the day and with village elders at night. In Laukanu Village, local people harvest turtles on special occasions, and thus the local theater group helps to provide awareness information (Fig. 5).

The Huon Coast Leatherback Turtle Network now holds annual meetings for members to come and share their experiences. In 2003, the Labutale village Network members had dialogue with the community, and the community agreed to set aside a no-take zone to protect nests at Kamiali. In January 2004, SPREP provided funding for the annual meeting. At this meeting a shared

vision for the Network was developed, “To increase and maintain at a viable level the leatherback turtle population in the Morobe province, for the benefit of our present and future generations,” and a project concept and activities were discussed.

The activity plan includes awareness raising activities such as T-shirts and posters, ideas for ecotourism, and implementation of a tagging and monitoring research program. The Network has further discussed the need to address the economic needs or economic aspects of turtle harvest. Furthermore, the Network aims to first work along the Huon Coast, and if successful, then extend efforts to the Huon Peninsula. Network members are also working to pass leatherback turtle conservation and management law for the Morobe and Salamaua local level government, under the section for the Organic Law on Provincial Government. Thus the Morobe Provincial Government has become very much aware of the leatherback issues in Province.

However, despite awareness initiatives, people continue to harvest turtles and their eggs. Coastal villagers complain about people from the inlands who camp on the beach and harvest turtles when they come up to nest (it is believed that these inland villagers do not have the same cultural connectivity with sea turtles and marine resources). Therefore it has been suggested that the Network conduct oral history research to understand how communities relate to leatherback turtles. Yet, in some meetings communities appear to have begun showing interest.

Currently, the Network is the best option for positively influencing government laws and regulations, and protecting the leatherback turtles in a much bigger area of PNG. The Huon Coast Leatherback Turtle Network intends to continue awareness building activities because interest in the Morobe Coast is increasing and education momentum should be continued.

Commercial fisheries-sea turtle interactions in Papua New Guinea: Mitigation and outreach program, a joint project of NOAA Fisheries and the National Fisheries Authority of Papua New Guinea (commencing June 2004)

Mike McCoy, NOAA Fisheries contractor: Gillett, Preston and Associates

In the last few years, two things have coincided, turtles and fisheries. This presentation is about what is currently being done to start a project that will address turtle bycatch on fishing vessels in Papua New Guinea (PNG). This project will be conducted in collaboration with the National Fisheries Authority (NFA) to expand outreach efforts in mitigating sea turtle-fishery interaction to fishermen in certain PNG commercial fisheries. And secondly, to enable NFA and PNG commercial fisheries to acquire a broader understanding of how to handle sea turtle interactions at sea and to lay the foundation for future turtle management activities. For perspective, Figure 1 is a map of the Exclusive Economic Zones (EEZ's) of the region.

Why undertake such a project in PNG?

This project is very important for a number of reasons: 1) this is an important area for sea turtle species; 2) NFA has an active onboard observer program with trained observers already in operation; and 3) initial observer information indicates that turtles are taken incidentally in certain commercial fisheries in PNG¹.



Figure 1. Exclusive Economic Zones (EEZ's) of the Pacific. Papua New Guinea EEZ: 3,120,000 sq. km

A problem that exists throughout the Pacific Islands is that turtle interaction data has not always been collected by observers in a method that is useful. Another problem is that although some fishermen may be well-intentioned, they may not currently possess information that would enable them to

minimize adverse interactions with sea turtles. For example (Fig. 2), on this Taiwanese longliner the fishermen is trying to get the hook out, but while he is doing that, he is blinding the turtle. A little bit of information, a little bit of training, would perhaps negate some of these poor practices. In some cases there are observers onboard, but the observers also don't know what to do. This program is designed to pass information along that can be readily used.



Figure 2. Improper handling protocol can be corrected with training and information. (ie., fisher is holding turtle by the eyes to remove hook.)

Project Design

Commercial fisheries similar to those operating around the region are also present in PNG's EEZ. Some are exclusively domestic with mainly domestic crews, others include foreign involvement and foreign crews. The tuna longline fishery in PNG is an exclusively domestic fishery. The shark longline fishery is also an exclusively domestic fishery, as is the prawn trawling fishery. There are, however, purse seine vessels that operate in the Bismarck Sea and elsewhere that are foreign, as well as some foreign domestic-based vessels. There are management plans for each of these fisheries, and many have observer programs. But these programs are set up primarily to monitor the catch of target species, they are not designed to determine how many turtles were caught, or do a million other things that scientists would like them to do.

¹ The South Pacific Secretariat for the Pacific Community (SPC) has been helping NFA to train observers and implement an observer program. Due to this program, information indicates that turtles are taken incidentally in certain commercial fisheries in PNG.

Since various access and operational arrangements exist for different fisheries, and for different segments within some fisheries, it is very important to start by getting the countries' cooperation. The program intends to focus on the subject of sea turtle interaction for a concentrated period to heighten awareness in all sectors (i.e., bombard the NFA with as much information as possible in a fairly short period of time to heighten peoples' awareness). Utilize the NFA onboard fishery observer program as the main vehicle for disseminating information through contacts with industry and government sectors, and engage the industry in a voluntary and participatory manner.

In domestic, local fishing operations, it is believed that in many countries of the Pacific, people do not feel they are outside the law, but as if the law does not apply to them. For example, "I'm a local guy, why are you bothering me. The U.S. is a totally separate situation. I don't think that these western countries' attitudes apply." Also, there are local crews, local guys who are used to eating turtles in their home province or island. They are out at sea for weeks and weeks at a time eating only fish and rice. They catch a turtle, and great! Why should they throw it back? "I'm a national of this country. This is a resource of my country." So there is a big difference to approach a domestic fleet than a foreign fleet that has licenses, or an access agreement. In an access agreement, for example, regulations state that all turtles go back over the side, that is easy, relatively speaking.

In summary, the Projects' objectives are to:

1. Expand activities of the NFA fisheries observer program by improving the capabilities of NFA staff and observers in recognizing, handling, and reporting interactions between sea turtles and the relevant commercial fisheries in PNG.

- Hold workshops and training for NFA fishery observers and industry in the proper handling of sea turtles incidentally hooked or entangled in fishing gear.
- Create training syllabus for use in current and future training sessions by senior NFA staff, and provide adequate reference documents for use by onboard observers.

- Provide relevant tools to observers and training for their use on board fishing vessels. These objectives are modeled after what NOAA Fisheries uses in the U.S.: big dipnets for small turtles to get it on the boat to safely release the hook, dehooking devices, bolt cutters for cutting off the hook, and line cutters for cutting the line for turtles that are too large to get onboard.

2. Familiarize commercial fishing operations in PNG with techniques of handling sea turtles caught incidentally to fishing operations, and provide appropriate instructions on how to address specific sea turtle interaction situations.

- Hold meetings with vessel agents and operators to explain importance of the topic.
- Provide appropriate handling and release instructions.
- Emphasize new role of NFA observers in utilizing these techniques and assisting vessel captains where necessary.

3. Integrate the topic of sea turtle interaction with commercial fishing operations into NFA's ongoing fisheries management program.

- Investigate use of specific sea turtle interaction mitigation methods in the commercial prawn trawl fishery.
- Analyze current data collection programs, including logsheets and observer programs, to determine what, if any, adjustments are required to current programs.
- Review existing fishery management plans and provide recommendations based on project results.
- Recommend appropriate protocols and arrangements for the sharing of sea turtle interaction information collected by NFA.

Optimal longline fishing areas are in the Bismarck Sea, but most fishing currently takes place in the Coral and Solomon Seas in the south. It is a fresh fish, sashimi operation primarily targeting yellowfin tuna (70 percent of total catch). But, optimal longline fishing areas, in terms



Figure 3. Anchored FAD Locations Reported in PNG, 2002 (note graph not to size).

of potential high longline catch rates and bigeye proportion of the catch, are in the north of the EEZ. These waters remain lightly fished owing to distance from transshipment points in Port Moresby and Lae. There is no foreign longlining allowed in PNG, it is all domestic. The fisheries that are going to be included in this project include:

- Domestic tuna longline (about 40 vessels) which operate primarily in the Coral Sea and the Solomon Sea;
- Domestic tuna purse seine (17 vessels) based in Madang and Lae;
- Locally-based foreign tuna purse seine (11 vessels);
- Domestic shark longline (8 vessels) based out of Lae, Robal, and Port Moresby; and
- Domestic prawn trawl (15 vessels) operating in the Gulf of Papua and the Western Province.

In 2002, 64 percent of the sets made by purse seiners were in association with FADs (fish aggregating devices), anchored and floating FADs, and drifting objects. Olive

ridleys in particular are known to be found around floating objects. It is unknown if leatherbacks are found in PNG in conjunction with floating objects or not. The anchored FADs are usually a big long float, maybe four to five meters long, anchored in 500 to 1,000 meters of water or greater, and have all kinds of palm fronds and things hanging from them to attract schools of tuna. They're strategically placed in the country by the local companies to intercept migrations of tuna. They don't attract tuna. They hold the tuna that comes near them. FADs are put in like a picket fence, stretching maybe eight, ten miles or more. There are about 800 of these

FADs currently registered in PNG (Fig. 3), and there are probably a couple hundred more that aren't reported. Unfortunately, the implications for turtles are unknown.

The other component of this project is to work with the domestic prawn trawl fishery. It is the largest fishery in the Gulf of Papua harvesting 1,200 tons a year, with 15 boats (limited entry fishery) that do not use turtle excluder devices (TEDs). There is no need for TEDs from a regulatory standpoint. They export all the prawns to Japan and thus do not have a marketing problem associated with TEDs if they were to import to the U.S. The plan is to utilize an expert from Australia to assist with the technology side, and then work to introduce the concept of TEDs and to see if they will be useful.

This similar project has been implemented, with the exception of the prawn trawlers, in the Marshall Islands and the Federated States of Micronesia. It has been successful in these countries. This is the third country to institute such a program, but it is by far the largest, and most complex. It has the most diverse types of fisheries and their observer program has only been up and running now for two or three years. It is going to be a real challenge, but the benefits are quite worthwhile compared to the costs.

Questions?

MS. FAHY: With regard to the FADs in the purse seine fishery. The IATTC, the Inter-American Tropical Tuna Commission, is beginning to collect a lot of information on turtle bycatch in FADs. They now require their observers to collect that data. I would recommend that if you haven't put that already in your forms, to try to collect that information to see what the impact is.

Also, fishermen are now required to, even if it's not their FAD, to release any turtle that's been entangled, that's found to be entangled, if they're just passing by and they see the FAD, even if it doesn't belong to that vessel, they are required to disentangle turtles.

MR. McCOY: A couple of points for PNG specifically, but even in the western Pacific, in general, most of the purse seine fishing is done by foreign fleets and the foreign fleets are licensed under access agreements. There usually is a set of minimum terms and conditions agreed by the Forum Fisheries Agency for these access conditions that require them to release all associated species with the maximum chance of survival. So there's at least a regulatory framework for complying with the licensing agreement. That part is not insurmountable. I think it can be done.

The FAD situation in PNG is going to be easier to tackle than the longline situation. Purse seine vessels are bigger and it's a little bit more comfortable for observers to be onboard. That's the good news. The bad news is that these guys stay out forever. The domestic boats are able to transship their catch and the seiner never comes in, never comes to port. Six months. Seven months. Eight months, they stay out – they are mostly Filipino operations and they just keep transshipping their fish to carriers within PNG's zone. So the ability of observers to stick it out that long is questionable.

MS. FAHY: Do all the vessels that are included in the project fish out of PNG? Or is that a percentage that you hope to get covered by observers?

MR. McCOY: Yes. For shark longline, that's a domestic limited entry fishery, eight boats. The prawn trawl fishery is domestic. That is also a limited entry fishery. The longline fishery is domestic. There's no limit right now. They haven't reached their limit. They have a TAC, but those are the only longline boats legally fishing there. Purse seine vessels, what is not covered is going to be the U.S., because the U.S. fleet operates under the U.S. Tuna Treaty and they have a whole separate observer program that goes on those boats and watches what's going on. Some domestically-owned boats throughout the FFA region operates under a thing called the Federated States of Micronesia Agreement that allows them to fish in FFA member countries together.

MR. BENSON: Did you mention that this was going to be a voluntary participation, observer program —

MR. McCOY: No, no. The observer program is required. Placing an observer onboard your boat is a required license condition. Any time you have a license you are subject to observer placement. What is going to be voluntary is when you don't have observers onboard, then we're still giving all these workshops for the captains. We're still passing out all the information. We're still trying to give them the techniques for release, and so forth.

MR. BENSON: What would be the incentive for them to participate?

MR. McCOY: The incentive right now is to include guys from the country. This is the problem with a domestic fleet. There is no real regulatory framework that comes down hard on them like it does in the U.S.. Countries in the South Pacific and the Western Pacific don't have a fishery development department or a fisheries management department. So when you go to NFA or when you go to Micronesia, these guys are doing two things at once. They've got a government mandate to develop their fisheries, and in PNG it's really strong and they're trying to develop export-oriented fisheries, shore-based stuff, everything. In the same building in the next room is the guy who is doing the regulatory stuff. It's a real conflict. But in countries like this they can't afford to have a Fish and Wildlife Service and a Fisheries Development Service.

DR. DUTTON: There's a great potential here for adding a layer of research in the observer program which we have in our U.S. based observer program. But what's your sense of how – what is the potential, for including genetic sampling and biopsy, or other types of more directed research, particularly with the juvenile turtles?

MR. McCOY: I think it depends on the program you're dealing with in the country, how established it is and the experience of the observers. It really boils down to the guy on the boat.

MR. BALAZS: It might be appropriate to re-emphasize that test tubes and syringes and stuff are fortunately no longer needed by geneticists. A little tab of skin in a salt shaker in a plastic bag, right?

DR. DUTTON: Yes. It's part of the kit for leatherback sampling. But your point is well taken. In starting a new program, you don't want to add layers of complications. But George and myself and others have put thought into how to make things as simple as possible.

MR. MacKAY: Mike, I've got two questions. The SPC observer data did not record any leatherbacks caught. There were some turtles caught in the early days, but they were not identified to species. Anyway, it said there were no reported leatherbacks in the observer data. You showed a number of pictures. I wonder, are those from the Pacific fishery? Are those from observers?

MR. McCOY: Yes. Yes.

MR. MacKAY: And that's not getting to SPC?

MR. McCOY: No, no, no. These are not from PNG.

MR. MacKAY: No, I know. But I'm talking of the whole observer coverage that SPC has, they have not reported any leatherbacks.

MR. McCOY: Your right, it's a huge problem. The problem is that their data collection form showed mostly unidentified turtle.

DR. SWIMMER: Can you characterize the tuna and shark fisheries, are they deep-set fisheries?

MR. McCOY: That's something I didn't get into. That's a nuance that's really important.

The shark fishery is a surface fishery, real shallow setting, and there are two segments of the longline fishery. The longline fishery that fishes Taiwanese style, mainly based out of the North Coast of Lae, which is also a shallow set. It's 70 percent yellowfin. Two reasons, the Taiwanese style fishes shallow. There is a lot of yellowfin in that area. There are a few boats based in Moresby that use Japanese deeper sets. I say Japanese because there are a few boats that use mono. But most of these are fishing shallow, five hooks between the floats, fishing at night, offal discards for bait or whatever they have got for bait.

DR. SWIMMER: That's why there's a higher interaction rate with the shark fishery?

MR. McCOY: Definitely.

MR. BALAZ: Just a few words of honor and respect to Mike. Many in the room may know – I met Mike in '74, and I'm telling you, I don't see him as much as I would have liked to in recent years, but his presentation, to my mind, shows the depth, the scope, the knowledge that he has on the ground, contacts and experience with Pacific Ocean peoples.

In 1975 he wrote a hallmark article, scientific article, for the Journal of Micronesia called, the Green Turtle and Man in the Caroline Islands. He documents the cultural significance, the navigation skills of the family he married into, going to hunt turtles in the traditional way without outboard motors. This is highly significant to Hawaii, in my opinion anyway. Mau Pilaug (phonetic), from Mike's family, is the person that came from the Caroline Islands and retaught the ancient navigational skills to the Hawaiian people that resulted in the voyages of exploration with the Hokulea and the other vessels afterwards.

This man is a man of the Pacific and it's taken me 30 years to truly focus on the value that you are. Stay with us for a long time, Mike, you are needed.

MR. McCOY: I had to change Man and Turtle to Humans and Turtle. Times have changed.



Solomon Islands

Leatherback Turtles in the Solomon Islands

John Pita, Department of Fisheries & Marine Resources

The national Solomon Islands Marine Turtle Program includes monitoring programs for green, leatherback, and hawksbill sea turtles. The overall objectives of the program are to determine the local nesting population size and to collect baseline data to assist resource managers to promote management of leatherback turtles. Data that have been used to formulate legislation by which conservation initiatives to protect feeding and/or nesting grounds have been established. Recently, efforts have been made to better understand the migratory trends of leatherbacks and provide education and awareness programs at both the national and the community levels.



Figure 1. Map of the Solomon Islands.

History of Leatherback Research

The Marine Turtle Monitoring Program began in 1973 by the Solomon Islands Department of Fisheries, focusing primarily on green and hawksbill turtles. The leatherback program did not begin until 1989, prompted by a volunteer from Australia (Tanya Leary). She worked initially to bring stakeholders together to begin leatherback monitoring.

Six leatherback nesting sites were identified in 1989 with Isabel island the dominant site (Fig. 1): Kilokaka (Isabel Province), Sasakolo (Isabel Province), Litogahira (Isabel Province), Salona (Isabel Province), Lilika (Isabel Province), Tetepare (Western Province), Vaghu Beach (Choiseul Province). During these initial surveys, turtles were flipper tagged; nests were counted; genetic samples were collected (conducted in collaboration with Damien Broderick)¹; and information was provided to local communities to raise awareness and highlight the importance of conserving marine turtles,

especially the leatherback, and the negative impacts that will occur if people continue to harvest eggs or disturb nesting rookeries.

To date, however, the Department of Fisheries has capacity to monitor only two nesting sites, Tetepare, Western Province (in collaboration with Tetepare Descendants²) and Sasakolo, Isabel Province. Monitoring consists of flipper tagging (metal tags - PIT tags are not currently used) and nests counts (Table 1).

Table 1. Results of Surveys at Sasakolo, Isabel Province

Year	Monitoring Duration	No. Nests	No. Tagged Turtles
1993	10 nights	25	10
1995	40 nights	83	25
2000	52 nights	132	27

¹ Collected tissue samples were analyzed by Dr. Peter Dutton's laboratory. Sidebar: John Pita noted he was glad to see the results of this DNA analysis in Peter's presentation (see Dutton's presentation pg. 15).

² Tetepare Descendants Conservation Project (see MacKay's presentation pg. 69)

Threats

Current leatherback threats in the Solomon Islands include: an increase of the saltwater crocodile population nationwide; increase of human settlement in coastal areas; and egg harvesting (even though the law prohibits the harvesting of leatherback eggs, people continue to harvest due to lack of enforcement resulting from the isolation of nesting areas).

Management Initiatives

The first steps in management by the Department of Fisheries to conserve or protect the leatherback population in Solomon Islands were to formulate national legislation. This legislation prohibits harvesting nesting females and eggs throughout the year, a complete no-take legislation for the leatherback species. Secondly, the goal is to promote community participation at every level of the program. In our part of the world, the belief is that if communities are not involved, endeavors will not be successful. In the Solomons, eighty percent of the reefs and lands are owned by people in the community and are customary lands. Thus to implement any conservation program, there is a great importance to take into account and involve participation of the local community.

The third management initiative is to establish a national turtle database. This is a joint effort between The Nature Conservancy and the Government through the Department of Fisheries. Finally, management goals are to formulate a National Marine Turtle Management Strategy. This management strategy was completed last year (2003) during our national workshop, which was funded by SPREP. The Department of Fisheries is now in the process of submitting a paper to support these management strategies to be implemented at the national level, as well as the community level.

Tangio tumas an hem nomoa!

Questions?

MR. MacKAY: I am with the Canada South Pacific Ocean Development Program, which has funded the work out of SPREP since 1990. So a lot of the work in the Solomons was done through Canadian funding by SPREP. Over the last six

months or a year, I have been trying to pull together a lot of the information that has been done over the last 15 or so years. Unfortunately, Peter Ramohia is not here. John Pita and myself met in the Solomons about six weeks ago and we agreed that Peter was going to give the detailed numbers, but he could not be here today.

But what has impressed me, is that there is a lot of data and a lot of information in the Solomons on leatherbacks. So it galls me when I read the Bellagio Declaration that says of the ten nesting beaches in the world, the Solomon Islands is one. Von (phonetic) in 1981 said there are 61 leatherback nesting beaches in the Solomons. Fifteen have probably over 50 nests a year. John Pita identified seven or eight. So that information is there, and I think it's probably up to this meeting and up to us to get that out to the rest of the international community.

Also, when I saw the satellite tagging data today, wow, I realized you guys have got to start tagging in the Solomons! I think we can work out some places for you to do it from, because the ones from PNG – I call it the slot, between PNG and Solomons, all those turtles are whipping by, passing the nesting islands. There has to be a linkage.

I just wanted to make the point that they have done a lot in the Solomons and I think we're going to have to try to find a way to pull it together. Part of the problem is there's so much it gets hard to pull it together. But I think it's very useful information that we should all have a look at.

MR. BENSON: In the Solomon Islands, can you give me a ballpark figure, about how many nesting beaches have at least as many as 100 nests on it?

MR. PITA: I think four to five.

MR. BENSON: Four to five beaches with about that level of density?

MR. PITA: Yes.

MR. MacKAY: I'll provide little more information on Tetepare tomorrow, but there's probably three sites in Isabel. One, you've studied extensively. The other two, there's been very little work, but suggestions are they may be as high. There were 132 nests on your survey at Sasakolo. Choiseul is probably lower. I believe there might be five or six sites with more than 100 nests. And then there are areas where there may be 20 or 30 nests, but these beaches are close together.

MR. BENSON: Okay. Okay. All right. I think I understand.

MR. PITA: So before I sit down it's an open market. You guys better come to the Solomons and do some work there.

Tetapare Descendants Association Conservation Program

Kenneth MacKay, Canada-South Pacific Ocean Development Program

I am not directly involved in this turtle conservation project in the Solomon Islands, I am only the storyteller. So what I'd like to do is tell the story of a project that started in the last two years on a very important leatherback nesting beach.

In the Western Province of Solomon Islands adjacent to Marova lagoon are the islands of Rendova and Tetapare, both with exposed western coasts where leatherback turtles nest on black sand beaches. Rendova, a volcanic island, has settlements along the coast. Tetapare is the largest uninhabited island in the South Pacific, with vegetation still intact. It's been uninhabited for 150 years when the original peoples left to settle on Rendova Island and other islands in western province. They left probably for a variety of reasons that may have included disease and inter- and intra-tribal warfare.

Because of nearly 150 years of lack of human habitation, Tetapare has retained most of its primary lowland rainforest and has relatively intact terrestrial and marine ecosystems. However, over the last ten years, there have been various moves to log the island. As a result, two factions developed. The end result was that Tetapare Descendants Association (TDA), the anti-logging group, that won the fight and prevented logging. TDA is a registered charitable organization that represents the descendants of the original Tetapare islanders, and they claim hereditary use rights of the island. Tetapare Island has now been recommended for establishment as a nature reserve or protected area.

With over 1,500 members, TDA is one of the largest landowners associations in the Solomon Islands. Its main objectives are to ensure cooperation among Tetapare landowners and to promote the conservation and sustainable use of the island's resources. It is supported by two Australian project managers, by WWF, and a Canadian couple from CUSO who are both wildlife biologists and live on site. TDA is currently developing alliances with The Nature Conservancy (Solomon Islands) and Earthwatch. TDA is promoting projects to support the descendants to reduce incentives to harvest the resources on Tetapare. Although pig hunting is allowed, a marine protected area has been declared locally and there's a taboo on the harvest of turtles and other species.

The black sand beaches of the west coast of Rendova and the smaller beaches of Tetapare are nesting sites for the highly endangered leatherback turtles. The communities on Rendova have traditionally eaten leatherback turtles and eggs. In 2002, a community-based turtle conservation program began focusing first on Rendova on two villages, Baniata and Havilla (where the descendants of Tetapare live). The project started with conservation awareness and education training. This is complemented by community turtle monitors who are employed to discourage the harvesting of turtles and eggs, and to promote the survival of hatchlings.

Prior to the project, most eggs and at least ten adult turtles a year were consumed. And I say, "why not?" Villages are located where there is no coral reef, they are exposed to the waves, which makes access difficult. The village of Baniata consists of traditional leaf houses (Fig. 1), very little amenities, no electricity, no roads. Access is only by boat, or by foot across the island to the next village. The Havilla village is even less accessible.



Figure 1. Traditional leaf houses of the Solomon Islands.

Imagine that you are marooned on this island, have been living here for six months, and suddenly a 300-pound piece of meat came crawling up on your beach (Fig. 2). Why not harvest it? It's been done traditionally. The waves are such that you have difficulty getting out to fish. There's no boat coming in with food or supplies. So traditionally, turtles and their eggs have been a very, very important component of the seasonal diet.



Figure 2. Typical beach dynamics in the Solomon Islands.

There is no subsistence market, but there is a small incentive for conservation. Community cooperation is assured through the payment of small economic incentives when nests are discovered and protected (\$10 Solomon). Commitment to protection is ensured by photo documentation carried out by the turtle monitor. Turtle monitors also collect basic biological data such as track width, number of nests and number of hatchlings. If eggs are eaten, money is not provided. If the nest hatches, there is an additional incentive.

Summary of Research

In 2002 and 2003, turtle monitors and villagers collected data in Baniata, Havailla and Tetapare. In Baniata there were 68 crawls from September to August, with no activity April, May, June, and the peak in January (at both sites). Unfortunately, of these nests, only five hatched. At Havilla, there were 38 crawls. The communities no longer catch and eat leatherbacks nor do they collect eggs. At Tetapare, one nesting beach had 11 crawls, but this is quite inaccessible, so it was only periodically checked.

The Tetepare component of the community-based turtle monitoring project is focused primarily on counting numbers of turtle nests on known turtle beaches. TDA has an established field station on Tetepare Island and retains a small number of rangers who make regular patrols to the turtle beaches during the leatherback nesting season and record similar field data as turtle monitors on Rendova. There are two rangers on site, and

two nesting beaches, which have approximately 30 and 10 nests per year. It is suggested that Baniata on Rendova and Quero on Tetapare could be index sites for beach surveys.

Threats

The community has identified a number of threats most importantly the washing away and flooding of nests. High tides and higher seas in late February-March wash nests laid in November, December, and January when tides are lower. In March, tides are the highest, with high surf and winds switching around to the west.

At Tetapare, the iguanas or monitor lizards appear to be very effective in locating and destroying nests. Iguanas destroy at least 50 to 60 percent of the nests. However, because it is an ecotourism site, iguanas are protected. Therefore predator control will have to be creative. Additionally, it would seem that a low percentage of nests hatch, but more data is needed to quantify this. To address conservation, there is a need for adaptive research to increase survival to include relocation of nests laid in erosion prone areas, and predator control.

Questions?

MR. BALAZ: I am interested in why people fled 150 years ago. Why did they uninhabit the island?

MR. MacKAY: It was around the time of contact in the Solomon Islands when diseases were running through communities. In many places, the population dropped by 90 percent because of the exposure to western diseases. That would have clearly happened there. But these areas were pretty fierce as well, with different groups fighting each other. It may have been a combination of some internal difficulties within the communities, visits from some warring canoes or maybe diseases, then people said this is a bad luck place, we have to move out.

MR. BALAZ: Is it still known as a bad luck or ghost site?

MR. MacKAY: There are still lots of stories. Apparently, when the population left, a woman had to leave her child there. So at night you hear the child cry. Now, it may be feral cats meowing, I don't know. But there are a number of superstitious stories associated with it, and there are a number of sacred sites that one has to be very careful visiting.

MR. McCOY: Regarding the problem of predation of eggs by lizards, in Micronesia the lizards were brought by the Japanese before the war as a rat eradication measure. This didn't work, but then they were used as a food source when

the war started. For years I've been trying to figure out what can be done. People love them, they don't want to kill them. About a year and a half ago in the Journal of Micronesia, which is published by University of Guam, there was an article by some herpetologists working on Rota in the Northern Marianas which were doing a census of lizards. They developed a snare, a trap, that looks like it is really, really efficient.

Essentially it's a piece of chicken wire, wrapped around the tree. What you do is take the chicken wire and on every single square of the chicken wire you use monofilament line and tie a noose. Wrap it around the trunk of the tree and put some meat in the center so that the lizard has to crawl over the trap to get to the meat. When the lizard gets on the trap one or two of its legs get stuck in the snare. These traps were really effective. They compared their hand-catch rates, chasing them through the bush or digging them out of the tunnels, with what they would catch on the snares, and it was 14 to one.

MR. MacKAY: The problem is that the lizards are indigenous. They are protected. Even a snare to move them somewhere else won't work. If perhaps there is some sort of olfactory spray you can spray on top of the nest so they don't smell or sense the eggs, this might work. But is clearly is a problem on Tetapare.

MR. REI: With regard to the incentives that are provided to the people. How do the partners you are working with on Tetapare feel about the incentives?

MR. MacKAY: Personally, I have difficulty with it, but they don't seem to. It is a little more than just giving money to an individual, it becomes a community sort of thing, as opposed as to giving it individually to someone's pocket. Clearly it is more of a social thing, getting something to the community for their conservation of nests.

MR. BENSON: You said you were providing this financial reward. How does it connect with the place being food limited? These animals come along and the people are quite happy to be able to get the source of protein. How does the money bridge the challenges with getting food? There are no stores, it sounds like a subsistence lifestyle.

MR. MacKAY: I don't know enough to answer that, but my guess is that it's probably used to partially buy food from the next island and also meet some of the cash demands which are school fees, church fees, festivals. But this would be an interesting study to look at the incentives and how they are distributed.

DR. DUTTON: Exploring the lizard predation issue, I'm trying to jog my memory. It's been many years of beach work, but we used to use wire mesh cages for predation. Jeanne, do you recall how effective it was, or not?

DR. MORTIMER: I'm not sure about the wire mesh cages, but a flat piece of wire mesh that's big enough to let hatchlings out, but small enough to keep predators out. It worked well for us, and maybe it would work well for keeping the lizards out.

MR. MacKAY: On Tetapare that would be quite easy to do because the rangers are out there anyway.

DR. DUTTON: I think there are options. Especially if there are people monitoring. It can work against you if you put mesh out and hatchlings get caught when they emerge, but if people are monitoring it can be a quite effective strategy.



Leatherback Turtles in Vanuatu

George Petro¹, Francis Hickey², and Kenneth MacKay³

Introduction

Leatherback turtles (*Demochelys coriacea*) in the Pacific are highly endangered and there are suggestions that they may be extinct in ten years (Spotila et al., 2000). Nesting females have declined precipitously in Malaysia (Chan and Liew, 1996) and Costa Rica (Spotila et al., 2000). Similar long term data is not available for the Western Pacific but recent estimates suggest there are less than 2,000 breeding females in the Western Pacific Ocean (op cite).

Vanuatu Island residents from Tanna in the south, to Espiritu Santo in the north know leatherbacks. There are also indications that leatherback nesting has decreased over the years. This paper reports nesting for the Islands of Ambae, Pentecost, Ambrym, Malacula, Epi and Efate (Figure 1). Leatherback nesting in Vanuatu has not been previously reported in the international literature. Limpus (2002) states, "The strip that runs from north-west Irian Jaya out into the Solomon Islands is the last remaining stronghold of leatherback nesting in the western Pacific." Pritchard (1981) in a review of turtles in the South Pacific suggests that turtles of New Hebrides (as Vanuatu was then called) need further study. He quotes McElroy and Alexander (1979), "Information on the leathery turtle indicates that it occurs in some parts of the group but no nesting beaches were known."

Since then, there has been considerable effort directed at turtle monitoring and turtle conservation in Vanuatu. Beginning in 1990, a Regional Marine Turtle Conservation Program (RMTCP) coordinated by the South Pacific Regional Environment Program (SPREP) and funded primarily by Canada through the Canada-South Pacific Ocean Development Program (C-SPOD) was initiated and funded turtle monitoring in Vanuatu. The pivotal event occurred in 1995, during the Year of the Turtle, when the RMTCP funded the theatre group "Wan Smolbag" (WSB) to develop a play that toured the villages first in the main Island of Efate and subsequently most of the Vanuatu Islands. That play has had incredible impact, resulting in over 100 villages participating in turtle conservation. As a follow up, most villages have appointed a knowledgeable person as a turtle monitor (Petro, 2002; Johannes and Hickey, 2000). These village-based monitors have evolved into sustainable resource monitors and are now called Vanua-tai (Land-Sea) resource monitors (Figure 2).



Figure 1. Map of Vanuatu with historic leatherback nesting sites depicted in shaded areas.



Figure 2. Vanua-tai resource managers at a community workshop.

¹ Wan Smolbag Theatre, Port Vila, Vanuatu; Presenting author

² Vanuatu Cultural Centre, Port Vila, Vanuatu

³ Canada-South Pacific Ocean Development Program

WSB is currently documenting the impact of this program and producing a video. Preliminary results suggest that the program has conserved thousands of the four species of marine turtles present in Vanuatu. Given the importance of conservation of the highly endangered leatherback turtle, it is important to document information on this species in Vanuatu. To this end, we present recent information to determine the role of Vanuatu in leatherback nesting.

Methods

We reviewed recent unpublished (in country) reports on turtle monitoring, recorded information on traditional knowledge of the leatherback turtles, and interviewed knowledgeable turtle monitors. Additionally, detailed research including a nesting beach survey was carried out November to December 2002 in the southwest of Epi Island with follow-up in January to February 2003.

The nesting beach survey at Epi Island had several objectives and expected outcomes. These included:

- To quantify the number of turtles that nest at the site;
- To identify the different species of turtles that utilize the site;
- To determine if tagged turtles return to nest at the site where they were originally tagged;
- To quantify the average number of hatchlings per nest;
- To assess potential dangers (other than humans) that pose threats to nesting turtles; and
- To raise awareness through the research on the importance of the turtle nesting site.

The research was planned to be conducted in the following ways, although it was found necessary to change some of the methods to fit the local conditions:

- Survey of nesting turtles at night;
- Survey and mark turtle nests during the daytime;
- Check and count hatchlings as they swim out to the sea;
- Conduct meetings and interviews with the villagers about turtles at the nesting site.

Results

Traditional Knowledge

Leatherbacks are known throughout many islands of Vanuatu and there is often a name in the vernacular to identify them. Residents of a number of different islands, from Espirito Santo in the north through Ambae, Aneityum and Efate, to Tanna in the south indicate that

there were formerly at least small nesting populations of leatherbacks on these islands. Nesting events on these islands have significantly declined since the 1980s in response to increasing human population growth and subsistence pressure on nesting females and eggs. This reduction in leatherback nesting areas is the same trend observed with all species of turtles in Vanuatu, with more remote areas still supporting turtle nesting. Awareness efforts by WSB's Vanua-Tai Resource Monitors since the mid-1990s, however, has assisted significantly to stem this trend.

Nesting Beach Surveys

Hawksbill, green, and leatherback sea turtles were all found nesting on the Votlo, Southern Epi black sand beaches often associated with rivers. Table 1 summarizes the data for all species. More detailed results on weekly nesting activities are given in Table 2. Peak nesting activity occurred during the week of December 15-21, 2003. The survey team left on December 22 and the turtle monitor continued the survey until mid February. The coverage, however, during this period was less intensive.

A more detailed examination of time of crawls indicated that leatherback turtles crawled and nested mostly in the evening before midnight. Additionally, two green turtle nests hatched January 23 and 27, with 88 and 73 hatchlings surviving. Some nests were reported to have been destroyed by heavy waves and flooding associated with the fringes of a cyclone in late January.

Table 1. Summary of Results of the Nesting Beach Survey Votlo, Southern Epi between November 2003 and February 2004.

Activity	Green	Hawksbill	Leatherback	Grand Total
False Crawls	10	3	5	17
Nesting	15	2	31	46
Grand Total	25	5	36	63
Tagged ¹	2	0	9	11

¹ All turtles tagged with metal tags, PIT tags unavailable

Table 2. Weekly Activities of Leatherback Turtles at Votlo, Southern Epi, November 2002 to February 2003. Numbers in parenthesis are maximum number of turtles in one day.

Dates	Nesting	False Crawls	Tagged
November 10-16	0		
November 17-23	2	1	
November 24-30	2	0	1 (Nov 30, renested on Dec 19)
December 1-7		1	1
December 8-14	4 (3)		2
December 15-21	6 (3)	2	2
December 22-28	3	1	
December 29 to January 4	1		
January 5-11	1		1
January 12-18	3		
January 19-25			
January 26 to February 1	4		1
February 2 - 8	3		1
February 9-15	2		
Total	31	5	9

Threats to nesting turtles

During the course of research activities, the team identified possible threats to nesting beaches that included: wild horses, wild cows, wild pigs, crabs, dogs, and beach erosion from flooding rivers and large swells. Apart from flooding and storm swells that destroyed some nests during the survey, it was not possible to quantify the impacts of the other potential threats.

Nesting reports

The team learned a number of lessons related to community level fieldwork that will be applied to future surveys. The results of interviews with knowledgeable turtle monitors and the nesting beach survey are summarized in Table 3. The locations of historic leatherback turtle nesting areas of Vanuatu are depicted in Figure 2, with most recent nesting in Epi and Malekula. The following is a summary of island specific information for leatherback turtles:

Ambae – Primary leatherback sightings 20 to 30 years ago. Today, only Devils Rock identified as an area where nesting has occurred

Ambrym – All islands beaches are black sand, one large (3.3 m nesting female) tagged in Port Vato area, January 2003.

Efate – Reports of one leatherback in 1997, three in 1999-2000, but none since. Nesting is confined mainly to the Blacksand area of Mele Bay just north of Port Villa.

Epi – Most important nesting beach is on the SW coast from Votlo to Port Quimie. 31 nests identified in 2002-03 with five reported in January 2004. The Big Bay area on the east coast has previously been reported as an important area, one nest found in a limited survey in January 2004.

Malekula – A few nests are reported from a number of beaches right around the Island. Turtles are still consumed and five leatherbacks have been reported eaten or killed in past seven years.

Pentecost – One reported to have been eaten in 2000.

Table 3. Reports of Leatherback turtles in Vanuatu

Island	Location	Beach or Area	Date	No. Turtles				Notes
				Crawls	Nests	Tagged	Eaten	
Ambae	West Ambae	Devils Rock						Limited habit on Ambae but in this area long black beach & nesting reported in past, one consumed 30 years ago
Ambrym	Port Vato		Jan1, 03 04	None		1 (3.3m)		All Island beaches are black sand. Tagged turtle later seen swimming
Efate	Mele Bay	Black- sands	99/ 00			1		Caught coming ashore, tagged and released but in injured state
	Teouma Bay	Melemaat	99/ 00 99/ 00		1		1	Photographed & on postcard Black sand beach with river
	No location given		July30, 97			1 (127cm)		Fisheries laid charge
Epi	SW Epi	Votlo	Nov 12, 02 Dec 02	18	15	6		See nesting survey report for additional information Storm surge destroyed some nests, some hatchlings seen Jan-03
		Port Quimie	Late Jan 04 Jan 04		5 3	1		4-5 km suitable beach north end towards Votlo one nest destroyed by storm
	East Coast	Big Bay	Jan 04		1			4-5 km Black sand beach, limited surveys
Bamboo Bay	SW Bay	Dixon Reef to	Jan 04	2				3 km beach no regular monitoring
	SW tip	Malfakal	2000	Some				Suitable beaches between Caroline Bay & Malfakal
Malekula	SE Malukula	Maskelyne Islands	Few years ago				1	Killed but covered in sores so would not eat it.
	East Coast	Unua	Jan 02				1	Large area of suitable habitat—river estuary & 3 long black sand beaches
		Blacksand (N of Port Sanbdwich)	Feb 04				1	
	NW Malakula	Wilak	1997				1	4 km long black sand beach
Pentecost	Bay Martelli	Poinkros	2000				1	

Conclusion

Epi Island appears to have the largest number of nests, with two nesting areas. The southwest exposed coasts probably has 20-30 nesting females. A smaller number appear to nest on the east coast around Big Bay. On Efate Island, the nesting beaches are in the Mele Bay area adjacent to Port Villa, the capital city. The nesting beaches are in developed areas including a squatter settlement, a tourist resort and a golf course. The suggestions are that there are only 1-2 females nesting, but not every year, although there have been no reports since 2000. This nesting in Mele Bay may, however, represents the southern most nesting distribution of the western Pacific leatherback turtle.

Elsewhere there have been only sparse surveys, but there appears to be only scattered nesting by a few females. Malacula would appear to have the greatest number of nests after Epi. Of significance is that Malacula is the area where leatherbacks (and other turtles) are still consumed, including one leatherback in February 2004.

It appears critical that there be a follow-up nesting beach survey on Epi Island to cover the whole nesting period. There should also be exploration of the Big Bay area on the east coast. Some preliminary survey work should also be done on Malacula, but particularly, there needs to be an expansion of the turtle conservation program in Malacula to ensure leatherbacks are no longer hunted and eaten.



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Data Management

Regional Turtle Research Database System

Anne Trevor, Database Officer, South Pacific Regional Environmental Program
Irene Kinan, Western Pacific Regional Fishery Management Council

Background

In February 2002, the Western Pacific Regional Fishery Management Council convened the first Western Pacific Sea Turtle Cooperative Research and Management Workshop. At this meeting the 55 invited experts of the Central and Western Pacific recommended that a Pacific wide database be developed for the Pacific Ocean as a critical step in understanding the population status and trends of Pacific sea turtles (Kinan, 2002). Upon further investigation of this topic, it was discovered that such a database had at one time existed by the South Pacific Regional Environmental Program (SPREP), but was now defunct and outdated.

The Council therefore convened a steering committee to create a joint initiative between SPREP, the Secretariat of the Pacific Community (SPC), NOAA Fisheries (Mr. George Balazs), Queensland Parks Authority (Dr. Colin Limpus), ASEAN-SEAFDEC, and the Council to rehabilitate the database. The goal will be to provide this “new” and improved database, the Tagging Research Database System (TREDs), to programs throughout the Pacific region (to SPREP’s 25 member countries and ASEAN-SEAFDEC’s 10 member countries). As SPREP is the most appropriate umbrella agency to oversee the implementation of the database, a Database Officer was hired (staffed at SPREP) in March 2004 to manage and facilitate the use of TREDs, and thus through this effort also help rehabilitate SPREP’s Regional Marine Turtle Conservation Program (RMTCP).

SPREP Database Background

The RMTCP began in 1990 with financial support from the Canadian Government, through the Canadian South Pacific Ocean Development Project (C-SPOD). The main objectives of the RMTCP were to enable conservation and sustainable management of marine turtles in the Pacific through coordinating the exchange of information and technical expertise, provide in-country support for turtle conservation and sustainable use initiatives, produce and disseminate resource materials to member countries, and implement a regional database to document Pacific turtle population trends. In 1993, a regional database was established using expertise from the Queensland Department of Environment and Heritage. This “old” database was eventually transferred to SPREP in 1994, but underwent numerous transitions in 1995 and 1999.

Over time, the change of personnel at SPREP led to lack of database maintenance and upkeep, resulting in many mistakes contained within the database. After the rehabilitation project was begun, it was determined that a backlog of past data existed in need of entering (including the loss of (old) data because of software incompatibility, and possible loss of raw data due to datasheets not being submitted to SPREP). But more importantly, it was determined that the condition and quality of the database itself had deteriorated. Thus, the decision was made to manually re-enter “old” data from the former database into TREDs, and then work to recover missing data.

TREDs

The design of the “new” database or TREDs is largely based on the database developed by Dr. Colin Limpus and currently used by Queensland Parks Authority. Peter Williams and colleagues at SPC have generously provided technical support and have built the database from scratch in collaboration with Dr. Limpus and the steering committee. TREDs has been developed in Microsoft ACCESS because it is a widely used database system and most of the countries and territories in the region have access to this software.

Beach census and surveys data can be entered into TREDs, project-specific and/or site-specific reports can be generated, and it provides a systematic method to inventory tags used per project. For example, information

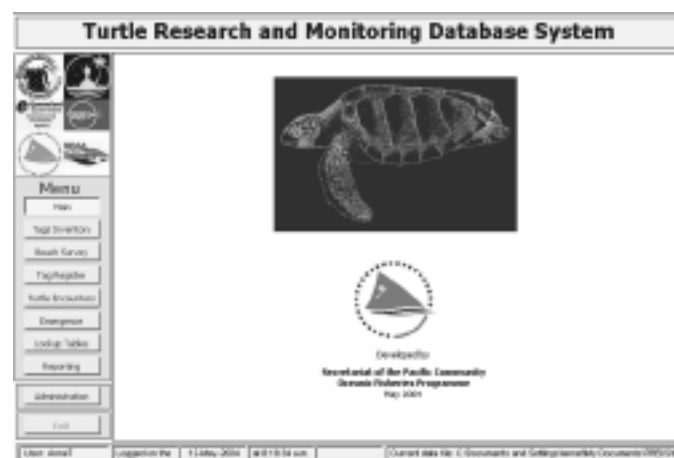


Figure 1. The main menu of the TREDs database.



Figure 2. Tag Inventory screen.



Figure 3. Tag inventory details when new tags are entered in TREDs.



Figure 4. Reporting field. Based on the parameters selected by the user reports are generated by TREDs based on imputed data.

which can be entered includes: tagging information (flipper, PIT, satellite tags), nesting and clutch information, hatchling information (i.e., emergence) and any information related to biological sampling such as genetics data [the list here is not exhaustive of TREDs capabilities]. The main menu allows researchers to add information easily (Fig. 1), such as: tag inventory, beach survey, tag register, turtle encounters, emergence, lookup tables (for the various fields that have been entered), and reporting.

The tag inventory screen is where one enters a project. The option then exists for “tag distributed,” “tag received” and “tags used” in this project (Fig. 2). If one were to enter a new tag inventory, one gets a second screen which prompts for information (Fig. 3). For a beach survey, TREDs prompts users to enter tag numbers, dates, if it was a primary or secondary tag, where it is positioned, et cetera. For reporting, the user gets a history of turtle encounters, summary of tagged turtles, summary of beach surveys, summary of nesting activities, emergence, hatchery data, growth rates, reports on inventory, encounters, or migration based on the information that has been previously entered (Fig. 4).

Current Status of TREDs

At this moment [as of May 2004] TREDs is still in its trial stages, but data can be entered and will not be lost if further modifications are made to the database interface. To date, data has been compiled dating back to 1980. Although several countries continue to send in tagging, recovery and nesting data, much data is missing and will need to be recovered (scope of data recovery to be determined). To verify data, the goal is acquire information of tag dispatch from the manufacturer, and then correlate this information with the applied tags of research projects and/or tag recovery data.

The database manual still needs to be prepared, one for the user and one for the programmer. Once TREDs is up and running, the goal is to introduce it, either through workshops or individual in-country visits. Optimally, TREDs and the database manual will be translated into different languages. Lastly, for this endeavor to succeed, it is important to collaborate with other organizations from outside the SPREP region with regards to networking and information sharing.

Discussion

MS. KINAN: I should clarify that it looks like there is a lot of information that we're possibly asking projects to collect. But the steering committee has decided that there is essential data and then there is more or "extra" data. In the database, fields are highlighted indicating "essential data" which must be filled in (such as date, tag number, turtle size) and those that are for more advanced data collection protocol (such as clutch size, genetic samples). If a project grows to a point where one thinks they are ready to collect other information, those fields are available, but just because the fields are there it does not mean they need to be filled in. In the reporting screen, the user tells the computer what fields to select and TREDs pulls information out of what you entered. Thus not every field needs to be filled out to make it a complete dataset. George is on our steering committee, do you have any additional comments —

MR. BALAZS: Only to emphasize that this is one of the absolutely and wonderful things that the Council, Kitty and Irene, have gotten behind and bitten on to it like a little bulldog and continue funding it, holding the meetings and drawing in the expertise of Peter Williams at SPC. I would ask, where are we on the user manual?

MS. KINAN: We have identified somebody in Australia to write the manual. Colin decided he wanted to be closely involved in the manual development process. So we figured an Australian would be the most appropriate person to help keep things moving because he gets bogged down with work.

MR. BALAZS: So it's got to be simplified. And then as Anne was saying, the next step is translation into some different languages.

MS. KINAN: Right. We talked about that with SEAFDEC and the Malaysian group.

MR. BALAZS: To clarify, if it isn't already clear, this is something that the Council, SPREP, SPC is going to give freely to anyone in the Pacific. It carries no strings attached, and is a wonderful contribution to the Pacific, and perhaps even later on globally outside of the Pacific. Although, we hope it will help to network the data into a central pooling place, shared, but with restrictions on who owns the data and who can publish it. The person that collected the data is the owner of the data, or at least the organization.

Anne, are you going to have to go back to the paper copies for data to enter? Are there big piles of data somewhere?

MS. TREVOR: Yes, I managed to find them in files at SPREP.

MR. BALAZS: Good. This is one of those things that no one person really is responsible for them going into shabbiness, if you will, but rather a number of years of absence of insufficient funding or personnel being brought aboard to keep thing running. There used to be a database officer many years ago, but there hasn't been one for five, six years. But anyway, wonderful contribution and we're all eagerly looking forward and very delighted that Anne is onboard and her presence is in part due to the funding from the Council.

DR. EGUCHI: Is it possible to run this database on the internet?

MS. KINAN: We talked about it being web-based, at our second database meeting [December 2003] we didn't think the database was ready for that yet. There are some issues with data ownership that the steering committee is still working through. At this point this is one of our biggest questions or problems to overcome, how do we get entered data from the actual field site back to SPREP.

DR. EGUCHI: I was thinking maybe you can enter data through the web, you can send it to everybody.

MS. KINAN: A goal is to have the database set up so that one enters data and then it gets compiled into a final folder, and then that folder gets sent in to SPREP. So every time a project sends data over, they're sending over the new data that has been entered since the last time data was sent. This part could be streamlined through the internet. But when one is actually working on the database, entering data, that is not online. The database lives in your computer at your field site and then it has a compilation screen or field that dumps all the data to be sent to SPREP. There are still some bugs, still some things that need to be worked out, but this is the thought behind how to consolidate data.

MR. BENSON: Would that be something you want to try to do, to progress to, that idea of internet entry of the data?

MS. KINAN: Perhaps, but this is something into the future.

MR. BENSON: Because then you would be disseminating the tag information probably more rapidly, less steps, possibly, right?

MS. KINAN: Right. We have identified two umbrella agencies; SEAFDEC and SPREP. SEAFDEC has 10 member countries, SPREP has about 20. So together these two agencies will be working together in collaboration, but be the umbrella agencies for their respective regions.

MR. BALAZS: Dissemination of the tag freely in both directions is not a goal nor a desirable thing, because then it cuts out where you could have tag recoveries made and the original reporter never finds out.

MR. BENSON: Unless you constructed this through the internet to do that, though.

MR. BALAZS: Yes. Anyway, the steering committee has some concerns about how quickly stuff gets – there has got to be some buy-in to it. It's the tragedy of the commons if it's all out there.

MS. KINAN: Right. Data ownership is one of our biggest issues we need to overcome.

DR. DUTTON: How much of this database is geared towards leatherback data? Because there are some subtle differences between hard-shell, loggerhead, hawksbill, green turtle kinds of project and the leatherback work. For instance, is the tag information set up to handle PIT tag data? And the kinds of measurements also?

MR. BALAZS: It is or will be. It was all considered.

MS. KINAN: Yes it will most definitely accommodate PIT tags. Essentially, today we wanted to introduce TREDs to the group - that this database is happening. It is coming and is being done. It's not 100 percent just yet, but we hope to have it finished by the end of the year. We have definite buy-in from ASEAN countries and from SEAFDEC. We have buy-in from SPREP and SPC and a lot of other people. So with Anne's presentation our goal was to raise awareness more than announce that the database is ready. At some point we will reach the time to announce that it's done and ready for distribution, but at this point we want people to know that it is floating out there.

MR. BALAZS: I should probably add one more thing, that the database was made very broad to encompass all sorts of data that can be collected; whether that data is being collected at a nesting beach or in-water capture site. To a simpler guy like me, there's a lot there. All I did was go out and tag the turtle, I know what species it is and I took a carapace measurement and, of course, I know where I caught it and what it was doing when I caught it. There's just four elements, but should I feel self-conscious that I haven't collected all of this other data that's in there? Well, there's an expression in Hawaii, if you can, if no can no can. You collect what you can and as long as you've got perhaps two or three or four of the basics that I've just said, my goodness, this is wonderful. So do not feel self-conscious because you haven't collected all those things that Colin and others who have larger programs collect. Fields are present to accommodate data collection and help prompt certain data if you were to have collected it. But if you can't collect all of that, you haven't collected all of that, don't worry about it. You collected the basics; the tag number, the species, the size and where you collected it. Wonderful, praise.

MS. KINAN: It will also be a means to help standardize data collection as researchers collect and enter data. TREDs will remind you what to collect by prompting the user to enter essential fields and lets the user know if they've left any essential fields empty. But if one hasn't collected or entered "non-essential" fields then that's all right.

HAWKSBILL WORKSHOP



HAWKSBILL WORKSHOP





Southwestern Pacific hawksbill sea turtle simulation model: A summary of model development

Dr. Milani Chaloupka, Ecological Modelling Services

Abstract

A stochastic simulation model was commissioned by the WPRFMC for the southwestern Pacific hawksbill sea turtle stock to foster better insight into regional population dynamics. The model comprises a sex-and-age class structure, which is linked by correlated time-varying habitat-, density- and temperature-dependent demographic processes subject to environmental and demographic stochasticity. The simulation model was based on demographic information derived for various sea turtle stocks, but has only very limited empirical information concerning southwestern Pacific hawksbill demography and population dynamics. The model was designed to support evaluation of the effects of competing mortality risks on stock abundance and for the design of conservation policies to protect this stock.

Introduction

The hawksbill turtle comprises five stocks or management units in the Pacific (Broderick et al., 1994; Dutton et al., 2002), which are shown in Fig 1. The hawksbill is critically endangered with some Pacific stocks in decline (Mortimer, 1992; Meylan and Donnelly, 1999; Seminoff et al., 2003). However, stable stocks include the Ko Khram rookery in the Gulf of Thailand (Charuchinda et al., 2002) and the Sabah Turtle Islands rookery in the Sulu Sea (Basintal, 2002). The eastern Pacific stock was abundant, but is now only occasionally found along the Baja and Pacific Mexico coast (Seminoff et al., 2003). However, reliable long-term monitoring of nesting abundance is only available for the Australian and Sabah stocks (Fig 2). The Australian stock has declined in recent years, but there are no foraging ground abundance estimates for any Pacific population. There are only limited demographic data available for hawksbills (Chaloupka and Limpus, 1997; Pilcher and Ali, 1999). There are no comprehensive demographic models of hawksbill population dynamics (Chaloupka and Musick, 1997). However, a simple stochastic simulation model based on a Bayesian surplus production model was developed recently for the IUCN review of a CITES application for downlisting of the Cuban hawksbill turtle population (Chaloupka, 2003 unpubl).

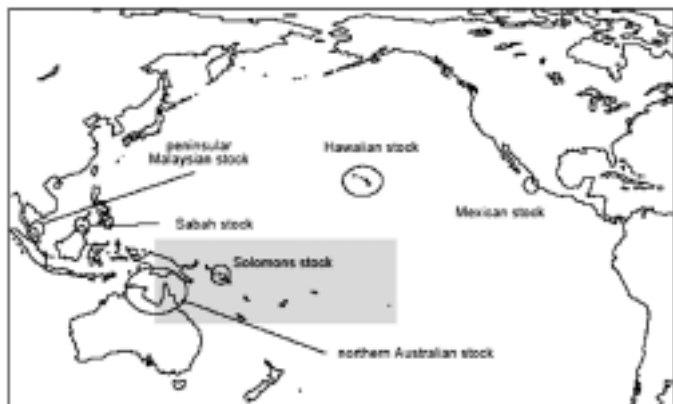


Figure 1. Location of the major regional rookeries for the Pacific hawksbill turtle stocks (Broderick et al., 1994; Dutton et al., 2002). Shaded area shows the foraging region of the modelled southwestern Pacific superstock.

Figure 2. Trends in nesting abundance of 2 Pacific hawksbill populations. Panel (a) shows number of nesters each year (solid curve) on Milman Island, northern Great Barrier Reef (Miller et al in prep). Underlying trend in nester series shown by a robust cubic spline smooth fit (dashed curve), which suggests that the nester series declined most rapidly during the early 1990s and then slowed since. Panel (b) shows the number of nesters at the Gulisaan rookery in the Sabah Turtle Islands (Pilcher and Ali, 1999; Bastinal, 2002).

Table 1. Summary of nesting seasons for some Pacific hawksbill turtle stocks shown in Figure 1.

Stock	Nesting location	Season	Source
Sabah	Gulisaan Island	Feb-Apr, Jun-Aug (yr round)	Basintal (2002)
Australian	Milman island	Dec-Apr (year round)	Loop et al (1995, 1999)
Hawaiian	Hawaii, Maui	May-Sep	Mangel et al (2001)

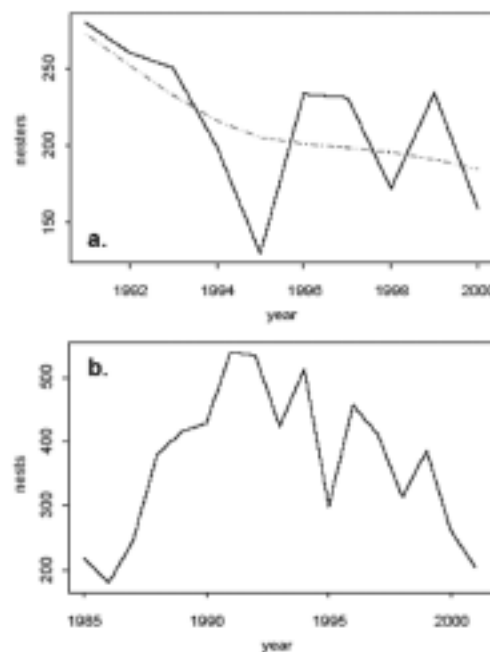


Figure 2. Trends in nesting abundance of 2 Pacific hawksbill populations. Panel (a) shows number of nesters each year (solid curve) on Milman Island, northern Great Barrier Reef (Miller et al in prep). Underlying trend in nester series shown by a robust cubic spline smooth fit (dashed curve), which suggests that the nester series declined most rapidly during the early 1990s and then slowed since. Panel (b) shows the number of nesters at the Gulisaan rookery in the Sabah Turtle Islands (Pilcher and Ali, 1999; Bastinal, 2002).

The hawksbill stock addressed here is the southwestern Pacific superstock (Australian, Solomons genetic stocks) that nests mainly in Australia and the Solomons, but forages throughout the southwestern Pacific (Fig 1). The main hazards for hawksbills in the Pacific Ocean are commercial harvesting for “bekko” (tortoiseshell), egg harvesting, subsistence hunting, and habitat destruction (Johannes, 1986; Milligan and Tokunaga, 1987; Groombridge and Luxmore, 1989; Hirth and Rohovit, 1992; Meylan and Donnelly, 1999). This stock is caught occasionally in southwestern Pacific pelagic purse seine and longline fisheries (SPREP, 2001) and in coastal fisheries (Poiner and Harris, 1996; Slater et al., 1998). The stochastic simulation model developed here is designed to explore the population dynamics of this stock and the risk to stock viability given exposure to these sorts of anthropogenic hazards. A workshop was held in May 2004 in Honolulu with a forum of eleven hawksbill turtle experts and/or conservation managers to test the model and review the model assumptions.

Model description

A sex-and-age class-structured stochastic simulation model of the population dynamics of the southwestern Pacific hawksbill stock was developed. The model comprises a coupled system of ca 74 ordinary differential equations (ODEs) that are linked by nonlinear, time varying and temperature- and density-dependent demographic processes. The ODEs are presented here in the Euler-type form as follows using a generic ageclass as an example:

```
adults(t) = adult(t-dt)+(yr34grows-yr35deaths)*dt
yr34grows = yr34-yr34deaths, yr35deaths = adults*(1-
adult_survival_probability*adult_risks_function)
{adult risks is a competing risks function of exposure to
coastal & pelagic fisheries and harvesting}
```

The model includes both environmental and demographic stochasticity, as well as correlated demographic processes (see Engen et al (1998) for prescriptive definitions of environmental and demographic stochasticity and Burgman et al. (1993) for details on correlated demographic processes). No spatial configuration was included in this version of the model because there is no known spatial variation in hawksbill demography.

Although this is most likely to be incorrect, it is more parsimonious to exclude any spatial variation until such information becomes available for consideration in future model revisions.

Environmental stochasticity was accounted for by sampling the demographic rates from probability density functions to reflect the temporal variability observed for several sea turtle species, such as greens and loggerheads (Chaloupka and Limpus, 2002; Limpus and Limpus, 2002; Chaloupka et al., 2004). Demographic stochasticity was accounted for by using a binomial sampling approach proposed by Akçakaya (1991). In some cases, a Poisson sampling approach (Gustafsson, 2000) was used instead, where it was considered appropriate to account for extra sampling variation. Brillinger (1986) and Breslow (1990) provide important discussions on accounting for over-dispersion in demographic processes, while Chaloupka and Limpus (1998) addressed this issue in relation to negative binomial regression modelling of green turtle survival probabilities. Compensatory sex-specific density-dependent processes were included in the model to account for temporal variability that is known for some sea turtle species in the proportion of females and males preparing to breed each year in response to major oceanographic anomalies (Chaloupka, 2001; Limpus and Limpus, 2002). Density-dependent somatic growth has been shown recently for immature green turtles (Bjorndal et al., 2000a) and so median age at sexual maturity in the hawksbill model was also assumed here to be density-dependent. Depensatory density-dependent processes or Allee effects (Dennis, 1989) were included in the model by using a female mating success probability function that was dependent on the probability of finding at least 1 male mate. All density-dependent functional forms in the model are based on the Morgan-Mercer-Flodin nonlinear form (Ratkowsky, 1990). All parameters in this function are readily adjustable to account for variable functional form, since density-dependence is not well understood for sea turtles. Moreover, it has been shown that risk assessment can be sensitive to the functional form assumed for such processes (Ginsburg et al., 1990).

Table 2. Summary of model ageclass structure within each of the southwestern Pacific hawksbill stock.

habitat	Ageclass (years)	Ageclass grouping	size range (cm CCL)	sex
oceanic	1	neonate	4-?	both
oceanic	2-5	juvenile	?-35	both
neritic	4-14	juvenile	35-50	both
neritic	15-24	immature	50-70	both
neritic	25-34	subadult	70-80	both
neritic	35+	adult	80+	both

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Brief Overview of the Hawksbill Turtle in Brazil

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EXECUTIVE SUMMARY

The Brazilian government established the National Marine Turtle Conservation Program (Projeto TAMAR) in 1980. At present, TAMAR is affiliated with the Brazilian Institute for the Environment (IBAMA) and co-managed by an NGO, the Pró-Tamar Foundation. The initial objectives of TAMAR were to quantify the number of sea turtle species in Brazil, their distribution and abundance, the seasonality and geographic range of nesting, and the primary threats to survival. A comprehensive two-year survey of the coastline was carried out between 1980 and 1981 (Marcovaldi and Marcovaldi, 1999). In 1982, as a direct result of this research and additional information, it became clear that (1) there were five species of sea turtle nesting on the mainland. These were the loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*), leatherback (*Dermochelys coriacea*) and the green turtle (*Chelonia mydas*); (2) the loggerhead turtle was the most abundant species nesting on the mainland; (3) only the green turtle nested on the islands; (4) the mainland nesting season spanned September to March; (5) the island nesting season ranged from December through June; and (6) harvest of eggs and nesting females constituted the main threat to sea turtles in Brazil. TAMAR has since expanded, and today a network of 20 stations and associated conservation and monitoring activities protect all sea turtles and their eggs along approximately 1100 km of coastline and oceanic islands (Marcovaldi and Marcovaldi, 1999). Coastal fishing villages are fully integrated into the program, with fishermen and local villagers comprising the majority of TAMAR's staff of 1200. The hawksbill turtle is included on the Brazilian government's (IBAMA) official list of endangered species threatened with extinction, and all life history stages, including eggs and hatchlings, are fully protected by law (Fundação Biodiversitas, 2003). The hawksbill is the second most abundant species nesting in the northern of Bahia coast and fourth most abundant nesting in Brazil (Fig. 1) (Marcovaldi and Laurent, 1996).

Trends

Studies carried out since 1990 demonstrate an increasing, but fluctuating trend in the number of hawksbill nests in the northern Bahia rookery, from 112 in the 1990/1991 season to 800 in 2002/2003 (Annual Technical Regional Reports, Bahia, ISSN 1677-4701, 1990-2003). Estimates of the trend in abundance of immature hawksbills in some foraging grounds (e.g., Fernando de Noronha) are underway based on a long-term capture-mark-recapture program.

Breeding Areas

The slaughter of nesting females, poaching of eggs, manufacture of shell ornaments, coastal development, and incidental capture in fisheries have significantly



Figure 1. Reproductive and Non Reproductive records of hawksbill occurrences along the Brazilian coast – Projeto Tamar-Ibama

reduced sea turtle occurrences along the Brazilian coast. Hawksbill populations are found today only in few areas. Occasional nesting has been recorded by TAMAR as far south as Espírito Santo State, and as far north as Ceará State (Figure 1) (Marcovaldi et al., 1999). Regular oviposition occurs mainly in the northern part of the coast of Bahia State, which is considered the primary hawksbill nesting area in Brazil. Sea turtle clutches numbering between 3150 and 3870 were registered there each season between 2000/2001 and 2002/2003. Most of these nests were loggerheads (65%, n=5283), followed by hawksbills (22%, n=1789). Less frequent nesting of olive ridleys (12%, n=958), and green turtles (1%, n=65) was also observed (Annual Technical Regional Reports, Bahia, ISSN 1677-4701, 2000-2003). The hawksbill nesting area at Pipa, State of Rio Grande do Norte, has also been monitored since 2000, and 150 nests were recorded along 8 km of beach in 2002/2003 (Annual Technical Regional Reports, Pernambuco e Rio Grande do Norte, ISSN 1678-6912, 2002/2003).

Methodology

Intensive and regular surveys have been carried out in breeding areas since 1982 (Marcovaldi and Marcovaldi, 1999). Management strategies include:

- Monitoring and management of nests in situ (I). These clutches are allowed to incubate undisturbed where originally laid. This management strategy is employed in Intensive Study Areas (ISA). These are permanently monitored sites of easy access where there are fewer risks to the nests of predation and beach erosion.
- Transference to protected areas. Nests that occur in conservation areas (CA), such as beaches that are difficult to monitor, located in urbanized areas, or where predation and beach erosion are high, are transferred to nearby ISA areas (P) or to hatcheries (T) (Marcovaldi et al., 1999).

Study duration and total number of nests

Between the 1990/1991 and 2002/2003 seasons, 4,066 *E. imbricata* nests were monitored. The data below were obtained during that time period, reported on the Annual Technical Regional Reports, Bahia, ISSN 1677-4701, 1990-2003.

Seasonal Distribution of Nesting

The nesting season for *E. imbricata* in northern Bahia extends from October to March (Marcovaldi and Laurent, 1996), and 80 percent of the clutches are laid between December and February.

Emergence Success

The annual mean emergence of hawksbill nests is generally < 60 percent. Between 1990/1991 and 2002/2003, the mean was 52.6 percent (n = 1,349) for in situ clutches, 44.8 percent for clutches relocated to open-air hatcheries (n = 2,199), and 45.5 percent for clutches relocated to beaches (n = 442).

Emergence Period

Between 1990/1991 and 2002/2003, the mean emergence period was 54.3 days for in situ clutches (n = 1,109), 54.1 days for clutches relocated to open air hatcheries (n = 2,116) and 53.7 days for clutches relocated to beaches (n = 402). Differences between seasons and among different management methods within each season are relatively small.

Sex Ratio, Pivotal Temperature and Pivotal Emergence Period

A pivotal temperature for hawksbills in Bahia of 29.6°C was determined by Matthew Godfrey and collaborators in 1999. The pivotal emergence period was estimated at 62.8 days. A six-season study of hatchling hawksbill sex ratios in Bahia estimated that the overall sex ratio of in situ nests is strongly female-biased (>90 percent female). Given the small differences in mean emergence period among management practices, it is likely that clutches relocated to hatcheries and beaches are also producing a majority of female hatchlings, and that, regardless of small differences in means, management practices are not influencing sex ratios (Godfrey et al., 1999).

Adult Female Size

Mean curved carapace length (CCL) for nesting females was 97.5 cm (range 81-112 cm, n = 89). On average, Brazilian hawksbills are larger than those from other populations nesting in the Atlantic and elsewhere (Marcovaldi & Laurent, 1996).

Clutch Size

Mean clutch size is 135.9 eggs (range 16-235, $n = 3,992$). General reviews of clutch sizes of hawksbill nesting populations show that the mean for the Brazilian population is roughly average (Marcovaldi and Laurent, 1996).

Internesting and Remigration intervals

Sea turtles are double tagged in both front flippers with Monel tags (for the breeding areas) and Inconel tags (for the feeding areas) (#681 National Band Company, Newport, Kentucky USA) (Marcovaldi and Marcovaldi, 1999). The tagging program is of great importance for studies on internesting and remigration intervals. Remigration intervals results were in the range of 2-5 years ($n = 12$ intervals, 10 turtles). The mean remigration interval was 2.9 years, and 75 percent of the intervals were in the range of 2-3 years.

Feeding Grounds

The major sea turtle nesting sites in Brazil have been protected as of 1980. Since then, TAMAR has been collecting information on dead and stranded turtles found along the Brazilian coastline, as well as turtles incidentally captured in fishing gear. Following the establishment of research stations at the main nesting areas, TAMAR began in 1991 to work at feeding grounds where levels of incidental capture in artisanal fisheries were high (Marcovaldi, 1991). The first efforts to increase protection of sea turtles in these areas, through close work with local fishers and environmental education activities, were carried out at Ubatuba, São Paulo State. Later, in-water research studies were initiated. These focused on the behavior and growth of turtles at sites where diving conditions were good, mainly Fernando de Noronha and Atol das Rocas (Marcovaldi et al., 1998).

The carapace length of these hawksbill turtles in Brazil ranges from 9 to 115 cm CCL. This range excludes records of reproductive females on nesting beaches. In the period between 1990 and 2003, hawksbill turtles constituted about 4 percent ($n=384$) of stranded or incidentally captured sea turtles on the mainland (that is, not including Fernando de Noronha and Atol das Rocas) (Tamar Non Reproductive Data Base, 2003). There are other records of two dead hawksbills measuring < 70 cm CCL stranded in Rio Grande do Sul in 1995. In the west-

ern Atlantic, the southernmost record of *E. imbricata* occurrence was registered in Uruguay in the summer of 1997. The turtle was a juvenile (38 cm CCL) captured by an artisanal fisherman in Cerro Verde (pers.comm. Proyeto Karumbé, 2004).

Capture mark recapture program

In Fernando de Noronha and Atol das Rocas, turtles have been captured for research purposes using snorkeling and scuba diving. Following capture, tagging, and measurement, biometric and behavioral data are recorded (Sanches & Bellini, 1999). A total of 440 hawksbill turtles have been captured since 1990. Carapace length ranged from 31 to 105 cm CCL. Recapture data are providing a basis for studies on population abundance and to deriving important demographic information such as somatic growth rates, survival and recapture probabilities, migratory routes, dispersal or movement rates and so on (Annual Technical Regional Reports, Pernambuco e Rio Grande do Norte, ISSN 1678-6912, 1990-2003).

Methodology

The main concentration areas of marine turtles have been monitored using two different strategies:

- SCUBA diving: turtles are captured in maximum of 42m deep, more frequent between 10m and 20m deep. The diving time period will depend on the area profile. The capture is related with the animal activity and not with its size, generally, they are captured while resting or feeding. The data collection is done in the water.
- Snorkeling: turtles are captured between 0.2m and 22 m deep, more frequent between 2m and 12m deep.

Since 1991, the field work is conducted at least twice a week and maximum seven days a week. In Fernando de Noronha, there are eight permanent places and eventually another area could be chosen depending on the water conditions. Since 2001, 95 percent of the scuba diving strategy work is done in collaboration with trained diving operators. In Atol das Rocas, the capture-mark-recapture program depends on occasional expeditions to the reserve that is associated with the reproductive season. The main hawksbill capture method used in the Atol das Rocas is snorkeling diving (Annual Technical Regional Reports, Pernambuco e Rio Grande do Norte, ISSN 1678-6912, 1990-2003).

Long distance movements

The recapture off Gabon, Africa of a sub-adult hawksbill turtle (75 cm CCL) tagged in Fernando de Noronha in 1994 was reported in 1999 (Bellini et al., 2000). A sub-adult hawksbill turtle (74 cm CCL) tagged at Atol das Rocas was captured off Senegal, Africa in 1990 (Marcovaldi & Filippini 1991). Atol das Rocas is located approximately 130 km. from Fernando de Noronha, and is another important hawksbill feeding area monitored by the Projeto TAMAR (Marcovaldi & Filippini 1991). Conservation programs on both sides of the Atlantic must collaborate to improve their knowledge of turtle distribution and movements, and to protect their shared natural resources.

Genetics

Conceição et al. (1990) conducted a study in Praia do Forte, Bahia, for an intermediate morphotype between *Eretmochelys imbricata* and *Caretta caretta*, with about fifteen individuals sampled in February 1989. A further study conducted by Bass et al. (1996), demonstrates that individuals possessing four haplotypes at a nesting location in Bahia, Brazil, were determined to be the result of hybridization between the loggerhead (*Caretta caretta*) and the hawksbill (*Eretmochelys imbricata*).

In the north coast of Bahia, it has been observed in the field (morphological external features) relative high numbers of hybrids between loggerhead and hawksbill, nonetheless, it is important to intensify genetic studies on hybrids to better understand it.

Research concerning hawksbill population structure as revealed by genetic analysis is planned for this year in Brazil. The studies will focus on females of the north coast of Bahia and juveniles that feed and rest at Fernando de Noronha and Atol das Rocas. Approximately 200 samples have been collected for these analyses. It is important to point out that intensive studies on tagging, genetics and capture-mark-recapture can considerably enhance our understanding of hawksbill population structure in Brazil.

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Hawksbills in the Indian Ocean: Brief Summary of Status, Trends, Threats, and Available Data

Dr. Jeanne A. Mortimer, Chair, Hawksbill Task Force, IUCN Marine Turtle Specialist Group

EXECUTIVE SUMMARY

Status of Hawksbill Nesting Populations

The map in Figure 1 indicates the size of hawksbill nesting populations in the Indian Ocean region based on estimated numbers of females nesting annually. The largest known hawksbill rookeries, with annual nesting numbers estimated between 1,000 and 5,000 animals, occur in western Australia (Limpus, 1997). Seychelles hosts almost 1,000 females annually (Mortimer, 2004; unpubl. data). Other important nesting populations include those of Iran where some 500 to 1,000 females are believed to nest annually (B. Saeedpour, pers. comm.; JAM pers. obs.), and northwestern Madagascar (A. Cooke, pers. comm. to JAM), which, although not yet completely surveyed, may host similar numbers of nesting females. Baseline nesting beach surveys are still needed in parts of western Australia, northwestern Madagascar, Iran, Somalia, and Eritrea (Mortimer, 2002).

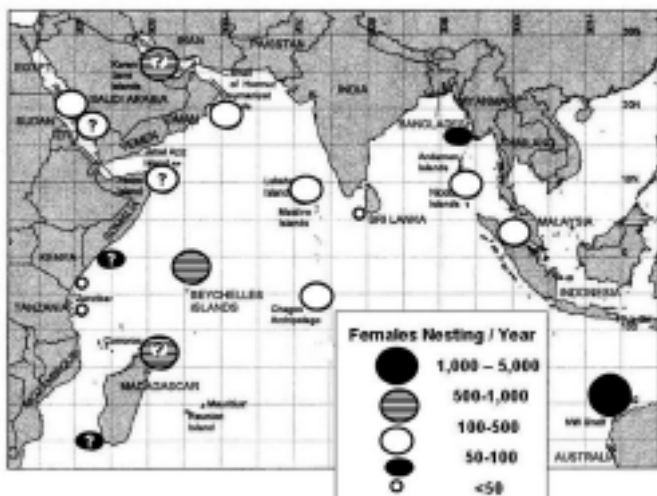


Figure 1. Estimated numbers of female hawksbills nesting annually at key sites in the Indian Ocean region.

Current numbers of nesting females, however, provide an inadequate index of the true health of some hawksbill nesting populations. One needs also consider the impact of historic levels of harvest. For example, at some sites (e.g., Seychelles) slaughter of females at the nesting beach was so intense between the mid-1960s and 1992 (when Japan stopped importing raw shell) that very little reproduction occurred at many sites. In effect, this resulted in a 'lost generation' of turtles, whose absence may not yet have fully manifested itself at the nesting beach (Mortimer, 1995). Indo-Pacific hawksbills are slow to

mature, sometimes taking 30 to 35 years to reach adulthood. The fact that many of the females nesting today are actually very old turtles born prior to the onset of this very intense period of harvest may mask the true damage to the population caused by the intense harvest at the nesting beach. In such cases, further declines in numbers of nesting females are likely.

Data Sources Used to Assess Population Status & Trends

Data used to assess population status and trends include the following (see also review by Meylan & Donnelly, 1999):

- Trade statistics for tortoise shell – e.g., for Chagos, Kenya, Madagascar, Mauritius, Seychelles, Tanzania, etc. (Milliken & Tokunaga, 1987);
- Egg collection statistics – e.g., Indonesia, Malaysia, Sri Lanka, etc.;
- Nesting beach surveys (i.e., involving some combination of turtle track counts & tagging) – e.g., Andamans, Australia, Chagos, Cocos-Keeling, Eritrea, Iran, Kenya, Madagascar, Mauritius, Nicobar, Oman, Seychelles, Sri Lanka, Tanzania, etc.;
- Egg clutch survival statistics – e.g., Malaysia, Seychelles, etc. (Statistics of Malaysian Fisheries Department & WWF-Malaysia; Mortimer 2004);
- In-water studies of immature foraging aggregations provide data on growth rates, and local & long distance movements – e.g., Chagos, Cocos-Keeling, Maldives, Seychelles, etc. (Mortimer et al., 2002; Whiting, 2000; Mortimer, 2004; Mortimer et al., in press.);
- Satellite tracking of post-nesting hawksbills – e.g., Seychelles (Mortimer & Balazs, 2000);
- Genetic analysis of nesting populations and breeding aggregations – e.g., Australia, Chagos, Malaysia, Saudi Arabia, Seychelles, Iles Eparses, etc. (Broderick et al., 1994; Broderick & Moritz, 1996; Mortimer & Broderick, 1999; Bourjea et al., in prep.).

Threats to Turtle Populations

The survival of hawksbill turtle populations in the Indian Ocean region is jeopardized by mortality of the turtles themselves as well as by damage to their habitats.

Turtle Mortality

Turtle mortality can be either purposeful or accidental. Purposeful exploitation falls into the following categories (also see Frazier, 1980; review by Meylan & Donnelly, 1999):

- Historic shell trade caused serious population decline throughout the region some of the impacts of which are yet to be manifested. Affected countries include: Chagos, Kenya, Madagascar, Mauritius, Seychelles, Sri Lanka, Tanzania, etc. For example, in Seychelles alone, between 1894 and 1982 (88 years) at least 81,700 hawksbill turtles were harvested for shell export to Europe and Japan (Fig. 2).
- Harvest for meat continues at some sites including: Madagascar, Seychelles, Somalia(?), etc.
- Egg collection continues to be a problem in Madagascar, Malaysia & South East Asia (in general), Somalia(?), etc.
- On-going trade in hawksbill shell continues at some sites, and may involve either the domestic sale of worked shell, or illegal export of raw shell. In Madagascar, worked shell is on sale to visiting tourists, and export of raw shell may occur. Seychelles has effectively ended domestic trade in tortoise shell, but some illegal export is possible.

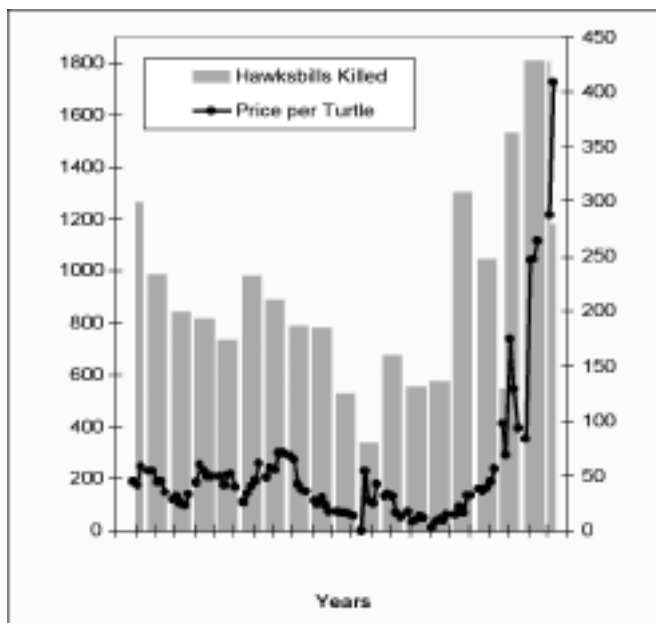


Figure 2. Number of Hawksbill turtles harvested in Seychelles between 1894 and 1982 for export to Europe and Japan (Mortimer, 1984).

Accidental mortality to hawksbills that is primarily fisheries related includes the following factors:

- Trawling: known to be a problem in Eritrea, Iran, Saudi Arabia, Somalia(?), etc. (Humphrey & Salm, 1996).
- Gill nets: a serious problem for hawksbills whenever they are used in near shore waters – e.g., Kenya, Malaysia, Seychelles, Somalia(?), Tanzania, etc. (Humphrey & Salm, 1996; Mortimer, 1998).
- Long line fisheries: a documented source of mortality to hawksbills in Seychelles, and likely elsewhere in the region (Mortimer, 2004);
- Artisanal hook & line: regularly catches hawksbills when they take baited hooks – e.g., recorded often in Seychelles (Mortimer, 1998), and likely to occur elsewhere.
- Fish traps: sometimes trap hawksbills that investigate the devices – e.g., recorded in Seychelles (Mortimer, 1998), and likely elsewhere.
- Purse seines: known to trap post-hatchling turtles in the pelagic habitat – e.g., reported in Seychelles (Mortimer, 2004).
- FADs & Nets below FADs: attract hawksbills that may become entangled in the nets or drift with them over long distances (pers. comm. B. Wendling to JAM).

Accidental mortality is also caused by:

- Boat strikes: regularly reported in Seychelles (Mortimer 1998, 2004), likely elsewhere.
- Dogs: known to frighten and even kill(!) nesting females in Seychelles (Mortimer, 2004), likely elsewhere.

Habitat Destruction.

Vulnerable habitat includes both nesting beaches and foraging grounds; these are subject to the following impacts (also reviewed in Meylan & Donnelly, 1999):

- a) Unregulated coastal development: a serious problem for hawksbill nesting beaches throughout the region – e.g., Malaysia, Maldives, Seychelles, etc.
- b) Pollution: oil pollution is especially problematic in Iran, Saudi Arabia, etc.
- c) Erosion of nesting beaches: caused by rising sea levels and coral reef mortality in adjacent water is a serious problem in Chagos, Seychelles, and elsewhere in the region (Sheppard et al., 2005).
- d) Coral reef damage due to warming events and other factors: especially problematic for hawksbills, whose foraging habitats are typically associated with coral reefs – a problem throughout the region.

Population Trends

Throughout much of the Indian Ocean region, hawksbill populations have declined significantly during the past several centuries, and during the past 105 years alone (3 turtle generations as per IUCN criteria) by more than 80 percent. Based on these figures, the IUCN Red List classifies the hawksbill as “Critically Endangered” (Meylan & Donnelly, 1999).

There is evidence, however, that protection of turtles at the nesting beach can effectively arrest or reverse downward population trends. In the inner islands of Seychelles, overall numbers of nesting turtles have declined by some 25 percent during the past 25 years. A closer look at the data, however, reveals that at sites where turtles received no protection from exploitation, nesting numbers declined by an average of 60 percent (Fig. 3).

In contrast, at sites where nesting turtles had been protected during the same period, overall nesting numbers actually increased by 142 percent (Fig. 4).

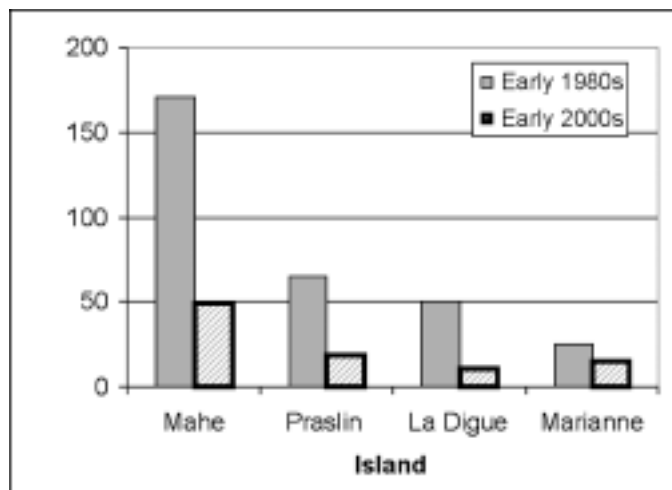


Figure 3. Unprotected islands of the Seychelles (n=13). Overall, there has been a decreasing trend of 60 percent. Between the 1980s and 2000s, nesting has decreased from approx. 536 to 220 turtles per season (Mortimer, 2004).

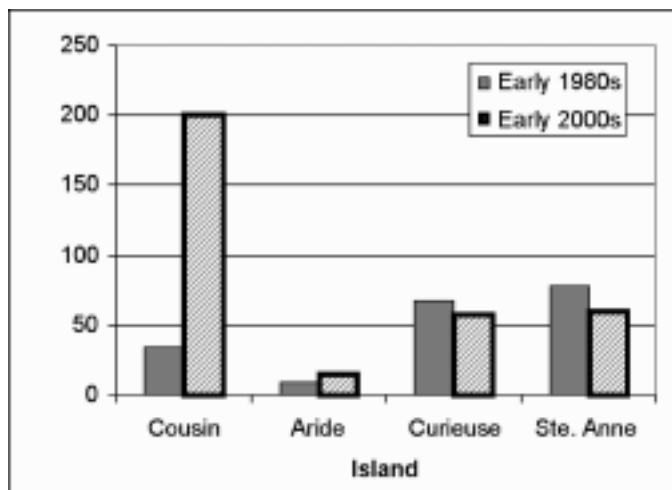


Figure 4. Protected islands of the Seychelles (n=8). Overall, there has been an increasing trend of 142 percent. Turtles protected since 1970 at Cousin and 1976 at Aride. Between the 1980s and 2000s, nesting has increased from approx. 284 to 405 turtles per season (Mortimer, 2004).

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Hawksbill Turtles in the Solomon Islands

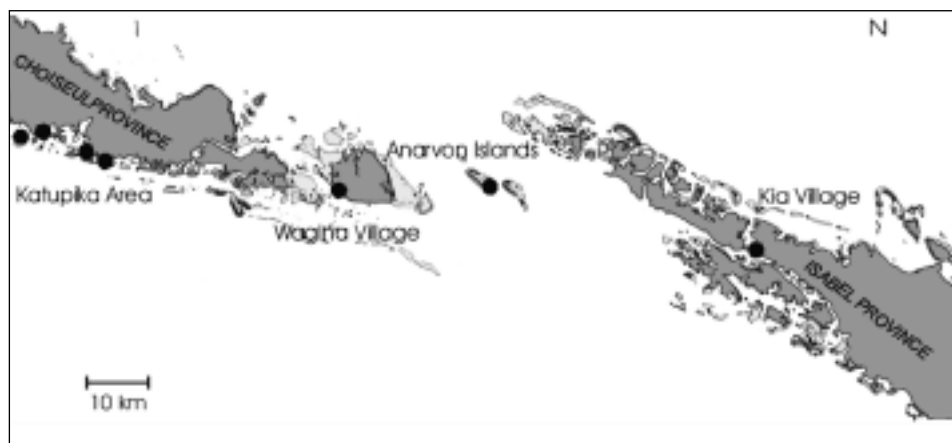
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Dr. Damien Broderick, University of Queensland

EXECUTIVE SUMMARY

A joint presentation was provided on the status of hawksbill turtles in the Solomon Islands indicating that adult harvest remains a significant threat in the area, and there exists an urgent need to implement monitoring and intensive conservation activities. The Arnavon Islands is a significant hawksbill rookery in the Solomon Islands; the most recent survey in 2000 estimated that 270 female hawksbills laid 785 nests. However, historic commercial harvest in the Solomons was unsustainable (over 10,000 turtles harvested) and that the current subsistence harvesting is probably limiting recovery. This was further supported by data comparing rookeries at Milman Island in Australia versus the Arnavons. At Milman, there are a high proportion of experienced breeders with shorter remigration intervals (2-3 yrs) and larger clutches, where as in the Arnavons, there are a low proportion of experience breeders, longer remigration intervals (5-7 yrs) and smaller clutches. Additionally, it would appear that there are still many hawksbill turtle mysteries in the southwest Pacific. For example, there exists a genetic stock of hawksbill turtles that forage at Heron Island, Australia that comprise approximately 40 percent of the population, but the nesting stock of these turtles has yet to be identified. Furthermore, it is unclear where the Milman hawksbill turtle nesting population migrates to forage.

The Arnavon Islands Management Conservation Area

The national Solomon Islands Marine Turtle Program includes monitoring programs for green, leatherback, and hawksbill sea turtles. The objectives of the program are to provide scientific baseline data that will assist in managing of marine turtles; developing of legislation; conducting conservation and monitoring projects to determine local population trends, and understanding migratory patterns; and providing education and awareness at both the national and community level. Surveys undertaken between 1973 and 1982 established the Arnavon Islands Management Conservation Area (AMCA) as a significant hawksbill rookery in the Solomon Islands.



Consistent hawksbill surveys have been conducted in the AMCA since 1990. Between 1993 and 1996, Damien Broderick (Queensland University) conducted the most comprehensive research in the AMCA consistent with genetic studies of nesting females, as well as in-water studies at foraging grounds and subsistence harvest studies to characterize and understand the harvest pressures to the population (Fig. 1).

Genetic data has revealed that the AMCA nesting hawksbill population is genetically different from those in Australian waters (based on mitochondrial DNA). Harvest studies indicate that there continues to be great pressure on the population, with approximately 1,893 turtles (hawksbills and greens) harvested per year (Table 1). Although tag recovery information as well as data from limited satellite telemetry studies has determined that hawksbills nesting in AMCA may also reside in PNG and Australian waters, high site fidelity has been identified in the Solomon Islands foraging grounds. Of the 259 turtles tagged, a large proportion (30 percent hawksbill and 11.5 percent green turtle) were been recaptured. Unfortunately, almost half of these recaptures were harvested.

Table 1. Estimated Yearly Harvest

Island	Kia	Wagina	Katupika	Total
Chelonia	753	201	114	1,068
Mydas				
Eretmochelys	360	450	15	825
imbricata				
Total	1,113	651	129	1,893

AMCA Population Surveys

Surveys conducted in the early 1980 estimated that 560 hawksbill nests and 45 green sea turtle nests were laid annually in the AMCA (Mckeown, 1981). Leary et al. (1992) estimated that 679 hawksbill nests were laid resulting in a nesting population of 239 turtles. In 1995, surveys conducted by the Department of Fisheries (Ramohia and Pita) estimated that 206 nesting hawksbill females laid 599 nests, and in 2000, it was estimated that 270 female hawksbills laid 785 nests in the AMCA.

Nesting Dynamics

The average hawksbill curve carapace length for nesting turtles in AMCA is approximately 85 cm. The average clutch size is about 150 eggs, and hatching success is about 80 percent after an eight to ten week incubation period. In the Arnavons, the remigration interval for turtles in the AMCA is 5-7 years and there are a low proportion of experience breeders. This is in contrast to the Milman Island, Australian nesting population where there are a high proportion of experienced breeders with shorter remigration intervals (2-3 yrs) and larger clutch-es.

Future Recommendations

Given that data suggests that commercial harvesting was unsustainable and subsistence harvesting is probably limiting recovery, it was recommended that the following measures be implemented to promote hawksbill turtle conservation in the Solomon Islands:

- Properly analyze and report data from nesting and in-water surveys need to be – tagging database is needed
- Strengthen regional collaboration for turtle conservation
- Establish a national turtle conservation strategy
- Decentralize turtle monitoring work through community involvement
- Increase awareness and education for turtle monitoring
- Reassess rookeries and implement consistent monitoring programs

- Conduct in-water feeding ground and genetic studies
- Understand fishing gear related mortality in country
- Undertake satellite tracking projects
- Increase government support for community Marine Protected Areas

Hawksbill Sea Turtles in Indonesia

Hiroyuki Suganuma, Everlasting Nature of Asia

EXECUTIVE SUMMARY

Historic data indicates there are many hawksbill turtle rookeries in Indonesia, however, the exact number or how many turtles occur in each rookery is unknown. This project started in 1995 based on the CITES report written by Groombridge and Luxmoore (1989). We interviewed local people, local government staffs, bidders and egg collectors, and regarded relative number of nests as important. A rough number of nests were estimated from this information, and it was determined that one or two islands, Seribe and Segama Islands, are relatively important hawksbill turtle rookeries.

Over 474 islands in 33 areas were surveyed by the project since 1995 (table 1). More than 101 nests were found at eight islands, between 51 to 100 nests were found at 9 islands, and 11 to 50 nests were identified at 56 islands, one to ten nests occurred at 196 islands, and there were no hawksbill nests located at over 205 islands. Between 1961 to 1987, 7.27 tons of Bekko shell materials had been annually imported to Japan from Indonesia and Singapore. This amounts to approximately 7,000 hawksbill turtles harvested annually in Indonesia. Available information suggests that egg harvest remains a significant threat in the region, and thus conclude that the population of hawksbill turtles in Indonesia is declining.

Table 1. Comparison of number of nests between 1980s (Groombridge, B and R. Luxmoore, 1989) and recent surveys by Everlasting Nature of Asia.

Name of province	1980s	since 1995
Liau	3170	2,900
Sumatra Selatan	5,050-5,450	1,300
Daera Khusus Jakarta	550?	150
Jawa Tenggara	300	100
Kalimantan Barat	300	450
Kalimantan Selatan	1,000?	400
Sulawesi Selatan	3,000-4,000	100
Sulawesi Tenggara	1,000-1,500	0 (only Westside)
Papua	5,000-6,500	50 (only Jamursba-Medi)
Total	19,370-22,770	5,450

To assist in population recovery, three monitoring projects have been implemented by Everlasting Nature of Asia at important hawksbill rookeries: Segama Besar Island, Pesemut Island and Momperang Island. Results of monitoring efforts at these islands are shown in tables 2, 3 and 4.

Table 2. Results of daily monitoring at Segama Island.

Year	1996	1997	1998	1999	2000	2001	2002	2003
No. Nests	103*	104*	133	168	234	188	235	225

* number of body pits

Table 3. Results of daily monitoring at Pesemut Island.

Year	1999	2000	2001	2002	2003
No. Nests	190	97*	150	140	160

* number nests from May to December only

Table 4. Results of daily monitoring at Momperang Island.

Year	2000	2001	2002	2003
No. Nests	153	131	134	126

References

Groombridge, B and R. Luxmoore (1989) The green turtle and hawksbill (Reptilis: Cheloniidae) world status, exploitation and trade. Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. 601pp.



Appendix I

Western Pacific Leatherbacks — Threat Matrix

RISK MATRIX: THREATS RANKED (1-4)

- 1 = High threat level; high importance to take action
- 2 = Medium threat level
- 3 = Low threat level; low importance to take action
- 4 = No threat level (not applicable)

High level threats versus medium level threats ranked and/or prioritized based on tasks that are within reason to implement given available monetary resources.

Threat	Adults	Juveniles	Hatchlings	Eggs
Threats to Leatherbacks on Nesting Beaches				
Direct harvest (humans)	2	4	4	1
Coastal construction (disruption of nesting & hatching activities)	4	4	1.5	1.5
Nest predation by domestic, native and feral animals	3	4	3	2
Artificial lighting	4	4	3*	4
Data deficiencies (nesting activity, identify nesting beaches, determine and monitor trends, nesting beach origins, define stock boundaries, genetics)	1	4	1	1
Threats to Leatherback Nesting Habitat				
Degradation due to erosion-control measures, jetties, breakwaters	4	4	3	3
Sand removal & mining practices	4	4	4	4
Vehicular driving*	3	4	3	3
Degradation by upland, coastal erosion, siltation (mining)	4	4	2	2
Global warming*	3	4	3	3
Threats to Leatherbacks in marine habitats				
Direct harvest	2	2	4	4
Data deficiencies (distribution, abundance, migration, growth rates, survivorship, threats on foraging grounds)	1	1	4	4
Entanglement and ingestion of marine debris	3	3	3	4
Boat collisions	3	3	4	4
Incidental take in Fisheries				
Longline	1.5	1.5	4	4
Purse seine	3	3	4	4
Trawl	2.5	2.5	4	4
Coastal fisheries (gillnet, ___?)	1	1	4	4
Pound nets/traps/pots	3	3	4	4
FADs	3	3	4	4
Hook and line	3	3	4	4
Disease	4	4	4	4
Predation	3	3	3	4
Threats to marine habitat				
Data deficiencies (identification of important foraging habitat)	1	1	1	4
Degradation of reefs by boating, diving activities	4	4	4	4
Degradation by upland, coastal erosion, siltation, including mining, pollution	3	3	4	4
Degradation of pelagic habitat by oil trans-shipment	3	3	4	4
Jellyfish Fishery*	3	3	4	4

*emerging issue



Appendix II

Leatherback Turtle Nesting Beach Catalogue

Western Pacific Leatherback (*Dermochelys coriacea*) Nesting Populations in Papua, Papua New Guinea, Solomon Islands and Vanuatu identified by workshop participants during the leatherback workshop, May 19 – 21, 2004

Beach (>20 nests)	Size (km)	Nesting Season by Month (P=Peak)												# Nests	# tagged	Threats	Moni- tored?	Quality of data	Notes	
		J	F	M	A	M	J	J	A	S	O	N	D							
Papua																				
Jamursba-Medi ²	18						P	P						1,865-3,601	70-300	feral/domestic pig, domestic dog, logging, tidal inundation	Yes	Exc. (Nests) Poor (tagging)	WWF data, 2002, 2003 complete seasons	
War-Mon	6	P	P											1,508		feral pig, logging, tidal inundation, egg collection	Yes	Exc.	WWF data, 2003 Complete season	
Mubrani-Kaironi	20													unk1		egg collection, feral pig	No	Incomplete	Adipati and Patay, 1984 - season unclear	
Sidey-Wibain	18													unk1		egg collection, feral pig	No	Incomplete	Adipati and Patay, 1984 - season unclear	
Raja Ampat									P	P				unk1		?	No	Incomplete	WWF 2003	
Yapen Island	5													unk		egg collection, tidal inundation	No	Incomplete	Maturbongs, 1999 season unclear	
PNG																				
Kamiali	11	P											P	P	107* (min)	40-72	predation (lizards, pigs, crocs) egg collection, erosion, gardening (remove trees), debris from river	Yes	Incomplete (nests); Good (tagging)	Wildlife management area. 4.2 km currently monitored. *Aerial surveys (one day), with ground truth.
Buang-Buassi	5.5	P											P	P	104* (min)	1	predation (lizards, pigs) egg collection, artificial lighting, coastal devt, debris from river	No	Incomplete	*Aerial surveys (one day), no ground truth. Beach is large and good for nesting, protection has begun.
Fulleborn	7.5												P	P	26 (min)		logging, egg collection, erosion, nest predation (feral dogs, crabs)	No	Incomplete	Data collected on aerial survey (one day), 2004
Korapun	3.25	P											P	P	14 (min)		feral pigs, iguana	No	Incomplete	Data collected on aerial survey (one day), 2004
Salus	4.57												P	P	19 (min)		feral pigs, iguana	No	Incomplete	Data collected on aerial survey (one day), 2004
Bouganville	5	P											P	P	10		feral pigs, iguana, sedimentation	No	Incomplete	T. Leary, 1990 (Laluai Pt)

Beach (>20 Dcnests)	Size (km)	Nesting Season by Month (P=Peak)												# Nests	# tagged	Threats	Moni- tored?	Quality of data	Notes
		J	F	M	A	M	J	J	A	S	O	N	D						
Solomons																			
Western Province																			
Baniata (Rendova Is)	2-3	P											P	65*	none	wave erosion	Yes villagers	Fair	Longest nesting beach in Solomons
Havila (Rendova Is)	2-3	P											P	38*	none	wave erosion	Yes villagers	Fair	
Quero (Tetapara Is)	.2	P												20	none	monitor lizards, wave erosion	rangers	Poor	3 other nesting beaches with 10-20 nests
Isabel																			
Sasakolo	~1	P											P	150+(167?)	7 ('93) 25 ('95) 27 ('01)	monitor lizards, croc.	Yes	Fair	Need assistance for continuation. Incomplete season surveyed for all three years.
Litogahira	1.5												P	150+(200+)		monitor lizards, croc., egg collec- tion, logging	Yes minimal	Incomplete	Urgent need to monitor. Incomplete sea- son surveyed.
Lilika	?												P	150		monitor lizards, croc., egg collec- tion, logging	No	Incomplete	Urgent need to monitor
Salona	?												P	150		monitor lizards, croc., egg collec- tion, logging	No	Incomplete	Urgent need to monitor
Katova Bay (E coast)														20-30		monitor lizards, croc., egg collec- tion, logging	No	Incomplete	Based on 1980, 1989
Rakata Bay														20+		monitor lizards, croc., egg collec- tion, logging	No	Incomplete	Based on 1980, 1989
Choiseul																			
Vachu River	2													50		egg collection, monitor lizards, croc.	No	Incomplete	Based on 1980, 1989, 1990 surveys
Vanuatu																			
Votlo (Southern Epi)	4	P											P	50 31	9	feral animals, flooding river, storm surge	No Yes	Incomplete Fair	Trial survey by VTRM (Nov, 02- Feb, 03)
Malakula	?															egg collection, meat harvest			Should be monitored. 5-6 potential nesting beaches

¹ Locals report approximately 20-25 nesting leatherbacks on Mubrani-Kaironi and Sidey Wibain

* = # crawls

² Includes: Wembrak, Batu Rumah, Lapon and Warmamed

Threats and Actions to be Addressed at Leatherback Nesting Beaches

	Legal Protectn	Nest Predation	Erosion	Meat Harvest	Egg Harvest	Logging/ Mining	Coastal Fishing	Coastal Construction	Data Deficiencies
Papua									
Jamursba-Medi	Soon	feral pig, dogs	Yes	No	No	Yes (logging)	Potential	No	Yes
War-mon	No	feral pig, dogs	Yes	No	Little (subs)	Yes (logging)	Potential	No	Yes
Mubrani-Kaironi	No	Feral pig, dogs	Yes	No	Yes (subsist)	Yes (unk)	Potential	No	Yes
Sidey-Wibain	No	Feral pigs, dogs	Yes	No	Yes (subsist)	Yes (unk)	Potential	No	Yes
Yapen Island	No	Feral pigs, dogs	Yes	No	Yes (subsist)	Yes (unk)	Potential	No	Yes
PNG									
Kamiali +	Yes crocodile	Lizards, pigs,	No	No	Yes (medium)1 (both)	Potential (both)	Yes (potential)	Potential (ongoing tourism project)	Yes
Buang-Buassi	No	Lizards, pigs	No	No	Yes (very high 80-90%) (both)	Potential (both)	Yes (potential)	Yes, and spreading	Yes
Fulleborn	No	Feral dogs, crabs	Yes	No	Yes (both)	Potential (both)	Low	No	Yes
Korapun	No	Feral pigs, dogs	Yes	No	Ye (both)	Yes (logging)	Shark/tuna longlining, prawn trawling	No	Yes
Salus	No	Feral pigs, dogs	Yes	Yes (subsist)	Yes (both)	Yes (logging)	Shark/tuna longlining, prawn trawling	No	Yes
Bougan-ville	No	Feral pigs, iguanas	Yes	No	Yes (very high)	Yes (copper mining)	Longlining	No	Yes
Solomons									
Baniata (Rendova Island)	No*	unknown	Waves (seasonal)	Previously	Yes (in 2003) (subsist)	Potential (logging)	Coastal fishing	No	Only crawls not nests
Havila (Rendova Island)	No*		Waves (seasonal)	Previously	Yes (in 2003) (subsist)	Potential (logging)	Coastal fishing	No	Only crawls not nests
Quero (Tetapare)	Yes	Monitor lizards	Waves (seasonal)	No	?	No (protected area)	No	No	Not daily coverage
Sasakolo	Soon*	Monitor lizards, croc.	Waves	No	Yes (low)	No	No	No	Yes
Litogahira	No*	Monitor lizards, croc.	Waves	No	Yes (high**)	Yes (logging)	Coastal fishing	No	Yes
Lilika	No*	Monitor lizards, croc.	Waves	No	Yes (high**)	No	Coastal fishing	No	Yes
Salona	No*	Monitor lizards, croc.	Waves	No	Yes (high**)	No	Coastal fishing	No	Yes
Vanuatu									
Votlo (Southern Epi)	No (beach banners)	Feral pigs	Flooding rivers, storm surge	Previous, not practiced anymore	Previous, not practiced anymore	None	Subsistence and commercial	None	Yes
Malakula	No			Yes	Yes				Yes

*National legislation of the Solomons protects leatherbacks. There is a ban on harvest of meat, eggs, or any commercial trade of leatherback products, but it does not empower communities to declare ordinances. This may change with the passing (1998) and gazetting (Sept., 2003) of the Wildlife Protection and Management Act. On Isabel, there is a wildlife protection ordinance, which empowers communities to declare the customary area as a protected area, which includes enforcement. In the Western Province,

**These beaches are close to villages; therefore, high egg collection. Sasakolo is more remote.

+ Since 2002, Kamiali has had a complete ban on egg collection.



Appendix III

Southwest Pacific Hawksbill Stock — Threat Matrix

THREATS RANKED (1- 4)

- 1 = High threat level; high importance to take action
- 2 = Medium threat level
- 3 = Low threat level; low importance to take action
- 4 = No threat level (not applicable)

High level threats versus medium level threats ranked and/or prioritized based on tasks that are within reason to implement given available monetary resources.

Threat	Adults	Juveniles	Hatchlings		Eggs
			Neritic	Ocean	
Threats to Hawksbills on Nesting Beaches					
Direct harvest (humans)	1	4	4	4	1
Coastal construction (disruption of nesting & hatching activities)	3	4	4	3	3
Nest predation by native, domestic and feral animals	3	4	4	4	2.5
Artificial lighting	3	4	4	3	4
Data deficiencies (nesting activity, monitoring trends, define stock boundaries, genetics)	1	4	4	2	3
Threats to Hawksbill Nesting Habitat					
Degradation due to erosion-control measures, jetties, breakwaters	4	4	4	4	4
Sand, coral rubble removal	4	4	4	4	4
Vehicular driving	4	4	4	4	4
Global climate change, global warming*					
Threats to Hawksbills in Marine Habitats					
Direct harvest	1	1	4	4	4
Data deficiencies (distribution, abundance, migration, growth rates, survivorship, threats on foraging grounds)	1	1	1	3	4
Entanglement and ingestion of marine debris	3	3	3	4	4
Boat collisions	3	3	4	4	4
Disease	3	3	4	4	4
Incidental take in Fisheries					
Longline	3	3	3	4	4
Purse seine	3	3	3	4	4
Trawl	3	3	3	4	4
Coastal fisheries (gillnet)	1	1	4	4	4
Pound nets/traps	4	4	4	4	4
FADs**	4	4	3	4	4
Hook and line	3	3	4	4	4
Dynamite Fishing	3	3	3	4	4
Threats to Hawksbills in Marine Habitat					
Data deficiencies (identification of important habitat)	3	2	2	4	4
Degradation of reefs by boating, diving activities (tourism)	4	4	4	4	4
Degradation of reefs by pollution, including agricultural runoff, cyanide	2	2	4	4	4

* global issue, more information is needed

**emerging issue



Appendix IV

South Western Pacific Hawksbill Population Dynamics Model Workshop Agenda

Monday May 17, 2004

- | | | |
|------|--|------------------|
| 0900 | Welcome | Kitty Simonds |
| 0915 | Introduction to workshop approach | Milani Chaloupka |
| 0930 | Summary of model structure | Milani Chaloupka |
| 1000 | Interactive model review | all participants |
| | <ul style="list-style-type: none"> • stock identification • somatic growth behaviour • age, size, sex and spatial structure | |
| 1030 | <i>Break</i> | |
| 1045 | Interactive model review | all participants |
| | <ul style="list-style-type: none"> • fecundity • female breeding probability • age class-specific survival probabilities • age class-specific dispersal behavior • compensatory effects (breeding probability, age class-specific survival) | |
| 1230 | <i>Lunch</i> | |
| 1330 | Hawksbills in Brazil | Neca Marcovaldi |
| 1350 | Interactive model review | all participants |
| | <ul style="list-style-type: none"> • depensatory effects (probability of finding mates) • population trends • environmental and demographic stochasticity | |
| 1500 | <i>Break</i> | |
| 1515 | Interactive model review | all participants |
| | <ul style="list-style-type: none"> • other demographic factors no yet considered • identification of competing mortality risks • identification of population viability scenarios | |
| 1600 | Model application | Milani Chaloupka |
| | <ul style="list-style-type: none"> • model sensitivitiy analysis approach (fractional factorial sampling) • demonstration scenario runs | |

Tuesday May 18, 2004

- | | | |
|------|---|--------------------------------|
| 0900 | Hawksbills in the Indian Ocean | Jeanne Mortimer |
| 0920 | Hawksbills in the Solomon Isl. | Damien Broderick/
John Pita |
| 0940 | Hawksbills in Indonesia | Hiroyuki Suganuma |
| 1000 | Play with model | all participants |
| | <ul style="list-style-type: none"> • scenario runs and test assumptions • use model switches to turn on and off environmental effects | |
| 1100 | <i>Break</i> | |
| 1130 | Summary of workshop | Milani Chaloupka |
| 1200 | Threat Matrix | Milani Chaloupka/
Tina Fahy |
| 1300 | Workshop close | Kitty Simonds |
| | <i>Reception 6pm</i> | |



Appendix V

Leatherback Workshop Agenda

Day 1 – May 19, 2004

9:00 am

Welcome Kitty Simonds

Introductions & Program Outline Irene Kinan

Western Pacific Leatherbacks: Peter Dutton
“Why we gathered here today”

Aerial Surveys Scott Benson/ Laura Sarti

Break

Jamursba Medi & Warmon - Papua Tetha Hitepeuw/
Julius Lawalata

Kei Kecil Islands - Papua Yulianus Thebu

Everlasting Nature of Asia:
Research in Indonesia Hiroyuki Suganuma

Lunch 12:00 - 1:30

Leatherback Status in PNG Vagi Rei

PNG – Kamiali Wildlife Area Karol Kisokau/
Levi Ambio

PNG – Huon Coast Network John Sengo

Leatherbacks in the Solomon Islands John Pita/
Peter Ramohia

Leatherbacks in Vanuatu George Petro

Reception 6:30 Council Office

Day 2 – May 20, 2004

9:00 am

Welcome Irene Kinan

Efforts to reduce fishery induced mortalities Mike McCoy
within the waters of PNG

The Tetapare Descendents
Conservation Project Kenneth MacKay

Regional Tagging Database Anne Trevor

Research on the mitigation and conservation of sea turtles
by the Fishery Research Agency, Japan Hideki Nakano

Break

Working Group – Threat Matrix Peter Dutton/Tina Fahy

Lunch 12-1:30

Working Group - Research and Conservation Peter Dutton
Quantification of Nesting Beaches

Day 3 – May 21, 2004

9:00 am

Working Group – Data collection methods Peter Dutton

Leatherback researchers from Indonesia,
Papua New Guinea, Vanuatu & Solomon Islands

Clinicals: “Bring your data”

- Informal meetings and discussions
- Data analysis
- Methods review

Workshop Summary & Recommendations Peter Dutton/
Tetha Hitepeuw

Workshop end 5pm



Appendix VI

Workshop Participants Contact Information

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