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REPORT ON THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM)

KUALA LUMPUR, MALAYSIA
15-17 OCTOBER 2008

Marine Fishery Resources Development and Management Department
SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

Sitting from right: Dr. Yosni, Prof.Dr. Chan, Dr. Sukarno, Dr. Nicolas, Ms. Hjh.Mahyam, The Honourable Dato' Junaidi, Dr. Abe, Mr. Minami, Ms. Rujarek and Mr. Syed Abdullah
Second row from right: Mr.Arvind, Ms.Nurhuda, Ms.Noararzah, Prof.Dr. Ngurah, Mr. Irwan, Ms. Lau, Ms. Wahidah, Ms. Sharifah Roqaiyah,
Ms. Julie, Ms. Desimawati, Mr. Lieng, Mr. Somchai and Dr.Renato
Third row from right: Mr. Mohd. Faisal, Mr. Ridzuan, Dr. Kongkiat, Mr. Ronnie, Mr. Fauzi, Mr.Robert Leong, Mr.Abd.Hamid, Mr.Dung, Mr. Cho,
Dr. Worawit, Mr. Zulkifli, Mr. James and Mr. Ku Kassim.

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PREFACE

Six species of sea turtles landing and nesting in the Southeast Asian region have been confirmed. These are Green (*Chelonia mydas*), Leatherback (*Dermochelys coriacea*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*), Loggerhead (*Caretta caretta*) and Flatback (*Natator depressa*). As these reptiles are known to be highly migratory species, regional efforts on research and conservation are crucial in ensuring the survival of sea turtle populations in this region.

In this regard, SEAFDEC-MFRDMD has been given the responsibility to conduct the Japanese Trust Fund IV program – Research for Stock Enhancement of Sea Turtles. The study started in 2004 and was planned to be completed in December 2008. The study covered stock identification of sea turtles in the region by DNA analysis as well as investigations on their multiple paternities, clarification of their migration routes by tagging and satellite tracking methods, and interactions between fisheries and sea turtles.

Third Regional Technical Consultation Meeting for the JTF IV program was held from 15-17 October 2008 in Kuala Lumpur, Malaysia to discuss the outcomes of the program activities from 2004 to 2008 and the planning for future programs. The objectives of the Meeting were to:

i. deliberate on reports presented by country representatives on tagging activities, satellite telemetry studies as well as investigations on interactions between fisheries and sea turtles.
ii. discuss the results and findings of the activities implemented under the JTF IV program from 2004 to 2008.
iii. discuss the proposal for supplementary JTF IV programs in 2009, and
iv. discuss the future activities of the Japanese Trust Fund V Program (2010-2014).

SEAFDEC-MFRDMD in collaboration with SEAFDEC-TD is proud to be a regional institution for the on-going research and conservation activities of sea turtles in the region. Indeed, the greatest tribute to us from our future generations must surely lie in our own concerted efforts to successfully conserve these noble creatures and enhance their populations.

On behalf of SEAFDEC-MFRDMD, I would like to thank the Japanese Government for providing the funds to organize this consultatative meeting. Appreciation also goes to all Member Countries of SEAFDEC and the meeting secretariat for making the Third Regional Technical Consultation a great success.

Dr. Osamu Abe
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Japanese Trust Fund IV Co-Manager
Kuala Terengganu, Malaysia

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REPORT ON THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

I. INTRODUCTION

1. SEAFDEC conducted collaborative work on sea turtle tagging with eight SEAFDEC member countries from 1998-2003 under the Japanese Trust Fund (JTF) I program with the objective of obtaining information on distribution, migration, growth and reproductive biology of sea turtles. A total of 12,000 Inconel tags have been provided by SEAFDEC to member countries. The program also developed sea turtle hatchery management techniques.

2. In 2004, Research for Stock Enhancement of Sea Turtles was implemented under the Japanese Trust Fund IV (JTF IV) Program in collaboration with the eight SEAFDEC member countries. The program consists of three main projects: i) tagging and satellite tracking telemetry, ii) DNA study, and iii) interaction between fisheries and sea turtles. In 2007, a Mini Symposium on Tagging and Satellite Telemetry Studies was held in Kuala Lumpur. The Second Technical Consultation Meeting (2nd TCM) was also held in the same city to evaluate and discuss the progress of the program activities from 2005 to 2006 as well as to propose the implementation plan for 2007. The JTF IV program will end in December 2008.

3. The Third Regional Technical Consultation Meeting of the JTF IV program was held from 15-17 October 2008 in Kuala Lumpur, Malaysia to discuss the outcomes of the program activities from 2004 to 2008 and the planning for future programs. The Meeting was attended by participants from Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam; and representatives from SEAFDEC-Secretariat, SEAFDEC-TD and SEAFDEC-MFRDMD. Resource persons were invited from the Research Institute of Far Seas Fisheries, Japan, Universiti Malaysia Terengganu, Universiti Kebangsaan Malaysia, Department of Fisheries Malaysia and Marine Research Foundation, Malaysia. The Meeting was also attended by observers from DOF Malaysia, IOSEA, Sarawak Forestry Corporation and WWF-Malaysia. The full list of the participants appears in Annex I.

II. OBJECTIVES

4. The objectives of the Meeting are:

   v. to deliberate on reports presented by country representatives on tagging activities, satellite telemetry studies as well as investigations on interactions between fisheries and sea turtles,

   vi. to discuss the results and findings of the activities implemented under the JTF IV program from 2004 to 2008,

   vii. to discuss the proposal for supplementary of JTF IV program in 2009, and

   viii. to discuss the future activities of the Japanese Trust Fund V Program (2010-2014).

III. OPENING OF THE MEETING

5. Ms. Mahyam Mohd Isa, the Chief of SEAFDEC-MFRDMD, welcomed all the distinguished guests, participants and observers to the Meeting. She then thanked the Honorable Dato' Junaidi bin Che Ayub, the Director-General of Fisheries Malaysia and the SEAFDEC Council Director for Malaysia, for opening the Meeting. She also thanked all the participants, resource persons and observers for attending this Meeting. She briefly elaborated the purpose of the meeting, which would be to discuss the outcomes of previous as well as future planning of turtle research. She hoped everyone would have a very fruitful discussion. Her welcome speech appears as Annex II.

6. In his Opening Speech, the Honorable Dato' Junaidi bin Che Ayub, on behalf of the Government of Malaysia welcomed all the participants and guests to Malaysia. He thanked MFRDMD for hosting this Meeting as well as giving him the opportunity to say a few words. He stressed on the importance of collaborative work at the regional level to enhance, as well as to conserve, the sea turtles, as these animals are highly migratory reptiles. He hoped the Meeting could consult, explore and discuss the common issues within the region which would provide a great boost in sea turtles protection and conservation. He also hoped the outcomes of this Meeting would promote better conservation and management approaches for these reptiles in the region. He expressed his appreciation to the Government of Japan, SEAFDEC and resource persons for making this meeting a success. He hoped the participants would have a fruitful discussion. The Honorable Dato' Junaidi then declared the Meeting open. His Opening Speech appears in Annex III.

IV. ADOPTION OF AGENDA

7. This session was chaired by Ms. Mahyam Mohd Isa. The Agenda as it appears in Annex IV was adopted.

V. OVERVIEW ON JAPANESE TRUST FUND IV PROGRAM 2004 -2008

8. Mr. Syed Abdullah Syed Abdul Kadir, Regional Coordinator of JTF IV presented the overview. The six main objectives of the JTF IV were listed. There were two components, namely Regional Meeting/Workshop/Training and Regional Research Program. The outcomes of these components were highlighted in detail, including the paternity patterns, migration patterns, foraging areas, use of C-hooks and TEDs, etc. The list of publications produced by SEAFDEC-MFRDMD from 2004-2008 was also presented. Details of his presentation appear as Annex V.

VI. COUNTRY REPORT ON TAGGING AND SATELLITE TELEMETRY STUDY

9. The Meeting expressed its appreciation to all the member countries for their good job in tagging and satellite telemetry study in the region, as presented by representatives from Brunei Darussalam, Cambodia, Indonesia, Malaysia-Peninsula, Malaysia-Sabah, Malaysia-Sarawak, Myanmar, the Philippines, Thailand and Vietnam (Annex VI to Annex XV).

VII. OTHER TAGGING AND SATELLITE TELEMETRY RESEARCH IN THE REGION

10. The projects on satellite tracking of turtles in Peninsular Malaysia by WWF Malaysia were presented by Ms. Lau Min Min and Ms. Sharifah Ruqaiyah (Annex XVI). There were two sites chosen, i.e. Melaka (for Hawksbill turtle) and Terengganu (for Green turtle). Eight Hawksbill turtles had been attached with PTT from 2006-2008. All these turtles migrated towards Singapore and Riau. The inter-nesting area was determined to be in Melaka waters, while the foraging ground was in the waters surrounding Riau. The nesting of Hawksbill turtles was 300-400 nests per year in Melaka. In Ma' Daerah, Terengganu, 150-250 nests of Green turtles were observed per year. The PTT tags had been attached to four Green turtles in Ma'Daerah, one of which headed towards Riau.

11. The study on satellite telemetry on Leatherback turtles in the western part of Papua (Jamursba Medi and Warmon) was presented by Dr. Hiroshi Minami (Annex XVII). The nesting study was done collaboratively with the government of Indonesia, NGOs and local people. The study revealed that the nesting grounds had been affected by beach erosion and the presence of predators (wild boars). The satellite telemetry studies conducted in Jamursba Medi determined the migration routes of turtles in the dry season to the North Pacific off Japan, Hawaii as well as California, against the westward flowing north equatorial current. During the rainy season, the turtle tagged in Warmon migrated towards Arafura Sea and New Zealand. Only two turtles moved westward to the Sulu Sea.

VIII. STOCK IDENTIFICATION OF SEA TURTLES IN THE SOUTHEAST ASIAN REGION

12. The regional analysis on stock identification of Green and Hawksbill turtles in the Southeast Asian region was presented by Ms. Wahidah Mohd. Arshaad, a Technical Officer of MFRDMD. The main objective of this analysis was to identify subpopulations of nesting Green and Hawksbill turtles in the region. For Green turtles, the tissue samples were gathered from 14 sites throughout the region. For Hawksbill turtles, 136 samples were collected from nine sites (nesting beaches). The summary of the methods used was presented. The results suggested that the Green turtles in the region could be grouped into 12 management units (subpopulations). However, no conclusive result could be made to the Hawksbill turtle population due to the small sample size. Details of her presentation appear as Annex XVIII.

IX. DETECTION ON MULTIPLE PATERNITIES OF GREEN TURTLES

13. Results on the study of multiple paternities of Green turtles were presented by Ms. Wahidah Mohd Arshaad (Annex XIX). This study was aimed at determining the level of paternity as well as to determine the male populations at Redang Island. The method was briefly presented. The preliminary results showed a high level of multiple paternities in Redang Island. Further study needs to be made to confirm this result.

X. INTERACTION BETWEEN SEA TURTLES AND FISHERIES

14. The progress and results of the project on Interaction Between Sea Turtles and Fisheries in the Southeast Asian Region was presented by Dr Worawit Wanchana, as appeared in Annex XX. This project had been undertaken from September 2005-2008. The pelagic longline was identified as one of the commercial gears that affect sea turtle mortality. The results of the tuna longline fishing operation in the East Indian Ocean in 2003 showed that two Olive Ridley turtles were caught. The present program compared the efficiency of J-hook and C-hook in pelagic longlines. Four trials were carried out in the Indian Ocean, Andaman Sea, SCS and Sulu Sea. Milkfishes and mackerels were used as baits for the longline. The results revealed that the Circle hook has higher hook rates for tuna, but similar rates for barracuda and billfish when compared to J-hooks. C-hooks also caught less by-catch species. The hooking positions on the bait were also mentioned. The set of guidelines for longline fisheries to reduce sea turtle mortality was produced including information packages.

15. The study suggested that in order to reduce sea turtle mortality when using C-hooks, the following steps should be considered, i.e. using circle hooks of 18/0, having de-hookers and line cutters readily on board, enhancing fishermen's understanding and ability to comprehend steps and procedures on board, and avoiding long periods of soaking of the hook in water during daytime. The C-hook has been proven to be easily and safely operated, as well as to lower the possibility of catch loss.

16. A paper on Circle Hook Trial on the Bottom Longline of SSF in Pahang and Melaka was presented by Mr. Zulkifli Talib (Annex XXI). The fishing experiment was carried out in waters 30 nm off Kuantan, Pahang on 17-19 October 2007. In the experiment, C-hooks and J-hooks were used on the bottom longline. The dimensions of C-hooks and J-hooks were presented. Five fishing operations were carried out using Roundscad as bait. The results showed that eight species of fish were caught, including five targeted species. A total of 102 fish were caught during the experiment of which the targeted fish for C-hooks comprise 71% of the total fish caught by those hooks, while for J-hooks it was 35%. The hooking positions of C-hooks were mostly around the mouth, while for J-hooks, it was in the stomach. The C-hook has been proven to be safer for use, performed better than J-hooks, and no endangered species were caught. Mr. Zulkifli suggested that more trials are needed and cheaper C-hooks are requested. The fishing trial was conducted in Melaka on 21 November 2007, using four small boats, each provided with 200 C-hooks and 200 J-hooks. Fishing was done 10 nm offshore using squids as bait and three hours of soaking time. A demonstration was also carried out for officials and fishermen. The results were almost similar with the trial run in Kuantan. Even though J-hooks caught more fish than C-hooks, the latter caught bigger fish.

17. The case studies on interaction between sea turtles and fisheries in Japan were presented by Dr. Hiroshi Minami (Annex XXII). The incidental mortality of turtles on longline fishery was mentioned. In order to save turtles, modifications should be made to the hook design (shape, size, offset, and material), fishing bait and additional devices used. The effects of C-hooks on Loggerheads had also been tested and the results on hooking position were shown. The use of C-hooks has proven to catch more big-eyed tuna and striped marlin than tuna-hooks. C-hooks had also been shown to reduce deep hooking, as well as reducing the catch rate of Loggerhead turtles. The study on the hook design and

morphology effects on catch rate and hooking position is being carried out. Modification of fishing bait has reduced the catch of Loggerhead turtles. The usage of mackerels bait was shown to reduce the catch rate of Loggerheads when compared to the use of squids. Mackerels caught more big-eyed tuna for deep-water longlines. The fishing depth, water mass selection as well as soaking time can affect the ability of longlines to catch Loggerhead turtles. The study on discharge of hooks from the stomach was also presented. Careful handling and release of hooked sea turtles could reduce the turtle mortality. This research program also included educational activities for fishermen and officials.

XI. TURTLE MIGRATION ROUTE AND INTERACTION WITH FISHERY ACTIVITIES AND ECOLOGICAL INFORMATION OF FORAGING HABITAT

18. The presentations on the migration routes, ecological information on foraging habitats and interaction with fishery activities by each country were presented by representative of each country as appear as Annex XXIII to Annex XXXI. The Meeting took note with appreciation to member countries for their comprehensive information provided at this Meeting.

XII. RECOMMENDATIONS

19. Turtle Tagging Study

    i. In order to ensure the continuity of previous and current tagging programs, member countries are encouraged to undertake long term programs on tagging at main rookeries at the national level.

    ii. Based on a preliminary report proposed by Thailand, high proportion of Inconel tags loss was found after six years. Further study on this issue is urged. The member countries are requested to tag the turtles properly on both flippers. The more expensive PIT tags could also be used as an additional tag.

20. Satellite Telemetry Study

    i. Member countries should take greater care in concluding the foraging grounds determined from the satellite telemetry study. The final stop of the turtle before the signal was lost could not be concluded as the sea turtle foraging ground, unless the turtle is confirmed to have stayed there for a considerable long period of time.

    ii. The Meeting encouraged the member countries to undertake habitat surveys at the suspected foraging ground determined by the satellite telemetry study.

    iii. Riau waters have been determined as major foraging grounds for turtles. Indonesia was requested to provide more information on the turtle habitats in this area, including the coral reefs.

    iv. The Meeting suggested member countries to clean up the track data prior to analyze the migration and home range. The higher accuracy of location class (LC) of LC1, LC2 or LC3 was recommended. The home range analysis program such as animal movement for ArcView™ was suggested.

21. Olive Ridley Turtle Conservation in Brunei Darussalam

i. The Meeting took note that although the nesting population of Olive Ridley turtles in Brunei Darussalam is low, it is a major species nesting in Brunei Darussalam. For this reason, Brunei Darussalam was encouraged to take steps to ensure that this species is managed and conserved properly.

22. Illegal Direct Catch of Sea Turtles

i. The Meeting took note of the critical issue of illegal direct catch of turtles in the region by foreign fishermen which remains unresolved to this day.

ii. The Meeting also requested SEAFDEC and the member countries to consider inviting agencies related to illegal catch of sea turtles to attend their future meetings on sea turtle.

iii. In order to stop illegal turtle catch, the Meeting encouraged the member countries to initiate campaigns to stop the demand for turtles and their products.

iv. The Meeting took note on the proposed turtle workshop on illegal direct catch of turtles to be held in March 2009.

v. The Meeting requested that SEAFDEC to raise the matters above at the 11th Meeting of the ASEAN-SEAFDEC Strategic Partnership and Fisheries Consultative Group in November 2008 for consideration of involvement of SEAFDEC.

23. Stock Identification Study

i. The member countries were encouraged to continue collecting sea turtles tissue samples to be preserved in absolute alcohol. The collected samples can be later analyzed by member countries or MFRDMD in the future.

ii. The Meeting suggested the application of microsatellite markers to complement results from mtDNA analysis. Stock identification based on mtDNA analysis alone may be misleading.

iii. The Meeting agreed that the stock determination using the DNA method should be supported by data from tagging experiment.

iv. The Meeting agreed to consider further studies to assess stock composition in the foraging grounds.

v. The Meeting recommended SEAFDEC to have a proper plan for the future stock identification study since some of the member countries might have difficulties in sending (exporting) the tissue samples to MFRDMD.

vi. The Meeting requested SEAFDEC to facilitate the development of a database system among member countries, which can be shared, updated and analyzed to yield more accurate stock structure of sea turtles in the region.

vii. The member countries which have good facilities were encouraged to assist their neighboring countries in DNA analysis.

24. Paternity Pattern

i. The relatively higher proportion of multiple paternities in Green turtles in Redang Island, Malaysia was contradictory to the reported results by some other countries. MFRDMD was requested to complete the analysis.

ii. The Meeting recommended this study to be considered in the supplementary JTF IV program for 2009.

25. Sea Turtles – Fisheries Interaction

i. The Meeting took note that the major cause of incidental mortality of sea turtles include trawl nets and gillnets. The consideration should be made also to study on these gears to reduce the turtle mortality.

ii. The Meeting agreed that the C-hook has proven to reduce the turtle mortality. The Meeting proposed the member countries encourage the use of C-hooks for longline fisheries.

iii. The Meeting recorded congratulations to MFRDMD, TD and member countries for the good work done for the sea turtle-fisheries interaction. The Meeting also took note on the information provided by the observer from IOSEA that this region is far ahead from the other regions in IOSEA in undertaking the research and awareness program on the sea turtle and fisheries interaction. IOSEA offered to help disseminate information obtained from this Meeting to other regions.

iv. The guidelines produced by TD would be translated into vernacular languages and distributed throughout the region.

v. The Meeting was informed on the Turtle Meeting 20-22 January 2009 in Honolulu, Hawaii. Member countries as well as MFRDMD and TD are encouraged to send their representatives to that meeting.

vi. The Meeting agreed that the alternative gear should be introduced first to the fishermen before the banning on certain gear. The study on the economical aspects of banned gear as well as the comparison with alternative gear should be considered.

vii. The Meeting took note on the successful use of TED by MRF to avoid the catch of turtles as well as maintain (as well as increase) the commercial fish catch in Sabah, Malaysia. The results could be used in the promotion programs of member countries.

viii. The risk factor used in the country report was very subjective and could not be used for comparison between countries. Some of the countries had quite comprehensive data reports, but some dis not have, which may give different risk factors between countries.

XIII. PROCEEDINGS AND TERMINAL REPORT FOR JTF IV PROGRAM

26. All member countries and technical officers were requested to provide full report (paper) of this Meeting to MFRDMD by 15 November 2008. The report would be published in the proceedings on 1 December 2008, and as Terminal Report of JTF IV by 15 December 2008.

27. MFRDMD would prepare a format of the report to be sent to member countries and technical officers.

XIV. PROPOSAL FOR SUPPLEMENTARY JAPANESE TRUST FUND IV PROGRAM 2009

28. Dr. Osamu Abe presented the proposal for JTF IV in 2009. The total budget for this program in 2009 would be USD55,200. The details of his presentation appear as Annex XXXII.

29. The Meeting agreed that SEAFDEC consider a study on tagging and satellite telemetry on Olive Ridley turtles in Myanmar, rather than Green turtles. The representative from Myanmar was requested to consult with the officials in Myanmar to identify the right place for the project, and inform it to MFRDMD.

XV. PROPOSAL FOR JAPANESE TRUST FUND V PROGRAM (2010-2014)

30. Dr. Osamu Abe presented the proposal for JTF V which would be carried out in 2010-2014. The proposed total budget for this program for five years would be USD370,000. The proposed program would focus on studies of turtles in foraging habitats. Other activities include organizing regional meetings/workshops and formulating management plan for fishing activities and other threats to turtle. The details of his presentation appear as Annex XXXIII.

31. The Meeting requested SEAFDEC to consider the following matters to be included in the proposal:

    i. Collection of data/information on poaching of sea turtles in the region

    ii. Laparoscopy analysis of turtles in foraging grounds in determining sex ratios and sexual maturity

    iii. Collection of information on threats on sea turtles at foraging ground

    iv. Training on sampling of sea turtles in foraging grounds

    v. Promote the application of C-hooks in the region

    vi. DNA analysis to be carried out also in member countries since foraging ground samples is expected to be large

    vii. The management plan for foraging habitats to be formulated earlier than 2014

    viii. The objectives of the program should be prioritized

XVI. ADOPTION OF REPORT OF THE MEETING

32. The Report of the Third Regional Technical Consultation Meeting on Research for Stock Enhancement of Sea Turtles (Japanese Trust Fund IV Program) was adopted on 17 October 2008.

I. CLOSING OF THE MEETING

Dr. Osamu Abe, the Deputy Chief of SEAFDEC-MFRDMD on behalf of the Chief of MFRDMD expressed his sincere appreciation to everyone for their cooperation and active participation during this Meeting. Then he thanked all the participants, resource persons, observers as well as members of secretariat for making this Meeting a success. He wished everyone a safe journey home.

REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

LIST OF PARTICIPANTS

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15-17 October 2008, Kuala Lumpur, Malaysia

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2. Mr. Ku Kassim Ku Yacob
3. Mr. Mohd. Faisal Md. Saleh
4. Mr. Nadzri Seman
5. Mr. Zahari Ismail
6. Mr. Aznan Zainal
7. Mr. Rosdi Mohd Nor

REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

WELCOME REMARKS

The 3rd Regional Technical Consultation
on Research for Stock Enhancement of SeaTurtles
(Japanese Trust Fund IV Program)
15-17 October 2008, Kuala Lumpur, Malaysia

Welcome Remarks
By
Hajjah Mahyam Bt Mohd. Isa

Chief of Marine Fishery Resources Development
and Management Department (MFRDMD)
Southeast Asian Fishery Development Center (SEAFDEC)
Kuala Terengganu, Malayia

The Honourable SEAFDEC Council Director fo Malaysia
General-Director Fisheries of Malaysia; Dato' Junaidi Che Ayub,
Representative from SEAFDEC Secretariate; Ms Rujurek Bunrasaringpai,
Deputy Chief of SEAFDEC-MFRDMD; Dr. Osamu Abe,
Distinguished Participants,
Ladies and Gentlemen,

Assalamulaikum and very good morning to all of you. It is my privilege to welcome all of you to Malaysia and to wish all Muslim participants a Selamat Hari Raya Aidil Fitri. I hope you will all have a comfortable stay in Malaysia particularly in Kuala Lumpur. Allow me to record my appreciation and thanks to the Secretariat, comprising the staff of the Marine Fishery Resources Development and Management Department (MFRDMD) for their tireless and painstaking efforts in ensuring that this Regional Consultation becomes a reality.

SEAFDEC-MFRDMD Kuala Terengganu has played an active role for conducting regional research activities on conservation and management of sea turtles in Southeast Asian region. These activities include tagging, satellite telemetry study, stock identification, hatchery management study, population census and interaction between sea turtles with fisheries for reducing turtle mortality rates in the region which had been funded by the Japanese government through the SEAFDEC regular fund and recently through the Japanese Trust Fund IV Program.

For instance, a total of 12000 units of inconel tags had been distributed to SEAFDEC participating member countries for conducting tagging exercises on sea turtles from 1998 to 2006. Five unit scanners of PIT tags had also been distributed to five participating member countries namely Indonesia, Malaysia, Myanmar, the Philippines and Thailand from 2003 to 2005.

Ladies and Gentlemen,

Recently SEAFDEC-MFRDMD had conducted a satellite telemetry study of sea turtles in Malaysia, Indonesia, Myanmar and Vietnam in 2005 and 2006 and this initiative will continue until 2008. Furthermore, several countries in this region had conducted tagging and a satellite telemetry study of sea turtles at their own capacity through national and other sources of funding. Indeed, it is essential for SEAFDEC-MFRDMD and SEAFDEC-TD to gather all

researchers in the region to present their outcomes help us gain more insight and knowledge on the migration of sea turtles in the region. I believe the outcomes on tagging and satellite telemetry study will facilitate researchers to determine the migration route, foraging habitat and other biological information. These findings are very important to initiate the regional conservation and management of sea turtles.

Ladies and Gentlemen,

As we all know that, sea turtles are highly migratory reptiles and share the waters in neighboring countries. Thus positive action on regional cooperation and collaboration for conserving and managing these resources is highly needed. Therefore it is vital to understand the discreetness of their population in the region through scientific evidence such as DNA studies. SEAFDEC-MFRDMD has conducted this study under the Japanese Trust Fund IV program and the outcomes of the study as well as the findings by tagging and satellite telemetry activities will promote better conservation and management approach of these reptiles in the region.

High mortality rates among sea turtles caused by fishing operations and their activities have become a serious issue for the several decades. These global issues have been carefully discussed in meetings, seminars and conferences, however, it is high time appropriate actions be taken to introduce new approaches in fishing techniques or technologies which will reduce turtle mortality in the region. I believe that the regional department, SEAFDEC-TD has conducted several experiments in reducing turtle mortality due to fishing activities and I am sure their research would throw much light on this issue and pave the way for the conservation of turtles in this region.

I have to emphasize that a better understanding of their biology and ecology is a crucial factor. In this, a multidisciplinary and integrated approach, taking into consideration the latest and up-to-date research findings is utmost important for promoting the sustainable management of sea turtles in the region.

Ladies and Gentlemen,

I trust that this Consultation will meet its objectives in providing the latest findings on research activities of sea turtles which had been conducted by SEAFDEC participating member countries.

I have high confidence that with the presence of regional experts, scientists and researchers this Regional Technical Consultation Meeting on Research for Stock Enhancement of Sea Turtles will achieve several outstanding outcomes.

Lastly, I would like to record my appreciation and congratulations to all of you, ladies and gentlemen for making this Regional Consultation a reality.

Thank you.

REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

OPENING SPEECH

The 3rd Regional Technical Consultation
on Research for Stock Enhancement of Sea Turtles
(Japanese Trust Fund IV Program)
15-17 October 2008, Kuala Lumpur, Malaysia

Opening Address
By
Y. Bhg. Dato' Junaidi Bin Che Ayub
SEAFDEC Council Director for Malaysia
Department of Fisheries Malaysia

Representative of the Deputy Secretary General of SEAFDEC,
Representative from SEAFDEC Secretariat, Ms Rujurek Bunrasaringpai,
Chief of SEAFDEC-MFRDMD,Hajjah Mahyam bt Mohd Isa
Deputy Chief of SEAFDEC-MFRDMD, Dr. Osamu Abe
Learned and Knowledgeable Resources Persons, Professors
Distinguished Participants and Observers
Ladies and Gentlemen,

Assalamulaikum and a very good morning to all of you. On behalf of the Government of Malaysia and the Southeast Asian Fisheries Development Center (SEAFDEC) I wish you all a very warm welcome to Malaysia in general, and to this Consultation Meeting, in particular. I would like to take this opportunity to also wish a Selamat Hari Raya Aidilfitri to all Muslim participants. It is indeed a great honor for me to be here with you to officiate the opening of the 3rd Regional Technical Consultation Meeting on Research for Stock Enhancement of Sea Turtles under the Japanese Trust Fund IV Program. I wish to record my sincere appreciation and thanks to the MFRDMD for inviting me to address the participants in this important regional meeting.

Ladies and Gentlemen,

The population of sea turtles has greatly declined in many parts of the world. Some are even endangered with the possibility of extinction in a few years. Numerous factors have contributed to the decline of these reptiles. The greatest threats today are related to man and his activities. It is sad to say that until today there are still countries around the globe which allow the commercial exploitation of sea turtles for food, oil, leather and jewellery. Conservation efforts are now focused on reducing and removing these threats. In reality, conservation work does not lie principally with animals, plants and ecosystem but in dealing with humans. Although some conservation programs are already in place, the results in general have not been encouraging. Perhaps, this would be the best platform to update ourselves with new knowledge and review our efforts for more effective conservation programs.

As we all know, sea turtles are highly migratory reptiles and inhabit the waters in neighbouring countries. Thus, positive actions with regional cooperation and collaboration for conserving and managing these resources are highly needed. Therefore it is vital to understand the discreetness of sea turtle population in the region through scientific evidence such as DNA studies. SEAFDEC-MFRDMD had conducted this study under the Japanese Trust Fund IV

program and the outcome of the study, as well as the findings via tagging and satellite telemetry activities, will promote better conservation and management approaches for these reptiles in the region.

Regional cooperation and programs will provide a great boost in sea turtles protection and conservation. The need for further regional and international collaborative programs in sea turtles conservation should be strengthened and be given priority, not only in terms of proper management of sea turtles and their habitats but also in reviewing existing regional and international programs, conventions and treaties which are directly or indirectly applicable to sea turtles.

Ladies and Gentlemen,

This is the final year for implementing the Japanese Trust Fund IV Program. This program began in 2004 and will end in December 2008. One of the major activities is satellite telemetry for determining the migration route and foraging ground of these reptiles. This regional consultation will also compile the information on migration routes of various species sea turtles that had been collected by member countries. I am confident that in this RTC, participants will have the avenue to deliberate on these pertinent issues and explore the common objectives for determining the proposed sea turtles refugias and migratory routes.

Sea turtle mortality caused by indiscriminate fishing activities is a major problem throughout the world. Scientists are being challenged to introduce new environmental-friendly technology or innovation in fishing gears to curb this problem. Encouraging and convincing the longline fishermen in the region to implement the Circle Hook is one the efforts that had been made by SEAFDEC under the Japanese Trust Fund IV Program. SEAFDEC through its Training Department (SEAFDEC-TD) had implemented a regional program towards this end to reduce sea turtles mortalities.

Ladies and Gentlemen,

As these animals are shared among the countries in the region, the greatest challenge facing scientists, researchers and managers is to protect these reptiles in the open sea, especially along the migration corridor and in their foraging habitats. I believe, based on satellite telemetry information that will be presented during these two days of consultation, the migration corridor as well as foraging habitats of sea turtles in the region can be clearly mapped out. This finding will enable member countries to determine and monitor fishing activities that occur in such routes or areas. This information is essential to develop research and conservation efforts for reducing sea turtle mortality in the open sea.

SEAFDEC-MFRDMD, as the regional Department tasked with implementing research programs on the protection and conservation of sea turtles, should be given priority in the future to implement such programs. A new research program on protecting and managing the foraging habitats of sea turtles should be implemented under the Japanese Trust Fund V (2009-2012). This study will challenge scientists to come out with models of management plans which can be applied to other foraging habitats in the region. The success of such a study will depend very much on the strong cooperation and support among the member countries in the region. I believe that this is the best platform to discuss the implementation of this study. In this regard, we thank the Government of Japan for funding the many activities on sea turtles in this region through the Japanese Fisheries Agency.

Ladies and Gentlemen,

I have no doubt there would be enough food for thought to keep you busy over the next two days. Therefore, I should leave you all for now. I trust that this Consultation will meet its objectives in providing the latest findings on the research activities of sea turtles that have been conducted by SEAFDEC Participating Member Countries. I do hope these findings will help us to develop a better management, based on The Ecosystem Approach, for Sea Turtles in the region.

I would like to record my appreciation and congratulations to all of you, ladies and gentlemen for making this Regional Technical Consultation a reality. I wish you all a fruitful meeting and will await with much anticipation the conclusion and final report from you. At the same time, I hope you will take this opportunity to enjoy yourself in our fair city of Kuala Lumpur.

On that note, IN THE NAME OF ALLAH, I HEREBY DECLARE THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES AND THE MINI SYMPOSIUM, OFFICIALLY OPEN.

THANK YOU.

REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

PROGRAM AGENDA

The 3rd Regional Technical Consultation
on Research for Stock Enhancement of Sea Turtles
(Japanese Trust Fund IV Program)
15-17 October 2008, Kuala Lumpur, Malaysia

PROGRAM AGENDA

15 October 2008 (Wednesday)

AGENDA 1	**OPENING SESSION**
0830-0900	Registration of Participants
0900-0910	Welcome remarks by Chief of SEAFDEC-MFRDMD
0910-0925	Opening Address by SEAFDEC Council Director for Malaysia
Chairperson:	***Chief of SEAFDEC-MFRDMD***
0925-0930	Adoption of Agenda
AGENDA II	**OVERVIEW ON JAPANESE TRUST FUND IV PROGRAM 2004 -2008**
0930-1000	Overviews on Regional Activities of Japanese Trust Fund IV Program 2004-2008 (by MFRDMD Technical Coordinator of JTF IV)
1000-1030	Photography Sessions, Refreshments & Press Conference
AGENDA III	**COUNTRY REPORT ON TAGGING AND SATELLITE TELEMETRY STUDY** **Resource Persons:** **Prof Dr. Chan Eng Heng & Dr. Sukarno bin Wagiman**
1030-1045	Report on satellite telemetry and tagging activities in Brunei Darussalam
1045-1100	Report on satellite telemetry and tagging activities in Cambodia
1100-1115	Report on satellite telemetry and tagging activities in Indonesia
1115-1130	Report on satellite telemetry and tagging activities in Peninsular Malaysia
1130-1145	Report on satellite telemetry and tagging activities in Sabah
1145-1200	Report on satellite telemetry and tagging activities in Sarawak
1200-1215	Report on satellite telemetry and tagging activities in Myanmar
1215-1230	Report on satellite telemetry and tagging activities in The Philippines
1230-1300	Discussion
1300-1400	Lunch

Chairperson: ***Deputy Chief SEAFDEC-MFRDMD***

1400-1415	Report on satellite telemetry and tagging activities in Thailand
1415-1430	Report on satellite telemetry and tagging activities in Vietnam
1430-1445	Report on satellite telemetry activities from WWF Malaysia (Melaka)
1445-1500	Report on satellite telemetry activities from WWF Malaysia (Terengganu)
1500-1530	Report on satellite telemetry activities from Japan (West Papua) by Dr. Hiroshi Minami
1530-1600	Discussion
1600-1615	Refreshments

AGENDA IV **STOCK IDENTIFICATION OF SEA TURTLES IN THE SOUTHEAST ASIAN REGION**
Resource Person: Dr. Yosni Bakar

1615-1645	Regional analysis on stock identification of green turtles and hawksbill turtles in the Southeast Asian region (by MFRDMD Technical Officer)
1645-1715	Discussion

AGENDA V **DETECTION ON MULTIPLE PATERNITIES OF GREEN TURTLES**
Resource Person: Dr. Yosni Bakar

1715-1730	Results on the study of multiple paternities of green turtles (by MFRDMD Technical Officer)
1730-1745	Discussion
2000-2200	Welcome dinner hosted by SEAFDEC-MFRDMD

16 October 2008 (Thursday)

Chairperson: ***Dr. Sukarno bin Wagiman***

AGENDA VI **INTERACTION BETWEEN SEA TURTLES AND FISHERIES**
Resource Persons:
Mr. Nicolas J. Pilcher & Prof Dr. Chan Eng Heng

0900-0930	Results on the project on interaction between sea turtles and fisheries (by Dr. Worawit Wanchana)
0930-0950	Case studies on interaction between sea turtles and fisheries in Malaysia (by Mr. Zulkifli Talib)
0950-1020	Case studies on interaction between sea turtles and fisheries in Japan by (Dr. Hiroshi Minami)
1020-1040	Discussion
1040-1100	Refreshments

AGENDA VII	**MIGRATION ROUTE, ECOLOGICAL INFORMATION OF FORAGING HABITAT AND INTERACTION WITH FISHERY ACTIVITIES** **Resource Persons:** **Dr. Hiroshi Minami & Mr. Nicolas J. Pilcher**
1100-1115	Report from Brunei Darussalam
1115-1130	Report from Cambodia
1130-1145	Report from Indonesia
1145-1200	Report from Peninsular Malaysia
1200-1215	Report from Sabah
1215-1230	Report from Sarawak
1230-1245	Report from Myanmar
1245-1300	Report from The Philippines
1300-1430	Lunch
1430-1445	Report from Thailand
1445-1500	Report from Vietnam
1500-1530	Results on the information collection on sea turtle interaction with fishing operation (by Dr. Worawit Wanchana)
1530-1600	Discussion
1600-1615	Refreshments

Chairperson: ***Chief of SEAFDEC-MFRDMD***

AGENDA VIII	**JAPANESE TRUST FUND V PROGRAM**
1615-1645	Presentation on Japanese Trust Fund IV (2009) & Japanese Trust Fund V Program by Deputy Chief of SEAFDEC-MFRDMD
1-1715	Discussion

<u>17 October 2008 (Friday)</u>

Chairperson ***Deputy Chief of SEAFDEC-MFRDMD***

AGENDA IX	**ADOPTION OF THE REPORT**
1000-1200	Presentation of the Third TCM report (by Chief of Rapporteur)
AGENDA X	**CLOSING**
1200-1210	Closing Remarks by Deputy Chief of SEAFDEC-MFRDMD
1210	Lunch

REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

OVERVIEW ON JAPANESE TRUST FUND IV PROGRAM

OVERVIEW ON REGIONAL TAGGING AND SATELLITE TELEMETRY STUDY IN THE SOUTHEAST ASIAN REGION

Syed Abdullah Syed Abdul Kadir & Zulkifli Talib
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Introduction

Since 1996, SEAFDEC-MFRDMD had been appointed as Lead Department for the Implementation on Research, Conservation and Management of Sea Turtles in the Southeast Asian Region. The project was supported and funded by the Japanese Government through the SEAFDEC Secretariat in Bangkok, Thailand. Sea Turtles Tagging Program and Satellite Telemetry Studies in the Southeast Asian Region was conducted under three programs; (i) SEAFDEC Regular Fund For Conservation and Managements of Sea Turtles in the Southeast Asia (1996-2000), (ii) Japanese Trust Fund 1 For Conservation and Managements of Sea Turtles in the Southeast Asia (2001-2003) and (iii) Japanese Trust Fund IV For Research On Stock Enhancement of Sea Turtles in the Southeast Asia (2004-2008).

Objectives

The objectives of this program are as follows:

i. To initiate and promote regional sea turtles tagging in the Southeast Asian region.
ii. To estimate female population at selected nesting beaches.
iii. To obtain regional biological information e.g. migration routes, foraging habitats, nesting behavior, growth rates and etc.

Program/Activities

1. Conservation and Management of Sea Turtles in the Southeast Asia from 1996 to 2000.

Under this program, SEAFDEC-MFRDMD successfully conducted the First Meeting on Regional Tagging Program and Data Collection on Marine Turtle from 21 to 23 December 1997 in Kuala Terengganu, Malaysia. Following this meeting SEAFDEC-MFRDMD had established the regional Tagging Code of Sea Turtles in the Southeast Asia. Each country has its own code-number and series; Brunei DS (BN), Cambodia (KH), Indonesia (ID), Malaysia (MY), Myanmar (MM), The Philippines (PH)**,** Thailand (TH) and Vietnam (VN). In 1998 SEAFDEC-MFRDMD had distributed inconel tags to several SEAFDEC participating member countries. The distribution on inconel tags are shown in Table 1.

Table 1: The distribution of inconel tags to SEAFDEC member countries in 1998

Country	No. of Tags	Series Number
BN : Brunei	200	BN0001-BN0200
ID : Indonesia	2000	ID0001-ID2000
MY : Malaysia	2000	MY0001-MY2000
	1000	MY(S)0001-MY(S)1000
	1000	MY(Sa)0001-MY(sa)1000
TH : Thailand	500	TH0001-TH0500
	500	TH(P)0001-TH(P)0500
PH : Philippines	1000	PH0001-PH1000
VN : Vietnam	300	VN(N)0001-VN(N)0100
		VN(C)0001-VN(C)0100
		VN(S)0001-VN(S)0100

In this regard, SEAFDEC-MFRDMD organized the Regional Training Course on Marine Turtle Research and Conservation from 24-30 August 1998 in Kuala Terengganu, Malaysia. Technical Officers from SEAFDEC participating member countries, namely, Brunei Darusslam, Indonesia, Malaysia, Myanmar, The Philippines, Thailand and Vietnam participated in this training workshop.

2. Japanese Trust Fund I (2001-2003): Conservation and Management of Sea Turtles in Southeast Asia"

As a result of this program, SEAFDEC-MFRDMD has continued to distribute inconel tags to the participating member countries. By the end of year 2003, SEAFDEC had distributed a total of 11,600 unit of inconel tags to the member countries. The details are shown below in Table 2.

Table 2: The distribution of inconel tags to SEAFDEC member countries (1998-2003)

Country	No. of Tags	Series Number
Brunei Darussalam	300	BN0001 - BN0300
Cambodia	300	KH0001-KH1000
Indonesia	2,000	ID0001-ID2000
Peninsular Malaysia	2,000	MY0001-MY2000
Sabah	1,000	MY(S)0001-MY(S)1000
Sarawak	1,000	MY(SA)0001-MY(SA)1000
Myanmar	300	MM0001-MM300
The Philippines	2,000	PH0001-PH2000
Thailand	2,100	TH0001-TH11100
		TH(P) 0001-TH (P) 1000
Vietnam	600	VN(N)0001-VN(N)0200
		VN(S)0001- VN(S)0200
		VN(C)0001-VN(C)0200

Passive Integrated Transponder (PIT) tags were also introduced in the year 2003 of which SEAFDEC-MFRDMD distributed 25 units of PIT tags and scanners to Malaysia, Myanmar, the Philippines and Thailand. SEAFDEC-MFRDMD published the Field Guide on Tagging of Sea Turtles and distributed it to the participating member countries. This guidebook aims to assist member countries to conduct the tagging activities according to proper techniques.

3. Japanese Trust Fund IV (2004-2008): Research for Stock Enhancement of Sea Turtles in the Southeast Asia.

From 1998 to 2007, SEAFDEC-MFRDMD continued to support member countries to conduct tagging activities of sea turtles. In this regard, a total of 14,600 inconel tags had been distributed to SEAFDEC participating member countries. The details on distribution of inconel tags are shown in Table 3:

Table 3: The distribution of inconel tags to SEAFDEC member countries (1998-2007)

Country	No. of Tags	Series Number
Brunei Darussalam	300	BN0001 - BN0300
Cambodia	300	KH0001-KH1000
Indonesia	2,600	ID0001-ID2000
Peninsular Malaysia	2,600	MY0001-MY2000
Sabah	1,000	MY(S)0001-MY(S)1000
Sarawak	1,000	MY(SA)0001- MY(SA)1000
Myanmar	300	MM0001-MM300
Philippines	2,600	PH0001-PH2000
Thailand	2,700	TH0001-TH11100 TH(P) 0001-TH (P) 1000
Vietnam	1,200	VN(N)0001-VN(N)0200 VN(S)0001- VN(S)0200 VN(C)0001-VN(C)0200

2. SEAFDEC'S Satellite Telemetry Study In Selected Member Countries

Introduction

Information on the long distance migration and foraging ground of turtles is very important to consider the reduction of incidental catch and this information provides the ecological complement for the population identification by the mtDNA method being conducted by SEAFDEC. The satellite transmitter was deployed at selected nesting sites in SEAFDEC member countries where this experiment has not been done before or has not provided much information.

Studies on turtle migration have been conducted by numerous researchers and Platform Transmitter Terminal (PTT) was used as the main turtle locator. The objectives of this study were to find out the migration route of the turtles and the location of the foraging ground.

Materials and Method

Locations and Species

The locations and species of sea turtle used for this study are presented in Table 1. These sites were chosen because compared to other sites in SEAFDEC member countries, there was a lack of research on satellite tracking done there.

Table 1 Locations and species for the satellite telemetry study

Country	Site	No. of PTT	Serial Number	Species	Implementation date
Malaysia	Upeh Island	1	64016	Hawksbill	16/06/2006
Indonesia	Sangalaki Island	1	25402	Green	16/09/2006
Myanmar	Kadongalay Island	1	25403	Olive Ridley	03/01/2007

Platform Transmitter Terminal (PTT)

Three Kiwisat Argos PTT were used to tag the turtles. The PTT were manufactured by Sirtrack and the satellite service was provided by ARGOS. The data from ARGOS were relayed through the ARGOS website. The migration routes of the turtles were plotted using Maptool.

Results

Malaysia

The Hawksbill turtle that was attached with a PTT was released on 16th June 2006 after it nested for the third time. It was first detected in the vicinity of Upeh Island where it nested two more times before it started moving southward on 6th July. The turtle arrived at Riao archipelago on 20th July. The turtle has been observed to be in the vicinity of the Riao archipelago until now.

Another an adult female Hawksbill turtle with a size of CCL: 79.0 cm and CCW: 68.0 cm and weighing 47 kg was released at Pengkalan Balak, Melaka nesting beach on 14 July 2007. Since 13 August 2007 till now, this turtle has been detected in the inter-nesting habitat.

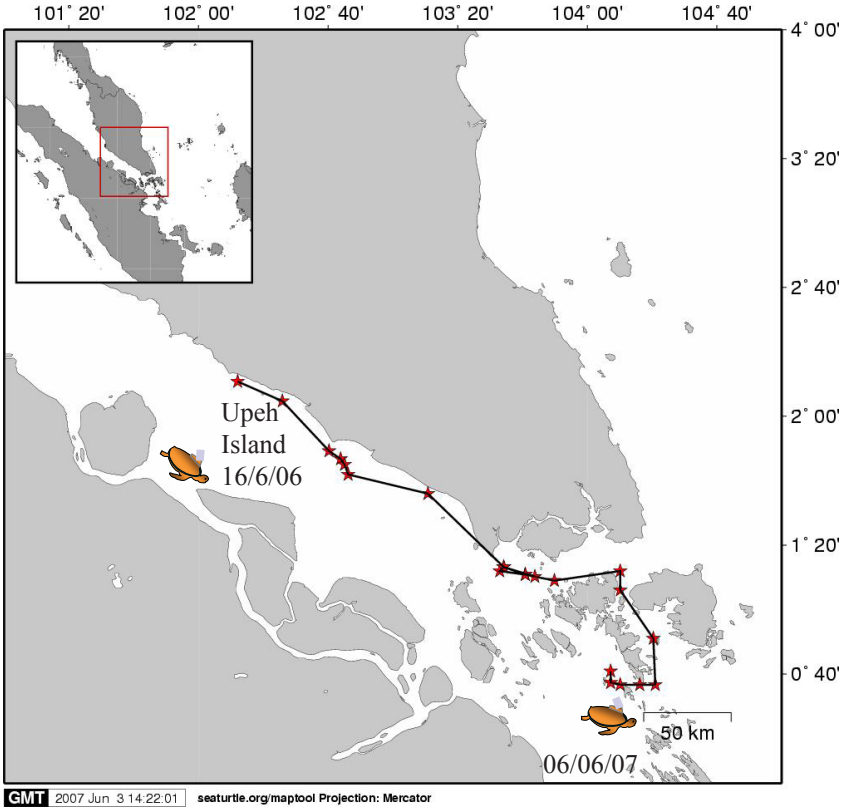

Fig. 1 Migration route of hawksbill turtle, ID 64016 from Upeh Island to Riau archipelago.

Fig. 2 Migration Route of Hawksbill Turtle, ID 64016 from Upeh Island To Linggi Waters Within One Duration in Nesting Season

Indonesia

The Green turtle that was attached with a PTT was released on 16th September 2006 after it nested for the third time. It immediately headed north towards Sabah after it was released. It did not nest again. It reached Southeast of Sabah on 30th of September and stayed in that area until 30th March 2007 when the PTT stopped sending signals.

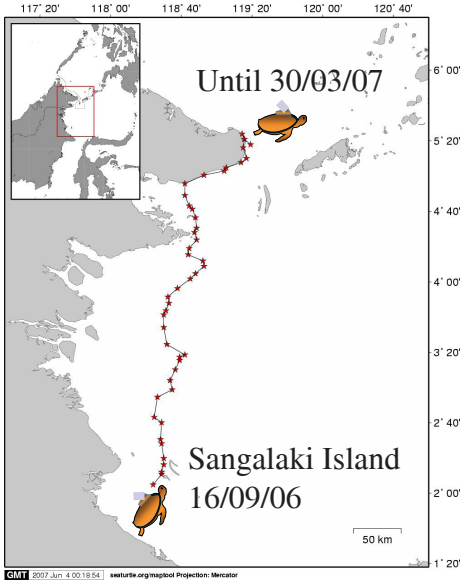

Fig. 2 Migration route of a green turtle ID 25402 from Sangalaki Island.

Myanmar

The Olive Ridley turtle that was fitted with a PTT was released on 3rd January 2007 after it nested for the first time. It swam in the vicinity of Kadongalay Island until 14th January 2007 when the PTT stopped transmitting signals.

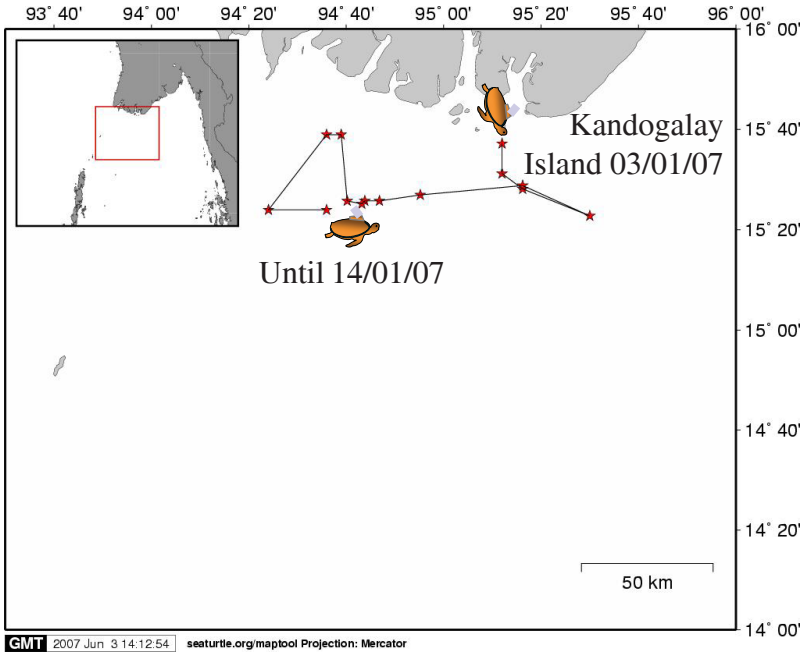

Fig 3 Movement of Olive Ridley turtle, ID 25403 from Kadongalay Island

Discussion

This is the first study on movement of sea turtles using the PTT conducted by SEAFDEC even though other agencies (SEASTAR2000, WWF, NOAA) had conducted these activities in collaboration with individual SEAFDEC member countries. The results of the study conducted by these agencies had provided valuable information on the movement of the sea turtles from the Southeast Asian region.

The results from the study conducted by SEAFDEC only confirm the results conducted by other agencies. The Green turtle that was released from Upeh Island finally ended up in the Riao archipelago, the same destination for the Hawksbill turtle that was used for the satellite telemetry study conducted by the WWF. Another Green turtle used in the study by the Department of Fisheries Malaysia also end up in Riao archipelago. From this evidence it can be concluded that the Riao archipelago is one of the foraging grounds of sea turtles.

The Green turtle from Sangalaki Island, Indonesia headed in the direction of Southeast of Sabah, an area which is also the destination of other turtles from other satellite telemetry studies. The area of the Southeast can also be concluded as one of the foraging grounds of sea turtles.

As for the Olive Ridley turtle released from Kadongalay Island, Myanmar, it was suspected that the turtle was caught in a fishing net. Kadongalay Island sea area is heavily fished by fishermen using set net and also trawlers.

Finally, the study by SEAFDEC confirms the migratory route and foraging grounds of sea turtles from this region as conducted by other agencies. More studies need to be done especially on the Straits of Malacca, Andaman Sea and also Indian Ocean where this study is still lacking.

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REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

COUNTRY REPORT ON TAGGING AND SATELLITE TELEMETRY STUDY

SATELLITE TELEMETRY AND TAGGING ACTIVITIES OF SEA TURTLES IN BRUNEI DARUSSALAM

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Introduction

Brunei Darussalam is a small coastal state in northwestern Borneo with a land area of 5,765 sq. km and has a total of 130 km coastline bordering the South China Sea. It shares a common border with the East Malaysian State of Sarawak and the coastline continues from the western end of the state into Sarawak. A long stretch of sandy beaches interrupted only by a few rocky headlands dominates the coastline of Brunei Darussalam. Made up of mainly fine-grained sand, the beaches generally provide suitable nesting sites for the female turtles.

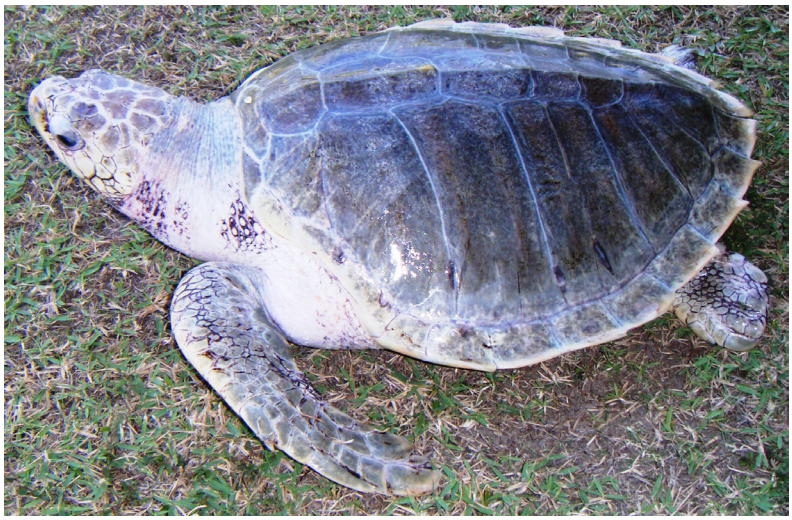
Sea turtles have been around over 200 million years (they are around the same time as dinosaurs). They are unique creatures that can breathe and nests on land but spend most of their life is spent in the water. Sea turtles are valued by people around the world. For some communities they are considered as a symbol of longevity, fertility, strength and protection from harm. They are often a valuable eco-tourism attraction. In spite of this, sea turtle populations are declining due to hunting, disturbance of nesting habitats, marine pollution, predation and incidental catches in fishing gears.

In order to prevent the extinction of sea turtles in Brunei Darussalam, the Fisheries Department through the Marine Eco System and Conservation Section is doing several management and conservation programs such as :-

- Landing Sites Monitoring Program
- Eggs Hatching Program
- Hatchlings Release Program
- Tagging Program
- Public Awareness Program
- Turtle Volunteers Program

The most commonly seen turtles in the waters of Brunei Darussalam are those of the Olive Ridley Turtle or Penyu Lipas (*Lepidochelys olivacea*), Hawksbill Turtle or Penyu Sisik (*Eretmochelys imbricata*) and Green Turtle or Penyu Kangkam (*Chelonia mydas)*.

Unconfirmed reports have also indicated that Leatherback Turtles or Penyu Belimbing (*Dermochelys coriacea*) have been sighted near oil platforms (Elkin 1991). Olive Ridley turtle is the most common among all the turtles landing in beaches of Brunei Darussalam followed by Hawksbill turtle and Green turtle.



Scientific name	:	*Lepidochelys olivacea*
Family	:	*Cheloniidae*
Common name	:	Olive Ridley Turtle
Vernacular name	:	Penyu Lipas
Type	:	Sea Turtle

Scientific name	:	*Eretmochelys imbricata*
Family	:	*Cheloniidae*
Common name	:	Hawksbill Turtle
Vernacular name	:	Penyu Sisik
Type	:	Sea Turtle

Scientific name	:	*Chelonia mydas*
Family	:	*Cheloniidae*
Common name	:	Green Turtle
Vernacular name	:	Penyu kangkam
Type	:	Sea Turtle

Tagging studies

Monitoring activities are carried out during the turtle nesting season in the month of November to June involving the staff of the Marine Eco System and Conservation Section of the Brunei Darussalam's Fisheries Department and turtle volunteers.

The nesting season in Brunei Darussalam coincides with the North East Monsoon season. The nesting sites are distributed along the coast of Pulau Muara Besar, Pulau Pelompong, Muara beach, Meragang beach, Seri Kenangan beach, Danau beach, Sungai Liang beach, Lumut beach, Anduki beach, Seria Terminal and Panaga beach are known as turtle nesting grounds. Since 1999 a total of 255 turtles have been recorded nesting along the coast and beaches of Brunei Darussalam.

The tagging program in Brunei Darussalam started in 1999 under the Japanese Trust Fund Program. However a lack of manpower in the Fisheries Department makes it difficult to do full time monitoring. In view of this, the Department has trained several volunteers and local eggs collectors to do tagging exercises. With this joint effort and partnership, it is hoped that nesting turtle can be tagged and vital information recorded.

The Department received 300 inconel tags from 1998 until 2002 and since then a total of 53 turtles have been tagged. Olive Ridley (21), five turtles tagged during turtle nesting; Hawksbill turtle (23); four turtles donated from fishermen and 19 from reared turtle age 11 month to two years old; and the green turtle (8), six obtained from fishermen, one turtle from KP Tenggiri (Fisheries Research Vessel) and one from captivity.

Summary on tagging data

Species: Green Turtles

No	Year	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubate	Total of hatchlings release
1	1999	1	0	0	0	0
2	2001	1	0	0	0	0
3	2002	1	0	0	0	0
4	2006	1	0	0	0	0
5	2007	3	0	0	0	0

Species: Hawksbill Turtles

No	Year	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubate	Total of hatchlings release
1	2001	14	0	N/A	97	65
2	2002	2	0	159	159	87
3	N/A	6	N/A	N/A	N/A	N/A
4	2006	3	0	0	0	0
5	2007	1	0	0	0	0

Species: Olive Ridley

No	Year	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubate	Total of hatchlings release
1	1999	1	0	N/A	N/A	N/A
2	2001	3	0	935	935	655
3	2002	4	1	2,678	2,678	2,097
4	2003	2	1	1,292	1,292	905
5	2004	1	0	1,400	1,400	806
6	2006	1	0	302	302	212
7	2007	8	0	110	110	103

Summary on tag recovery (remigration interval)

Species : Olive Ridley

No	Date of tagged and released	Date of tag recovery (remigration)*	Remigration interval (years)
1	17 February 2002 (Muara Beach)	13 February 2004 (Meragang Beach)	2 years

Stock size of nesting population

N : (Estimated) number of nests per year : 10
C : Estimated number of cluch per female/year : 2
F : Estimated number of females to nest per year = (N/C) : 5
I : Average remigrating interval in year = 2
S : Estimated stock size of nesting females = (5 x 2) = 10

Satellite Telemetry studies

Unfortunately, Brunei Darussalam has not had the opportunity to do a satellite telemetry study yet. However satellite telemetry that had been done in other countries indicated that some turtle populations do come to Brunei Bay area for grazing.

SATELLITE TELEMETRY AND TAGGING ACTIVITIES OF SEA TURTLES IN CAMBODIA

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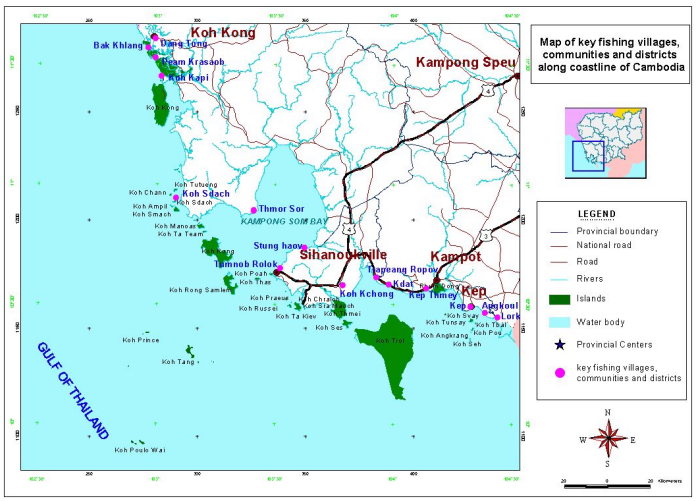
Introduction

Cambodia is a tropical country and it has a coastline of 435 km located in the Gulf of Thailand, extending from the Vietnamese border in the Southeast to the Thai border in the Southwest. There are four provinces/municipalities (Map) located along this coastline namely Koh Kong, SihanoukVille, Kampot and Kep. Five species of sea turtle have been recorded in Cambodia, Olive Ridley turtles (*Lepidochelys olivacea*), Loggerhead turtles (Caretta caretta), Green turtles (*Chelonia mydas*), Hawksbill turtles (*Eretmochelys imbricata*) and Leatherback turtles (*Dermochelys coriacea*).

Cambodia and other countries in the region and sub-region have ratified several international conventions and MoUs involved in sea turtle conservation and management: CITES, Biodiversity Convention and ASEAN's MoU on sea turtle conservation and protection. After being a member of CITES, Cambodian's sea turtle have been protected and conserved since 1997. Scientific research such as tagging began after the training/workshop was held from 2 to 4 September 2002 although the conservation was initiated after becoming the CITES's member. During the workshop SEAFDEC Malaysia sponsored 3000 inconel tags and six applicators to the Department of Fisheries.

During the Regional Technical Consultation on "Finalization of Implementation Plan on Research for Stock Enhancement of Sea Turtles" from 25 to 26 April 2005, the SEAFDEC member countries had agreed to conduct the study on population genetic study of green turtles (*Chelonia mydas*) and Hawksbill turtles (*Eretmochelys imbricata*) in the Southeast Asian region. Among twenty rookeries selected for collecting the tissue samples covering the entire Southeast Asian countries, Cambodia was chosen as one of the rookeries for the study. Green turtle tissue samples collection started in 2004 and ended in 2006 while Hawksbill began in 2006 and ended in 2008.



Map: Key fishing villages, communities and districts along the coastline of Cambodia

Summary of tagging studies

Inconel tags obtained from SEAFDEC Malaysia were used to tag the edge of the turtle's front flippers, both left and right side. The inconel tags were stamped with the code KH, mean Khmer, in the front and a four-digit number. Provincial/Municipality fisheries officer were asked to help in the tagging activities with the explanation and research materials provided such as record table of sea turtle tag and tag recovery (Annex1), sea turtle identification (Annex2) and turtle measurement and tagging (Annex3). In addition, inconel tags were given out to the provincial/ municipality fishery officer such as:

- Kep municipality : KH0101 to KH0300
- Kampot province : KH0301 to KH0500
- Sihanoukville : KH0501 to KH0700
- Koh Kong province : KH0701 to KH0900

Regarding the tissue sample, fishermen who were experienced in collecting turtle eggs were selected to provide valuable information. Spawning sites of green turtles from the interview were selected for observation.

NESTING GROUND AND NESTING SEASON

In Cambodia, sea turtles lay their eggs from September to April, especially, during the full moon of October and December (Try, 2002). In fact, in the middle of September 2002, a hawksbill turtle was reported to have landed on the beach at Koh Ses, Sihanoukville, to lay its eggs (Fishermen, pers. comm.).

Old fishermen reported that over the last 40 years, there have been many nests at Koh Ses. Recently one hawksbill turtle has been sighted at a sandy beach of Koh Ses for laying its eggs but unfortunately the female turtle was killed by military on the island before a fishery officer could contact them. Over the last ten years, some nests of sea turtles have been seen at Koh Tunsay but the actual number of nests is not known.

Old fishermen said that they have collected eggs from October to February. Before 1988 they used to collect turtle eggs at Koh Thmey and Koh Ses and before 1993, they collected the eggs at a sandy beach of Oh Chheuteal (12 nests per year), Koh Anloung (ten nests per year), Koh Rong (12 nests per year), Brorlaymeas (seven nests per year) and Thmor Kropeur (three nests per year).

Other sea turtle nesting grounds are sandy beaches of Chke Prous, Tanun and Trapeang Roung of Koh Kong province and sandy beaches of Koh Thas, Koh Rong, Koh Rong Sanleum, Koh Tang and Koh Pring (Tana, 1997). Of these sandy beaches, some islands have been disturbed by human activities, thus causing turtles to move to other beaches where there are no disturbances (Longdy, 2002). Recently, according to Try (2003), sea turtle nesting grounds have been identified at Koh Rong, Koh Rong Sanleum, Koh Tang, Koh Pring, Koh Poulewai, Koh Thmey, Koh Tonsay, Koh Ses, Koh Dong, Poy Sa Reur and Brorlaymeas. Moreover, Koh Krass has been identified as nesting ground of Hawksbill turtle.

HABITATS OF GREEN TURTLES

The on land interview with residents around the selected sites indicated that green turtles were a well-known species which were found all year round in their area. Furthermore, green turtles

have been considered as an abundant species in the Cambodian sea. On the other hand, green turtles have also been found in broad expanses of shallow, sandy flats covered with seagrass or near seagrass beds around Phnom Dong, Rolous and Angkoul areas which were the largest areas among all other areas in which an underwater research had been conducted. However, information related to a specific feeding ground… (editor's note: sentence here is incomplete)

Summary on tagging

Tagging activities have started in Cambodia since September 2002, during a training/workshop on "Sea Turtle Research, Biology and Conservation in Cambodia" which was held in Sihanoukville. Since that time 28 sea turtles have been tagged (reported during technical consultation held in Kuala Terengganu, Malaysia on 25-26 April 2005). The Fisheries Administration (FiA) has implemented sea turtle tagging along the coast of Cambodia. FiA, at central level, has proposed that the provincial fishery officer, at the local level, provide awareness and extension to the local people regarding turtle conservation and tagging activities. As result, the number of sea turtles tagged increased as shown n Table 1. During the periods of this project, some turtles were given to the local fisheries officer for scientific research or tagging purposes such as:

Kep municipality: located 173 km from Phnom Penh in the southwest part of the country and has coastline of 27 km. Kep has extensive seagrass beds in shallow water, 2 or 3 meters in depth. It plays an important role, both as a habitat and food for marine life, particularly sea turtles, dugong and other species. In fact, during the implementation of the project, local fisheries officers did not obtain any turtles from the fishermen, at landing sites or markets; therefore, in Kep municipality, there was no possibility found for turtle tagging.

Kampot province: located in the southwestern part of Cambodia with a total coastline of 67 km. It consists of eight districts and 92 communes. Three of these districts: Kompong Bay, Kompong Trach and Kampot are located in the coastal areas with 26 villages. In Kampot province, some fishermen have been reported and given turtles to the fisheries officer. Among the turtles provided, some are died turtle (two green turtles and two hawksbill turtles) and some were tagged and released (three green turtles and two hawksbill turtles). The two hawksbill turtles tagged were caught by surrounding net at Phnom Dong and Prek Tnout. Among three green turtles tagged, two turtles were caught by trawl fishing at Karang Island and in front of Kep Thmei while another turtle was caught by crab gillnet at Thmor Rung.

Sihanoukville: located 224 km from Phnom Penh. In this municipality, two green turtles have been caught and tagged. One green turtle was caught by stingray hook and line by a fishery community's member of Prey Nob II on 05 of February 2006. Another green turtle was gotten from the fish middlemen who bought it from fishermen using trawling fishing about two Kilometers in front of Dong Island on 08 of March 2006.

Koh Kong province: located 271 km from Phnom Penh in the south-western part of Cambodia with coastline of 237 km. During the running of the project, turtles could not be found for tagging.

So far, Department of Fisheries has not received any information of the turtles with inconel tags. Although information about sea turtles tagged has not yet been obtained, it is hoped that more turtles will be tagged and in collaboration with local fishermen and neighboring countries, the tagged turtles will be found and recorded.

Table 1. Turtles tagged with Inconel before release

Nº	Date	Species	Released Area	Inconel Code		Length (cm)	Width (cm)	Weight (Kg)
				Left	Right			
01	04-09-02	Green turtle	Koh Rong Sanleom	KH0001	KH0002	89	81	92
02	04-09-02	Green turtle	Koh Rong Sanleom	KH0003	KH0004	90.5	84.2	88
03	25-10-02	Green Turtle	Kampot province	KH0094	KH0099	67	52	57
04	21-02-03	Hawksbill turtle	Koh Tor Toeung (Koh Kong)	KH0006	KH0007	70.20	61.5	35
05	24-02-03	Green turtle	Koh Krasar (Koh Kong)	KH0008	KH0009	42	40	7
06	25-02-03	Hawksbill turtle (*)	Poy Lamthean (Koh Kong)			30	25	2.4
07	30-10-03	Green turtle	Prek Ampil (Kampot)	KH0010	KH0011	106	91	145
08	07-11-03	Green turtle	Prek Ampil (Kampot)	KH0013	KH0014	44	42	7.6
09	18-12-03	Hawksbill turtle	Koh Ses	KH0015	KH0016	73.2	67	45
10	03-01-04	Green turtle	Koh Rong Sanleom	KH0017	KH0018	102	87	114
11	11-01-04	Hawksbill turtle	Koh Rong Sanleom	KH0019	KH0020	48	42.3	19.5
12	28-04-04	Hawksbill turtle	Koh Krass	KH0021	KH0022	81	75.7	60
13	10-05-04	Hawksbill turtle	Koh Onderk	KH0023	KH0024	87	76	66
14	18-05-04	Green turtle	Koh Tang	KH0025	KH0026	65	50	53
15	29-05-04	Hawksbill turtle	Koh Dong	KH0027	KH0028	78.6	68	51
16	06-06-04	Green turtle	Kbal Romeas	KH0029	KH0030	92.4	78.9	88
17	29-06-04	Green turtle	Koh Karang	KH0031	KH0032	87	80	75
18	16-07-04	Green turtle	Koh Tunsay	KH0033	KH0034	64	50	54
19	20-08-04	Green turtle	Koh Sdach	KH0035	KH0036	66.5	50.2	56
20	03-10-04	Hawksbill turtle	Thmar Anteas Banh	KH0037	KH0038	67	58	33
21	21-10-04	Green turtle	Koh Dong	KH0039	KH0040	68.7	53.1	61
22	06-11-04	Hawksbill turtle	Koh Angkrang	KH0041	KH0042	50	43	20

23	30-11-04	Hawksbill turtle	Kbal Romeas	KH0043	KH0044	34	27	7.2
24	26-12-04	Green turtle	Koh Krass	KH0045	KH0046	84	76	71
25	08-02-05	Green turtle	Thmar Kandal	KH0047	KH0048	70	54	62
26	05-03-05	Green turtle	Koh Khteas	KH0049	KH0050	45	42	9
27	16-03-05	Hawksbill turtle	Phoum Ta Ang	KH0051	KH0052	73	62	39
28	26-03-05	Green turtle	Kilodapi	KH0053	KH0054	87	81	79
29	07-04-05	Green turtle	Koh Karang	KH0055	KH0056	85	78	72
30	20-12-05	Hawksbill turtle	Phoum Dong	KH0301	KH0302	85	77	62
31	30-01-06	Hawksbill turtle	Prek Thnout	KH0303	KH0304	70.5	65	42
32	22-03.06	Green Turtle	Treuy Koh	KH0305	KH0306	47	45	14
33	29-03-06	Green Turtle	Kep Tmey	KH0307	KH0308	57	53	28
34	31-03-06	Green Turtle	Koh Karang	KH0309	KH0310	45	43	10
35	05-02-06	Green Turtle	Prek TorTung	KH0503	KH0504	70	64	38
36	08-03-06	Green Turtle	Koh Dong	KH0673	KH0674	95	80	90
37	01-08-06	Loggerhead (F)	West of Phnom Dong	KH0311	KH0312	67	59	34
38	30-08-06	Green turtle (*)	Kampot					
39	09-11-06	Loggerhead (F)	Changhon Village	KH0313	KH0314	100	87	108
40	09-11-06	Loggerhead (M)	Changhon Village	KH0315	KH0316	85	73	64
41	09-11-06	Loggerhead (F)	West of Phnom Dong	KH0317	KH0318	48	43	11
42	07-09-07	Green Turtle	Changhon Village	KH0319	KH0320	50	45	11
43	23-12-07	Green Turtle	Prek Thnout	KH0321	KH0322	61	55	30
44	14-01-08	Hawksbill turtle	Kep Tmey	KH0323	KH0324	48	42	18.7
45	10-05-08	Green Turtle	Prek Ampil	KH0325	KH0326	62	49	51.5
46	02-09-08	Hawksbill turtle	Phoum Dong	KH0327	KH0328	76.5	65	48

Sea turtle landing survey and tissue samples

As proposed during the technical consultation, Sihanoukville area is a preliminary site selection for turtle landing survey and tissue samples. Sihanoukville is one among four provinces/ municipalities along coastal areas and is one of the most popular tourist destinations besides Phnom Penh and Siem Reap. It is prioritized in the first phase as an area for tourism development because it is well-known as its natural characteristics such as good and long beaches, fresh air, transparent sea water and abundance of coral reefs in some islands.

Today, some islands in Sihanoukville are being developed and more people are migrating to live there, thus turning turtles away from nesting on these islands. For instance, Tres Island which used to be known as the island where turtles came to lay their eggs has currently lost its turtle nesting attraction after a house was constructed by the beach. Similarly, Dong Island recognized as a spawning ground of turtles saw fewer and fewer turtle landings after the island was developed by a high ranker who constructed a building for his relaxation. However, some islands are still in good condition and propitious for turtles to lay their eggs such as the sandy beaches of Thas Island, Ses Island, Russey Island, Thmey Island, Rong Island, Tang Island, Polovai Island. Tang Island and Polavai Island are far from the bay; therefore, five islands were chosen for turtle laying eggs observation.

Although Sihanoukvill still has some islands for turtle spawning but during the observation at the five sandy beaches of Thas Island, Ses Island, Russey Island, Thmey Island and Rong Island, turtles do not come to lay eggs because it is not their peak period of the spawning season. As fishermen informed, turtles come to lay eggs, mostly, during the full moon of October to December and rarely during January to March. In addition, spawning ground observation in each island was only two days; thus it may not have been the best time to catch the turtles in action.

1. Summary on tag recovery (remigration interval)

Sea turtles are known to migrate for long distances between their feeding grounds and nesting sites during their adult lives. From the data provided by-catch owing to stingray hooks and line, it is known that green turtles and hawksbill turtles are abundant and are caught in large numbers around sea grass sites. Around 100-120 sea turtles, not identified by species, are caught per year in Kep municipality (Fishermen, pers. comm.). According to Try (2003), islands such as Kilodapi Village, Kbal Romeas, Koh Rong, Koh Rong Sanleum, Koh Khteas, Koh Ses, Koh Polowai, Koh Thmey, Koh Tunsay, Koh Po, Koh Tbal, Koh Dong, Koh Preah, Koh Pring, Koh Tang, Koh Sdach, Koh Krass, Thmar Rieng, Thmar Kandal and Thmar Anteas Banh have been identified as sites for observing sea turtles, again with no reference to a particular species of sea turtle.

Green turtles can be seen at Koh Khteas, Koh Dong, Kilodapi, Kbal Romeas of Kampot province, eastern part of Koh Karang of Kep municipality and Thmar Rieng, Thmar Kandal and Thmar Anteas Banh of Koh Kong province. Moreover, two green turtles were caught accidentally by stingray hooks and line at Koh Krass in Koh Kong province (late August 2002). These turtles were released during the workshop on sea turtles research, biology and conservation in Cambodia from 2-4 September 2002 in Sihanoukville. Before being released those turtles were weighed and tagged and one of them had a PTT attached to her carapace. The larger specimen was a female weighing 92 kg. It was tagged with inconel with Cambodia Code and also had a Platform Transmitter Terminal (PTT) attached to her carapace. The smaller animal (a female)

weighed 88 kg and was tagged with inconel. After tagging, they were both released into the sea. The turtle with the PTT was caught by accident again on 26 September at Thmor Rieng, Sre Ambel district. After the capture, the fishermen called the sea turtles working group and they went to release it again on 30 September 2002.

Hawksbill turtles can be seen at Koh Dong, Kbal Romeas, Phoum Ta Ang of Kampot province, west of Koh Angkrang, and south of Koh Karang of Kep municipality and Thmar Rieng, Thmar Kandal and Thmar Anteas Banh of Koh Kong province.

Loggerhead turtles are rarely seen, but have been reported at Kilodapi of Kampot province and south of Koh Tbal, East of Koh Karang of Kep resort city.

Olive Ridley turtles have been rarely seen at Kbal Romeas of Kampot province and eastern part of Koh Pou, west of Koh Angkrang of Kep resort city.

There is no information related to Leatherback turtles, but in year 2000, one specimen of this turtle was caught accidentally by trawl net. It was immediately released because the fisherman was scared and believed that this species is poisonous. Hawksbill and green turtles are caught accidentaly around Poy Sareur, Koh Tang, Koh Pring, Koh Russy, Koh Thas, Koh Dong, Poy Rong Rang, Anloung Sor, Koh Ses, Koh Rong and Koh Rong Sanleum (Try, 2003; Fishermen, pers. comm.).

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SATELLITE TELEMETRY AND TAGGING ACTIVITIES OF SEA TURTLES IN INDONESIA

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Introduction

From the remaining 7 (seven) species of marine turtles in the world, there are 6 (six) species which have been identified to live and nest in Indonesian marine waters such as Leatherback turtles (*Dermochelys coriacea*), Olive Ridley turtles (*Lepidochelys olivacea*), Hawksbill turtles (*Eretmochelys imbricata)*, Loggerhead turtles *(Caretta caretta*), Flatback turtles (*Natator depressus*), and Green turtles *(Chelonia mydas*). Whereas *Lepidochelys kempi* is not found in Indonesian waters as this species only live in the Atlantic Ocean around Mexico and American beaches. In fact, the most common species found in Indonesia are the Green turtle, Hawksbill, Loggerhead, Olive Ridley, Flatback and Leatherback turtles.

With its numerous islands, extensive coastline, vast areas of sea grass beds and coral reefs, Indonesia provides important nesting and foraging grounds to sea turtles. Indonesia hosts the largest rookery for Green Turtles recorded in SouthEast Asia, in the Berau Islands, East Kalimantan and Pangumbahan (West Java), and the largest nesting rookery for Leatherback turtles, located along the Northern Coast of Papua. Each season between 1865–3601 nests are recorded at Jamursba-Medi and 2881 nests at Wermon (Hitipeuw *at al*., 2007). Satellite tracking data and tracing records of flipper tags indicates that from their nesting grounds these Green and Leatherbacks migrate very large distances over open water to get to their feeding and mating grounds.

With regard to its importance as nesting sites for sea turtles, Indonesia is working hard to exert more effort on sea turtle conservation. Management measure was taken by establishing some regulations from 1978 to 2007 (Table 1) to protect the exploitation and use of sea turtles for human consumption and other needs.

Table 1. Relevant regulations for sea turtle conservation in Indonesia.

Relevant National Decrees	Year	Remarks
Presidential Decree No. 43	1978	Ratification of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)
Ministerial Decree agriculture No. 327	1978	Determination of several types of wild animal to be protected (whales, Dolphin, Crocodiles, Leatherback Turtle)

Ministerial Decree agriculture No. 716	1980	Determination of several types of wild animal to be protected (whales, Gray, Olive and Loggerhead Turtles)
Act No. 4	1982	Basic provision for management of the living environment
Presidential Decree No. 26	1986	Ratification of ASEAN agreement on the conservation of nature and natural resources
Act No. 5	1990	Conservation of living natural resources and their ecosystem
Presidential Decree No. 32	1990	Management of protected areas
Act No. 5	1990	Ratification of the Convention on Biodiversity
Government Regulation No. 7	1999	Protection of all turtle species including green turtle
Act No. 31	2004	Fisheries
Act No. 32	2004	Regional Autonomy
Government Regulation No. 60	2007	Fish Resource Conservation

Even though measures are being taken to manage the conservation of sea turtles, Indonesia faces many problems due to several factors, such as:

- ✓ Harvesting of female turtles for the meat trade.
- ✓ Illegal collecting of turtle eggs which is still occurring in some regions;
- ✓ Illegal harvesting of turtles for subsistence and trade both for their meat and shells, especially done by foreign vessel;
- ✓ Pollution and debris including lost and discarded fishing gears;
- ✓ Destruction of nesting habitats due to the coastal development;
- ✓ Human activities such as unintended capture in fishing activities or fisheries by catch using trawls, long lines, gillnets, etc;
- ✓ The number of conservation officers to control and enforce the law against illegal hunting and harvesting marine turtles is still limited;
- ✓ Lack of coordination among parties concerned with management of marine turtles and their habitats;
- ✓ In some regions where the most important rookeries exist, the local governments are focusing more on short term economic interests rather than long term ones;
- ✓ Lack of supporting programs for research and management of endangered species particularly to those species of marine turtles.

Realizing these problems, Indonesia has increased their efforts to reduce the direct and indirect intake of sea turtles and to monitor certain management spot areas for the enhancement of

hatchling production and ensuring their successful release to the sea. The most well managed and important nesting sites are Derawan Complex (including: Derawan, Sangalaki, Semana, Mataha, Belambangan, Bilang-bilangan, Balikukup and Sambit Islands) and Pangumbahan beach (West Java) for Green turtles; Anambas and Natuna-Riau; Lima Momperang, Pesemut-Belitung, Segamat Island-Lampung, South of Ujung Pandang, Birah-birahan, Derawan-East Kalimantan for Hawksbill turtles; Sukamade beach and Alas Purwo National Parks in East Java for Olive Ridleys; and Jamursba Medi and Wermon in western part of Papua for Leatherback turtles. Some studies on sea turtle management are continuing in those areas involving the Indonesian government together with other international institutions and local Non-Government Organizations, mostly the World Wildlife Fund-Indonesia. Recently, some research activities have been supported by SEAFDEC member countries under Japanese Trust Fund.

Summary of Tagging Studies

Studies on sea turtles for the management purpose were conducted for many years ago. The tagging activities started in the 1980's at Pangumbahan, Seribu, Sukamade, Segamat-Lampung, Belitung Island and Semut Island. Inconel, titanium and plastic tags were used. Tagging activities on Green turtles have been done quite intensively on Sukamade Beach, Meru Betiri National Park since 1984. During 1984 to 1998, there were about 1,172 individuals of Green turtles tagged (mostly female) and about 1,135 individuals were recaptured as shown in Fig 1.

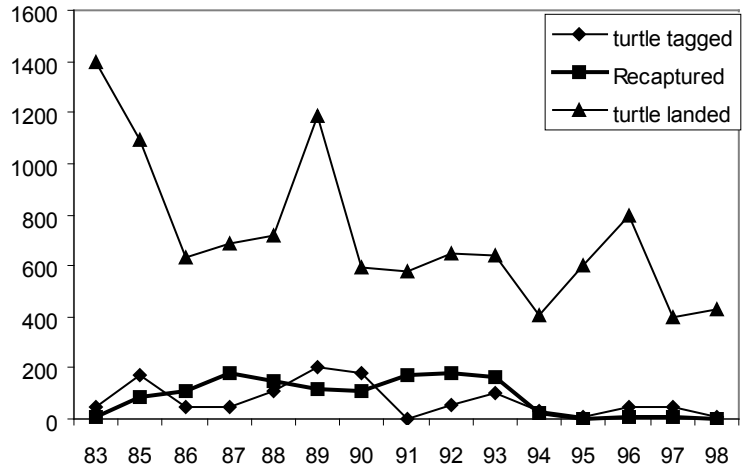


Fig. 1. Variation of green turtles tagged and recaptured at Sukamade Beach, Meru Betiri National Park.

During 1995 to 2000, the Japan Bekko Association funded the tagging monitoring program on Hawksbills. There were 124 individuals tagged and only two individual turtles were recaptured accidentally by fishermen in the same place where the turtles were released.

Under the Japanese Trust Fund, the tagging activities using inconel tags were restarted in the year 2000. About 2000 units of inconel tags were received previously by the Ministry of Forestry (1998 – 2003), while in 2006 a total of 600 units of inconel tags were received by the Research Center for Capture Fisheries (RCCF), Agency for Marine and Fisheries Research – Ministry of Marine Affairs and Fisheries. The tags were distributed to the Agency of Natural Conservation located in the districts and provinces. Only a small number of tags were kept and used by RCCF.

Tagging activity was started by the RCCF in March, 2007 in Belitung District of Sumatera where Hawksbill turtles usually come to nest in the islands (Fig. 5). Kimar island is one of those areas that has a good access to conduct a study on sea turtles.

Fig. 5. Locations of tagging activities conducted during period 2007 – 2008.

As a continuation of previous tagging activities that was reported in 2007 for Kimar Island (Bangka – Bitung Province), sea turtle tagging was undertaken at Segamat Island (Lampung Province) Derawan Complex (Berau District) and Pangumbahan Beach (Sukabumi District) (See Figure Above). In Kimar island and Segamat island, the tagging was focused on Hawksbill turtles, while for the two other locations, the tagging was done for Green turtles. The total number of tag releases during the work in Kimar island was about 41 tags (the number of ID 2201 to ID 2245), until the end of May 2007.

A number of 400 tags for Green turtles were released in Derawan Complex (Berau Distict – East Kalimantan) and at Segamat island in Lampung Province of Sumatera. The tag releases during the tagging activity in West Java was about 40 tags, involving six months of field work at Pangumbahan Beach and Citirem Beach. The information on tagging activities was summarized in Tabel 2.

Table 2. Summary of tag releases in four nesting beaches.

Period Time	Nesting Beach Location	Number of Tag Releases (ind.)	Tag Serial
March – May 2007	Kimar Island (Belitung District)	41	ID 2201 – ID 2245
January – December 2007	Derawan Complex (Berau District)	200	ID 2001 – ID 2200
April – December 2007	Segamat Island (Lampung Province)	200	ID 2401 - ID 2500 ID 2600 – ID 2700

May – August 2008	Pangumbahan Beach and Citirem Beach (West Java Province)	40	ID 2524 – ID 2549 ID 2551 – ID 2575
Total number tag releases in four nesting beaches		481	

There are about 41 individual turtles (38 hawksbills and three Green turtles) were tagged from about 63 individual sea turtles which landed in Kimar island of Belitung Distict with daily variations described in Fig. 6. The details of turtles tagged are presented in Table Annex 1.

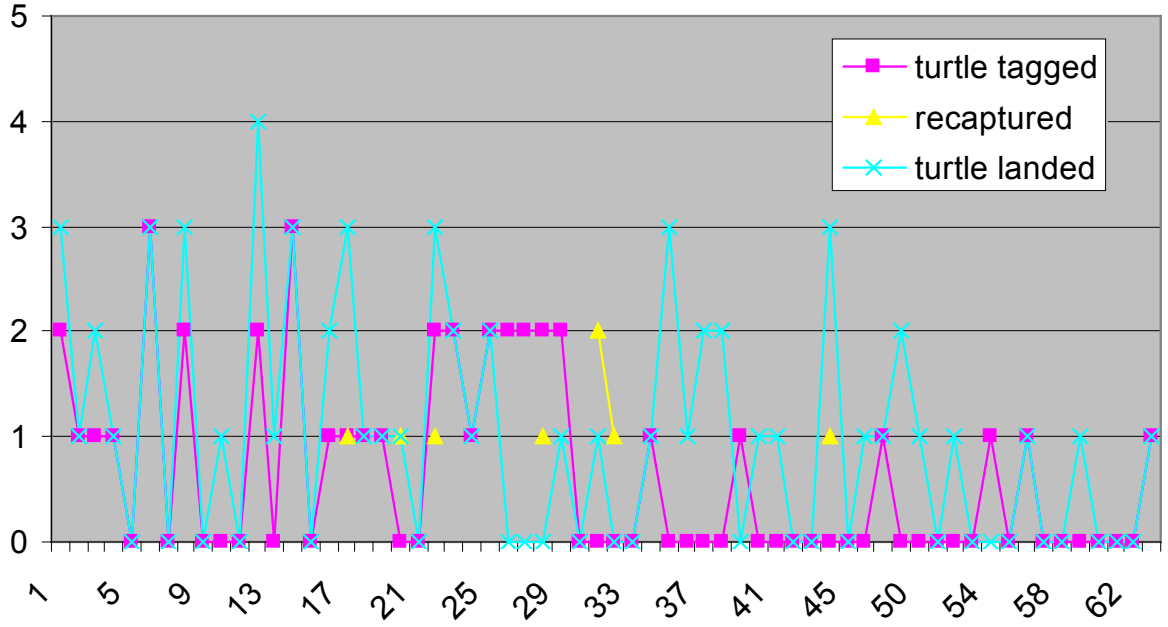


Fig. 6. Variations of turtle tagged, turtle recaptured and landed turtles at Kimar Island during March to May 2007

Species: *Chelonia mydas*

No	Year	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubated	Total of hatchlings released
1	1984 - 1998	1172	1135	123,060	123,060	83,680
2	2002 - 2006	2058	1956	201,684	201,684	143,881
3	2007 - 2008	240	193	24,240	24,240	17,511

Species: *Eretmochelys imbricata*

No	Year	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubated	Total of hatchlings released
1	2007	38	7	2698	2698	1835

Stock size of nesting population

Sangalaki Island: green turtle

N : (Estimated) number of nests per year: 1625 nests
C : Estimated number of clutch per female/year: 4
F : Estimated number of females to nest per year = (N/C): 1625/4= 406
I : Average remigrating interval in year: 3 years
S : Estimated stock size of nesting females = (F x I) = 406 x 3 = 1218 nesting females

Pangumbahan Beach: green turtle

N : (Estimated) number of nests per year: 780 nests
C : Estimated number of clutch per female/year: 3.5
F : Estimated number of females to nest per year = (N/C): 780/3.5= 202
I : Average remigrating interval in year: 4 years
S : Estimated stock size of nesting females = (F x I) = 202 x 4 = 808 nesting females

Satellite Telemetry Studies

The satellite telemetry tracking activities of sea turtles started in Pulau Segama – Lampung District in 1989 using the ST-10 PTT sponsored by the Japanese Government. The post nesting monitoring of the Hawksbill was done in 2003 by using ST-10 PTT in Pulau Seribu Islands National Park. There were three units of the transmitter, which had been attached on adult female hawksbills. The turtles would be monitored by ARGOS satellite for six months. The satellite tracking had also been conducted on Leatherbacks in Wermon and Jamursba Medi beach of Irian Jaya.

In Wermon (western part of Papua), the satellite tracking was done in 2005 for Leatherback turtles, deploying thirteen individuals. The migration routes of those turtles were described in Fig. 2 where they went to the islands around Pacific Ocean and in side waters of Indonesia.

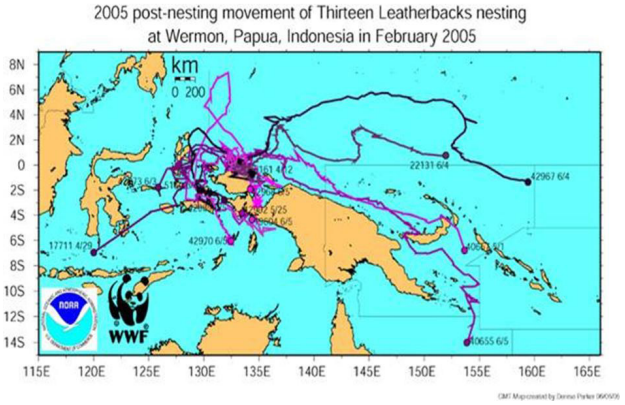


Fig. 2 The route of leatherback turtle tagged by using the PTT, released in 2005 in Wermon beach, Papua.

Recently, a tagging study using satellite telemetry had been conducted by WWF – Indonesia in cooperation with the local government by using the Telonics ST-20 A-2010 transmitters. The transmitters were attached on three post nesting females of Green turtles. The turtles were released on June 12th – 18th, 2006 from Derawan Island. The turtles caught after nesting on June 11th and 12th were tagged on the 13th and released the next day. One turtle (named Putri Derawan) went into the Philippines waters and two others (named Putri Hijau and Putri Berau) went into the Sabah waters (Fig. 3).

In 2006, a satellite telemetry study was also done in Derawan Complex under SEAFDEC program led by Malaysia. The satellite telemetry with specification Kiwisat 101 Argos PTT was attached on a post nesting Green turtle. The turtle, named Miss Sangalaki, was released on September 16, 2006 from Sangalaki Island. This turtle nested on September 14 and kept more than one day before being released for attachment the PTT. The route of Miss Sangalaki (Fig. 4) is described as well:

a. On September 23, 2006, Miss Sangalaki arrived in around Tarakan Island, Sulawesi Sea.
b. On September, 26 2006, the turtle traversed the border and arrived in Sabah water.
c. On October 1st, the turtle had reached Southwest of Sabah and she stayed in that area until March, 3 2007 when the signals ran out. It is presumed that her feeding ground is around this water area.

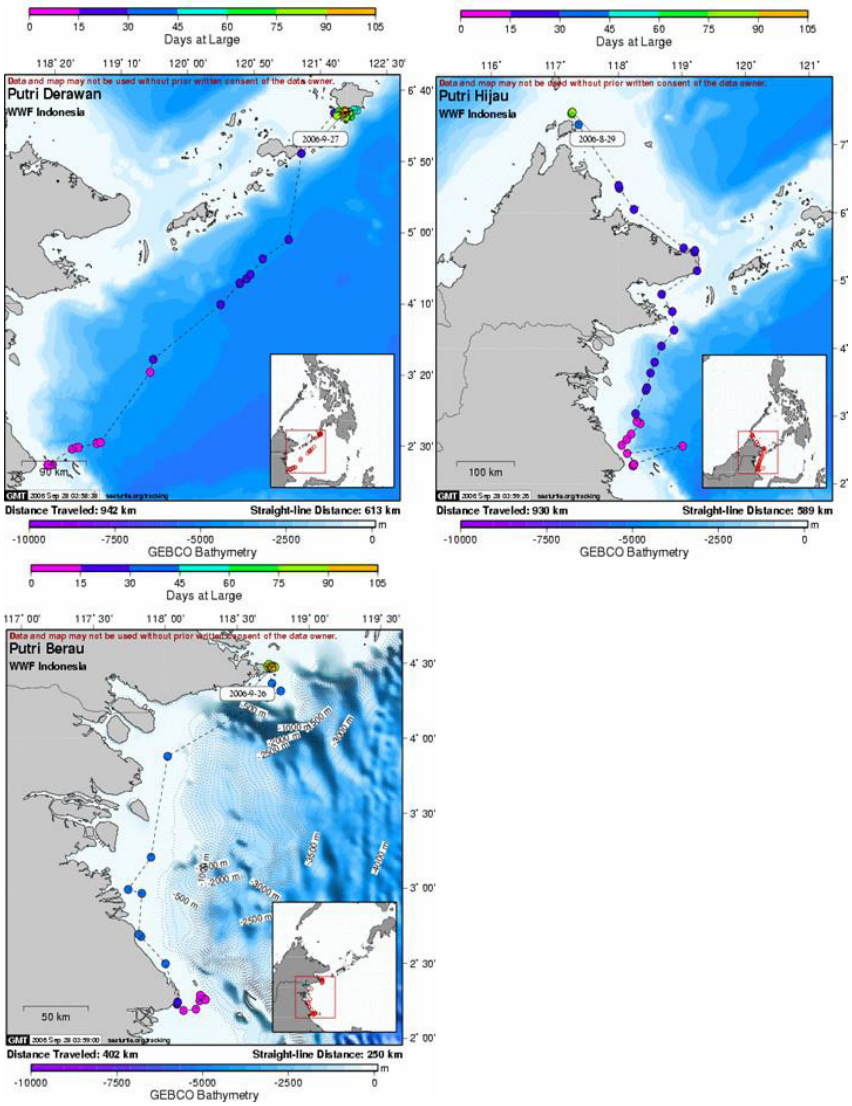


Fig. 3. The route of green turtle tagged by using the Telonics ST-20 A-2010 transmitters, released on June 2006 in Derawan Island, Berau District – East Kalimantan.

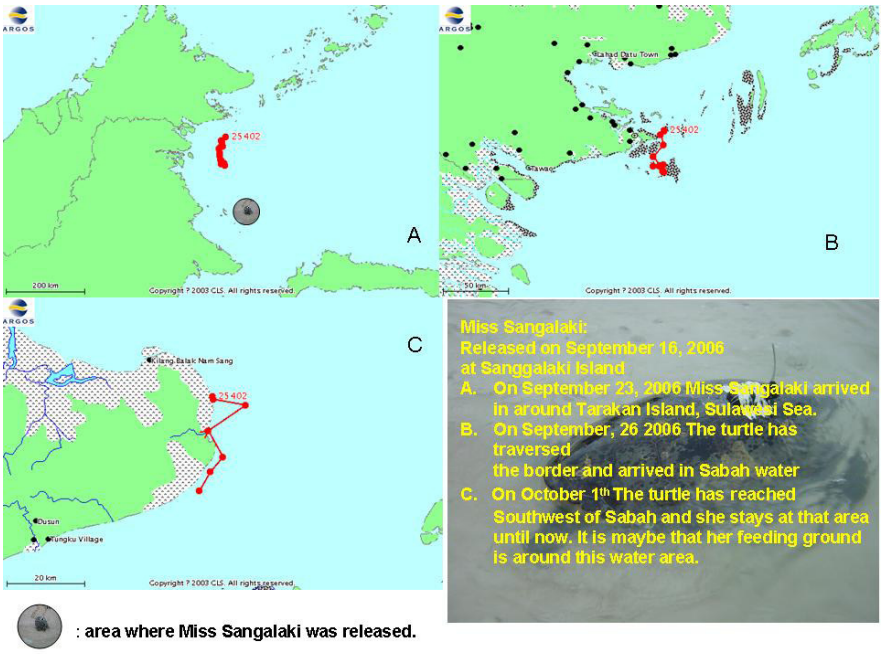


Fig. 4. The route of green turtle tagged by using the Kiwisat 101 Argos PTT, released on September 2006 in Sangalaki Island, Berau District – East Kalimantan.

Summary of Telemetry Studies

Nesting Beach	Species	Migration Area	Foraging Area	Source (Tag/ Satellite Tracking)	References
Seribu Island	Hawksbill	NA	NA	ST-10 PTT	Dermawan, 2002
Wermon Beach	Leatherback	Pacifica Ocean, Banda Sea, Aradura Sea	Arafura Sea, Coastal waters of Pacific Islands	PTT	WWF - Indonesia
Derawan Island	Green	Sulawesi Sea, Sulu Sea	Coastal waters of Philippines and Sabah	Telonics ST-20 A-2010 transmitters	WWF - Indonesia
Sangalaki Island	Green	Sulawesi Sea, Sulu Sea	Coastal waters of Sabah	Kiwisat 101 Argos PTT	MFRDMD - SEAFDEC

Annex 1. Tags releases in West Java nesting beach

No	Date	Tagging ID Number	CCL Length (cm)	Widht (cm)	Remark
1	11/5/2008	ID 2524	97	95	Citireum
2	14-05-2008	ID 2525	103	98	Citireum
3	16-05-2008	ID 2526	99	89	Citireum
4	17-05-2008	ID 2527	105.5	115	Citireum
5	20-05-2008	ID 2528	98	89	Citireum
6	23-05-2008	ID 2529	102	99	Citireum
7		ID 2530	98	90	Citireum
8	24-05-2008	ID 2531	104	100	Citireum
9	26-05-2008	ID 2532	96.7	94	Citireum
10	28-05-2008	ID 2533	107	103	Citireum
11		ID 2534	95	88	Citireum
12	31-05-2008	ID 2535	98.4	92	Citireum
13	2/6/2008	ID 2536	89	88	Citireum
14	4/6/2008	ID 2537	106	97	Citireum
15	6/6/2008	ID 2538	98	93	Citireum
16	16-06-2008	ID 2250	107	98	Citireum
17	13-07-2008	ID 2549	102	96	Citireum
18	28-08-2008	ID 2551	101	90.5	Pangumbahan
19		ID 2552	108	98	
20		ID 2553	103	91.5	
21		ID 2554	110	100	
22		ID 2556	106	91	
23		ID 2557	112	106	
24		ID 2558	97	85,5	
25		ID 2559	103	95	
26		ID 2563	115	100	
27		ID 2564	105	96	
28		ID 2565	101	92	
29		ID 2566	105	83.5	
30	29-08-2008	ID 2567	105	97	Citireum
31		ID 2568	105	96	
32	30-08-2008	ID 2569	105	95	Pangumbahan
33		ID 2570	108	94	
34		ID 2571	97	86	
35		ID 2572	99	98	
36		ID 2573	107	96	
37		ID 2574	101	90	
38		ID 2575	106	95	
39		ID 2501	106	92	
40		ID 2502	98,5	88,5	

Tagging Activities At Mak Kepit Nesting Beach, Redang Island, Terengganu

Syed Abdullah bin Syed Abdul Kadir

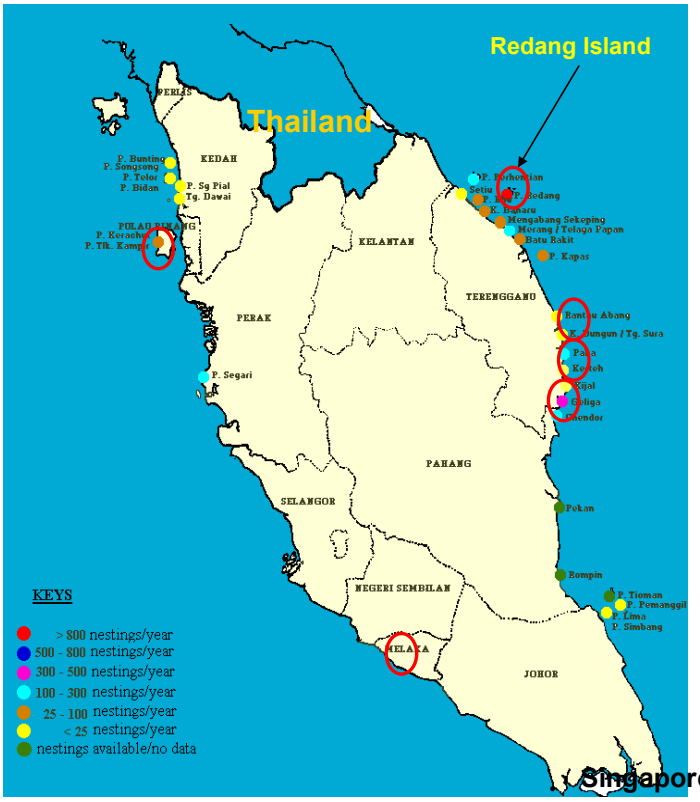
Turtle and Marine Eco-system Center

Department of Fisheries Malaysia

Rantau Abang, Dungun, Terengganu

Tagging Activities At Mak Kepit Nesting Beach, Redang Island, Terengganu

- Intensive tagging exercises using inconel tags have been conducted since 1993.
- 95% are Green turtle nesters and 5 % are Hawksbill nesters.
- Nesting season starts from Mac to October; peak season – May to July
- Number of tags received; 2000 units


Redang Island
Thailand
PERLIS
KEDAH
P. Bunting
P. Songsong
P. Telor
P. Bidan
P. Sg Pial
Tg. Dawai
PULAU PINANG
P. Kerachut
P. Tk. Kampit
KELANTAN
TERENGGANU
PERAK
P. Segari
Rantau Abang
Kg. Bungun / Tg. Sura
Paka
Kerteh
Cajal
Tg. Biga
Chendor
PAHANG
SELANGOR
Pekan
Rompin
NEGERI SEMBILAN
P. Tioman
P. Pemanggil
P. Lima
P. Simbang
MELAKA
JOHOR
Singapore
KEYS
> 800 nestings/year
500 - 800 nestings/year
300 - 500 nestings/year
100 - 300 nestings/year
25 - 100 nestings/year
< 25 nestings/year
nestings available/no data


PULAU REDANG
Tanjung Lang
Teluk Batu Sauh
Tanjung Semah
Tanjung Biola
Tanjung Tok Kong
Teluk Tenak
Tanjung Teluk Gutong
Tanjung Batu Perpanji
Pasir Chagar Hutang
Tanjung Gua Tong
Tanjung Gua Buaya
Pasir Mak Kepit
Pasir Bujang
Tanjung Teluk Nyatoh
Teluk Dalam Kechil
Tanjung Gua Kawah
Tanjung Lebah
Mak Simpan
Teluk Gua Kawah
Che Keling
Teluk Dalam Besar
Tanjung Bakong
Ayer Gemuroh
Pulau Paku Besar
Nyior Gading
Pasir Panjang
Teluk Rotan
Tanjung Batu Rabong
Pulau Paku Kechil
Pulau Lima
Lipat Kain
Tanjung Gemok
Tanjung Mak Chantek
Pasir Macham Ayam
Kampung Tanjung Bakau
Teluk Mak Chantek
Tanjung Bertigi
Pasir Kechil
Pasir Teluk Kalong Kechil
Teluk Bakau
Pulau Kerengga Kechil
Tanjung Teluk Siang
Pulau Kerengga Besar
Tanjung Batu Berak
Kampung Pinang
Tanjung Telaga Batu
Teluk Kalong Besar
Tanjung Batu Manjing
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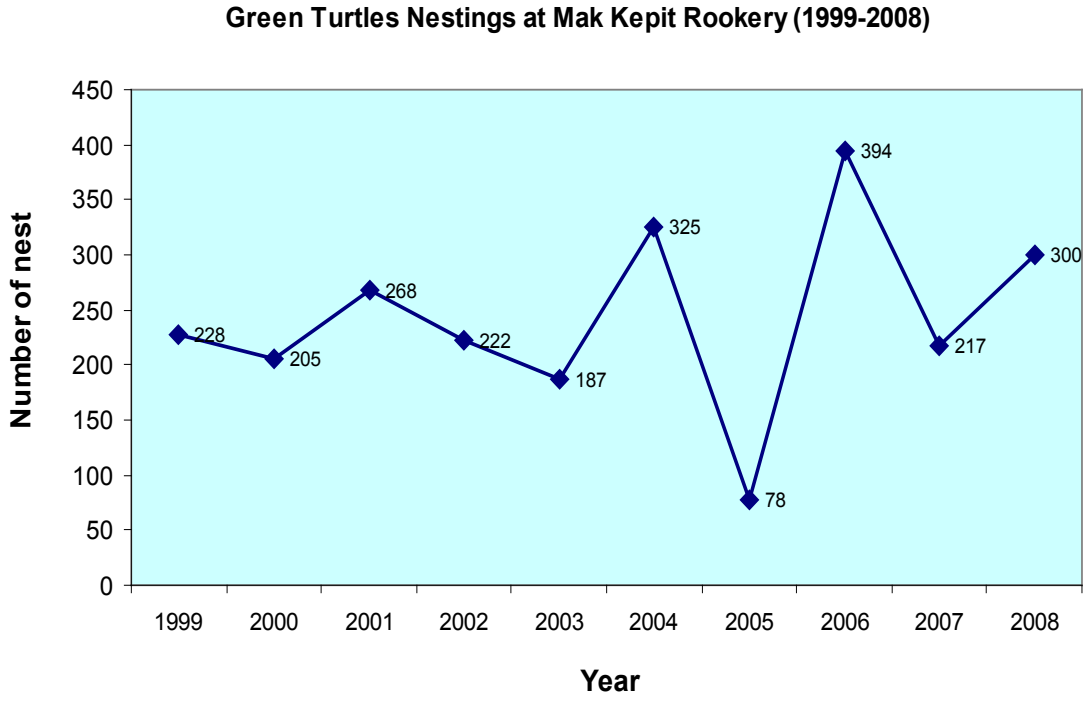
Pulau Ling
Teluk Lelong
Ayer Raja
Pasir Tenggara



:Number Of Green Turtle Tagged And Recovered Starting From 1999 – 2000 At Mak Kepit, Pulau Redang

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	No. of individuals recovered
1999	55		* 2	* 3	* 5	* 4	* 4	* 4	* 4	* 3	29
2000		46		* 1	* 6	* 5	* 1	* 3	* 5	* 4	25
2001			63		* 2	* 10	* 3	* 4	* 3	* 5	27
2002				44		* 7	* 1	* 6	* 2	* 3	19
2003					24		* 2	* 7	* 4	* 2	13
2004						55		* 4	* 6	* 2	10
2005							13		* 5	* 4	9
2006								85		* 3	3
2007									35		
2008										53	Total (135)
Total of turtle tagged	65	46	65	48	37	81	24	113	64	79	662

*** Number of individual recovered**

Green Turtle Population At Mak Kept Nesting Beach (1999-2008)

No	Year	Number of Nest	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubate	Total of hatchlings release	Average of landing frequency
1	1999	228	55	29	22246	22246	20060	3 (8)
2	2000	205	46	25	21638	21638	17550	4 (9)
3	2001	268	65	27	25933	25933	22185	4 (10)
4	2002	222	48	19	21587	21587	17761	4 (13)
5	2003	187	37	13	17422	17422	13910	5 (11)
6	2004	325	81	10	27815	27815	21821	3 (9)
7	2005	78	24	9	8426	8426	6946	3 (8)
8	2006	394	113	3	37744	37744	27550	3 (8)
9	2007	217	64	3	19119	19119	15291	3 (9)
10	2008	300	79		25700	25700	20560	3 (10)
	Total	224	612	137	227630	227630	183634	

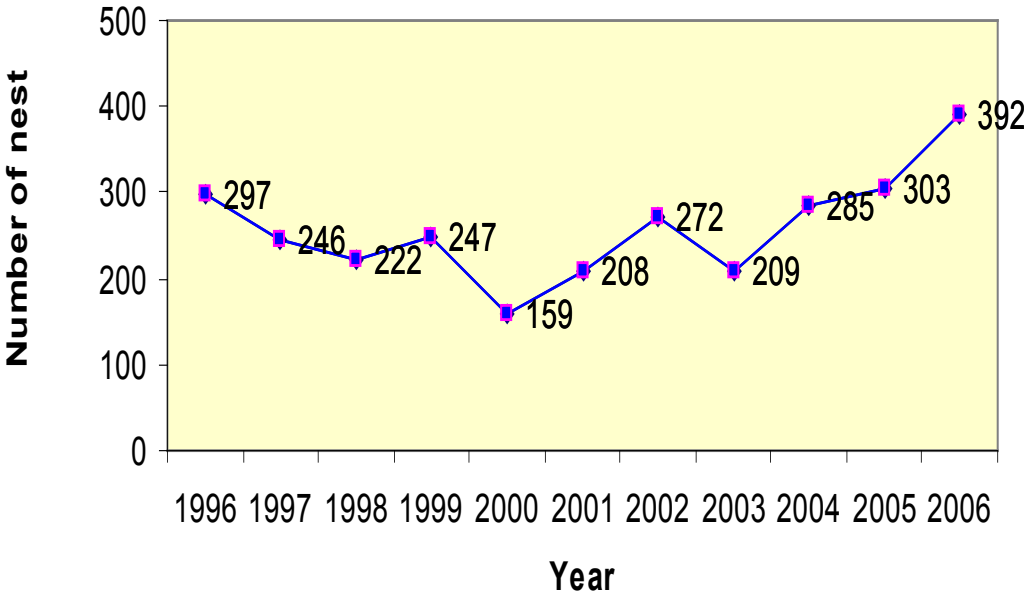
Tagging Activities of Hawksbill Turtles At Melaka Nesting Beach

- Tagging exercises using inconel tags began in 2006 in collaboration with WWF Malaysia.
- Dominant species is Hawksbill turtles *(Eretmochelys imbricata).*
- Nesting season throughout the year and peak season May to August.
- Number of tags received - 200 units.

Melaka Nesting Beaches

Upeh Island

Number of Nesting of Hawksbill turtles in Melaka



The Population Of Hawksbill Turtles At Melaka Nesting Beach (2006-2008)

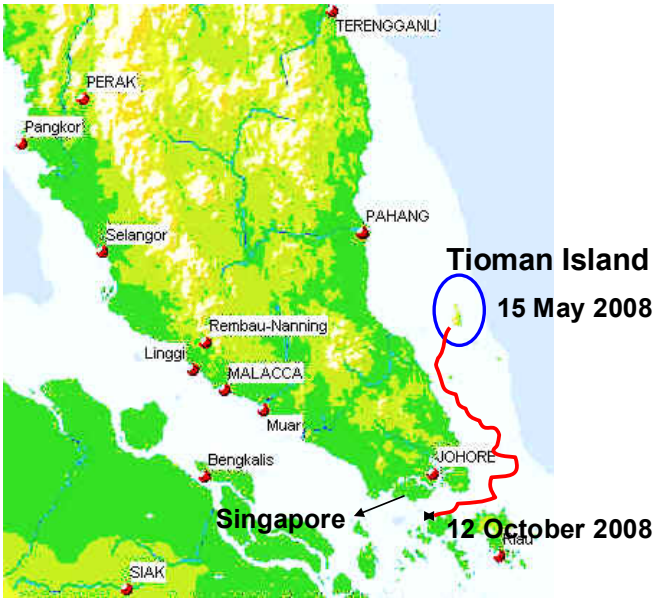
No	Year	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubate	Total of hatchlings release
1	2006	26		2730	2730	
2	2007	32		3398	3398	
3	2008	56	9	6424	6424	

Number Of Hawksbill Turtle Tagged And Recovered Starting From 2006 – 2008 At Melaka Nesting Beaches

Year	2006	2007	2008	No. of individuals recovered
2006	26		8	8
2007		32	1	1
2008			56	(total = 9)

Satellite Telemetry Study of Green Turtle in Tioman Island, Malaysia

An adult female Green; CCL 103 cm, CCW 78 cm and weight 103 kg which attached with satellite device was released at Juara nesting beach, Tioman Island on 15 May 2007. After three months(18 August 2008) this turtles had reach Riau Archipelago waters.



TERMINAL COUNTRY REPORT ON TAGGING AND SATELLITE TELEMETRY STUDY: SABAH, MALAYSIA

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Introduction

Sabah Turtle Islands Park is located about 40 km to the North of Sandakan on the edge of the Malaysia-Philippines international border. The Park consists of three beautiful islands namely Selingaan (8.1 ha), Bakkungan Kechil (8.5 ha) and Gulisaan (1.6 ha). Overall the park's area covers approximately 1, 740 hectares, mostly sea and coral reefs with some seagrass patches. The Park lies within the 6^0 9' to 6^0 11' latitude and 118^0 3' to 118^0 6' longitude on the Sulu Sea. TIP provides a nesting habitat to one of the largest aggregations of green turtle and the largest remaining hawksbill turtle population in the entire South East Asian Region (Chan and Liew, 1996).

Although the early sea turtles conservation in Sabah can be drawn back from as early as 1927, the conservation efforts were more obviously made known to the public in 1966 with the first turtle hatchery on Selingaan being in operation. And these efforts have become more noticeable with the establishment of the Turtle Islands Park in 1977.

The first tagging activities at TIP were initiated in 1970 (de Silva, 1986) using single a Monel tag which was applied on the left flipper of the females turtle. This effort continued until October 1999. In early 1998, SEAFDEC/MFRDMD, the Japanese Trust Fund IV provided Sabah Turtle Islands Park with 1000 Inconel tags with series MY(S) 0001 – MY(S) 1000. Tagging turtles using Inconel tag was only employed by early July 1999 with double tagging system on both front flippers.

This paper is basically an updated report of the tagging activities and the satellite telemetry tracking program in Sabah Turtle Islands Park.

Tagging Implementation Program

a. Year of Implementation

The first inconel tagging activities at TIP was implemented in July 1999 using the inconel provided by SEAFDEC/MFRDMD under the Japanese Trust Fund IV. The use of Inconel tags replaced the use of Monel tags in the Sabah TIP tagging program. The details are as shown in Table 1.

Table 1: Number of tagging used and turtle tagged from 1970 - 2007

Year	No. of Monel Tag Used (Single tag)	No. of Inconel Tag Used (Double)	No. of Turtles tagged	
			Green	Hawksbill
1999	(from 70's -Oct. 1999)			
2000	-	2, 364	2, 262	102
2001	-	5, 391	2, 380	106
2002	-	5, 156	2, 272	118
2003	-	4, 982	1, 587	122
2004	-	5, 534	2, 443	107
2005	-	3, 876	1, 582	157
2006	-	4, 944	1, 994	144
2007		4,770	1,913	133
Total	59, 306	38,017		
Grand Total				

b. Number of inconel tag received from MFRDMD

Under the Trust Fund 1 Sabah Parks were supplied with 1000 Inconel tag with MY(S) 0001 – MY(S) 1000 series in 1998.

c. Species

Tagging activities within TIP involve both species of turtles; Green and Hawksbill. However, for the experimental tagging activities using the 1000 inconel tags supplied by MFRDMD/ SEAFDEC in 1998 only involved the Green turtle.

d. Location/Nesting Beach

Tagging experiments for the Inconel Tags that were supplied by MFRDMD/SEAFDEC were carried out at all three islands at Turtle Islands Park, namely Selingaan, Bakkungan Kechil and Gulisaan. Inconel tags from the national fund have also been used to carry out tagging activities at Pulau Sipadan nesting turtles since December 2005.

e. Number of Turtle Tags

For the inconel tags supplied by the MFRDMD/SEAFDEC in 1998, a total of 500 female turtles have been tagged. On the other hand, from the 1970's to 1999 a total of 59, 306 turtles were tagged with Monel tags, while beginning from October 1999 to 2007, a total of 38, 017 inconel tags were used involving a total of 21, 608 turtles. To date, from the 1970's to 2007, a total of 97, 323 tags have been used (Monel & Inconel tags) involving 80, 914 turtles (Green and Hawksbill). The details are shown in Table 1.

f. Information on Tag Recovery at Nesting Beach/ Non-Nesting Sites

The number of tag recoveries from TIP was rather low compared to the number of turtles that have been tagged. Chan and Liew (1996) updated the total to 78 tag recoveries until December 1994. Of this number, 72 recoveries were reported in Philippines, three in Indonesia and one in Republic of Palau. The other two tags were domestic recoveries from Pulau Maiga and Sipadan both in Semporan district. From 1995 to 2007, a total of 54 tag recoveries have been reported in various places; Philippines with 39 tags, Indonesia with 10 tags and Papua New Guinea with one tag while local tag recoveries within Sabah saw Malaysia with four tags. See Appendix 1.

To date, together with TIP updated data, a total of 132 international and six local tag recoveries have been made. Of this number, 111 tag came from Philippines (51 were from adjacent Philippines Turtles Islands), 13 from Indonesia, one tag each from Papua New Guinea and Republic of Palau, respectively. The six local tag recoveries were mostly from islands within Semporna district with five tag recoveries, while one tag recovered came from the West cost of Sabah.

Summary On Tagging Data

i. Species: Green Turtle

No	Year	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubate	Total of hatchlings release
1.	2004	2,443	149	517,507	516,753	420,397
2.	2005	1,582	70	417,827	416,559	346,372
3.	2006	1,994	86	506,523	505,490	431,083
4.	2007	1,913	96	485,028	483,569	399,493
	Total	7,932	401	1,926,885	1,922,371	1,597,345

ii. Species: Hawksbill Turtle

No	Year	Number of turtle tagged	Number of turtle recovery	Total of turtle eggs	Total of eggs incubate	Total of hatchlings release
1.	2004	107	6	35,213	35,132	25,511
2.	2005	157	15	54,918	54,835	40,089
3.	2006	144	16	54,412	54,174	40,871
4.	2007	133	5	47,032	46,998	35,614
	Total	541	42	191,571	191,139	142,085

summary on tag recovery (remigration interval)

i. Species: Green Turtle(n=3,000)

No	Date of tagged and released (Year)	Date of tag recovery (remigration)* (Year)	Remigration interval (years)
1.	1999	2002	4 years
2.	2000	2003	3 years
3.	2001	2004	3 years

ii. Species: Hawksbill Turtle (n=150)

No	Date of tagged and released (Year)	Date of tag recovery (remigration)* (Year)	Remigration interval (years)
1.	2000	2003	3 years
2.	2001	2005	4 years
3.	2002	2006	3 years

Stock Size Of Nesting Population

a. GT (1997-2007):

N : Estimated number of nests per year: 7,178 nests
C : Estimated number of clutch per female/year: 1 clutch
F : Estimated number of females to nest per year= (N/C):7,178/1= 8,338 females
I : Average remigration interval in year: 3 years
S : Estimated stock size of nesting females= (F x I): 8,338 X 3 = 21, 534 females

b. HB (1997-2007):

N : Estimated number of nests per year: 401 nests
C : Estimated number of clutch per female/year: 2 clutches
F : Estimated number of females to nest per year= (N/C):401/2= 200 females
I : Average remigration interval in year: 3 years
S : Estimated stock size of nesting females= (F x I):200 X 3 = 600 females

Satellite Telemetry Study

From 1998 to 2001, six turtles have been successfully attached with satellite transmitters which involved three nesting turtles from both the Green and Hawksbill turtles species respectively. The Green turtle tracking was conducted under the TIHPA program, while the post-nesting of the Hawksbill turtle was sponsored by NOAA, USA in 2000/2001 to Sabah TIP.

The results from this project have shown us three different routes of Hawksbill post nesting turtles (Fig. 1). Turtle 1 (Maria), travelled about 821 km from TIP to the area of Samarinda on the East Kalimantan, Indonesia. Turtle 2 (Marina) did not travel far from TIP, and was recorded roaming around Sandakan Bay about 46 km from TIP. Turtle 3 (Mariana) travelled to the north of Sabah within islands around Banggi at Kudat district about 144 km from TIP. It was recorded to be roaming within the coral reef area for quite some time before the transmitter battery ran out. Interestingly, after almost six years away from the nesting beach, she returned to nest at Pulau Gulisaan on 26 December 2006 with the transmitter still well attached to her carapace. On the other hand, no additional satellite telemetry study has been conducted for both species in Sabah TIP since 2001.

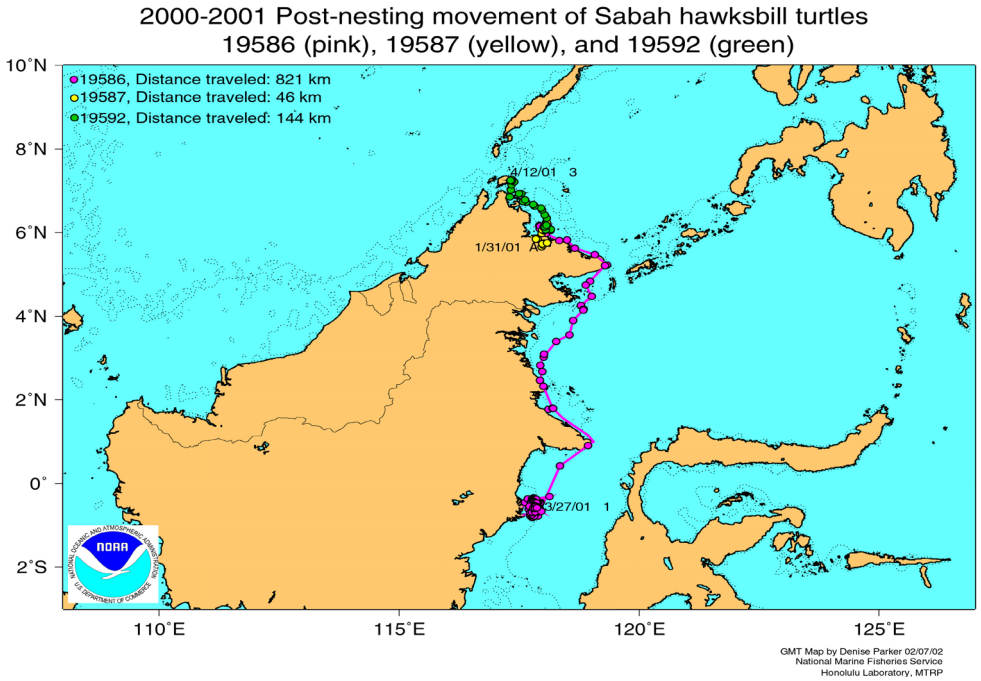

Figure 1: Hawksbill post-nesting tracking project 2000-2001 (Maps by Denies Parker, NOAA)

Conclusion:

- From 1970 – 2007, a total of 97, 323 tags have been used involving 80, 914 females turtles.
- Inconel tag and double tags system were only introduced to the TIP tagging program in mid 1999.
- To date, a total of 132 international and six local tag recoveries have been made.
- Although recoveries tags results are encouraging, it is still low compared to the number of turtles which have been tagged.
- Remigration intervals for Green and Hawksbill turtles at TIP were between 3-4 years with an average of three years.
- The stock size of nesting population for Green turtles was estimated about 21, 534 females, while for the hawksbill turtles, it was about 600 females.
- Satellite telemetry study for both Green and Hawksbill turtle was only conducted from 1998 to 2002.

Acknowledgement

On behalf of The Board of Trustees of The Sabah Park, we would like to express our thanks and appreciation to MFRDMD/SEAFDEC for the invitation to this meeting. To my friends and also my colleagues Mr. Johny Buis and Mohd Kassim Karim for assisting me in data collection, thank you vey much for their commitment. To the Park manager and all the Turtle Islands Park staff for their contribution in carrying out turtle conservation and data collection, thanks. Last but not least to my beloved wife and kids, thank you for your prayers and love.

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Appendix 1 (a)

International Tag Recoveries of turtle tagged at Turtle Islands Park, 1995-2007

No.	Tag number	Recovery date	Recovery Location	Remarks
1	39552	14.2.1995	Taganak Is. Philippines	GT, Nesting
2	28617	20. 2.1995	Taganak Is. Philippines	GT, Nesting
3	NA	17.5.1995	Zambonga City, Philp.	?
4	41470	20.6.1995	Lihiman Is. Philippines	GT, Nesting
5	41464	22.6.1995	Lihiman Is. Philippines	GT, Nesting
6	40638	24.6.1995	Lihiman Is. Philippines	GT, Nesting
7	41423	25.6.1995	Lihiman Is. Philippines	GT, Nesting
8	40655	26.6.1995	Lihiman Is. Philippines	GT, Nesting
9	32291	27.6.1995	Lihiman Is. Philippines	GT, Nesting
10	42038	28.6.1995	Lihiman Is. Philippines	GT, Nesting
11	41404	4.7.1995	Lihiman Is. Philippines	GT, Nesting
12	42119	5.7.1995	Lihiman Is. Philippines	GT, Nesting
13	NA	6.7.1995	Zambonga City, Philp.	?
14	NA	6.7.1995	Zambonga City, Philp.	?
15	NA	21.7.1995	Tapul Is. Philippines	GT, Dead
16	NA	20.8.1995	Zambonga, Philp.	?
17	14756	14.9.1995	Biak Irian Jaya, Indonesia	GT
18	NA	1.11.1995	Zambonga, Philp.	?
19	41404	19.10.1995	Great Bakkungan, Philp.	GT
20	NA	1.12.1995	Linalinan, Philippines	?
21	NA	17.1.1996	Maginti Is., Indonesia	?
22	NA	11.5.1996	Tuhung-Tuhogsiasi, Sulu Philp.	?
23	44524	8.11.1996	Puerto Princesa City, Philp.	GT
24	41459	2.12.1996	Lihiman Is. Philippines	GT
25	41459	11.3.1997	Dangleg, Pumaran, Philippines	GT
26	NA	15.6.1997	Sapa-Sapa, Philippines	?
27	48595	17.7.1997	Siani Sulu, Philippines	GT, Dead
28	?	26.7.1997	Papua New Guinea	?
29	45034	14.12.1997	Dangleg, Pumaran, Philippines	GT, Alive
30	44529	8.11.1998	Great Bakkungan, Philippines	GT, Nesting
31	59305/59306	23.7.1999	Great Bakkungan, Philippines	GT, alive
32	?	20.5.2000	Indonesia	GT, alive
33	6117/6118	10.3.2001	Narra, Palawan, Philippines	GT,?
34	MY(S)0917/MY(S)0918	3.3.2001	St. Jolo, Sulu, Philippines	GT, Dead
35	MY(S)091	3.9.2001	St. Jolo, Sulu, Philippines	GT, Dead
36	MY(S)0197/MY(S)0198	25.10.2002	St. Jolo, Sulu, Philippines	GT, Dead
37	MY(S)2889	27.3.2003	Sitangkai, Tawi-Tawi, Philippines	GT, Dead
38	MY(S)19160	10.12.2003	Princese City, Palawan, Philp.	GT, Dead
39	MY(S)2843/MY(S)2844	2003	Palawan, Philippines	GT, Dead
40	MY(S)21975/MY(S)21976	15.10.2004	Tawi-Tawi, Philippines	GT, Dead
41	63743	2.6.2005	Pulau Panjang, Derawan, Indon.	GT, Alive
42	26012/26011	16.6.2005	"	GT, Alive
43	58191	16.6.2005	"	GT, Alive
44	MY(S)0946/MY(S)0945	16.6.2005	"	GT, Alive
45	31599	2005	Pulau Panjang, Derawan, Indon.	HB, Alive
46	11317	2005	"	GT, Alive
47	21390	2005	"	GT, Alive
48	MY(S)16559/MY(S)16560	19.6.2006	Zambonga City, Philippines	GT, Dead
49	MY(S)30937/MY(S)17437	20.1.2006	Negros, Occidental, Philippines	GT, Alive
50	MY(S)9469/?	21.5.2007	Jolo, Sulu, Philippines	GT/?

Appendix 1(b)

Local Tag Recoveries of turtle tagged at Turtle Islands Park, 1995-2007

No.	Tag number	Recovery date	Recovery Location	Remarks
1	NA	22.5.1995	Semporna, Sabah, Malaysia	?
2	59617	4.2.2001	Mabul Is., Sabah, Malaysia	GT, alive
3	MY(S)20267	13.2.2004	Kg. Beringgis, Papar, Sabah	GT, dead
4	MY(S)26350	20.7.2005	Semporna, Sabah, Malaysia	GT, alive

TERMINAL COUNTRY REPORT ON TAGGING AND SATELLITE TELEMETRY STUDY IN SARAWAK, MALAYSIA

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Introduction

The state of Sarawak is a part of the Federation of Malaysia and is geographically situated at the North-West of Borneo Island. All northern parts of Sarawak are bounded by the South China Sea on all sides, except in small portions where the country of Brunei Darussallam is located. Sarawak is bordered by Sabah (Malaysia) on the east and Kalimantan (Indonesia) on the south. It has 10 million ha (160,000 km^2) land area, almost 1,000 km coastline and 20,000 km^2 of territorial waters extending to 20 km into the South China Sea (Not included is the Exclusive Economic Zone, EEZ).

Under the Turtle Trust Ordinance 1957, all turtles and their eggs from all of the Sarawak Turtle Islands have been owned by the Sarawak Turtle Board since 1957. The Museum Sarawak Museum department is responsible for research and conservation programs on sea turtles of the Sarawak Turtle Islands under the capacity of its Director as the Executive Officer for the Turtle Board. The number of eggs for conservation and for sale to the public is decided by the Turtles Board. Most of the eggs collected are sold to the public. Revenue from selling of turtle eggs is used for the management of Sarawak Turtles Board and for Sarawak Malay Islamic Charity. Since 1990, the Sarawak Museum has received annual grants from the state government to purchase turtle eggs for conservation from the Sarawak Turtle Board. All eggs nested from May to September were bought for conservation and transferred to the hatcheries, while eggs nested from month of October till April were sold to the public.

The management and research on sea turtles of Sarawak changed in 1998 with the gazetting of the Wild Life Protection Ordinance 1998 and Sarawak Biodiversity Ordinance 1998. All species of Chelonidae and Dermochelyidae were listed as Totally Protected Animals, under the Wild Life Protection Ordinance, 1998 (Amended 2003). Any person who hunts, kills, captures, sells, offers to sell or claims to offer for sale, imports, exports, or is in possession of, any totally protected animal or any recognizable part or derivative thereof, or any nest thereof, except in accordance with the permission in writing of the Controller of Wildlife for scientific or educational purposes or for protection and conservation of such protected animal, shall be guilty of an offence. The Penalty is imprisonment for two years and a fine of twenty five thousand Ringgit (Sarawak Government Gazette, 2003).

Management and research on sea turtles of Sarawak have been undertaken by the Sarawak Forest Department. The practices by the Turtles Board selling turtle eggs to the public were revised by the Sarawak State Government. Permit to sell turtle eggs was only granted for conservation purposes. All eggs nested and conserved at Pulau Talang-Talang Besar and Pulau Satang Besar were paid by the Sarawak Museum Department, while all eggs that conserved

at Pulau Talang-Talang Kechil were purchased by Sarawak Forest Department for RM 1.00 per egg. In 2003, operational functions of Sarawak Forest Department were taken over by the SARAWAK FORESTRY Corporation (SFC). Management authority of sea turtles and all wildlife in Sarawak fall under jurisdiction of the Protected Areas and Biodiversity Conservation Unit (PABC) of SFC. Beginning from 2004, payment of turtle eggs for conservation at Talang-Talang Kechil Island has been made by the Sarawak Forestry Corporation, while at Talang-Talang Besar Island and Satang Besar Island payment is still being done by the Sarawak Museum Department.

Summary of Tagging Studies

The tagging program in Sarawak was first reported by Harrison (1956). 4,000 green turtles were tagged at the Sarawak Turtle Islands from 1953 to 1955. The tagging program was reactivated by the Sarawak Museum using monel tags in 1982, but this program was terminated due to insignificant number of tags recovered. Tagging trial using inconel tags were conducted at Talang-Talang Kecil by Sarawak Forest Department in 1996. In 1997 and 1998, the tagging program was only conducted during the peak season (May to September) at Talang-Talang Besar and Talang Talang Kechil Islands. A whole year round tagging program for all three of the Turtle Islands only began in 1999. The tagging program on the mainland was only conducted in 2004. When a regional tagging project for the South East Asian Fisheries Development Centre (SEAFDEC) member countries began in 1998, Sarawak Forest Department received 1000 units of inconel tag with code-number series MY(SA) 0001 – 1000. These 1000 inconel tags were applied on turtles at Satang Besar Islands only, because stocks of inconel tags owned by Sarawak Forest Department's were still in large amounts.

Summary on Tagging

Years	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**			
1996	299	0	0	3	1	11	6	2	0	1	1	0			
1997		489	0	1	2	12	3	5	2	2	0	0			
1998			334	0	1	10	10	2	7	3	0	0			
1999				991	0	8	26	12	27	18	9	4			
2000					710	0	1	20	14	14	3	11			
2001						738	0	5	38	33	14	21			
2002							776	0	10	22	20	18			
2003								366	0	4	5	6			
2004									639	0	3	3			
2005										511	8	5			
2006											849	3			
2007												1061			
													total	**average**	**stdev**
New turtles	299	489	334	991	710	738	776	366	639	511	849	1061	7763	646.92	252.44
% new turtles	100.00	100.00	97.09	99.60	99.44	94.74	94.40	88.83	86.70	84.05	93.09	93.73		94.31	5.41
Total Turtles	299	489	344	995	714	779	822	412	737	608	912	1132	8243	686.92	263.32
Returned	0	0	10	4	4	41	46	46	98	97	63	71	480	48	34.32
% returned	0	0	2.91	0.40	0.56	5.26	5.60	11.17	13.30	15.95	6.91	6.27	5.82	6.83	5.33

Stock Size of Nesting Population

N : (Estimated) number of nests per year:	2308.58
C : Estimated number of cluch per female/year:	3.70
F : Estimated number of females to nest per year = (N/C):	623.94
I : Average remigrating interval in year	3.18
S : Estimated stock size of nesting females = (F x I)	1984.12

Satellite Telemetry Studies

Please refer to publication below;

Bali J. 2007. Satellite Telemetry Studies on Marine Turtles of Sarawak, Malaysia in Ku-Kasim, K.Y., Syed-Abdulallah, S.A.K.(Eds.) 2008. Report of the 2^{n} Regional Technical Consultation on Research for Stock Enhancement of Sea Turtles (Japanese Trust Fund IV Program). SEAFDEC-MFRDMD/RM/23 24pp

SATELLITE TELEMETRY AND TAGGING STUDY IN MYANMAR

Chou Hla Aung
Fishheriies Officer
Department of Fiaheries of Myanmar

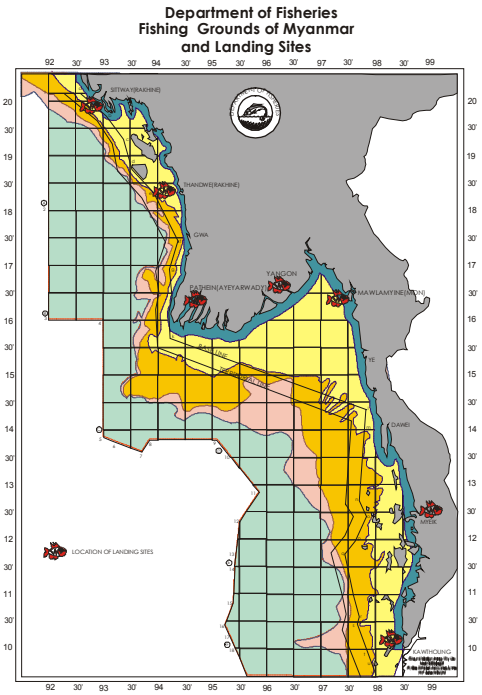
LOCATION & AREA

- Situated between
Longitude 90° – 108° E
Latitude 10° – 28° 31' N

Three Coastal Regions-
(1) Rakhine coastal
(2) Ayeyarwady and Gulf of Mottama (Delta zone)
(3) Taninthayi coastal

Coastline - 2832 km

- **Many Islands and sandy beaches for sea turtle banks.**



1963 DOF breed and protected sea turtles at Thameehla Island in Ayeyarwaddy
- In 1986 hatchery was established on Thameehla
- At present Myanmar is declared member of ASEAN / EAFDEC in 1999.
- Myanmar became Signatory State of IOSEA in 2001.

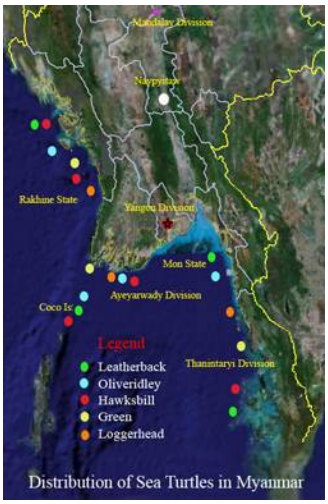
Sea Turtle Resource in Myanmar

Turtle Species found in Myanmar

Lepidochelys olivacea **(Olive ridley)**
Chelonia mydas **(Green Turtle)**
Caretta caretta **(Loggerhead)**
Eretmochelys imbricata **(Hawksbill)**
Dermochelys coriacea **(Leatherback)**

Two species considered almost extinct

- **Loggerhead and Leatherback are found in some parts of Rakhine but seldom in Thaninthayi.**



Objectives for Sea Turtle Conservation

1. Preserve and restore development feeding and nesting habitats.
2. Make nesting beaches acceptable to turtles by eliminating the advised impact through compulsory, mandatory and law enforcement.
3. To implement beach cleaning programmes and prevent predator activities.
4. Minimizing waste and pollution of the marine environment.
5. Increasing public awareness and participation in Sea turtle Conservation through extension and public education work.

Nesting Population of Turtle Nesting Sites in Myanmar

NOs.	Nesting site	Average				Range				Remark
		CM	LO	CC	EI	CM	LO	CC	EI	
1.	Kadongalay	-	48.17	-	-	-	22-86	-	-	1-100
2.	Gayetgyi	-	48.48	-	-	-	34-16	-	-	1-100
3.	Thameehla	176.5	5	-	-	20-282	1-10	-	-	CM -101-500 LO 1-10
4.	Ashaet Phyar	-	4.75	-	-	-	2-6	-	-	1-10
5.	Nga Mun Thaung	-	8	-	-	-	1-13	-	-	1-10
6.	Ma Sein Yone	-	6.2	-	-	-	2-8	-	-	1-10
7.	Hnet Oo Thaung	-	8	-	-	-	5-11	-	-	1-10
8.	Thin Pann (Oyster)	-	9	-	9	-	9	-	9	1-10
9.	Long Lon Bok	-	7	-	-	-	1-13	-	-	1-10
10.	Mingalar Thaung Tann	-	4.33	-	-	-	1-10	-	-	1-10
11.	War Daw Gone	-	7	-	-	-	7	-	-	1-10
12.	Htaung Gyi Tann	-	1	-	-	-	1	-	-	1-10
13.	Coco	-	8	-	-	-	8	-	-	1-10
14.	Kwin Bauk (Amatt Gyi)	-	17.3	-	-	-	3.32	-	-	10-100

CM: *Chelonia mydas*, LO: *Lepidochetys olivacea*, CC: *Carreta carreta*,

EI: *Eretmochelys imbricata*

Tagging Activities

- Myanmar has been declared one of the member countries in SEAFDEC(1999)
- DoF's staff could participate in training organized by MFRDMD (1998)
- Applicators & Inconel Tags(National Band and Tag Co.,USA) were provided by MFRDMD(2001)

- Applicators & 3000 nos. of Inconel Tags were sent to Bogalay, Laputta Township& Ngapudaw Township in Ayeyarwaddy Division in 2001 and 2005 respectively and sent to Longlone Township in Thanintharyi Division in 2006

DoF has received 25 PITs Microchips and Reader(AVID Power Tracker II, 3197 Hamner Avenue,Norco, California,USA) were sent to Thameehla Island in Ngapudaw Township in March, 2004

Tagging Activities

- **Tagging activity was carried out during the nesting season starting from 23/12/2001**

Tagging Areas

Ayeyarwaddy Division

Thameehla Island(Ngapudaw Tsp) -15°.51' N 94°.17' E

Kadongalay Island(Bogalay Tsp)-15°.40'.42.72''N 95°.13'.08.27'' E

Gayetgyi Island (Bogalay Tsp)-15°.39'.56.77''N 95°.17'.18.44'' E

Wardawgone Beach (Laputta Tsp)-15°.42'.26.84'' N 95°.03'.28'.83'' E

Amattgyi Beach(Laputta Tsp)-15°.46'.07.57''N 94°.54'.21.80'' E

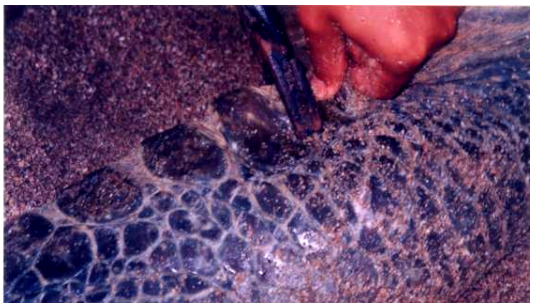
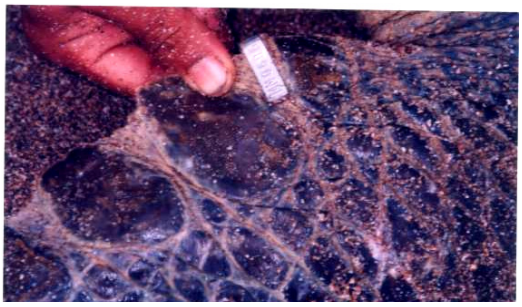
Thanintharyi Division

Longlonbok Island(Longlone Tsp)-13°.49'.54.34'' N 97°.54.51' E

The Numbers of Inconel Tagged Turtles in Myanmar (2001) to (2008)

Site	Green	Olive ridley	Hawksbill	Total
Thameehla (Diamond) Island	270	2	1	273
Kadongalay Island		96		96
Gayetgyi Island		125		125
Coco Island	42	1	4	47
Long Lon Bok Island	3		1	4
Sittwe Beach		1		1
Thin Pann (Oyster) Island	1	20	6	27
Nga Mun Thaung Island		6		6
War Daw Gone Beach		3		3
Kwin Bauk (Amatt Gyi) Beach		9		9
Total	**316**	**263**	**12**	**591**

Tagging on Sea Turtles

Tagged Turtles and Tags Recovered in Myanmar

Spices Tagged	Total No. of Tagged Turtles	Tags Recovered			
		Nos.	Frequency	% of Nos	% of Frequency
Chelonia mydas	316	77	112	24.36	35.44
Depidochelys olivancea	263	32	29	12.16	11.026
Erethmochelys imbricata	12	-	-	-	-
	591	**109**	**141**	**18.44**	**23.85**

PTT tagging activities in Myanmar

- **Applicators and Inconel Tags were supported by MFRDMD in November 2001. Tagging activity was carried out for nesting Sea Turtles which were returned to the sea starting from 23 December 2001.**
  - **Green Turtles- 243 nos.**
  - **Olive Ridley - 189 nos.**
  - **Hawksbill - 1 no.**
- **DOF received Passive Integrated Transponders (PIT) and Scanner from MFRDMD in April 2003.**
  - **Green Turtles - 25 nos.**

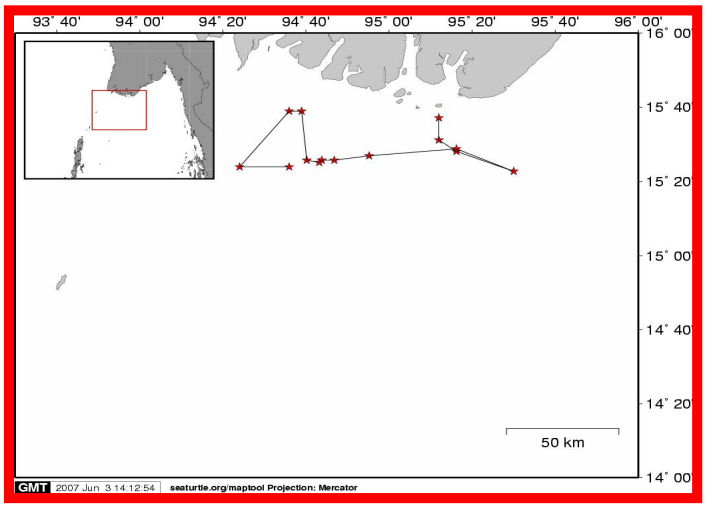
PTTs was installed on Olive Ridely in January, 2007. It was provided by MFRDMD.(In line with the Japanese Trust Fund IV PTTs)
At the same time the research officer from MFRDMD conducted training on Turtle Conservation and Installation of PTTs from 24 to 28 December 2007 .

Signal of an Olive Ridley turtle fitted with Platform Terminal Transmitter (PTTs) was lost at 94° 35' E 15° 25' N on 14 January 2007.

Microchip (ID) Tagged On Green Turtles (*Chelonia Mydas*) And Recovered At Thameehla Island,myanmar

Date	Tag Number	1st	2sth	3th	4th	5th	6th
8/3/04	114523170 A						
8/3/04	126964693 A						
12/3/04	114812692 A						
12/3/04	114545357 A	26/3/2004					
13/3/04	114663455 A						
15/3/04	114814791 A						
22/3/04	116866163 A						
23/3/04	116926322 A						
24/3/04	116521191 A						
25/3/04	116921451 A						
5/4/04	114546163 A						
20/4/04	114752327 A						
21/4/04	114754662 A						
22/4/04	114768726 A						
21/7/04	114811522 A						
31/7/04	114531322 a						
10/8/04	114561560 A						
25/8/04	114836335 A						
25/8/04	114809527 A						
26/8/04	116454624 A						
26/8/04	116853597 A						
13/11/04	116926512 A	27/11/04	3/2/05				
14/11/04	114649627 A						
14/11/04	114757227 A						
15/11/04	114672447 A	27/11/04	8/12/04	1/1/05			

- **Signal of an Olive Ridley turtle fitted with Platform Terminal.**
- **Transmitter(PTTs) was lost at 94° 35' E 15° 25' N on 14 January 2007.**
- **Movement of Olive Ridley turtle, ID 25403 from Kadongalay Island**



TERMINAL COUNTRY REPORT ON TAGGING AND SATELLITE TELEMETRY STUDIES IN THE PHILIPPINES

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Introduction

The Pawikan Conservation Project (PCP) of the Protected Area and Wildlife Bureau (PAWB) under the Department of Environment and Natural Resources (DENR) is the focal agency in the implementation of marine turtle conservation activities in the Philippines. Part of the conservation activities is the population and migration studies that include tagging of marine turtles. In coordination with the DENR Regional Offices, Local Government Units and non-government offices, tagging activity is being implemented almost throughout the coastal areas of the Philippines.

Summary of Tagging Studies

The PCP-PAWB is responsible for distributing marine turtle tags throughout the country. It started its tagging activity in 1982. The first turtles tagged were Green turtles, nesting in the Turtle Islands (now the Turtle Islands Wildlife Sanctuary, a protected area) in the province of Tawi-Tawi. The first tags were made of stainless steel manufactured in the Philippines. Inscription of the first batch of stainless steel tags were number series from A001-A999 to J001-J999. The next batch of stainless steel tags came out in 1990 with number series RP001-RP999 and with letter suffixes from A to F. In 1997, the PCP-PAWB procured tags from the National Band and Tag Company for the first time. These were monel tags with number series of P10001-P20000. However, from 2001 onwards, inconel tags were being used. The first batch of inconel tags were with number series P20001-23000. Also the number series with prefix PH came out in 2001. The prefix PH was assigned to the Philippines by the Marine Turtle IOSEA MoU for the purpose of standardizing tags worldwide. Aside from its regular tag procurement, the PCP-PAWB was fortunate to receive tag donations from the Marine Fishery Resources Development and Management Department-Southeast Asian fisheries Development Center (MFRDMD-SEAFDEC) and NGOs (*refer to Table 1*).

Table 1. Donated Inconel Tags

Donor of inconel tags	Number series	No. of tags	Date donated
MFRDMD-SEAFDEC	PH1001-PH2000	1000	2003
Environmental Protection for Asia Foundation Inc.	PH6001-PH7000	1000	2005
Conservation International Philippines	PH7001-PH8000	1000	2005
MFRDMD-SEAFDEC	PH8001-PH8600	600	2006

In 2006, another batch of inconel tags was procured. It has a number series with prefix PH and suffix letters from A to C. The summary of tags used in the Philippines since 1982 to present can be seen in *Table 2*.

Table 2. Summary of Tags Applied in the Philippines from 1982 to 2008

Prefix	Number series	Suffix	Tag Model / Manufacturer	Return Message on Tag	Approx Year Applied
A to J	001-999	none	Stainless Steel Philippines	Task Force Pawikan, Phils	1982
RP	001-999	A	Stainless Steel Philippines	PCP, PAWB-DENR, Quezon City, Philippines 1101	1990
RP	001-999	B	Stainless Steel Philippines	PCP, PAWB-DENR, Quezon City, Philippines 1101	1990
RP	001-999	C	Stainless Steel Philippines	PCP, PAWB-DENR, Quezon City, Philippines 1101	1990
RP	001-999	D	Stainless Steel Philippines	PCP, PAWB-DENR, Quezon City, Philippines 1101	1990
RP	001-999	E	Stainless Steel Philippines	PCP, PAWB-DENR, Quezon City, Philippines 1101	1990
RP	001-999	F	Stainless Steel Philippines	PCP, PAWB-DENR, Quezon City, Philippines 1101	1990
P	10001-20000	none	Monel National Band & Tag Co.	PCP-PAWB-DENR Philippines	1997
P	20001-23000	none	681 Inconel National Band & Tag Co.	PCP-PAWB-DENR Philippines	2001
PH	0001-8600	none	681 Inconel National Band & Tag Co.	PCP-PAWB-DENR Philippines	2001
PH	0001-1000	A	681 Inconel National Band & Tag Co.	PCP-PAWB-DENR Philippines	2006
PH	0001-1000	B	681 Inconel National Band & Tag Co.	PCP-PAWB-DENR Philippines	2006
PH	0001-1000	C	681 Inconel National Band & Tag Co.	PCP-PAWB-DENR Philippines	2006

Although five species of marine turtles are found in the Philippines, inconel tags have been applied mostly to Green turtles (*chelonia mydas*), Hawksbill turtles (*eretmochyles imbricata*) and Olive Ridley turtles (*lepidocyles olivacea*) since 2001. Most of these tags were applied in the Turtle Islands. Tags were also applied to turtles in nesting beaches of the provinces of Ilocos, Pangasinan, Zambales, Bataan, Batangas, Palawan as well as in the Bicol region, coastal areas of the Visayan provinces and Davao Gulf in Mindanao. The tags donated by the MFRDMD-SEAFDEC in 2003 and 2006 were mostly applied in the Turtle Islands Wildlife Sanctuary (TIWS) which is part of the Turtle Islands Heritage Protected Area (TIPHA), a bilateral agreement between the Governments of the Philippines and Malaysia (*refer to Map 1*). Outside TIWS, about 111 marine turtles have been tagged using SEAFDEC donated tags.

Summary on Tagging

A total of 15,269 marine turtles were tagged throughout the Philippines from 1982 to 2007. Out of the total number of tagged turtles, 11,289 marine turtle nesters or 74% came from the TIWS. From 1983-1986, 360 green turtle nesters were tagged in Bancauan Island which is part of San Miguel Islands and within the Municipality of Mapun (formerly Cagayan de Tawi-Tawi), province of Tawi-Tawi.

In 1985, tagging activity started outside the TIWS and Bancauan Island. A total of 3,620 marine turtles were tagged from 1985-2007. Inclusive of the said figure are 92 Olive Ridley nesters tagged in Morong, province of Bataan from 1999 to February 2008 *(refer to Table 3)*. Also, since 1985, tagging of turtles has not been limited to nesting turtles but also to juvenile and sub-adult turtles measuring at least 40cm carapace length.

Table 3. Species: Olive Ridley in Morong, Bataan 1999-February 2008

No	Nesting Season (Aug-Feb)	Number of turtles tagged	Number of turtle recoveries	Total no. of turtle eggs	Total no. of eggs incubated	Total no. of hatchlings released
1	1999-2000	14	4	2993	640	lost data
2	2000-2001	9	0	6175	6175	3828
3	2001-2002	17	5	5900	6568	4961
4	2002-2003	15	2	5048	5360	4431
5	2003-2004	20	6	5985	5979	4988
6	2004-2005	7	1	5790	5787	5026
7	2005-2006	0	2	3874	3874	3447
8	2006-2007	5	0	3553	3545	2912
9	2007-2008	5	2	4388	4387	3656

Species: Green and Hawksbill Turtles in Turtle Islands Wildlife Sanctuary 1997-2007

No	Year	Number of turtles tagged	Number of turtles recovery*	Total no. of turtle eggs	Total no. of eggs incubated**	Total no. of hatchlings released
1	1997	770		1737063		
2	1998	557		1051399		
3	1999	614		1719132		
4	2000	487		1071832	26498	14171
5	2001	671		1107004	168205	42580
6	2002	689		1097045	13925	20652
7	2003	375		1093388	11420	4806
8	2004	286		1491626	82526	31784
9	2005	116		909013	132815	62289
10	2006	204		1139086	189902	83018
11	2007	136		1054291	104625	111016

*Refer to Summary of Tag Recovery

**Out of 5 islands of Turtle Islands, Baguan Island has about 52% of the total number of eggs in TIWS. “In-situ” practice is being applied to most nests in Baguan Island.

Summary on Tag Recovery

There are about 87 tag recoveries with SEAFDEC tags gathered in the Turtle Islands Wildlife Sanctuary. However, 52 of these tag recoveries showed only inter-nesting data and only about 35 of the tag recoveries showed remigration data. Below is the summary of the SEAFDEC tag recovery with remigration data.

Table 5. SEAFDEC tag recoveries of Green Turtles in Turtle Islands Wildlife Sanctuary

	Tag No.		Release		Recovery		Interval	
	Right	Left	Date	Rookery	Date	Rookery	Yr	Mo
1	PH6663	P10566	26-May-97	Baguan	7-Jul-05	Baguan	8	
2	PH6454	PH0725	21-May-99	Baguan	15-Jun-05	Baguan	6	
3	PH0317	PH0318	17-May-99	Baguan	29-Jun-05	Baguan	6	
4	PH0988	P20824	3-Jul-99	Baguan	7-Jul-05	Baguan	6	
5	PH1017	P20007	9-Sep-00	Baguan	14-Nov-03	Baguan	3	2
6	PH1989	PH1990	Sept 2000	Langaan	06-Nov-03	Langaan	3	2
7	PH1501	PH1502	5-Oct-00	Lihiman	19-Sep-03	Lihiman	2	11
8	PH1578	PH1579	29-Sep-00	Lihiman	22-Sep-03	Lihiman	3	
9	PH1584	P19288	28-Sep-00	Lihiman	29-Sep-03	Lihiman	3	
10	PH1588	PH1587	28-Sep-00	Lihiman	11-Oct-03	Lihiman	2	11

11	PH1587	PH1588	28-Sep-00	Lihiman	27-Nov-03	Lihiman	3	1
12	PH1303	PH1304	26-Nov-00	Baguan	12-Feb-04	Baguan	3	2
13	PH1016	PH1659	28-Aug-00	Baguan	24-Sep-06	Baguan	6	1
14	PH1476	RP6469	25-Sep-00	Baguan	24-Sep-06	Baguan	6	
15		PH1632	18-Aug-00	Baguan	14-Oct-06	Baguan	6	2
16	PH1423	PH1422	28-Aug-00	Baguan	21-Dec-06	Baguan	6	4
17	P20573	PH1924	18-Aug-00	Baguan	9-Apr-04	Baguan	3	8
18	PH1903	P19209	16-Aug-00	Baguan	19-Jul-06	Lihiman	5	11
19	PH1031	PH1032	3-Sep-00	Baguan	24-May-04	Baguan	3	8
20	PH1953	PH1954	Feb 2001	Baguan	08-Nov-03	Langaan	2	8
21	PH1322	PH1323	20-Feb-01	Baguan	15-Feb-04	Baguan	3	
22	PH1935	PH1936	5-Feb-01	Baguan	18-Feb-04	Baguan	3	
23	PH1442	PH1443	28-Apr-01	Langaan	7-Jun-05	Lihiman	4	11
24	PH1786	PH1785	27-Jul-01	Baguan	11-Apr-06	Baguan	4	9
25	PH1436	PH1435	3-Apr-01	Langaan	26-May-06	Langaan	5	
26	PH1373 MYS4044	MYS4045	28-Mar-01	Lihiman	24-Jun-06	Lihiman	5	3
27	PH6653	PH1745	25-Jul-01	Bakungaan	6-Jul-05	Baguan	4	
28	PH1725	PH1751	25-Jul-01	Baguan	24-Jul-04	Baguan	3	
29	PH1413	PH1381	1-Sep-01	Baguan	26-Aug-05	Baguan	4	
30	PH4250	PH4253	21-Apr-02	Lihiman	2-Apr-05	Lihiman	3	
31	PH4459		28-Jul-02	Lihiman	22-May-05	Lihiman	3	
32	PH5485	PH5486	29-Jul-02		23-May-05	Lihiman	3	
33	PH6500	P22468	25-Jun-02	Baguan	29-Jun-05	Baguan	3	
34	P22355	PH6449	20-Jul-02	Baguan	29-Jun-05	Baguan	3	
35	P22388	P22389	29-Jun-02	Baguan	9-Jul-05	Baguan	3	

Stock Size of Nesting Population

Table 6. Formula to Estimate Stock Size of Nesting Females

N	(Estimated) number of nests per year
C	Estimated number of clutch per female/year
F	Estimated number of females to nest per year = **(N/C)**
I	Average remigrating interval in year
S	Estimated stock size of nesting females = **(F x I)**

The existing data gathered from Morong, Bataan is insufficient to calculate the 'Estimate Stock Size of Nesting Females' (ESSNF) for Olive Ridley turtles given the formula above. In addition, more data should be gathered from other areas of Bataan and the provinces of Zambales and Batangas to get a better estimate of the ESSNF for Olive Ridleys.

In the case of Green turtles in TIWS, ESSNF cannot be calculated since data to get factors C and F of Table 6 are insufficient. However, the ESSNFs of Green and Hawksbill turtles in TIWS can be calculated considering the following factors:

1. Green turtle nesters in TIP and TIWS are one distinct stock based from the results of two genetic studies done. The first set of results were published by Dethmers, KM et al., 2006 and the second set of results were presented at the 3rd Regional Technical Consultation on Research for Stock Enhancement of Sea Turtles at Kuala Lumpur, Malaysia on 15-17 October, 2008;
2. Sabah Parks has calculated the ESSNFs of Green and Hawksbill turtles in the Turtle Island Park (TIP) to be 21,534 and 600, respectively. The figures were presented at the 3rd Regional Technical Consultation on Research for Stock Enhancement of Sea Turtles at Kuala Lumpur, Malaysia on 15-17 October, 2008;
3. The percentages between Green turtles and Hawksbill turtles in TIP are 91.14% (green) and 8.86% (hawksbill). The figures were based on the total number of eggs in TIP (2003-2005) of Sabah Parks' reports during the meetings of the Philippine-Malaysia Joint Committee Management for the TIHPA;
4. The total number of eggs in TIP from 1997-2007 is 7,067,004. This was provided by Sabah Parks;
5. The total number of eggs in TIWS from 1997-2007 is 13,470,879; and
6. The percentages between Green turtles and Hawksbill turtles in TIWS are 99.89% (green) and 0.11% (hawksbill).

Taken all these into account, the 'Estimated Stock Size of Nesting Females' for Green and Hawksbill turtles in TIWS are 44,991 and 14, respectively. In conclusion, the 'Estimated Stock Size of Nesting Females' for Green and Hawksbill turtles in the Philippine-Malaysia Turtle Islands Heritage Protected Area are 66,525 and 614, respectively *(Refer to Figure 1)*.

Satellite Telemetry Study

A total of 12 satellite transmitters were tagged to Green turtle and Hawksbill turtle nesters at the Turtle Islands Heritage Protected Area (TIHPA) from 1998 to 2002. This was one of the joint studies conducted by the PCP-PAWB and Sabah Parks, focal agencies of the Philippine-Malaysia Joint Management Committee for the TIHPA.

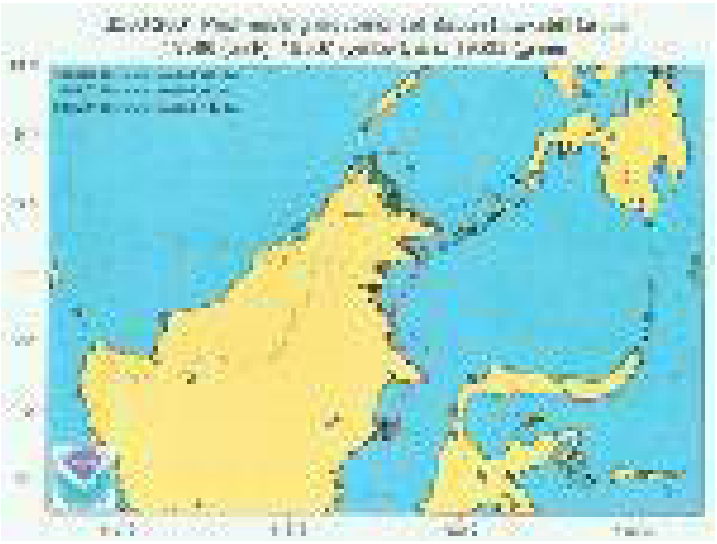
In 1998, two Green turtle nesters were tagged at Baguan Island, TIWS. In 1999, two Green turtle nesters were tagged, one from Baguan Island and one from Selingaan Island under Sabah Parks, Malaysia. Telonics ST 14 transmitters were used in this particular activity. In 2001, four Green turtle nesters were tagged, two from Baguan Island and two from Selingaan, Sabah Parks. Telonics ST 18 transmitters, cheaper than Telonics ST 14 were used. Also from 2001-2002, four Hawksbill turtle nesters were tagged, two from Lihiman Island and two from Sabah Parks, Malaysia. Telonics ST 14 transmitters were used.

The first four Telonics ST 14 transmitters were provided by the Coastal Resources Management Program, a USAID funded program of the DENR. The Telonics ST 18 transmitters were donated by the WWF-Philippines and the Telonics ST 14 transmitters which were attached to Hawksbill turtles were provided by the National Oceanic and Atmospheric Administration (NOAA) of the US Department of Commerce.

The satellite tracking results showed that the probable foraging areas for Green turtles are within the waters of Balabac, Palawan and the provinces of Tawi-Tawi, Jolo and Basilan, Philippines. The feeding areas for Hawksbill turtles are: Balabac, Palawan; northern part of Sabah; Berawan Islands, East Kalimantan, Indonesia and probably beyond East Kalimantan, Indonesia (*Refer to Maps 2-4)* (Cruz and Torres, 2003).

Map 2

Map 3



Map 4

Table 7. Green and Hawksbill Turtles' Migration

Nesting Beach	Species	Migration Area	Foraging Area	Source (Tag/ Satellite Tracking)	References
Turtle Islands Wildlife Sanctuary, Tawi-Tawi	Green	Sulu sea	Tawi-Tawi, Jolo, Basilan, Palawan, Bicol region, Visayan waters-central part of the Philippines	Satellite tracking and tag recovery	Cruz and Torres, 2003
Turtle Islands Wildlife Sanctuary, Tawi-Tawi	Hawksbill	Sulu sea and Suluwesi	Balabac, Palawan; Northern Sabah; and Berawan Islands, East Kalimantan, Indonesia	Satellite tracking	Cruz and Torres, 2003

Information on Sea Turtle Migration and Possible Interaction with Fisheries

One of the details included in the tagging reports regularly sent by the DENR Regional Offices, throughout the Philippines is the type of fishing gear that causes the capture of turtles. From 1985 to 2007, fish corral/'otoshi-ami' and gill nets ranked as the top fishing gears that accidentally captured turtles. This was followed by hook and line. In 2006-2007, perception surveys conducted by the Fisheries and Aquatic Resources of the Department of Agriculture in 15 sites in the Philippines showed that set net, gill net, and fish corral/'otoshi-ami' were the top fishing gears that accidentally captured turtles. This was followed by hook and line and trawl fishing. However, turtles caught in 'otoshi-ami' and fish corral did not cause mortality to turtles. *(See Matrix on interaction of marine turtle with fisheries in inter-nesting, migration route and foraging areas)*

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Figure 1

Turtle Island Park (Malaysia)	Est. Stock Size of Nesting Females based on 1997-2007	Turtle Islands Wildlife Sanctuary (Philippines)	Est. Stock Size of Nesting Females based on 1997-2007
Green	21,534	Green	???????
Hawksbill	600	Hawksbill	???????

TIHPA No. of Eggs from 1997-2007	
Malaysia TIP	7,067,004
Philippines TIWS	13,470,879

Based on Malaysia TIP No. of Eggs from 2003-2005		Based on Phil TIWS No. of Nests from 2003-2007	
Species	Percentage	Species	Percentage
Green	91.14	Green	99.89
Hawksbill	8.86	Hawksbill	0.11

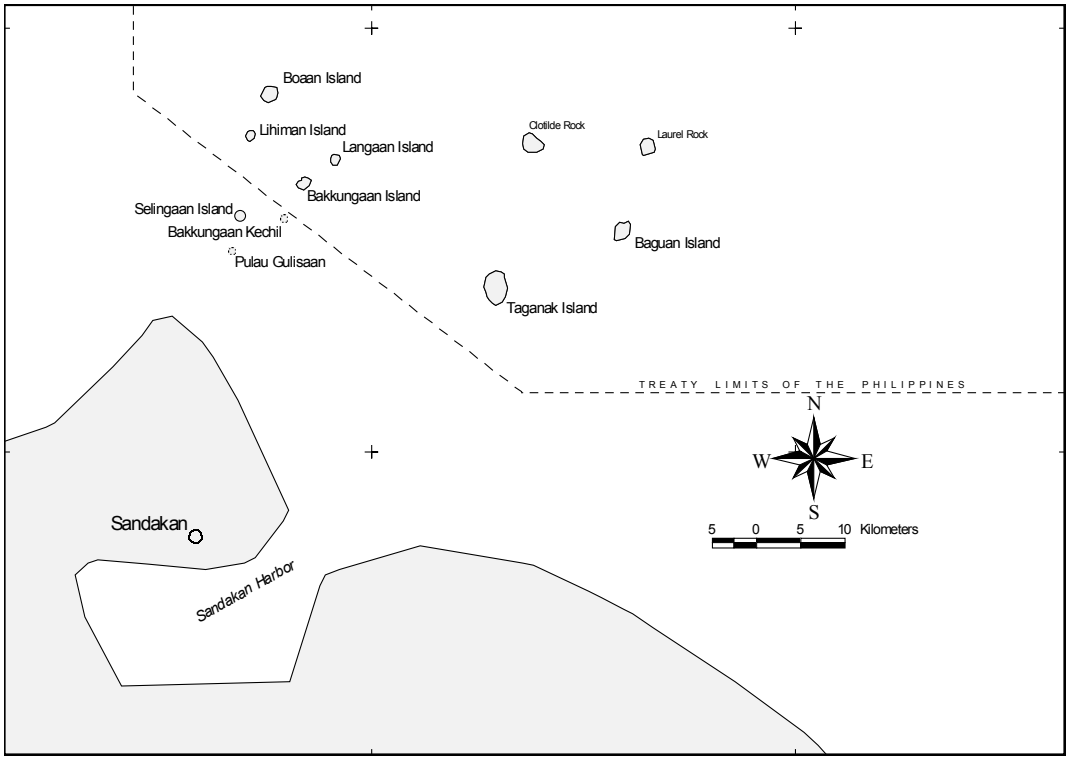
Malaysia TIP			Philippines TIWS		
Species	No. of Eggs 1997-2007	% based on TIP No. of Eggs (2003-2005)	Species	No. of Eggs 1997-2007	% based on TIWS No. of Nests (2003-2007)
Total	7,067,004	100.00%	Total	13,470,879	100.00%
Green	6,440,867	91.14%	Green	13,456,061	99.89%
Hawksbill	626,137	8.86%	Hawksbill	14,818	0.11%

TIHPA Hawksbill turtles			TIHPA Green turtles		
Malaysia TIP	626,137	97.69%	Malaysia TIP	6,440,867	32.37%
Phil TIWS	14,818	2.31%	Phil TIWS	13,456,061	67.63%
Total	640,955	100.00%	Total	19,896,928	100.00%

TIHPA Green Turtles	Est. Stock Size of Nesting Females	
Malaysia TIP	21,534	
Philippines TIWS	44,991	= (21534) x 67.63% / 32.37%
Total	66,525	

TIHPA Hawksbill turtles	Est. Stock Size of Nesting Females	
Malaysia TIP	600	
Philippines TIWS	14	= (600) x 2.31% / 97.69%
Total	614	

Map 1


Boaan Island
Lihiman Island
Langaan Island
Clotilde Rock
Laurel Rock
Bakkungaan Island
Selingaan Island
Bakkungaan Kechil
Pulau Gulisaan
Baguan Island
Taganak Island
TREATY LIMITS OF THE PHILIPPINES
N
W
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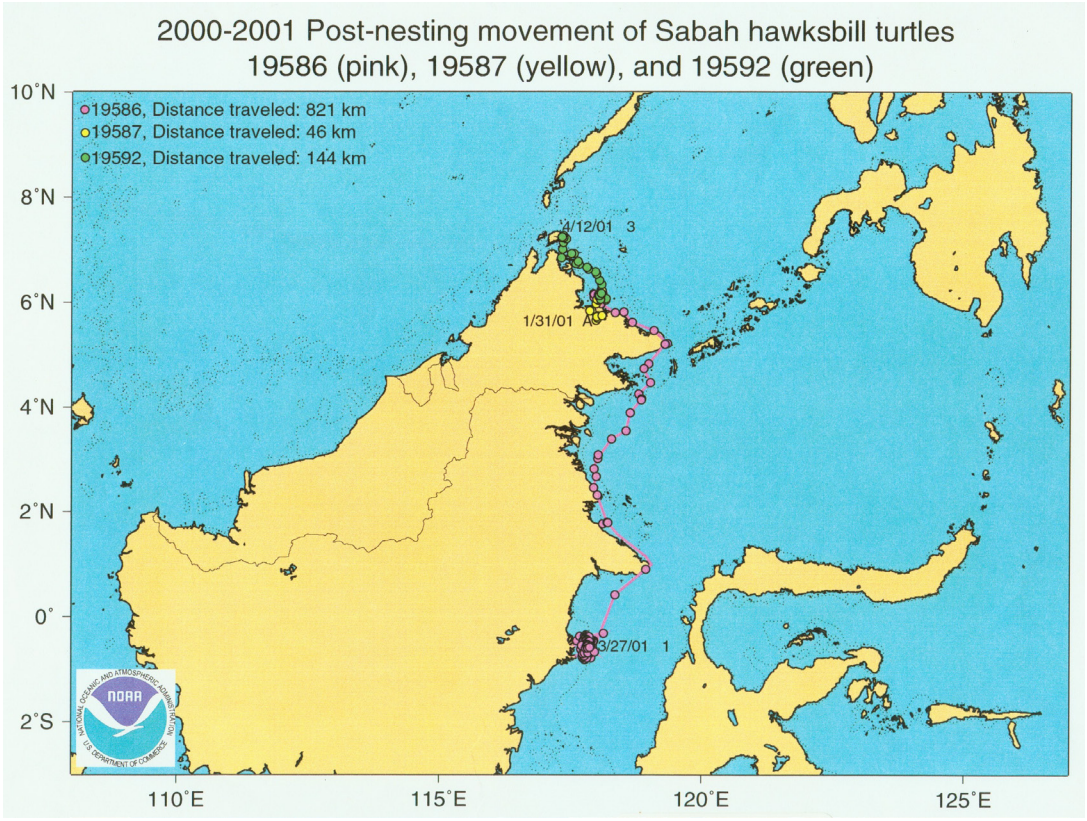
5 0 5 10 Kilometers
Sandakan
Sandakan Harbor

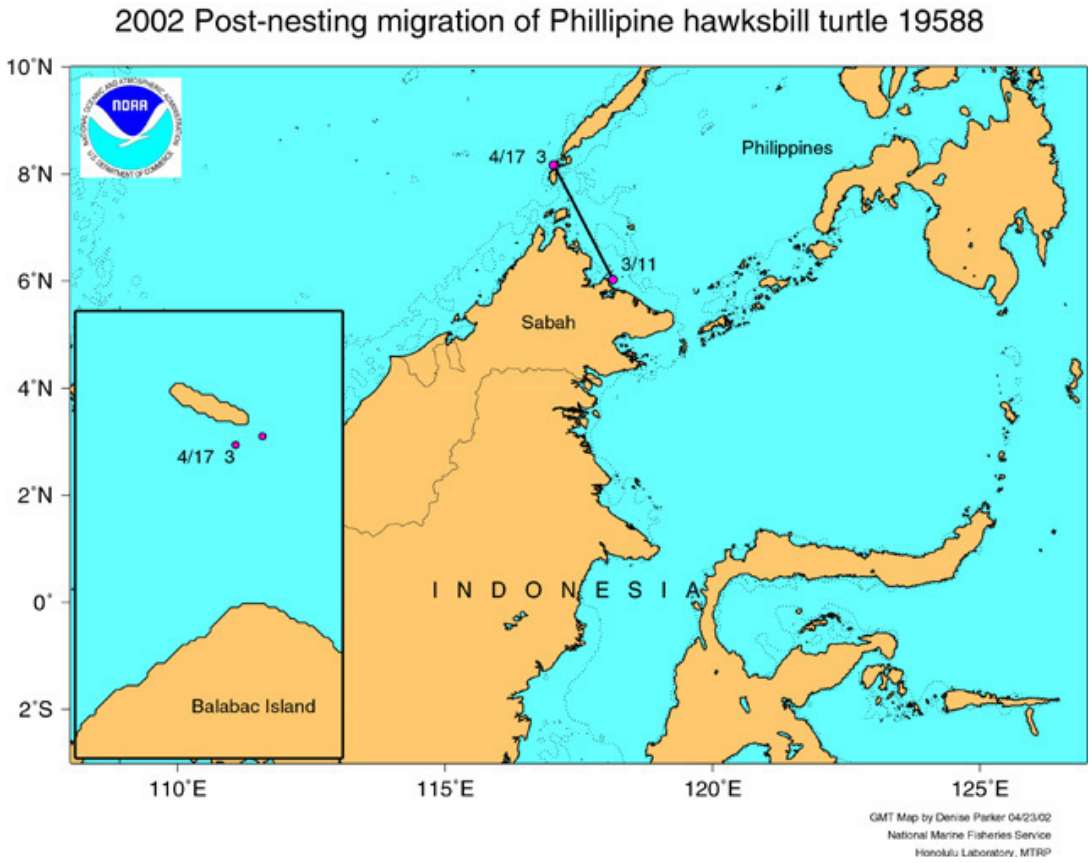
Map 2


TURTLE ISLANDS
BORNEO
(Malaysia)
SULU
SEA
SULU ARCHIPELAGO

Map 3


2000-2001 Post-nesting movement of Sabah hawksbill turtles
19586 (pink), 19587 (yellow), and 19592 (green)
19586, Distance traveled: 821 km
19587, Distance traveled: 46 km
19592, Distance traveled: 144 km
4/12/01 3
1/31/01 A
3/27/01 1
10°N
8°N
6°N
4°N
2°N
0°
2°S
110°E
115°E
120°E
125°E

Map 4


2002 Post-nesting migration of Phillipine hawksbill turtle 19588
4/17 3
3/11
Philippines
Sabah
4/17 3
I N D O N E S I A
Balabac Island
10°N
8°N
6°N
4°N
2°N
0°
2°S
110°E
115°E
120°E
125°E
GMT Map by Denise Parker 04/23/02
National Marine Fisheries Service
Honolulu Laboratory, MTRP

TAGGING AND SATELLITE TELEMETRY STUDY IN THAILAND

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[1]Phuket Marine Biological Center, 51 Sakdides Rd. Phuket 83000 Thailand, [2]Mannai Seaturtle Conservation Center, [3]Marine and coastal Research Center Songkhla

Introduction

Five species of seaturtles (ranked from the highest relative abundance to the lowest) *i.e.* Green turtles (*Chelonia mydas*), Hawksbill turtles (*Eretmochelys imbricata*), Olive Ridleys (*Lepidochelys olivacea*), Leatherback turtles (*Dermochelys coriacea*), and Loggerhead turtles (*Caretta caretta*) have been observed (Figure 1). All species except Loggerhead turtles nest along the coast or islands in Thailand.

Attempts to protect and enhance sea turtle populations have been launched in several ways. Four national Acts (Fisheries Act 1947, National Park Act 1961, Export and import Act 1979, Wildlife Reservation and Protection Act 1992) were enacted to directly protect sea turtles as well as to protect their feeding, inter-nesting and nesting grounds. Along with the law enforcement, various aspects of biological studies for instance, nesting statistics and behavior, rearing technique, population genetic and telemetry have been carried out to get better understanding of sea turtle life history. Captive rearing and breeding projects have begun since 1973. The project was, later on, adopted by Her Majesty Queen of Thailand. More than 70,000 sea turtles aged between 4-12 months old have been released under the project. Public awareness building programs have also been deployed as an additional means for the conservation of sea turtles in Thailand. A national action plan has also undergone the various developing process among responsible organizations.

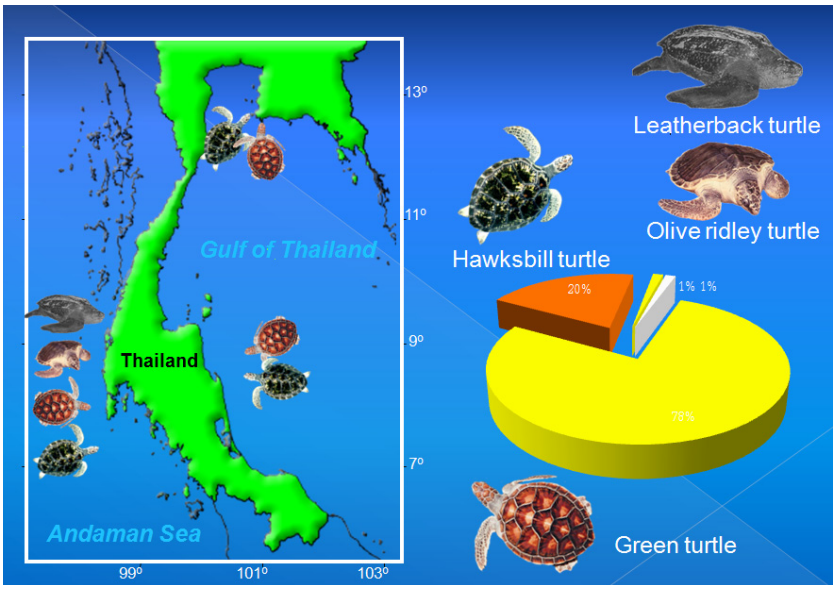


Fig 1. Species, Nesting Sites and Relative Abundance of Sea Turtles Found in Thai Waters.

The above illustration shows that the occurrence of Green, Hawksbill, Leatherback, Olive Ridley and Loggerhead turtles were 78%, 20%, 1%,1% and lesser than 1%, respectively.

Summary of Tagging Studies

During 1979-1983, 2000-3000 head-started turtles (green, olive ridley and hawksbill turtles) were tagged with plastic tags (Figure 2.) and released into the Andaman Sea. From 1999 till recently, a total number of 1336 Inconel tags and 3302 PIT tags have been deployed (Figure 3.). A summary of tagging numbers is revealed as Table 1. A large proportion of PIT tags (75%) were used in head-started sea turtles, nearly equal amount of PIT tags were used in head-started sea turtles (44%) and nesters (46%) as shown in Figure 4.

Fig 2. A round shaped plastic tag, one of several types of plastic tag employed to tag Green, Olive Ridley and Hawksbill turtles in Thailand during 1979-1983.

Fig 3. The Inconel tags used in Thailand has a prefix “TH(P)” for tagging the sea turtles from the West coast of Thailand while the prefix “TH” was for the turtles from the East coast. The tags were usually attached to the right flipper.

Table 1. A Summary of Tag (Inconel And PIT) Used in Thailand.

Year	Andaman Sea		Gulf of TH		SEAFDEC MFRDMD	
	Inconel	PIT	Inconel	PIT	Inconel	PIT
1998					1100	-
1999	14	20	260	239	-	-
2000	5	86	62	175	-	-
2001	71	70	50	95	-	25
2002	66	71	87	126	-	-
2003	65	50	101	242	-	-
2004	77	64	15	125	-	-
2005	117	251	12	107	600	-
2006	112	160	10	152	-	-
2007	98	291	18	221	-	-
2008	39	258	9	65	-	-
Total	664	1321	672	1981	1700	25

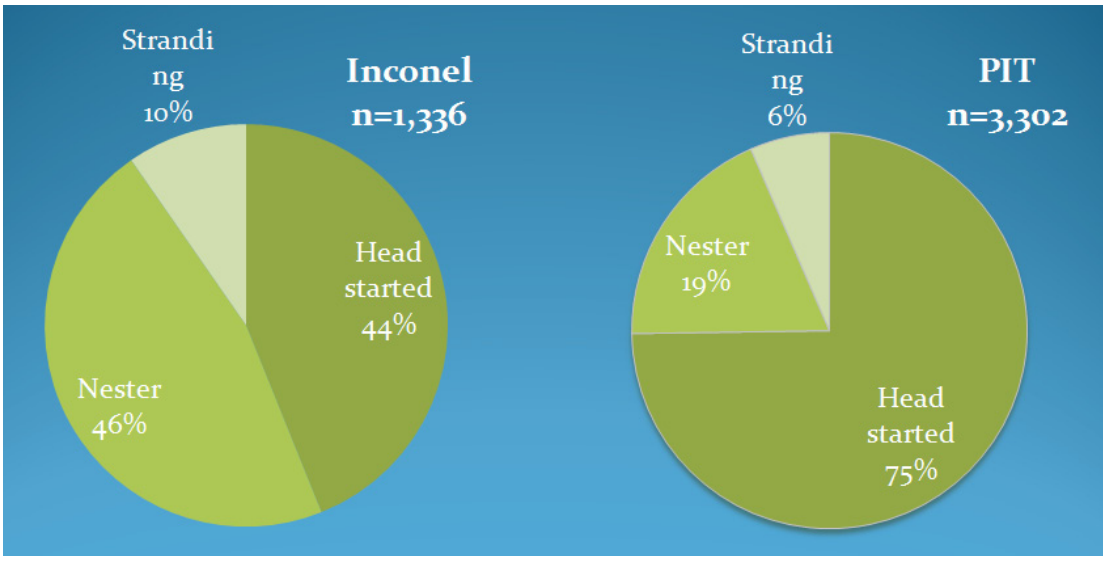


Fig 4. The Proportions of Inconel and PIT Tags Used during 1999-2008.

Summary on Tagging

The tagging database of sea turtles in Thailand is available at www.pmbc.go.th. The summary of tagging of Green and Hawksbill turtles at Khram Island were shown as Table 2 and 3, respectively.

Table 2. A Summary of Tagging of Green Turtle at Khram Island

Year	No.turtle tagged	No.turtle recovery	Total of found	% of turtle remigration	Total of nests found
1994	11	0	11	0%	215
1995	25	0	25	0%	238
1996	16	0	16	0.00%	223
1997	21	0	21	0.00%	257
1998	13	2	15	13.30%	235
1999	15	6	21	29%	292
2000	12	2	14	14.30%	134
2001	14	8	22	36.40%	162
2002	10	8	18	44.40%	114
2003	3	6	9	67%	98
2004	8	12	20	0.6	128
2005	2	4	6	67%	75
2006	5	13	18	72%	
2007	2	4	6	66.70%	
2008	2	3	5	60.00%	

Table 3. A Summary of Tagging of Hawksbill Turtle at Khramisland

Year	No.turtle tagged	No.turtle recovery	Total of found	% of turtle remigration	Total of nests found
1999	3	0	3	0%	99
2000	1	0	1	0%	49
2001	1	1	2	50.00%	43
2002	5	2	7	28.60%	68
2003	1	2	3	66.70%	44
2004	3	0	3	0%	58
2005	2	2	4	50.00%	70
2006	1	1	2	50.00%	
2007	7	1	8	12.50%	
2008	4	0	4	0%	

Summary on Tag Recovery (Remigration Interval)

Tag recovery data revealed that Green and Hawksbill turtles have a remigration mode interval of one and three years, respectively (Figure 5 and 6). The Inconel tag losses in Green and Hawksbill turtles were reported in Table 4 and 5. It was found that most of Inconel tags were lost after six years.

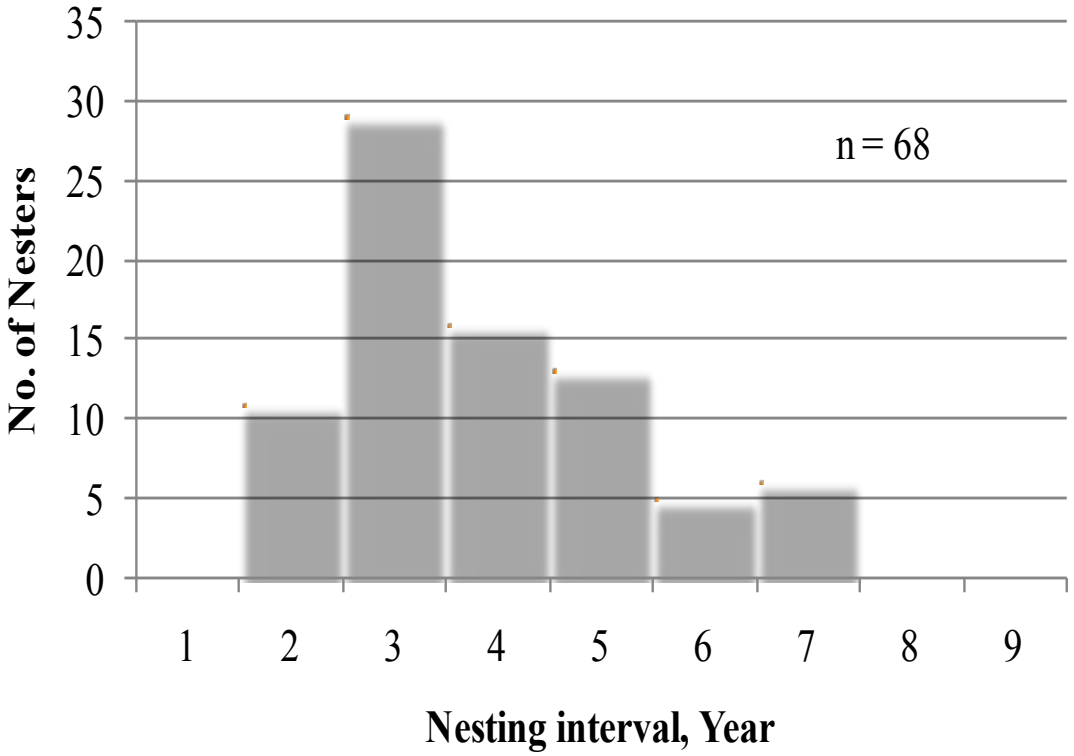


Fig 5. Remigration Interval of Nesting Green Turtles at Huyong and Khram Islands.

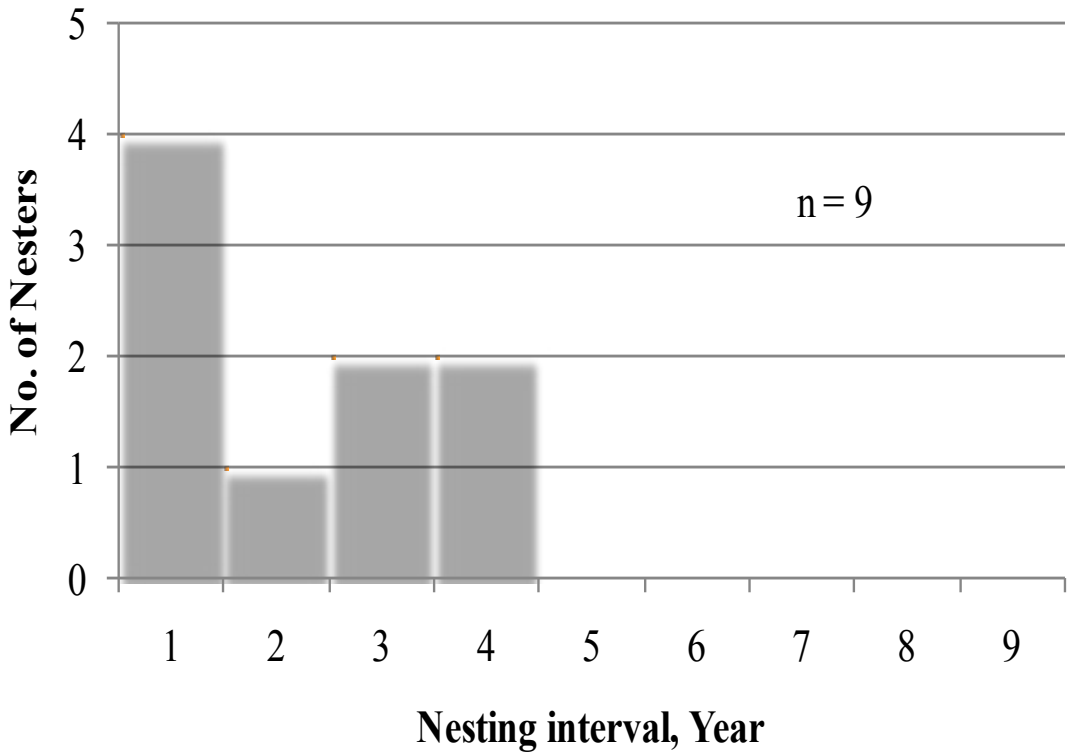


Fig 6 Remigration Interval of Nesting Hawksbill Turtlesa Khram Island.

Table 4. Loss Percentage of Inconel Tag Used in Green Turtle Nester at Khram Island. The Inconel Tag Loss Was Referenced with a PIT Tag.

Year	1	2	3	4	5	6
Tag loss		1/4	8/15	5/10	2/4	0/2
% Tag loss		25%	53%	50%	50%	100%

Table 5. Loss Percentage of Inconel Tag Used in Hawksbill Turtle Nester at Khram Island.

Year	1	2	3	4
Tag loss	0/4	0/1	1/2	0/2
% Tag loss	0%	0%	50%	0%

The Inconel tag loss was referenced with a PIT tag.

Satellite Telemetry studies

The satellite tracking activity in Thailand was initiated in 1995 with the support of the Kyoto University, Japan.. During 2000-2008, a total number of 59 platform transmitter terminals (PTTs) were deployed on five sea turtles species (Table 6). The PTTs were deployed mostly on nesters (64%), head-started sea turtles (24%) and wild incidentally caught sea turtles (12%). The tracking results were reported as following references. The tracking findings for inter-nesting grounds, migratory routes and foraging grounds were revealed in Figure 7, 8 and 9.

Table 6. The Number Of Platform Transmitter Terminals (PTT) Employed in Satellite Telemetry Studies in Thailand during 2000-2008 Separated by Sites *I.E*. Andaman Sea and the Gulf of Thailand and Species of Sea Turtles.

	Andaman	Gulf	Total
Green	20	23	43
Hawksbill	-	12	12
Logger-headed	-	2	2
Olive ridley	1	-	1
Leatherback	1	-	1
Total	22	37	59

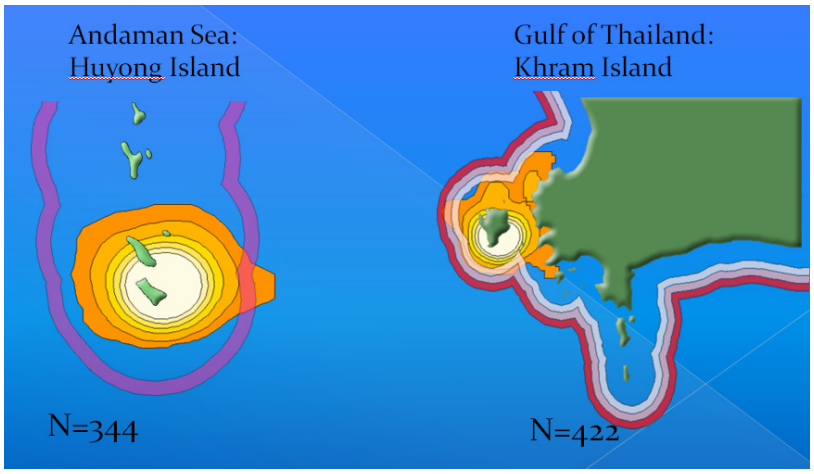
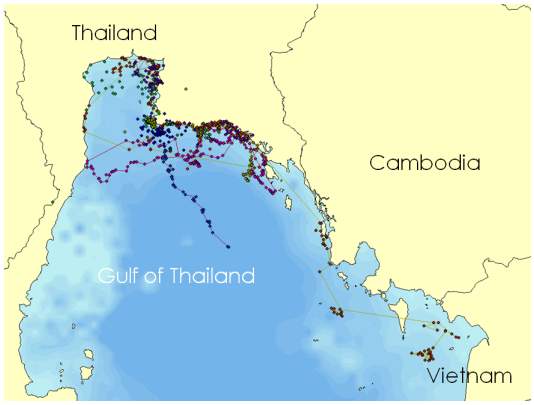
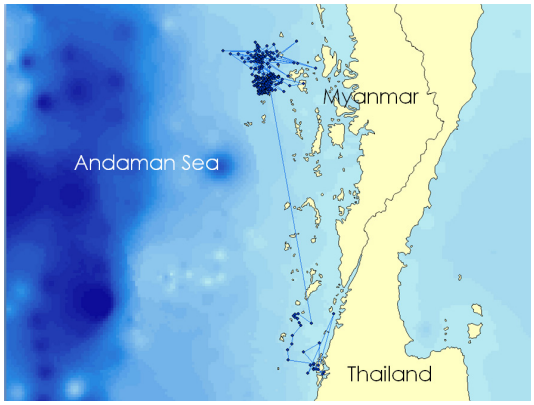


Fig 7. Kernel Home Range during Interesting of Green Turtles (Orange Color) at Huyong and Khram Islands. The Red Bands Indicating 5 And 6 km Boundaries.

a.



b.



c.

d.

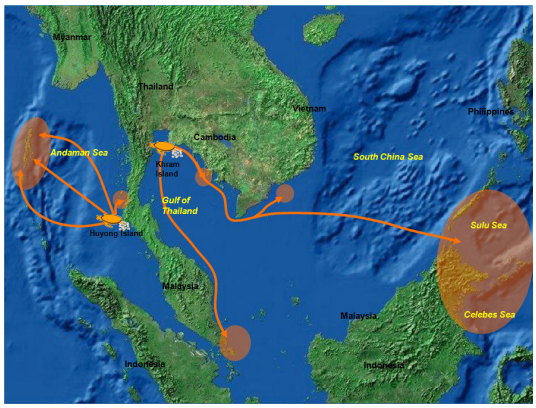
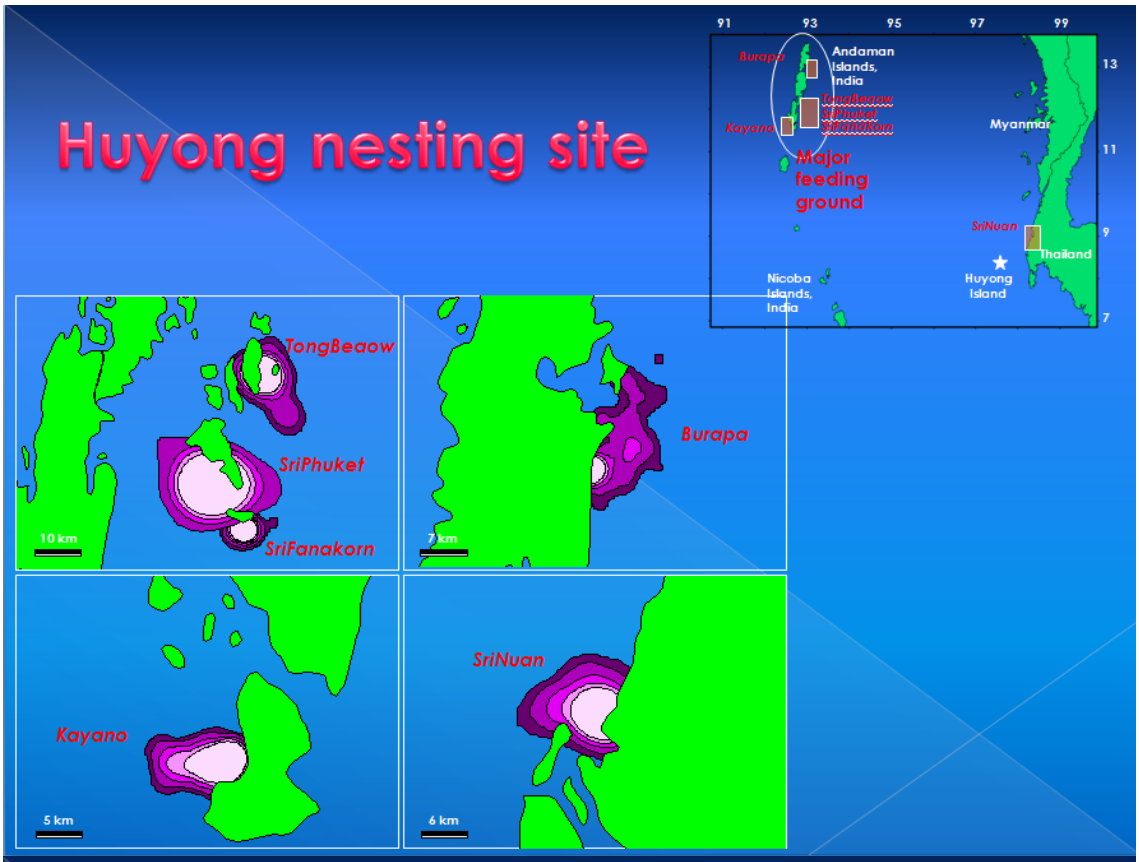


Fig 8. Migration Routes of Satellite Tracked Sea Turtles. A) Hawksbill Turtles, B) Olive Ridley Turtles, C) A Loggerhead Turtle, and C) Green Turtles.

A.



B.

Fig 9. Feeding Home Range of Green Turtles Tracked from Huyong (A) and Khram (B) Nesting Sites.

Stock size of nesting population

Nesting site: **Huyong Island**
Species: **Green turtle**
N: (Estimated) number of nests per year: 66
C: Estimated number of clutch per female/year: 5
F: Estimated number of females to nest per year = (N/C): 13.2
I: Average remigration interval in year: 3
S: Estimated stock size of nesting females = (F x I): **36.6**

Nesting site: **Khram Island**
Species: **Green turtle**
N: (Estimated) number of nests per year: 188
C: Estimated number of cluch per female/year: 5
F: Estimated number of females to nest per year = (N/C): 37.6
I: Average remigration interval in year: 3
S: Estimated stock size of nesting females = (F x I): **112.8**

Nesting site: **Khram Island**
Species: **Hawksbill turtle**
N: (Estimated) number of nests per year: 125
C: Estimated number of clutch per female/year: 4
F: Estimated number of females to nest per year = (N/C): 31.25
I: Average remigration interval in year: 1
S: Estimated stock size of nesting females = (F x I): **31.25**

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Review sea turtle tagging and satellite tracking activities. in Viet Nam

Phan Hung Dung
Department of Marine Biodiversity and Conservation Research
Research Institute for Marine Fisheries (RIMF-MARD)

Friday, March 06, 2009

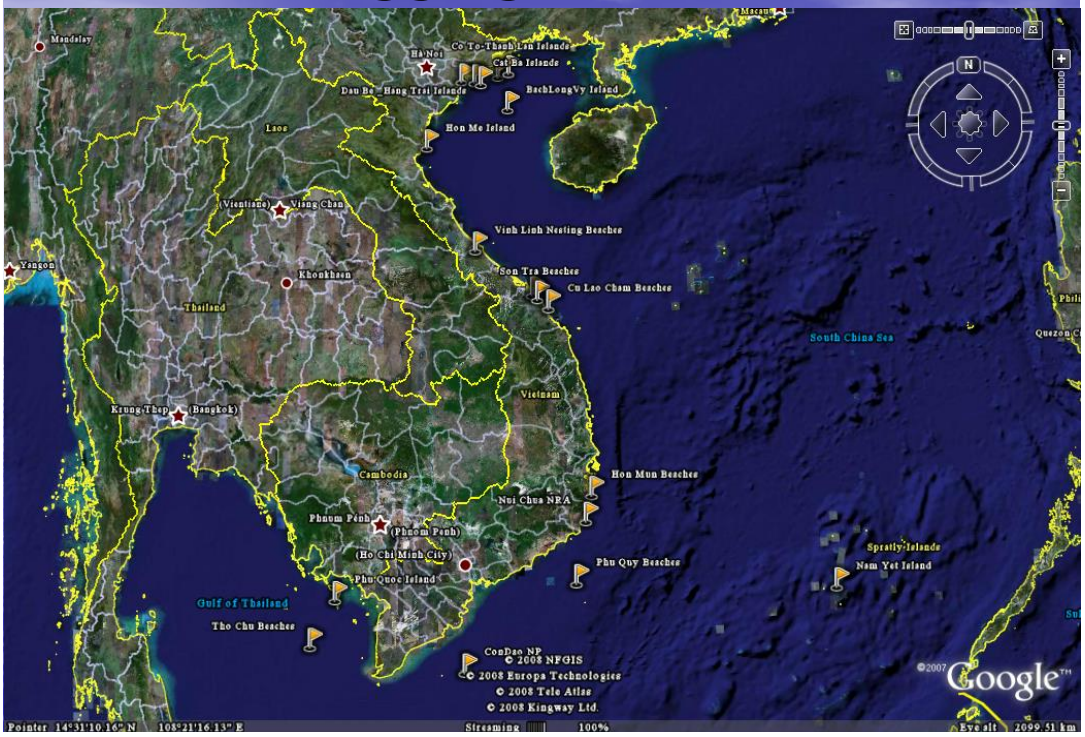
Tagging Activities

- Tagging activities have been initially conducted since 1998.

Tagging Activities

1,850 FM turtles have been tagged.

ST Tagging Areas in VN



Inconel tagging code that had been used in Vietnam

- (1) CD XXXX;
- (2) VN XXXXXX;
- (3) VN(S)XXXX
- (4) VN(C)XXXX
- (5) VN(N)XXXX

Friday, March 06, 2009

- 8/1996–09/2008: 2,870 female had been tagged.
- Frequency back to re-lay egg as 3,11±1,87 year (n:64)

- 2004 - 2008: 1,658 FM had been laid with total of 3,266 cluster . That means of 270,29±106,17 female/year(404–568)

- 2004 - 2008: Moved 1,303 clusters into hatchery and 155,354 hatchling were rearing before releasing.

Friday, March 06, 2009

Review sea turtle satellite tracking activities in Viet Nam

Friday, March 06, 2009

Satellite Telemetry Activities

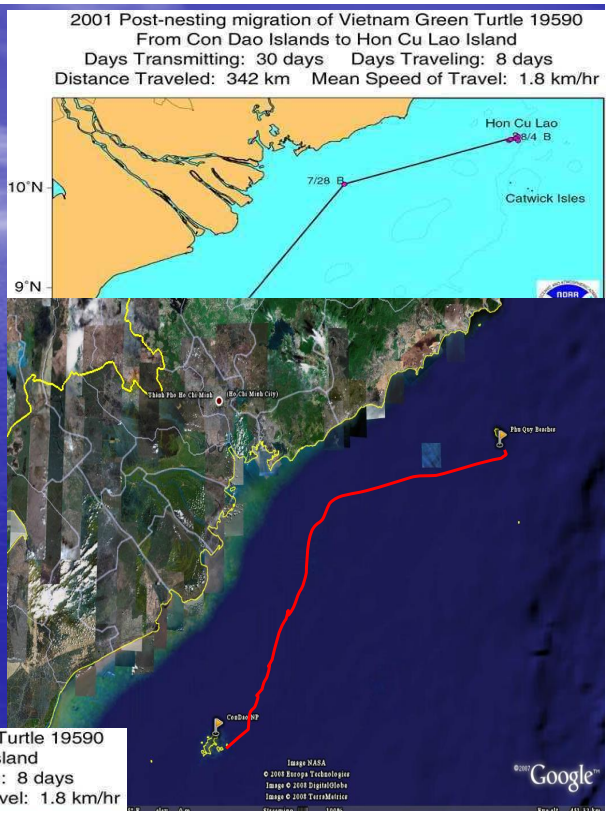
- Satellite telemetry project using modern satellite telemetry be initiated by WWF_Indochina and NOAA at Con Dao National Park in 2001,

This primarily allowed Con Dao NP tracking of the turtle migrations back to their foraging area.

- Reorganized a lot of biological characteristics

-Mating and laying season

-Food chain and foraging areas at South China Sea.

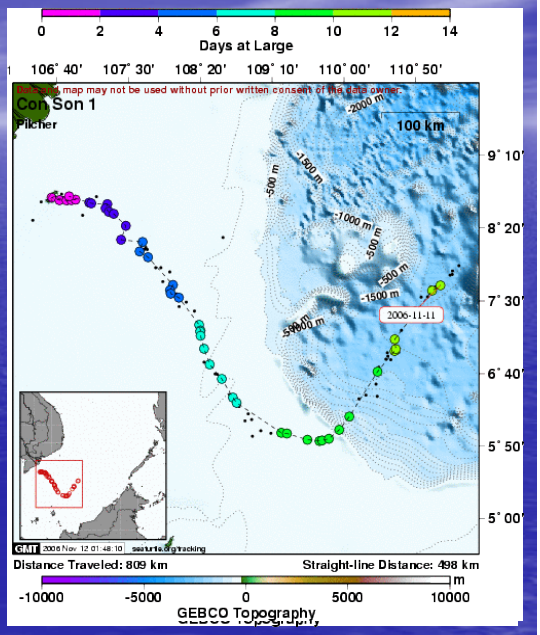


2001 Post-nesting migration of Vietnam Green Turtle 19590
From Con Dao Islands to Hon Cu Lao Island
Days Transmitting: 30 days Days Traveling: 8 days
Distance Traveled: 342 km Mean Speed of Travel: 1.8 km/hr

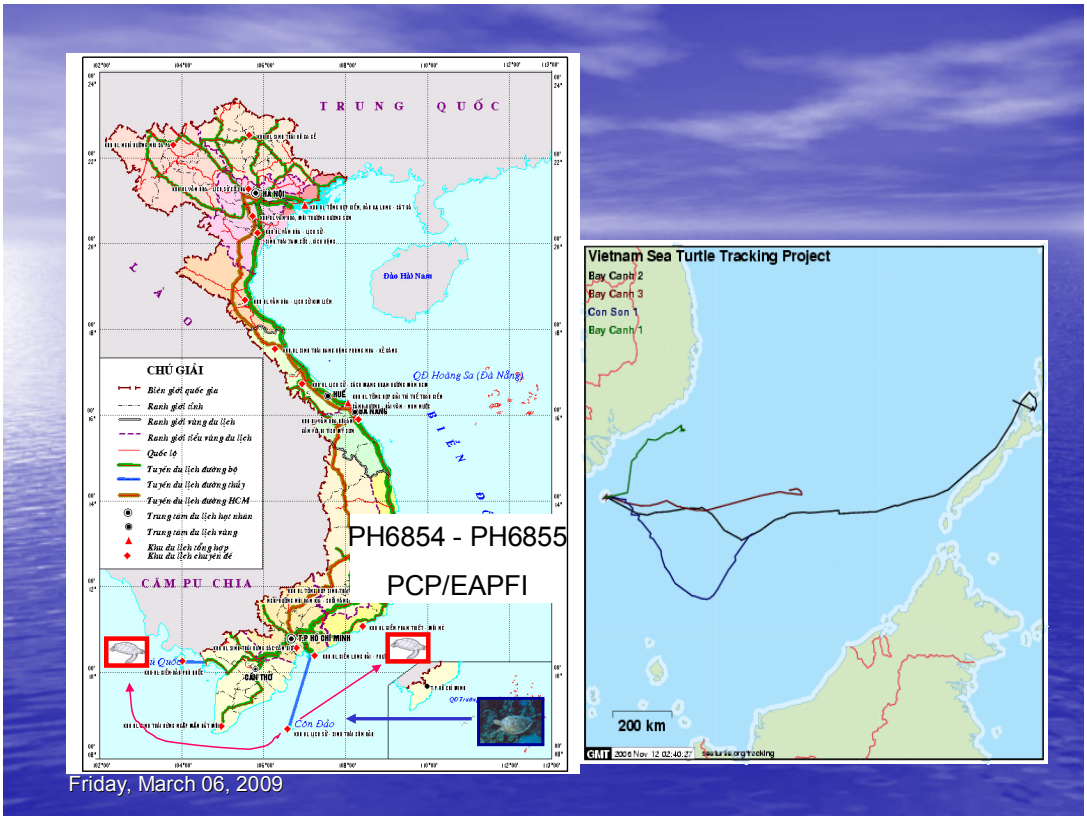
- Reorganized a lot of biological characteristics

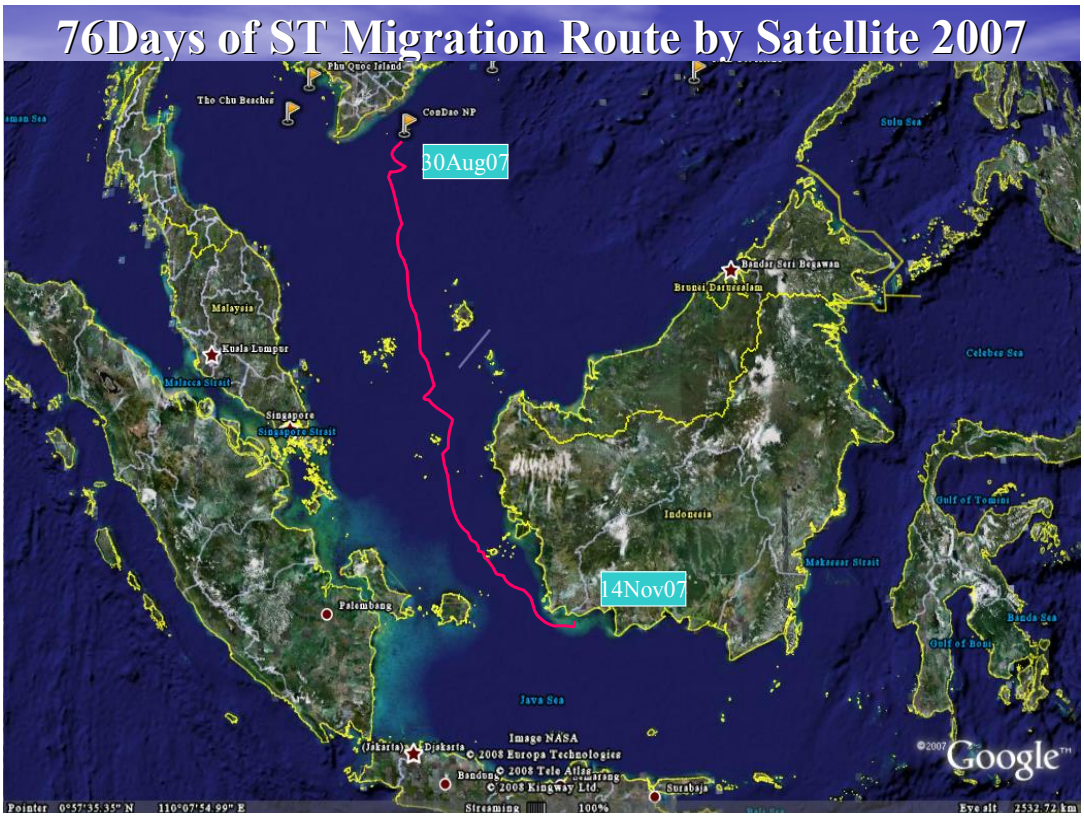
-Mating and laying season

-Food chain and foraging areas at South China Sea.



Friday, March 06, 2009


TRUNG QUỐC
CHÚ GIẢI
CÀ MAU
Đảo Hải Nam
QĐ Hoàng Sa (Đà Nẵng)
Côn Đảo
Vietnam Sea Turtle Tracking Project
Bay Canh 2
Bay Canh 3
Con Son 1
Bay Canh 1
200 km
PH6854 - PH6855
PCP/EAPFI
Friday, March 06, 2009


76Days of ST Migration Route by Satellite 2007
Phu Quoc Island
Tho Chu Beaches
CooDao NP
30Aug07
14Nov07
Malaysia
Kuala Lumpur
Malacca Strait
Singapore
Singapore Strait
Palembang
Indonesia
Celebes Sea
Sulu Sea
Makassar Strait
Java Sea
Jakarta
Surabaya
Image NASA
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REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

OTHER TAGGING AND SATELLITE TELEMETRY RESEARCH IN THE REGION

SATELLITE TRACKING OF GREEN TURTLES AND HAWKSBILL TURTLES IN PENINSULAR MALAYSIA BY WWF-MALAYSIA

Min Min Lau[1], Sharifah Ruqaiyah[2], Arvind Devadasan[1], Grace S. Duraisingham[1], Rahayu Zulkifli[2]

[1]Conservation of Hawksbill Turtles and Painted Terrapins in Malacca, WWF-Malaysia

[2]Community Based Conservation in Terengganu, WWF-Malaysia

INTRODUCTION

There are two predominant species of marine turtles in Malaysia; greens (*Chelonia mydas*) and hawksbills (*Eretmochelys imbricata*) and a site was chosen for each species (Fig. 1) for the purpose of conducting a study on the migration and location of foraging grounds by satellite telemetry. Malacca (*Melaka*) was a definitive choice for the study on the hawksbill turtles as it currently has the largest nesting population in Peninsular Malaysia, while Ma' Daerah in Terengganu records one of the largest population of nesting greens on mainland Peninsular Malaysia.

Fig. 1. Deployment locations for the satellite telemetry study in Peninsular Malaysia; greens at Ma' Daerah in Terengganu and hawksbills along the coast of Malacca (*Melaka*). Map constructed with Google Earth.

Hawksbill nesting in Malacca concentrates along the northern sandy coastline of Malacca and on Upeh Island (Pulau Upeh), an island further south (Fig. 2). The satellite telemetry study started in 2006, concurrently with the initiation of a saturated tagging and nesting monitoring program by WWF-Malaysia on Upeh Island. In 2008, three prime nesting beaches (Upeh Island, Kem Terendak, and Padang Kemunting) were part of the tagging and monitoring program

during the peak nesting season (from May to August). Inconel tags used were supplied by the Southeast Asian Fisheries Development Centre – Marine Fishery Resources Development and Management Department (SEAFDEC - MFRDMD).

Hawksbill nesting numbers in Malacca present a fairly static trend from 1991 to 2005 (Fig. 3), but reveal significantly more nests have been recorded over the more recent years due to an increased in the collection and securing of egg clutches for incubation, in tandem with the nesting monitoring program. Hawksbill turtle nests in Malacca are protected by a licensing system where nests are collected by licensed egg collectors and are translocated to a hatchery managed by the Department of Fisheries Malaysia at Padang Kemunting.

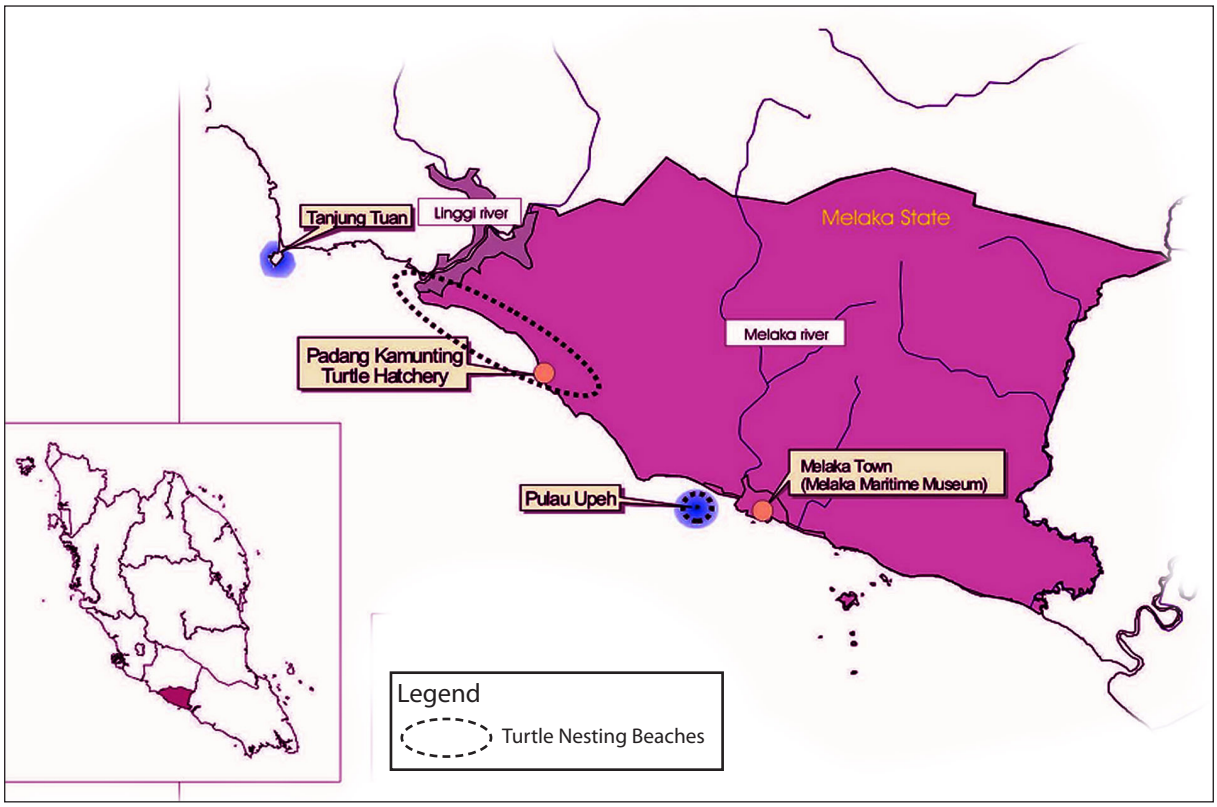


Fig. 2. Turtle nesting beaches along the coastline of Malacca (Melaka). Nesting concentrates towards the north, with the exception of Upeh Island (Pulau Upeh).

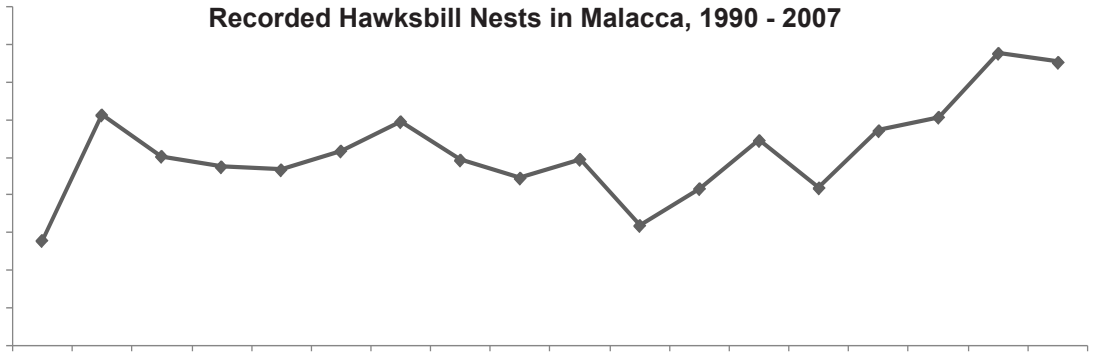


Fig. 3. Total numbers of hawksbill nests in Malacca recorded from 1990 to 2007. Nesting trends remained consistent until 2006, where the spike in the trend is due to an increase in protection and does not signify a population increase. Source: Department of Fisheries Malaysia.

Ma' Daerah is a 1.7km stretch of nesting beach located near a series of forested hills called Bukit Labohan in Kerteh, Terengganu. Except for a few fruit orchards fringing the hills, the nesting beach lies on a secluded stretch away from any human settlement. However, just 1km away beyond the hills is one of the country's largest petrochemical complexes. On most nights, artificial lights from this petrochemical complex flood the nesting beach causing confusion to emerging hatchlings, and deterring turtles from nesting. During nesting season i.e. from May until October, the beach is patrolled by two rangers employed by the Department of Fisheries Malaysia whose responsibilities include monitoring nesting, collecting data, and relocating eggs into a temporary hatchery built on the same beach.

Ma' Daerah records the second largest nesting population of green turtles on mainland Peninsular Malaysia, and records each year, between 150 to 250 egg clutches were laid on the beach. Figure 4 depicts the nesting trend of green turtles at this beach starting from 1993. Records have shown that the leatherbacks, hawksbills and olive ridleys once nested on this beach also, but since 2005, the only species that nests on Ma' Daerah beach are the greens.

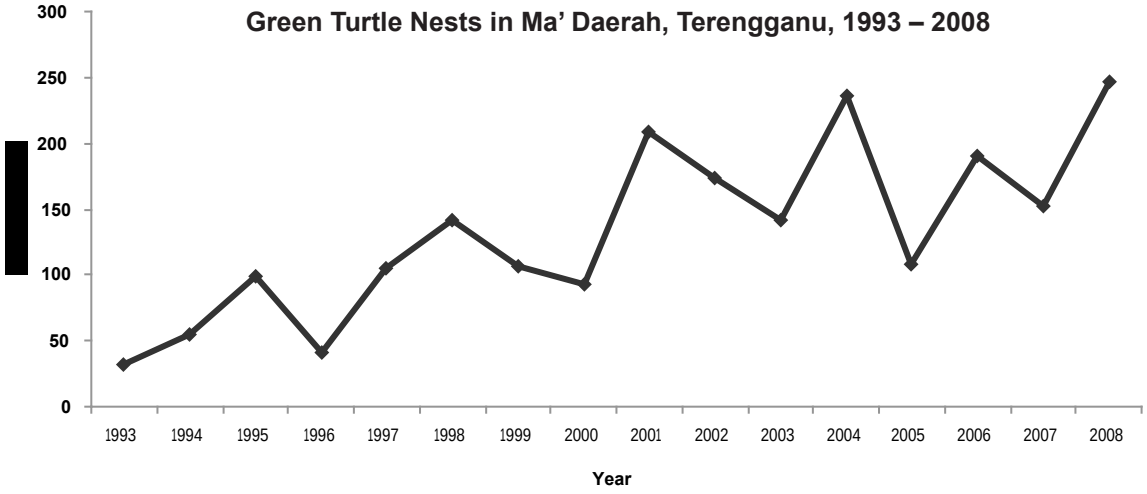


Fig. 4. Green turtle nests in Ma' Daerah recorded from 1993 to 2008. The 2008 data represents total nest numbers as of 31 August 2008 only. Source: Department of Fisheries Malaysia

MATERIALS AND METHODS

Detention procedure. ***1) Malacca.*** Eight female hawksbill turtles were deployed with Sirtrack platform transmitter terminals (PTT, model KiwiSat 101) at four different locations along the coast of Malacca (Tanjung Dahan, Upeh Island, Kem Terendak, and Padang Kemunting) from 2006 to 2008. The turtles were transferred after nesting, each into a 4x3 ft basin to limit their movement and to relocate them away from the nesting beach (so that the lighting needed for the deployment process would not prevent subsequent turtles from landing). They were temporarily detained and restrained for approximately 3-4 hours and were released back at the nesting location after the deployment process was completed. ***2) Terengganu.*** Four green turtles were deployed with the same type of transmitter at the Ma' Daerah nesting beach in 2008. The turtles were detained after they had finished nesting using a plywood frame measuring 2 feet in height which was used to contain the turtles and limit their movement. The transmitters were deployed without relocating the turtle and the plywood was then removed to allow the turtle to return to sea upon completion of the deployment process, which took approximately 4 hours.

Attachment of PTT. Transmitters were affixed to the highest point of the carapace, which in most cases refers to the second vertebral scute from the nuchal scute (V2). In 2006, transmitters were deployed using a silicone elastomer as the base and fibreglass cloth and polyester resin to cover and attach it to the carapace after cleaning the surface area on the carapace of any debris that might compromise the attachment. From 2007 onwards, the silicone elastomer was maintained as the base but Power-Fast® PLUS Epoxy Adhesive was used to cover and attach the transmitter to the carapace, replacing the fibreglass and polyester resin. The epoxy adhesive was allowed to cure for approximately one hour after application, before the turtle was released. A duty cycle of 24 hours on/off was used for the two transmitters deployed in 2006, but the following transmitters deployed in 2007 and 2008 were not pre-programmed with a duty cycle as maximizing the amount of locations points received during migration was the main priority. Due to built-in saltwater switches, battery life didn't prove much of a concern.

Analysis of Data. Location data was stored, tabulated and filtered using Satellite Tracking and Analysis Tool (STAT). Only selected location points were used for data generation. The location points were consistently subjected to these criteria and were be discarded if: 1) locations were on land, 2) distance between two locations were 1000km or further, 3) travel velocity between two locations were greater than 5km/h. Due to low frequency of accurate location data received, locations with LC 3, 2, 1, 0, A, and B were all used for plotting.

RESULTS

Hawksbills in Malacca

All eight turtles (Table 1) were tracked south bound along the Strait of Malacca after they completed nesting for the season. Inter-nesting residency was documented to be within the waters of Malacca for the most part, although turtles have been occasionally tracked to venture into neighbouring state and Indonesian (Sumatra) waters.

Name	Tag no.	Location of deployment	Date of deployment	Date of last location	No. of days locations transmitted	No. of locations received
Puteri Tanjung Dahan	MY4410/ MY4411	Tanjung Dahan	26 Aug 2006	14 Mar 2007	201	213
Puteri Pulau Upeh	MY4488/ MY4489	Upeh Island	29 Aug 2006	22 Feb 2007	178	42
Freedom Flipper	MY4624/ MY4625	Upeh Island	29 Jul 2007	24 Apr 2008	277	222
Alphey	MY4627/ MY4628	Upeh Island	5 Aug 2007	4 Nov 2007	92	236
Terendak Queen	MY4444/ MY4445	Kem Terendak	11 Aug 2007	14 Apr 2008	248	423
MY4660/ MY4401[1]	MY4660/ MY4401	Padang Kemunting	12 Jul 2008	31 Jul 2008	18	39
MY4490/ MY4491[1]	MY4490/ MY4491	Upeh Island	3 Aug 2008	10 Oct 2008[2]	68[2]	141[2]
MY3267/ MY3268[1]	MY3267/ MY3268	Kem Terendak	12 Aug 2008	12 Oct 2008[3]	60[3]	102[3]

Table 1. Hawksbill turtles tracked by satellite telemetry. [1]Turtles yet to be named. [2]Still transmitting when analyzed, locations as of 10 October 2008. [3]Still transmitting when analyzed, locations as of 12 October 2008.

A total of 1418 location points were received; which includes LC 3, 2, 1, 0, A, B locations (number does not include LC Z data). Majority of the data received were LC B locations (74%), which have no accuracy range. Location points that do have an accuracy range only accounts for 11 percent of total location points received as illustrated in Fig. 5.

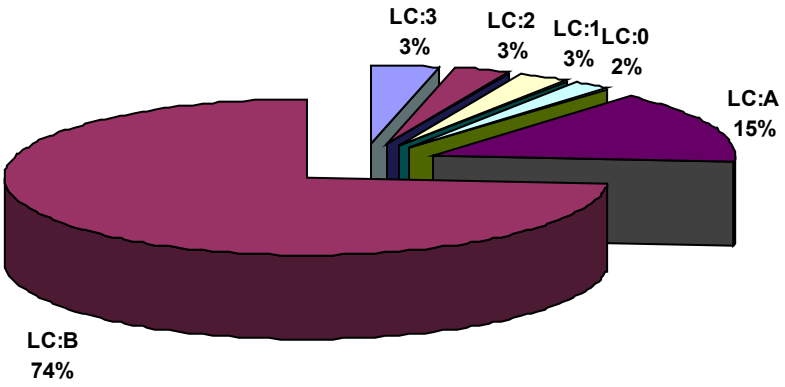


Fig. 5. Percentage of location classes received. Almost three quarter of location points were LC B, which has no accuracy range.

Puteri Tanjung Dahan was attached with a PTT on 26 August 2006 and proceeded to nest an additional 5 times, spanning her inter-nesting period across 81 days post deployment in which transmissions revealed that she swam as far as Indonesian (Sumatra) waters and back (based on LC B locations received). She took 17 days to migrate south along the Strait of Malacca to her foraging grounds at the Riau Archipelago where her movements concentrated in waters surrounding the islands for 102 days of transmission (Fig. 6).

Puteri Pulau Upeh was attached with a PTT after her third and final nesting (29 August 2006) for the season, hence no data on her inter-nesting behaviour was received. It took her 24 days to reach her foraging grounds around the Southern Islands of Singapore where she was transmitting signals for 153 days (Fig. 7).

Freedom Flipper nested 3 times before she was fitted with a PTT and proceeded to nest twice after that, after which she spent 9 days migrating south to the Riau Archipelago and resided there for 240 days of transmission (Fig. 8).

Alphey was fitted with a PTT on 5 August 2007 and nested a total 5 times before initiating a migration period of 14 days to the Riau Archipelago, where she was transmitting for 35 days (Fig. 9).

Terendak Queen was fitted with a PTT and proceeded to nest an additional 3 times before initiating her migration which spanned 20 days to the Riau Archipelago travelling a distance of approximately 320 kilometres, where she resided for 179 days of transmission (Fig. 10).

MY4660/MY4401 proceeded to travel to the southern islands of Singapore post deployment (migrating for 9 days), where we received signals from her for only 8 days (Fig. 11). **MY4490/ MY4491** and **MY3267/MY3268** both travelled to the Riau Archipelago where they continued to transmit signals at the time this report was prepared (Fig. 12 & 13). They nested a total of 6 and 5 times respectively.

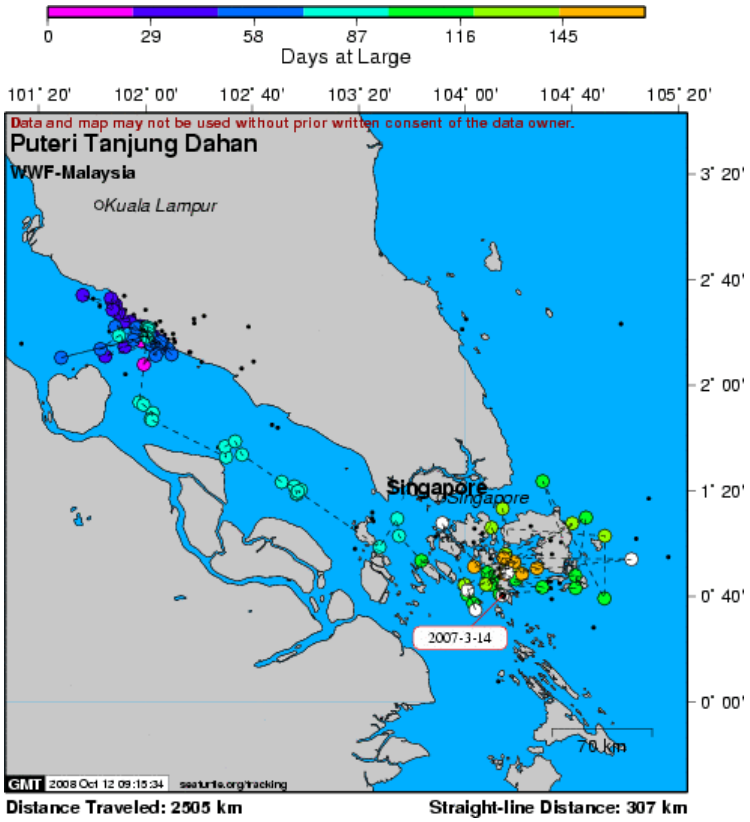


Fig. 6. Movement and migration of Puteri Tanjung Dahan.

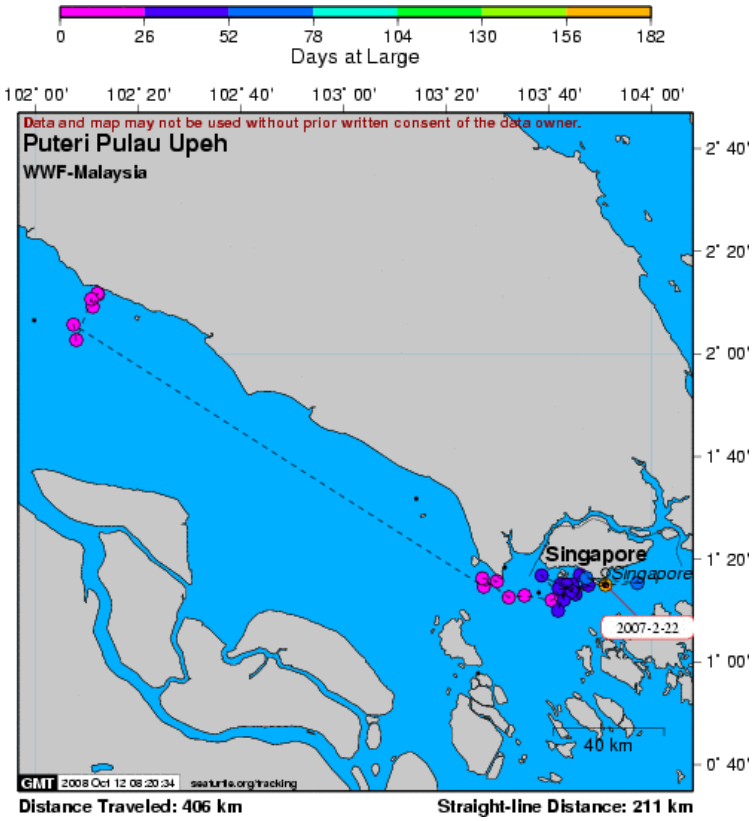


Fig. 7. Movement and migration of Puteri Pulau Upeh.

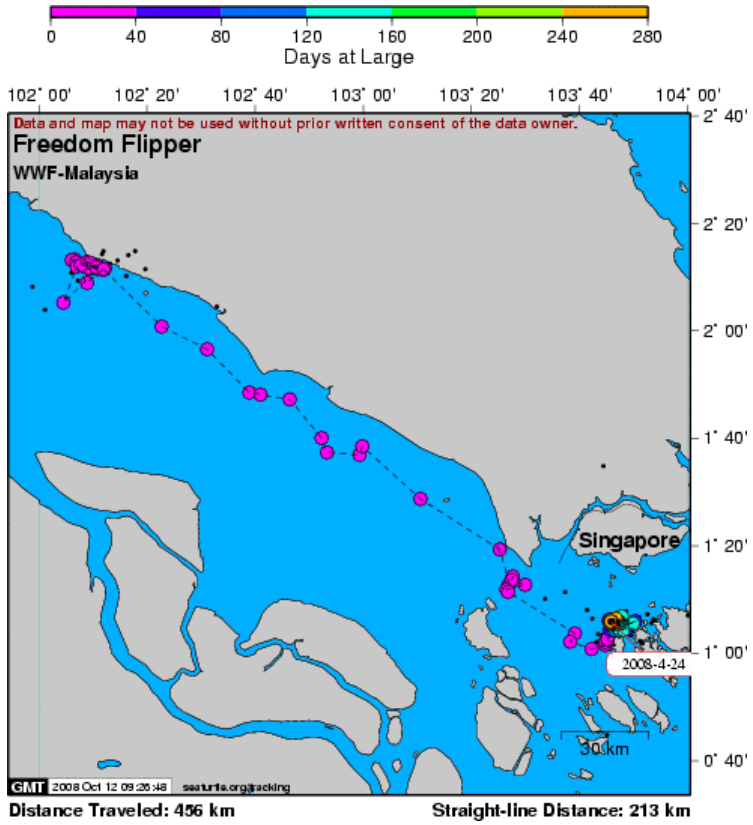


Fig. 8. Movement and migration of Freedom Flipper.

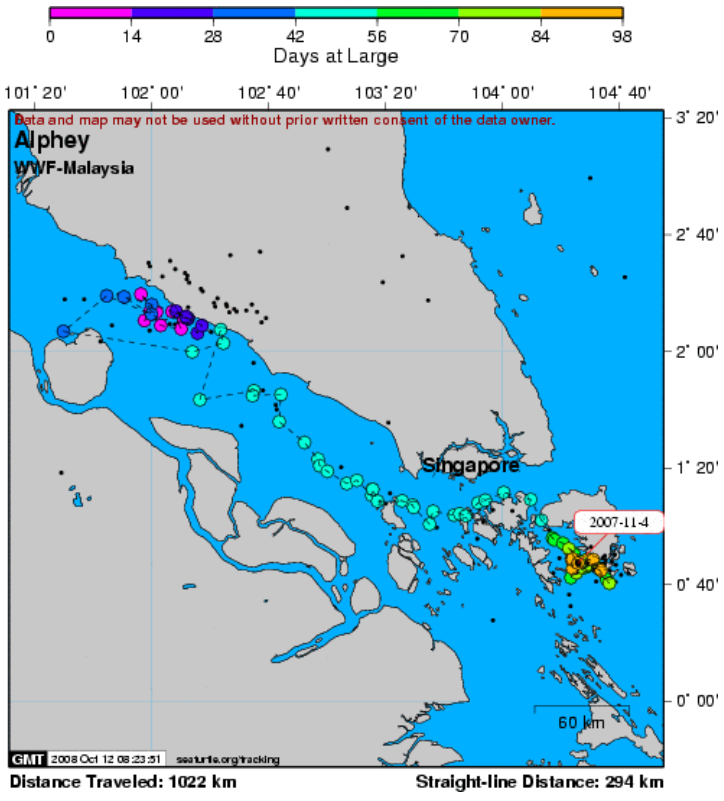


Fig. 9. Movement and migration of Alphey.

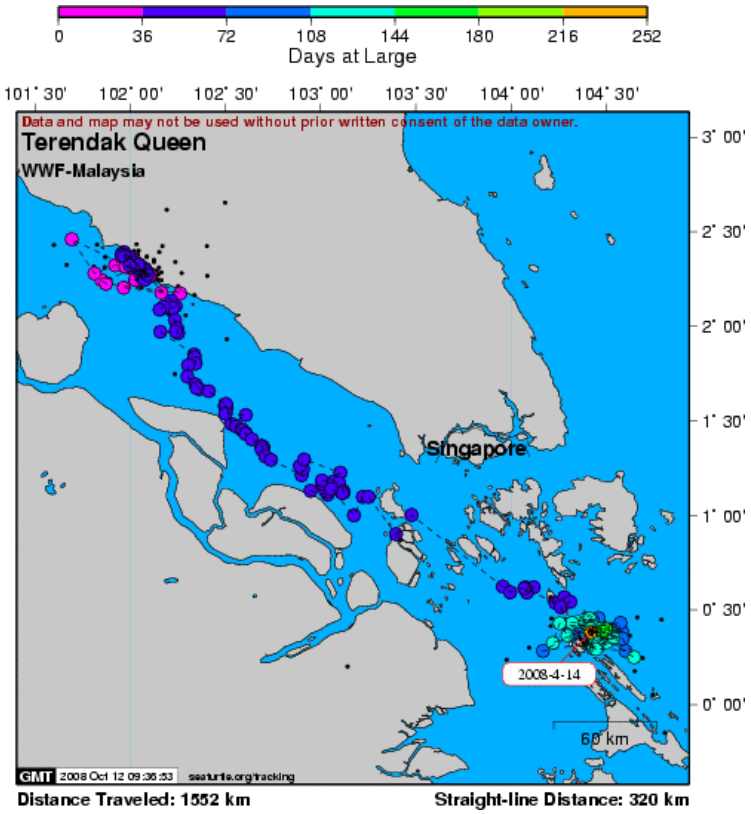


Fig. 10. Movement and migration of Terendak Queen.

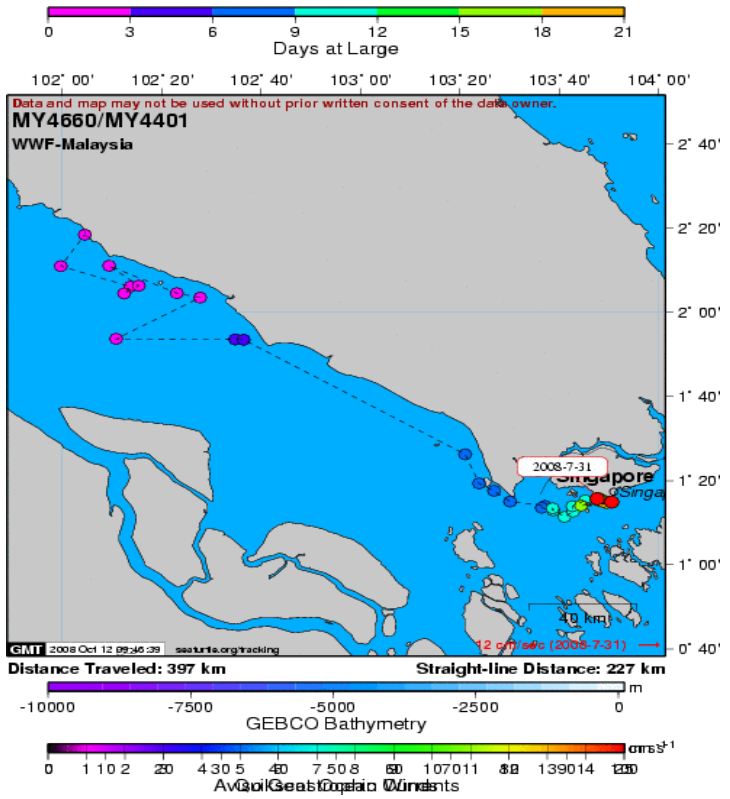


Fig. 11. Movement and migration of MY4660/MY4401.

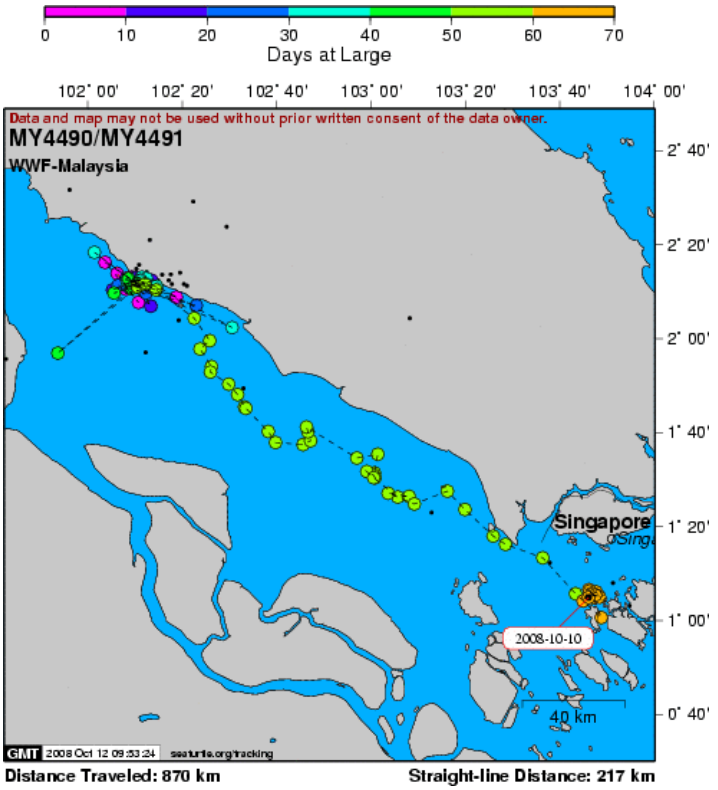


Fig. 12. Movement and migration of MY4490/MY4491.

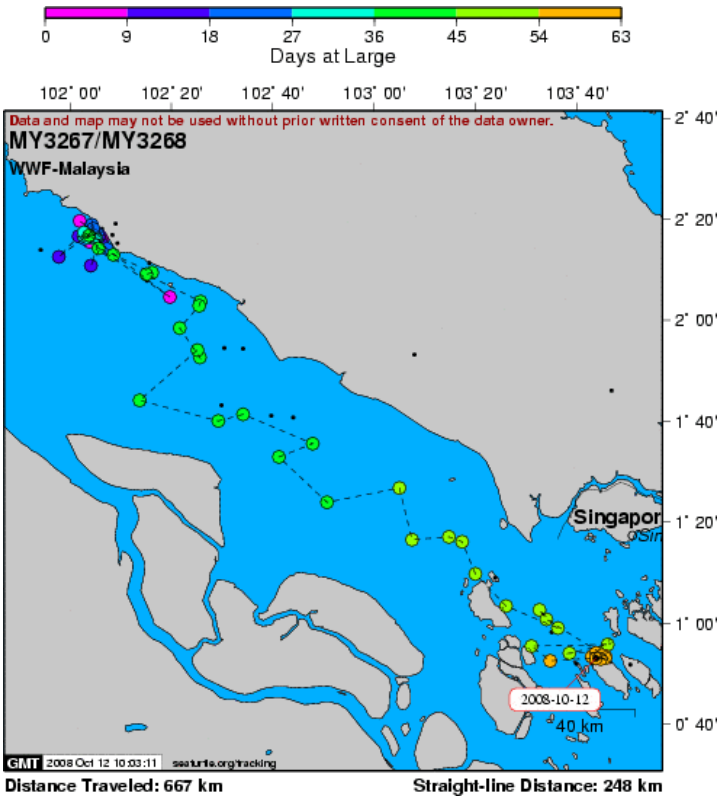


Fig. 13. Movement and migration of MY3267/MY3268.

Greens in Ma' Daerah, Terengganu

Four nesting female green turtles with a curved carapace length ranging from 91.5 to 100.0 centimetres were randomly chosen and deployed with PTTs (Table 2).

Name / PTT ID no.	Tag no.	Location of deployment	Date of deployment	Date of last location	No. of days locations transmitted	No. of locations received
Intel	MY4057/MY3208	Ma' Daerah	17 Aug 2008	2 Sep 2008	16	39
82204	MY4002/MY4025	Ma' Daerah	18 Aug 2008	10 Sep 2008	23	111
82205	MY4067/MY4068	Ma' Daerah	21 Aug 2008	31 Aug 2008	10	42
83991	MY3210/MY3211	Ma' Daerah	24 Aug 2008	6 Sep 2008	13	35

Table 2. Green turtles tracked by satellite telemetry at Ma' Daerah, Terengganu.

Intel was deployed with a PTT after her 6th nesting for the season on 17 August 2008. She moved southwards after release, travelling in close proximity to the shoreline. Three days post release, she was detected in the vicinity of Kuantan waters lingering for a few days before moving further south. She kept close to the shore and was later detected in the Eastern Straits of Singapore after 12 days at large. The last transmission received from Intel was on 2 September 2008 when she was spotted near the Riau Archipelago; 16 days after deployment. No further transmission was received from Intel thereafter.

On 18 August 2008, the turtle with tag numbers **MY4002/MY4025** was selected for the next PTT deployment. She was released at 1:50 am after being retained for 3 hours. After release, she was detected swimming not too far from the nesting beach, until she returned to nest on 31 August 2008. She too migrated southwards and travelled close to the shore all along her journey south towards Kuantan. Her last known location was off Tioman Island on 10 September 2008 before transmissions from her halted after 23 days of monitoring.

MY4067/MY4068 was deployed with a PTT on the 21 August 2008 around 10:30 pm after her second nesting of the season. After release, she was detected migrating south toward Geliga and then back up the coast moving in a northerly direction, occasionally keeping close to the Ma' Daerah shore. On 31 August 2008, she was detected moving northwards to her last known location off Paka before transmission from her ceased after 10 days.

MY3210/MY3211 was deployed with the PTT on 24 August 2008 around 11:20pm after her 6th nesting of the season. 10 days later (3 September 2008), she returned to nest again. During this inter-nesting period, she stayed close to the Ma' Daerah shoreline. After her last nesting, she started migrating south towards Pahang waters before her signal was lost on 6 September 2008. The last known location of the turtle placed her near the waters off Kuantan, 109 km south of Ma' Daerah beach.

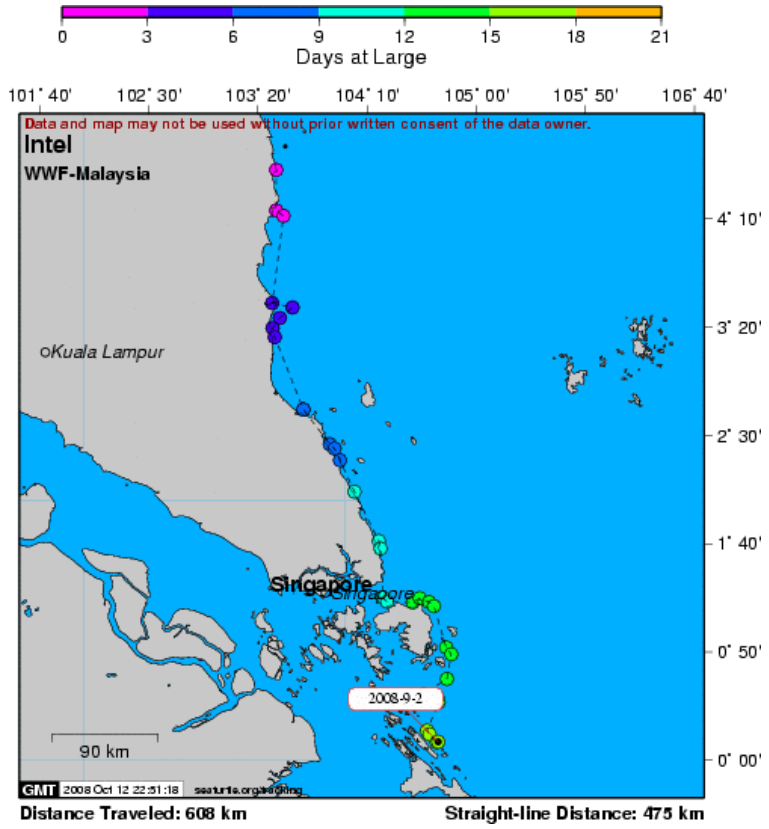


Fig. 14. Movement and migration of Intel.

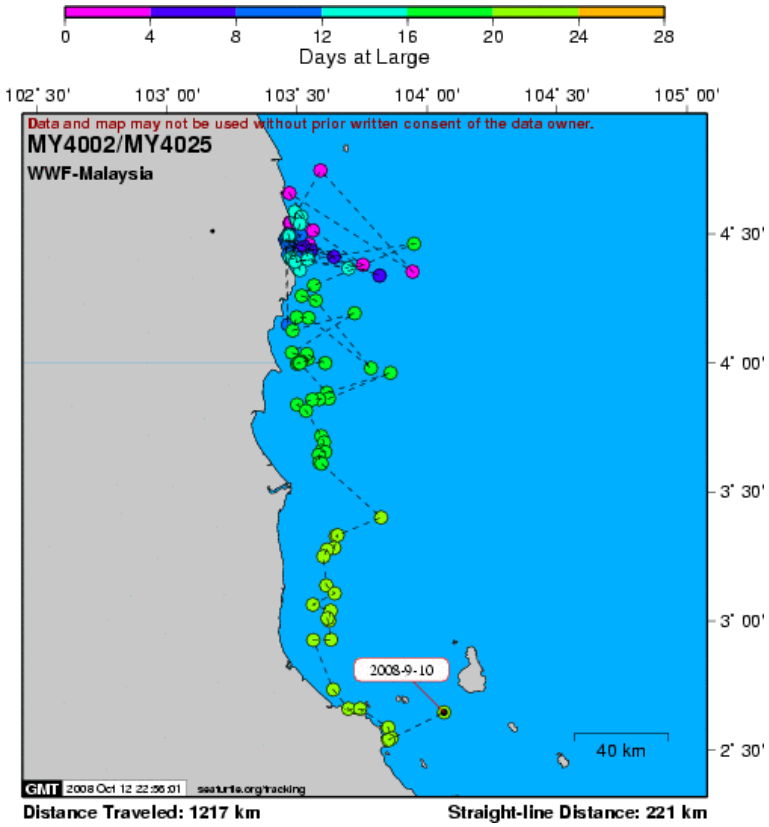


Fig. 15. Movement and migration of MY4002/MY4025.

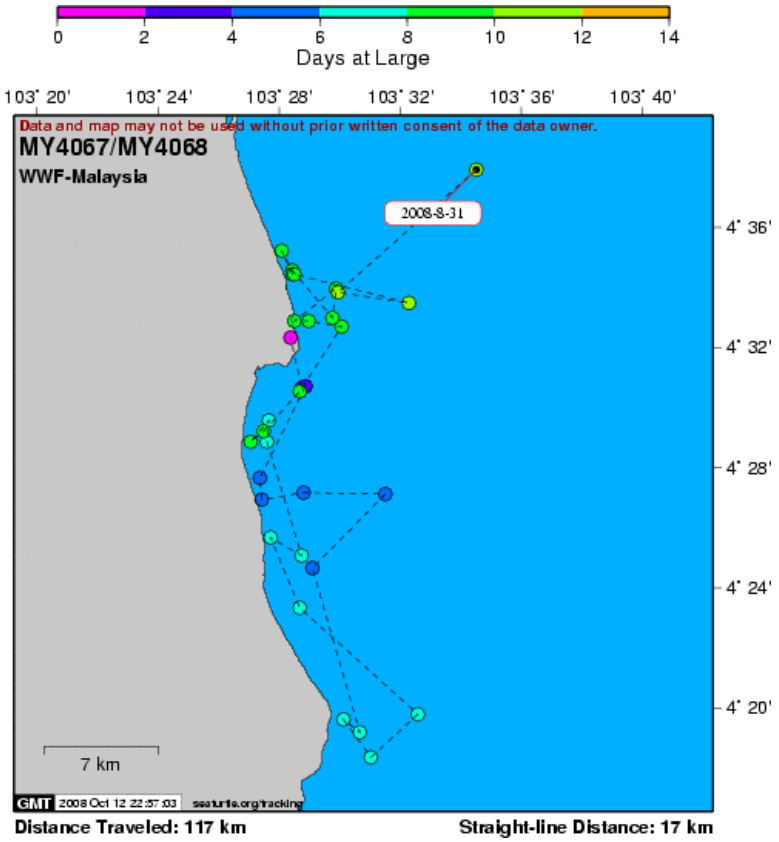


Fig. 16. Movement and migration of MY4067/MY4068.

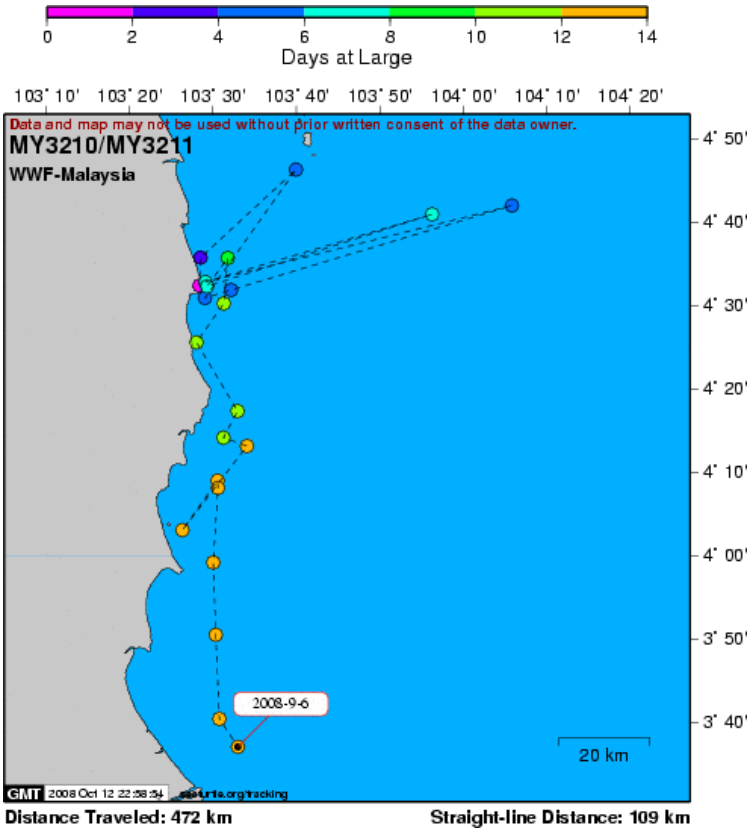


Fig. 17. Movement and migration of MY3210/MY3211.

A total of 227 location points were received; which includes LC 2, 1, 0, A, B locations (number does not include LC Z data). No LC 3 data were received. Similar to the hawksbills dataset, majority of the location points received were LC B locations (66%), which have no accuracy range. Location points that do have an accuracy range only account for 9 percent of total location points received.

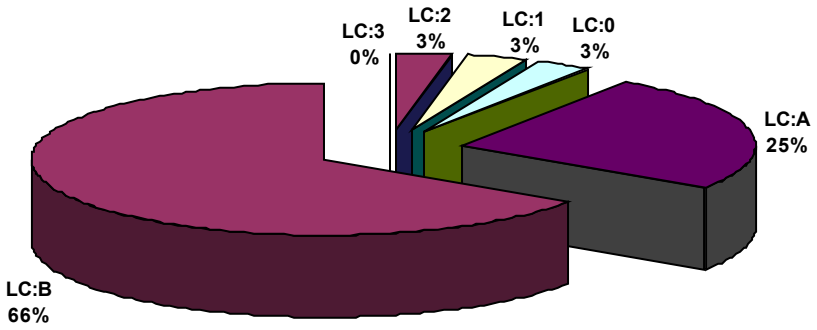


Fig. 18. Percentage of location classes received. 66 percent of location points were LC B, which has no accuracy range.

DISCUSSION

All the adult female hawksbill turtles in the Malacca study appeared to have migrated to the specific geographical area south of the Strait of Malacca. It is evident in regards to the vast number of location transmissions received, that the waters surrounding the Riau Archipelago (Indonesia) and the neighbouring islands are important foraging grounds for the species. Six out of the eight turtles were documented residing in the region within the Riau Archipelago while the other two were documented residing in waters of the southern islands of Singapore (which are islands adjacent to the archipelago, divided by international borders).

There were no distinct migratory channels observed as they seem to utilize a vast area south bound (as migration patterns oscillate from Malaysian waters to Sumatran waters), identifying the entire southern part of the Strait of Malacca as a migratory corridor for the hawksbills.

More information is needed especially in terms of identifying and mapping coral reefs in the Riau Archipelago to ascertain the conditions of the feeding habitat. Additionally, it would be vital to determine if fisheries interaction or other threats is a concern for the population of hawksbills in the archipelago and the surrounding waters.

As for the satellite tracking study in Ma' Daerah, all four greens transmitted signals for a relatively very short period of time (less than 30 days). Intel, which was tracked migrating south of Peninsular Malaysia, travelled the furthest of the four and was last detected moving in waters within the Riau Archipelago. However, it is not possible to conclude that Intel is foraging here as transmissions pin-pointing her location there were only received for one day and this could merely be an inter-migration pit-stop for her.

None of the transmitted locations on the map show that the turtles might have stayed longer at one place, indicating that at least three out of the four turtles were still in mid migration when transmissions were lost. Reasons for the loss are inconclusive, but dislodgement of the transmitters could be a probable cause.

ACKNOWLEDGEMENT

I. The Department of Fisheries Malaysia

II. The Malacca State Department of Fisheries

III. The Terengganu State Department of Fisheries

IV. Persatuan Khazanah Rakyat Ma' Daerah (MEKAR)

V. Licensed turtle egg collectors of Malacca

VI. Workers of the Ma' Daerah Turtle Sanctuary

VII. Volunteers of WWF-Malaysia

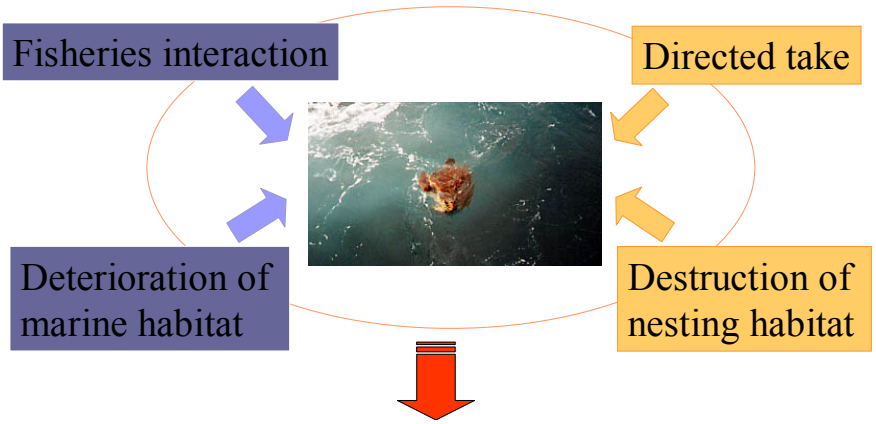
VIII. WWF-Netherlands

IX. Intel Corporation

X. Southeast Asian Fisheries Development Centre – Marine Fishery Resources Development and Management Department (SEAFDEC - MFRDMD)

Sea turtle…

Holistic Management



Holistic management of marine environment and nesting habitat is important for sea turtle conservation

Status of Sea Turtles in the World

Species/Subspecies	Pacific	Indian	Atlantic
Leatherback	East: Decreasing West: Decreasing	Sri Lanka: Stable Nicobar: Stable KZ-Natal: Increasing	Caribbean: Increasing West: Increasing East: Under Investigation
Green	West: Stable Central: Increasing	Seychelles & other Indian Ocean isls.: Stable Northwest: Decreasing Nicobar: Stable	Gulf of Mexico: Increasing Caribbean: Increasing
Loggerhead	North: Decreasing (Recently Increasing) South: Decreasing	Oman: Stable Sri Lanka: Stable KZ-Natal: Increasing	Gulf of Mexico: Increasing West: Increasing
Hawksbill	Malaysia: Stable Australia: Decreasing Hawaii: Stable	Seychelles & other Indian Ocean isls.: Decreasing Nicobar: Stable	Gulf of Mexico: Increasing Caribbean: Increasing
Olive Ridley	East: Increasing	Eastcentral: Decreasing	Under Investigation
Kemp's Ridley	–	–	Gulf of Mexico: Increasing Northwest: Increasing
Flatback	North: Stable East: Stable	–	–
Black	East: Decreasing	–	–

We collaborate with Governments of Indonesia.
Cooperation with local residents and NPOs

Research on the number of nests of leatherback turtles

Research on hatching rate success in nests

Research on the effect of using electric defense fences to protect nests from wild pigs (conducted by Everlasting Nature of Asia)

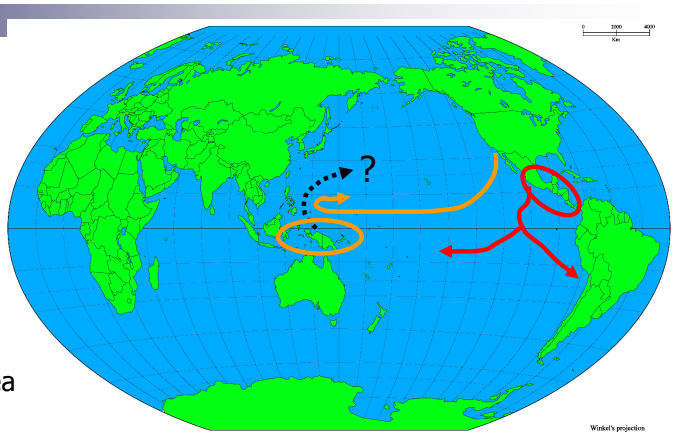
Research on movement and distribution of leatherback turtles after nesting using ARGOS satellite transmitters

Objective

Major nesting grounds
in the Pacific

East Mexico
Costa Rica

West Indonesia
Solomon Islands
Malaysia
Papua New Guinea

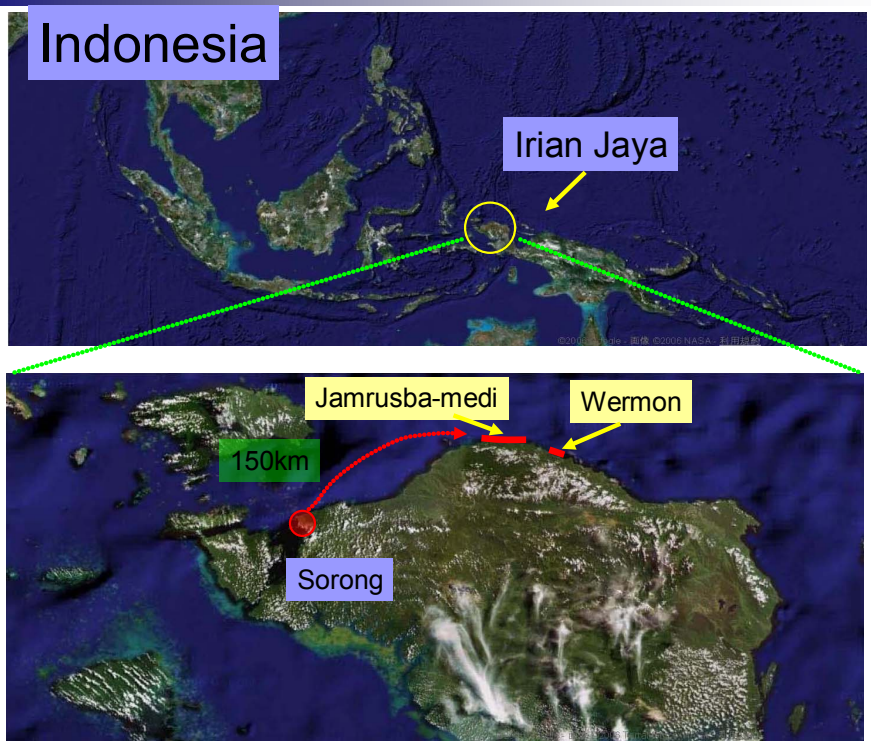


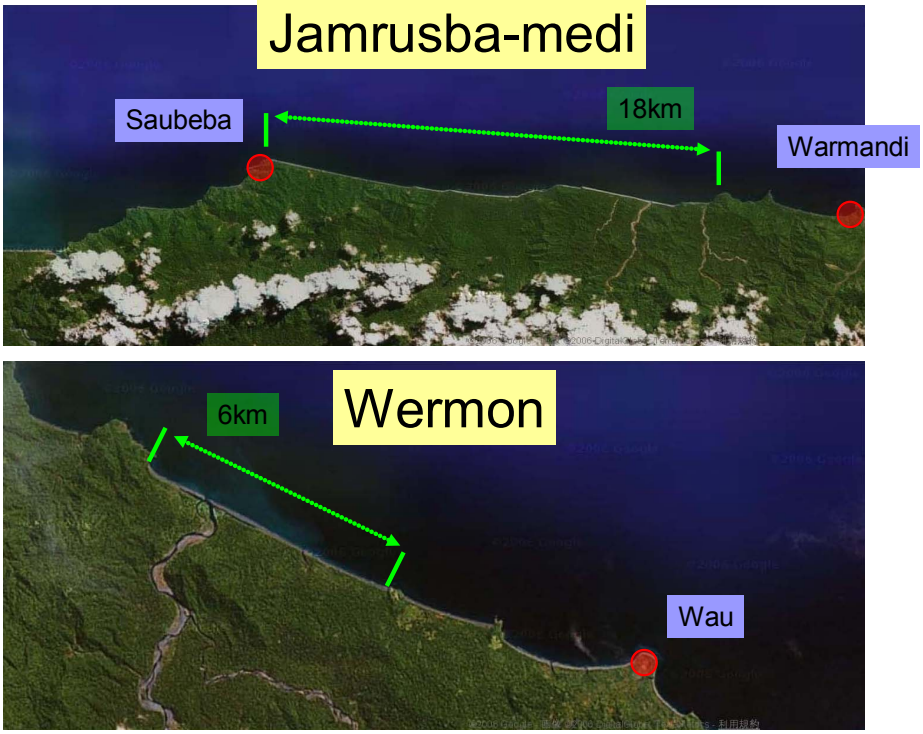
From Dutton et al. 2003,
Eckert and Sarti 1997

Migration routes
Eastern Pacific leatherbacks — Southward movement
Leatherbacks off California — Southwestward movement

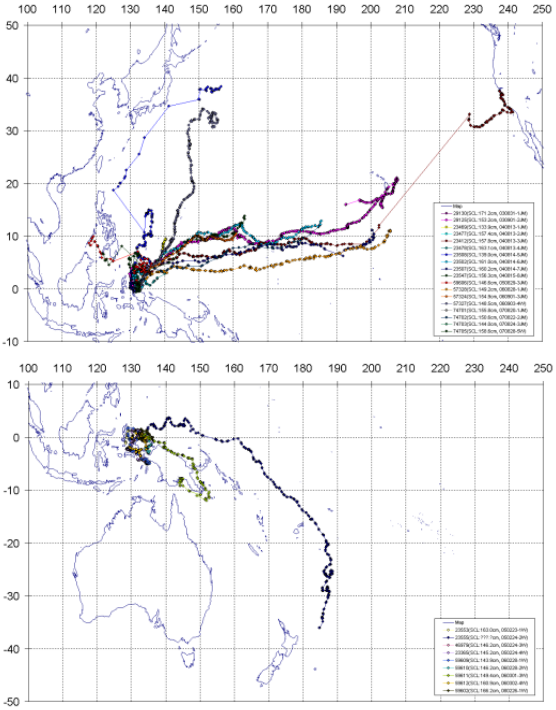
Where do the Indonesian leatherback turtles move??

We examined post-nesting movements of leatherback turtles tagged with satellite transmitters at Jamursba-Medi and Wermon, Indonesia.

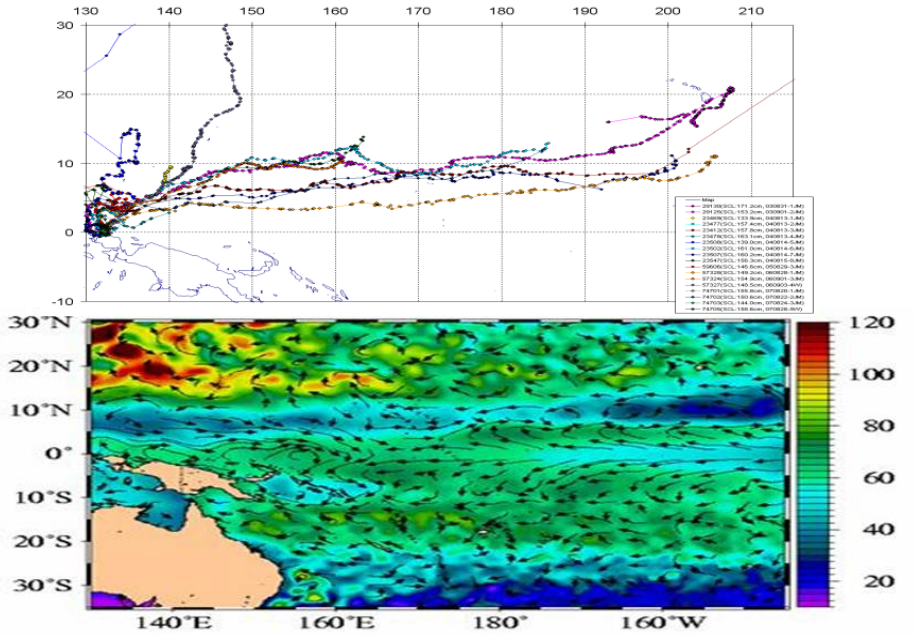




- Turtles that nested in dry season (mainly in the Jamursba-Medi) moved northeastward to the central tropical Pacific and northward to the western North Pacific off Japan and off Philippines
- Turtles that nested in rainy season (mainly in the Wermon) moved southward to the South Pacific off New Guinea Island and off New Zealand



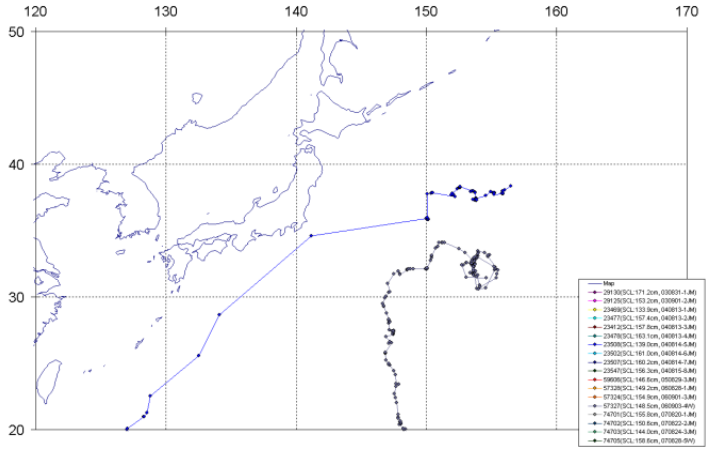
Relationship Between Movements Of Leatherbacks Moved Northeastward To The Central Tropical Pacific And Sea Surface Flow



Data on 1 Oct. 2006

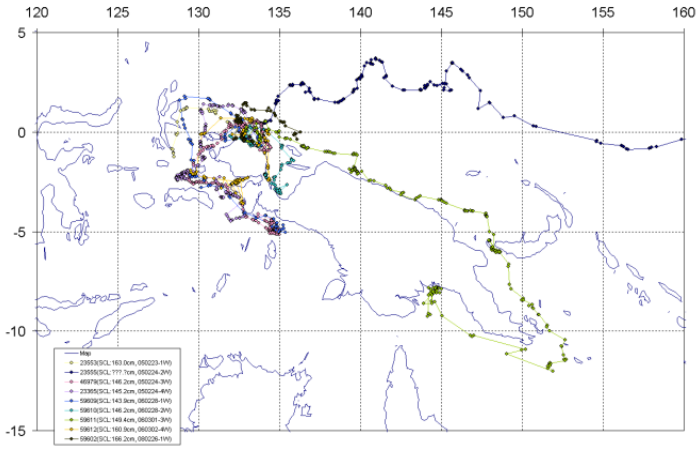
Data from the Naval Research Laboratory, US Navy Coastal Ocean Model (NCOM)

Movements of Leatherbacks off Japan



- Turtles moved eastward along the Kuroshio Current and its extension flowing to the east
- Turtles stayed continuously on the water mass

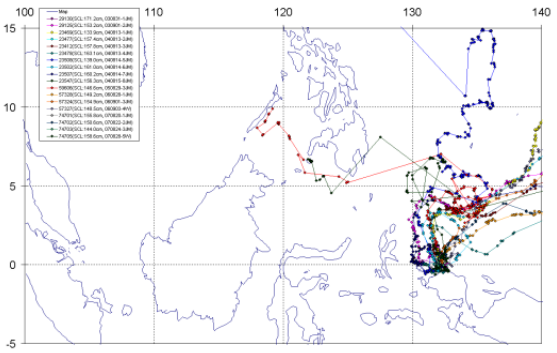
Movements Of Leatherbacks That Nested In Rainy Season Off New Guinea Island



- Turtles moved southward
- Most turtles stayed around New Guinea Island

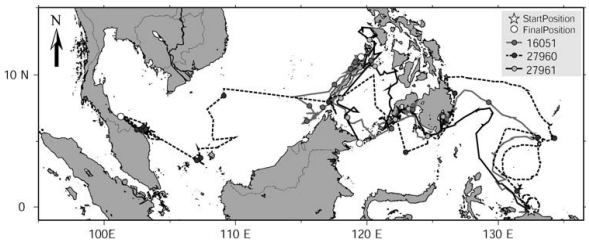
Two turtles moved westward…

- Two turtles stayed continuously on the water mass off New Guinea Island
- Turtles moved westward to South China Sea
- Benson et al. (2007) reported similar results about movement patterns of leatherback turtles



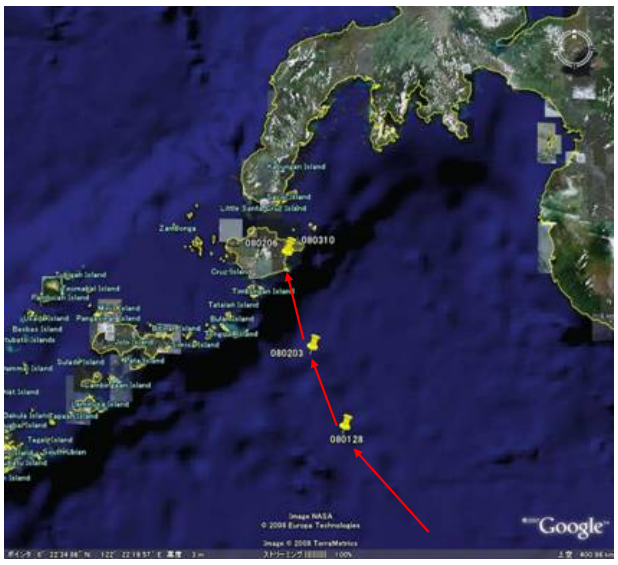
This study

→Relationship between Indonesian and Malaysian leatherback turtle populations?
International collaboration is important for conservation and management of leatherback populations



Benson et al. (2007)

One turtle moved to the tropical Pacific off Philippines



- Across Philippine Trench
- Toward Celebes Sea
- Near Basilan Island on 6 Feb. 2008

Current Position of This Turtle

- East side of Basilan Island
  - 6° 32′ N
  - 122° 12′ E

Artificial movement?
Stranding?
Dropped transmitter?

Recapture of transmitter provide important information to know what happens to leatherbacks

Summary

- **Post-nesting movements**

  Post-nesting foraging areas of females differed according to the nesting seasons and/or areas
  - Most of the females that nested in dry season (mainly in the Jamursba-medi area) moved eastward to the central tropical Pacific, and small number of them moved northward to the western North Pacific off Japan and off Philippines
  - Females that nested in rainy season (in the Welmon area) moved southward to the South Pacific
- **Two routes for eastward movements**
  - Some turtles moved rapidly along the eastward-flowing Equatorial Counter Current
  - Some turtles moved slowly against the westward-flowing North Equatorial Current

  →Migration routes varied among individuals by seasons and nesting area

  Leatherback turtles have many foraging grounds in the North and South Pacific

  International collaboration is important for conservation and management of leatherback populations

REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

STOCK IDENTIFICATION OF SEA TURTLES IN THE SOUTHEAST ASIAN REGION

IDENTIFICATION OF THE STOCK/POPULATION OF GREEN AND HAWKSBILL TURTLES IN THE SOUTHEAST ASIAN REGION

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Abstract

Conservation and enhancement of sea turtle resources require their ecological and physiological knowledge through life. Detection of subpopulations of sea turtles is a very essential ecological aspect to promote their conservation and enhancement because these resources-protective schemes should be made to each population unit. Molecular genetic analyses were used to investigate the population genetic structure of Green sea turtles of Southeast Asia. Population genetic studies were analysed using mitochondria (mt) DNA. We conducted multiscale assessments of mtDNA variation. For Green turtles, we combined results from mtDNA sequence with present studies. Analysis of Green turtles, mtDNA control region sequences identified 30 haplotypes from nesting samples and six of those haplotypes were first identified in this study and 15 haplotypes for Hawksbill turtles. The frequency distributions of Green turtles indicated 11 genetically distinct breeding stocks (Management Units, MUs) and DNA sequence diversities were in the range of 0.0 - 0.836 for Green turtles. For Hawksbill turtles, due to n [d4eso study has been reported and a limited number of samples, no conclusion can be made. In general, the haplotypes can be grouped into three categories; i) those shared in all nesting populations, ii) those shared by geographically adjacent nesting population and iii) those that are restricted only in a single nesting population. The significant genetic differentiations in mtDNA haplotype frequencies among rookeries support the hypothesis of natal homing.

Keywords: mtDNA, Management Units, *Chelonia mydas*, conservation.

Introduction

Knowledge of population dynamics is largely obtained from long-term mark-recapture studies of females tagged while nesting on the beaches. These studies show that breeding female turtles display high fidelity to the same nesting beaches and hypothesized that mature nesting female turtles select their natal beach to deposit eggs. Studies in the southern Great Barrier Reef (sGBR) demonstrate that Green turtles also display fidelity to resident feeding grounds throughout their adult lives (Limpus *et al*. 1992) with females reaching sexual maturity at about 40 years (Limpus & Chaloupka 1997). Detection of subpopulations of sea turtles is a very essential ecological aspect to promote their conservation and enhancement because the resources-protect schemes should be made to the each population unit. Mitochondrial DNA has proved particularly effective for detecting population structure in marine turtles. Analysis of mtDNA structure in Atlantic Green turtle population supported the natal homing hypothesis, as geographically distant were found to have heterogeneous mtDNA frequencies (Bowen & Avise 1996).

Objectives

1) To detect subpopulations of nesting Green and Hawksbill turtles in Southeast Asian region.
2) To identify the genetic markers of different management units.

Materials and Methods

Samples of skin or muscle were taken from nesting turtles and stored in 90-100% ethanol (Syed-Abdullah et al. 2006). For Green turtles, the present data set includes nesting-site haplotype frequencies from Dethmers et al. (2006), Joseph (2006) and Kittiwattanawong et al. (2004). Table 1 shows the number of samples collected for the Trust Fund IV program while Figure 1 shows the samples locations. Previous studies used a 384-bp fragment of the control region, therefore our analysis was limited to this segment to maintain compatibility.

The genomic DNA was isolated using MasterPure™ DNA Purification Kit (EPICENTRE® Biotechnologies) and store at -20°C. The mtDNA control region fragment was amplified by Polymerase Chain Reaction (PCR) with primers TCR-5 (5'-TTGTACATCTACTTATTTACCAC-3') and TCR-6 (5'- GTAAGTAAAACTACCGTATG

CCAGGTTA-3') for green turtles (Norman et al. 1994) and primers LTEi9 (5'-GGGAATAATCAAAAGAGAAGG-3') and H950 (5'-GTCTCGGATTTAGGGGTTT-3') for Hawksbill turtles (Abreu, unpublished). Template DNAs for samples of both green and Hawksbill turtles were amplified in 25 µl total reaction volumes containing 30 ng template, 0.2 unit FailSafe PCR Enzyme Mix and 1 x FailSafe PCR PreMix E (EPICENTRE® Biotechnologies). PCR cycling parameters for green turtles was one cycle of 93 °C (3 min), 39 cycles of (93 °C, 30 s +52 °C, 30 s +72 °C, 30 s) and one cycle of 72 °C for 10 min and for hawksbill turtles was one cycle of 94 °C (5 min), 25 cycles of (94 °C, 30 s +52 °C, 30 s +72 °C, 1 min 30 s) and one cycle of 72 °C for 5 min.

The amplified products were then purified using a PCR purification kit (Favergon) and quantified by compared bands with mass ladder. PCR amplicons were sequenced in both directions with an automated sequencer. Sequences were then aligned and edited using appropriate software. Estimates of nucleotide diversity and divergence were calculated using MEGA 4 (Kumar et al. 2007) and Arlequin 3.11 (Excoffier et al. 2007) based on Kimura 2P distance measures. Estimates of nucleotide sequence divergence (p-values) between genotypes were calculated with the Kimura 2-parameter method (Kimura 1980) and the resulting distances were clustered using Neighbor-Joining (Saitou and Nei 1987) provided by MEGA 4 (Kumar et al. 2007).

The GenBank database (National Center for Biotechnology Information, USA: NCBI Homepage http://www.ncbi.nlm.nih.gov was searched for similar sequences. Mitochondrial DNA sequences of Green and Hawksbill turtle were downloaded from the database for phylogenetic comparisons.

Table 1: Number Of Green And Hawksbill Turtle Samples Collected For The Trust Fund IV Program.

Country	Green turtle				Hawksbill turtle			
	Location	Year	N^1	N^2	Location	Year	N^1	N^2
Brunei	Brunei Beach	‘06	4	4	Brunei Beach	‘06	4	4
Indonesia	Derawan Island	‘06	23	22	Kimar Belitung	‘07	38	9
	Sangalaki Island	‘06	9	9				
	Panjang Island	‘06	16	16				
Malaysia	Redang Island	‘06	38	31	Melaka	‘07	29	29
	Sarawak Turtle Islands	’05-‘06	30	30	Sabah Turtle Islands	’07-’08	30	20
	Sabah Turtle Islands	‘05	30	30				
Myanmar	Tameahla Island	‘05	30	30	Coco Island	‘07	4	4
	Coco Island	‘06	30	30				
Philippines	Panikian Island	‘06	11	10	Davao Gulf	‘07	5	2
	APO Reef NP	‘06	4	4	APO Reef NP	‘07	5	4
	Baguan Island	‘06	27	24	Misamis Oriental	‘07	1	1
					Bataan	‘07	1	1
Thailand					Khram Island	’01-‘07	19	14
Vietnam	Con Dao Island	’06-‘07	65	34				
	Minh Chau	‘06	30	11				
Total			**347**	**285**			**136**	**88**

Note: N^1 = No. of samples collected and N^2 = No. of samples has been analyzed.

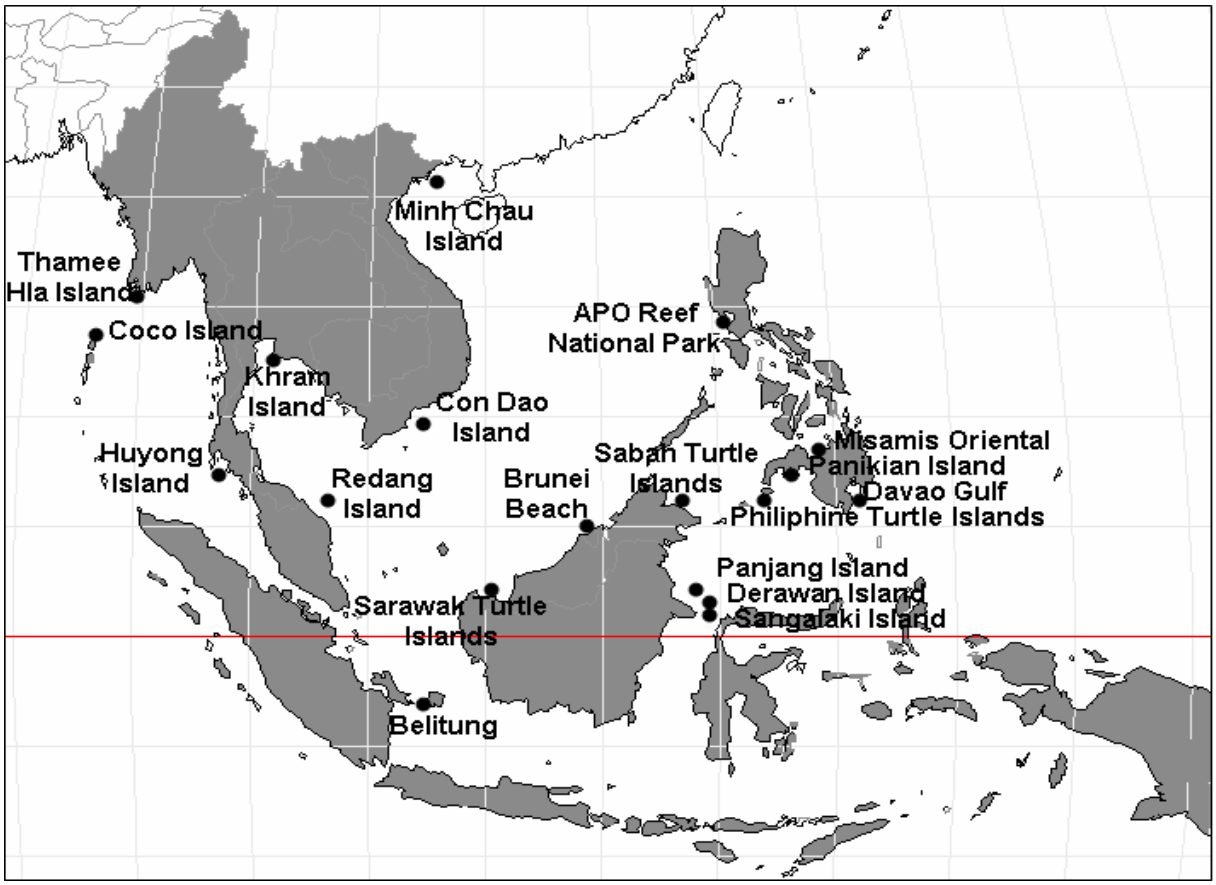

Fig 1. The Tissue Samples Locations Of Green And Hawksbill Turtles In Southeast Asia Region.

RESULTS

Green Turtles

Mitochondrial DNA diversity and phylogenetic structure

A total of 285 from 347 turtle samples from this study plus 245 samples from a previous study by Dethmers et al. (2006), Kittiwattanawong et al. (2004) and Joseph (2006) were analyzed. The number of samples analyzed by nesting beaches is shown in Table 1. The sequence analysis of the 389 bp fragments of Green turtles resulting in the identification of 43 polymorphic sites (Table 2) defining 30 haplotypes. A number of 30 haplotypes were detected of which 11 was published by Moritz et al. 2002, six are new from this study and the remaining was reported by Joseph (2006) and Kittiwattanawong et al. (2004). The sites were characterized exclusively by 342 conserved sites, 43 variable sites which is 28 parsimony informative sites and 15 singletons. In addition 2 indels in the sequences were observed.

The relationships among 30 mtDNA control region of Green sea turtle and Hawksbill turtle haplotypes as an outgroup are summarized in a neighbor-joining tree as shown in Figure 2. In this network analysis, most Green turtle haplotypes group in one major cluster (Clade I). The 21 haplotypes were clustered together in this clade. Clade II contained four haplotypes and Clade III contained five haplotypes. Figure 3 shows the haplotypes with the rookeries where the haplotypes were found.

Population diversity and subdivision

Table 2 shows the geographical distribution of the haplotypes and frequencies at which those haplotypes occur. A total number of 11 haplotypes are shared between nesting beaches and 19 haplotypes are unique to individual nesting beach. In general, the haplotypes can be grouped into three categories; i) those shared in all nesting populations (C3), ii) those shared by geographically adjacent nesting population (D2, C4, M1, C14, C7, M2, C5, B5, A3 and A6) and iii) those that are restricted only in a single nesting population (CMP 18, G15, R1, G11, G4, M3, T1, G2, G13, G5, P2, G3, G12, T2,G14, T3, G7, A2 and P1). Haplotype C3 was the dominant haplotype which is found at all samples sites except for Enu, Indonesia and Panikian Island, Philiphine. Haplotypes C3 also was identified as dominant haplotype for Pengumbahan (17/23 samples), Redang Island (42/73 samples), Paka (14/15 samples), Pahang (8/12 samples), Perak (13/15 samples), Sipadan (24/40 samples), Tamee Hla (18/30 samples), Coco Island (17/30 samples), Huyong Island (10/19 samples), Khram Island (15/30 samples), Vietnam (51/53 samples). Haplotype C3 of clade I was widely distributed across the Indian Ocean and Southeast Asia, and had limited occurrence in the Pasific Ocean (Dethmers et al. 2006). While C4 are dominant haplotype for Sarawak (40/62), D2 for Sabah (47/58) and Philippine Turtle Island (44/62), C14 for Enu (27/28) and A3 for Panikian (9/9).

Table 2: Frequencies of green turtle (Chelonia mydas) mtDNA haplotypes among 20 locations in Southeast Asia region. The result from this Trust Fund IV program was combined with data published by Dethmers et al. (2006) and Juanita (2006). Haplotypes nomenclature follows Moritz et al. (2002).

			Clade I																						Clade II				Clade III				
			CMP							C									G	G	G	G				G						
Country	**Location**	**N**	**R1**	**T1**	**M1**	**C4**	**D2**	**18**	**C3**	**M3**	**C7**	**14**	**P2**	**M2**	**C5**	**G2**	**G3**	**G4**	**G5**	**11**	**12**	**13**	**15**	**B5**	**T2**	**T3**	**14**	**A2**	**A3**	**A6**	**P1**	**G7**
Brunei	Brunei Beach	4				1	1		2																							
Indonesia	Derawan Island	22			6		3		5				1		5														1		1	
	Sangalaki Island	38			1		8		8			5			13															3		
	Panjang Island	16			7		4		2		1				1														1			
	Pengumbahan	23				6			17																							
	Enu	28										27																	1			
Malaysia	Redang Island	73	5			9	1		42			3									1	4		5			3					
	Paka	15							14															1								
	Pahang	12							8							1	2	1														
	Perak	15							13										2													
	Sarawak	62			1	40			16											1				4								
	Sipadan Island	40					8		24			1			4																	3
	Sabah Turtle Islands	58					47		10		1																					
Myanmar	Tameahla Island	30			1	2			18			9																				
	Coco Island	30			4	1			17	1		3		2														2				
Philippine	Panikian Island	9																											9			
	APO Reef NP	4							4																							
	Philippine Turtle Islands	62					44		17						1																	
Thailand	Huyong Island	19		1					10															8								
	Khram Island	30						1	15		3													8	1	1				1		
Vietnam	Con Dao Island	42							40					1									1									
	Minh Chau	11							11																							
	Total	643	5	1	20	59	116	1	293	1	5	21	1	3	24	1	2	1	2	1	1	5	1	26	1	1	3	2	11	4	1	3

Fig 2: Neighbour-Joining Tree Of Kimura 2-Parameter Distance For Green Turtle Haplotypes Based On 30 Mtdna Control Region Sequences, Using The Hawksbill Turtle Haplotypes As An Outgroup.

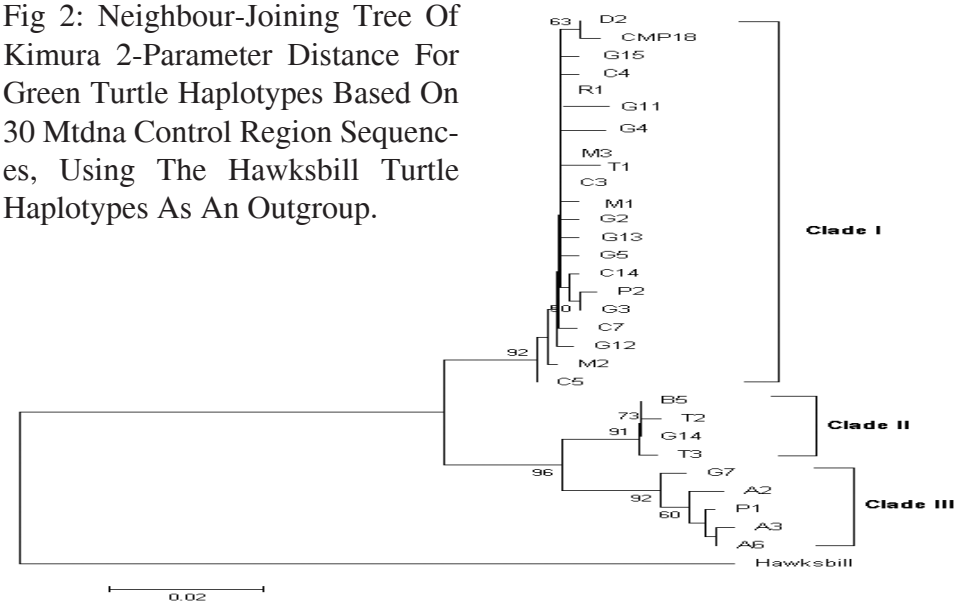

Fig 3: Neighbour-Joining Tree Of Kimura 2-Parameter Distance For All Sample Locations Of Green Turtle Haplotypes Based On 30 Mtdna Control Region Sequences, Using The Hawksbill Haplotype As An Outgroup.

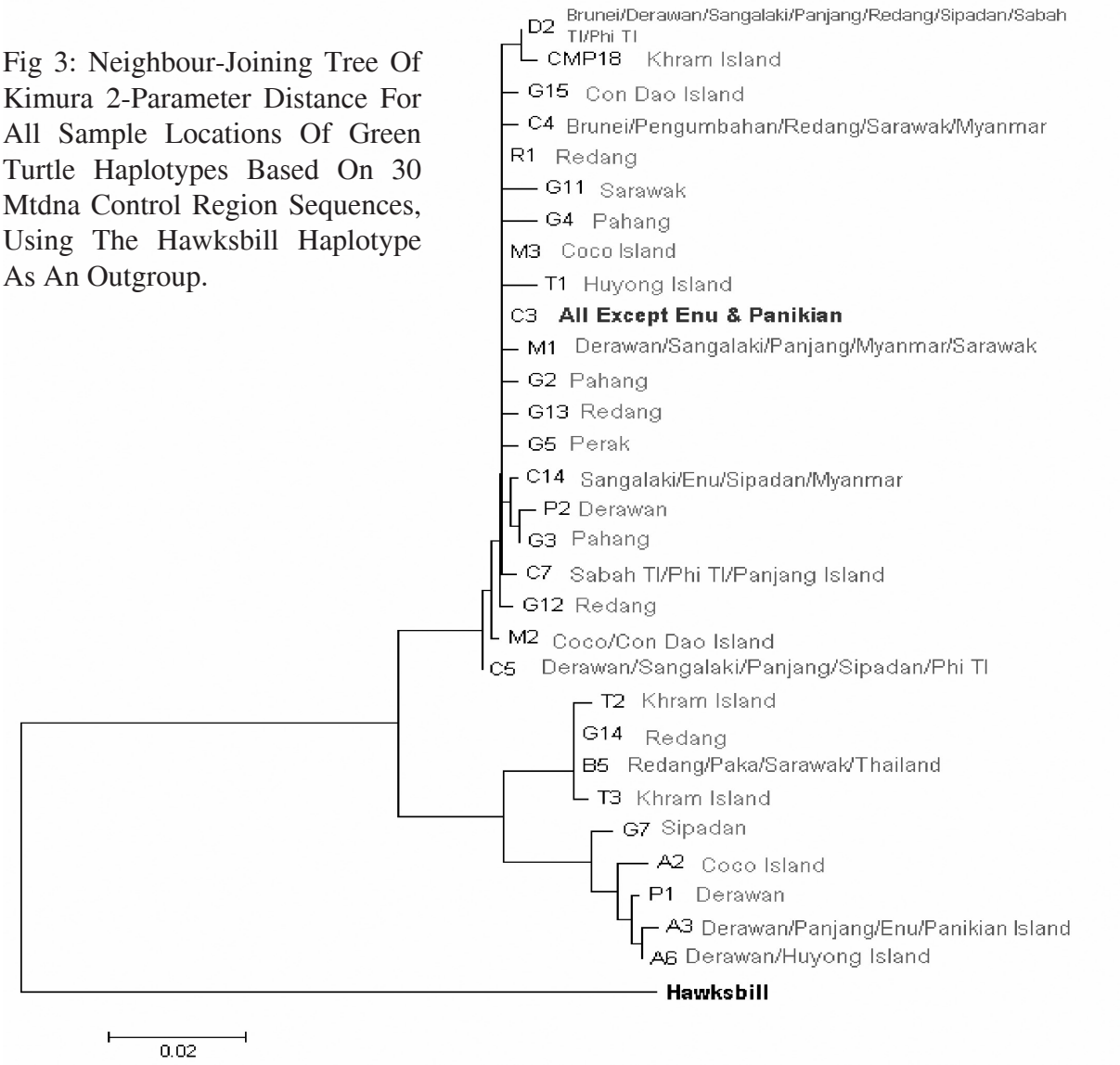

Table 3 shows the haplotype and nucleotide diversities within-population variation of Green turtles. The haplotype diversities are varied widely among the 22 nesting beaches (0 – 0.0836). The highest haplotype diversities are 0.836 for Derawan Island, Indonesia. Nearby to Derawan Island, Sangalaki Island also has high value of haplotype diversities, 0.791. The results also show that no haplotype diversities existed for APO Reef Natural Park, Panikian Island, Philippine and Minh Chau, Vietnam but may be due to the number of samples which were very small. Nucleotide diversity ranged from 0 – 0.0115 (Redang Island). Overall haplotype diversity was 0.4425 and overall nucleotide diversity was 0.0043.

Table 3**:** Haplotype (*h*) and nucleotide (π) diversities by nesting beaches.

No.	Country	Nesting beach	N	h	*hd*	π
1	Brunei	Brunei Beach	4	3	0.833	0.0026
2	Indonesia	Derawan Island	22	7	0.836	0.0126
3		Sangalaki Island	38	6	0.791	0.0106
4		Panjang Island	16	6	0.767	0.0101
5		Pengumbahan	23	2	0.403	0.0011
6		Enu	28	2	0.071	0.0039
7	Malaysia	Redang Island	73	9	0.647	0.0115
8		Paka	15	2	0.133	0.0062
9		Pahang	12	4	0.561	0.0021
10		Perak	15	2	0.248	0.0006
11		Sarawak	62	5	0.521	0.0072
12		Sipadan Island	40	4	0.599	0.0084
13		Sabah Turtle Islands	58	4	0.319	0.0009
14	Myanmar	Tamaehla Island	30	4	0.563	0.0016
15		Coco Island	30	7	0.662	0.0087
16	Philiphine	APO Reef Natural Park	4	1	0.0	0.0
17		Panikian	9	1	0.0	0.0
18		Philiphine Turtle Islands	62	3	0.427	0.0012
19	Thailand	Huyong	19	3	0.573	0.0025
20		Khram	30	7	0.687	0.0025
21	Vietnam	Minh Chau	11	1	0.0	0.0
22		Con Dao	42	3	0.094	0.0003
		Overall	**628**		**0.4425**	**0.0043**

Note: N = No. of samples analyzed, H = No. of haplotypes, hd = haplotypes diversity

and π = nucleotide diversity.

Population subdivision were tested using exact test for population differentiation and pairwise F_{st} test (using haplotype diversity) based on the frequencies of mtDNA variants. Nesting beach with small number of samples (Brunei, APO Reef Natural Island and Panikian Island, Philippine) were out from population subdivision analysis but two sites of samples from Vietnam were combined. From the two round tests, Green turtles were grouped into 11 groups with each group was considered to represent Management Units (MUs). The MUs is shown in Table 4. Indonesia and Malaysia have the highest MUs (4). The 11 MUs are Derawan Island, Sangalaki Island, Pengumbahan, Enu, Peninsular Malaysia, Sarawak, Sipadan Island, Sabah Turtle Islands and Philippine Turtle Islands Tamae Hla Island and Coco Island, Huyong Island and Khram Island, and Minh Chau and Con Dao. The geographic location of the 11 MUs is shown in Figure 4.

Table 4: Haplotype (*hd*) and nucleotide (π) diversities by management units (Exact test of sample differentiation based on haplotype frequencies, *Raymond M. and F. Rousset. 1995).*

No.	Country	Management Unit	N	h	*Hd*	π
1	Indonesia	Derawan Island	22	7	0.836	0.0126
2		Sangalaki Island	38	6	0.791	0.0106
3		Pengumbahan	23	2	0.403	0.0011
4		Enu	28	2	0.071	0.0039
5	Malaysia/	Redang+Paka+Perak+Pahang	115	10	0.539	0.0092
6	Philippine	Sarawak	62	5	0.521	0.0072
7		Sipadan Island	40	4	0.599	0.0084
8		Sabah+Philippine TI	120	4	0.377	0.0011
9	Myanmar	Tamae Hla+Coco	60	7	0.618	0.0053
10	Thailand	Huyong+Khram	49	8	0.640	0.0243
11	Vietnam	Minh Chau+Con Dao	53	3	0.075	0.0020
		Overall	610		0.503	0.0073

Note: N = No. of samples analyzed, H = No. of haplotypes.

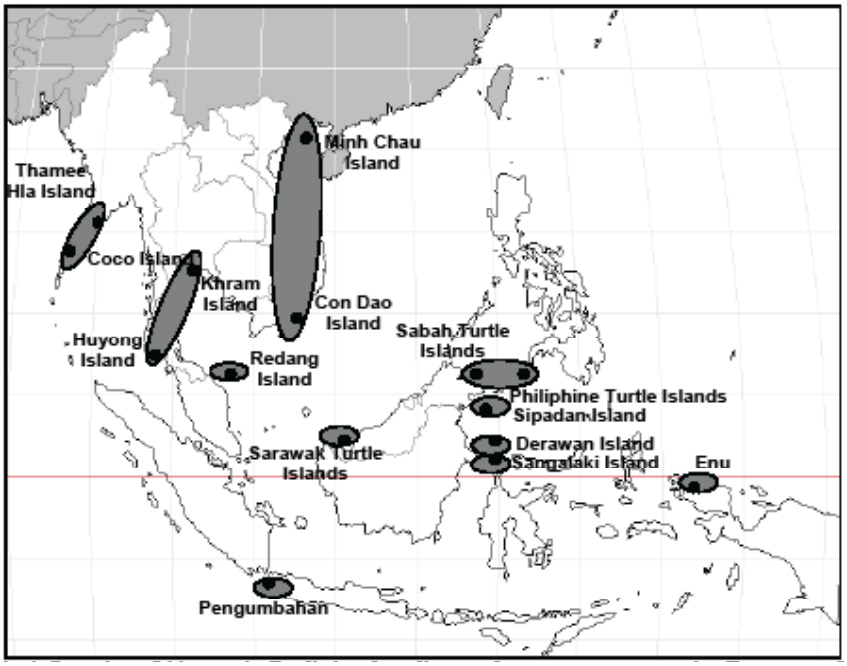

Fig 4**:** Location of 11 genetically distinct breeding stocks or management units. Exact test of sample differentiation based on haplotype frequencies *Raymond M. and F. Rousset. 1995.*

Hawksbill Turtles

From 136 samples collected only 88 samples have been analyzed. The Hawksbill turtle mtDNA sequences were aligned for 740 bases from 5' end of the control region. From these sequences, defining 15 haplotypes were observed with 43 polymorphic sites. Table 5 lists the geographical distribution of the haplotypes and the frequencies at which those haplotype occur. The relationships among the 13 mtDNA haplotypes of Hawksbill turtles are summarized in a median-joining network as shown in Figure 5. Figure 5 also shows the locations of the haplotypes occur. The haplotypes were group into two distinguished cluster. Haplotypes Ei_9, Ei_10 and Ei_15 are shared among nesting beaches while the remaining haplotypes (12) are unique to individual nesting beaches.

Table 5: Frequencies of hawksbill turtles mtDNA haplotypes.

				Clade I								Clade II							H
Country	Location	N[1]	N[2]	Ei_ 1	Ei_ 2	Ei_ 3	Ei_ 4	Ei_ 5	Ei_ 6	Ei_ 7	Ei_ 8	Ei_ 9	Ei_ 10	Ei_ 11	Ei_ 12	Ei_ 13	Ei_ 14	Ei_ 15	
Brunei	Brunei Beach	4	4				1					1	2						3
Indonesia	Kimar Belitung	38	9									7	2						2
Malaysia	Melaka	29	29									29							1
	Sabah Turtle Islands	30	20		9							1	8				1	1	5
Myanmar	Coco Island	4	4	2								1						1	3
Philipphine	Dava0 Gulf	5	2								1					1			7
	APO Reef Natural Park	5	4					1	2	1									
	Misamis Oriental	1	1			1													
	Bataan	1	1										1						
Thailand	Khram Island	19	14									9		3	2				3
	Total	136	88	2	9	1	1	1	2	1	1	48	13	3	2	1	1	2	

Note: N1 = No. of samples received, N2 = No. of samples analyzed, H = No. of haplotypes.

Fig 6: Neighbour-joining tree of Kimura 2-parameter distance for all sample countries of hawksbill turtle haplotypes based on 15 mtDNA control region sequences, using the green haplotype as an outgroup.

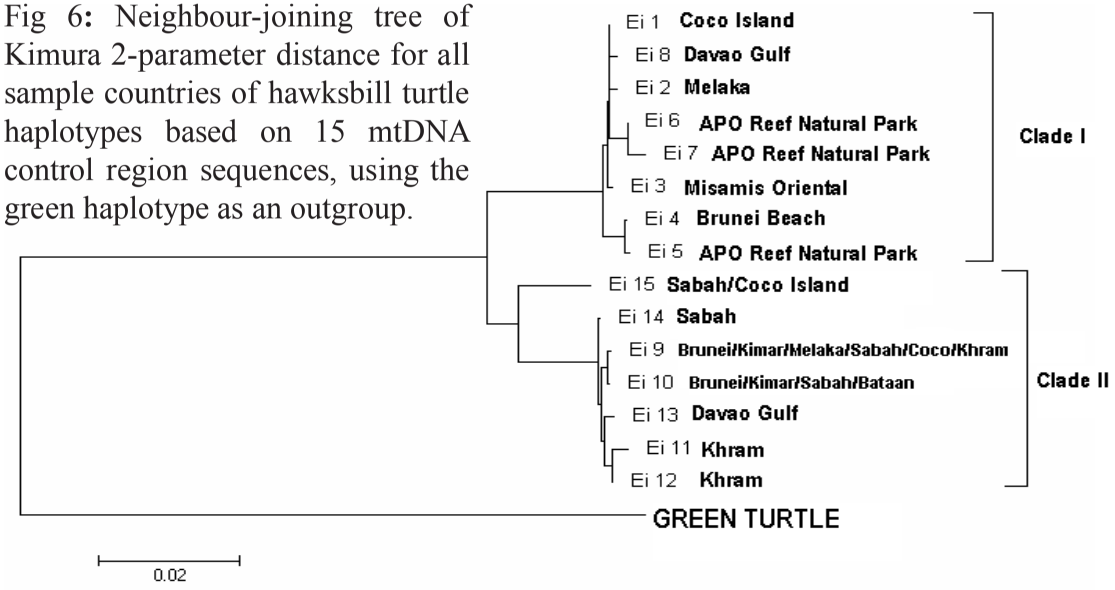

Table 6 shows the haplotype and nucleotide diversities of hawksbill turtle by nesting beaches. After combining together the samples from the Philippines with a total number of eight samples, it resulted in seven haplotypes giving the highest haplotypes diversities. The number of samples from Melaka is the biggest, but there is no haplotype diversity for Hawksbill turtles from Melaka.

Table 6: Haplotype (*h*) and nucleotide (π) diversities by nesting beaches.

Country	Nesting Beach	N	H	*h*	Π
Brunei	Brunei Beach	4	3	0.83333	0.019568
Indonesia	Kimar Belitung	9	2	0.38889	0.000525
Malaysia	Melaka	29	1	0.0	0.0
	Sabah Turtle Islands	20	5	0.66316	0.020392
Myanmar	Coco Island	4	3	0.83333	0.027440
*Philippine	Dava0 Gulf	8	7	0.96429	0.018942
	APO Reef Natural Park				
	Misamis Oriental				
	Bataan				
Thailand	Khram Island	14	3	0.56044	0.002313
Total		88			

Note: * All samples was combined together to calculate ***h*** *and* ***π.***

Discussion

The nesting beaches sampled in this study represent most of the major reproductive aggregations of Green and Hawksbill turtles in this region. From the combination of mtDNA Green turtle results from this study with Dethmers et al. 2006, Joseph 2006 and Kongkiat et al. 2004, 30 haplotypes were identified from 643 individuals. In general, these haplotypes can be grouped into three categories ; i) those shared in all nesting populatons, ii) those shared by geographically adjacent nesting populations and iii) those that are restricted only in a single nesting population. The dominant haplotype in Southeast Asia was C3 and it occurred in all nesting sites except for Enu and Panikian Island.

Estimates of haplotype and nucleotide diversities were substantially different among sites. Estimates of haplotype diversities can be related to the current rookeries size. Green turtles from Derawan and Sangalaki Island which have a large population size were shown to have the highest haplotype diversities in Southeast Asia region.

Two types of tests were used to examine the population subdivision of Green turtles: Exact test of population differentiation (Raymond & Rousset 1995) and paorwise Fst test Slatkin 1991). Both tests have differentiated the nesting location into 11 groups represented in Management Units (MUs). There were no significant differences in the haplotype frequencies of Green turtles between sites in Peninsular Malaysia (Perak, Pahang and Terengganu (Redang & Paka)). It was considered in one MU. Due to the low number of nesting samples of Hawksbill turtles, the number of samples collected for this study was also small. The values of haplotype diversities are not considered very informative. No report on genetic population of Hawksbill turtles in Southeast Asia region.

Conclusion

This study identified 11 genetically breeding aggregations of Green turtles throughout Southeast Asia (Management Units). The overall population diversity for Green turtles is still high except for Enu and Vietnam. More effort should be focused on these nesting populations to keep population size high and maintain this diversity.

Recommendations

Research on feeding ground must be done to know the feeding ground of our turtles especially for haplotype C3 which is found in most nesting beaches of green turtles in this region. More work should do on identify the genetic of hawksbill turtles.

Acknowledgement

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REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

DETECTION ON MULTIPLE PATERNITY OF GREEN TURTLES

MULTIPLE PATERNITY OF GREEN TURTLES (*Chelonia mydas*) FROM REDANG ISLAND, TERENGGANU, MALAYSIA.

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Introduction

Marine turtles are migratory species and in most cases migratory routes and reproductive behaviors are difficult to measure and these scientific gaps have continued to hamper conservation efforts. In this study, molecular techniques were used to investigate the reproductive patterns of Green turtles at nesting beaches in Redang Island, Terengganu, Malaysia.

All turtle species migrate from foraging areas to mating areas, after which the males return to the foraging areas and the females move to the nesting areas (Limpus et al. 1994). The number of clutches and eggs laid per clutch varies within and between species.

Populations of marine turtles have decreased in many parts of the world due to human factors. In general, female sea turtles do not reproduce every year. However, males of at least some species (e.g. *Caretta caretta*) may breed every year (Limpus 1993). Recent advances have shown multiple paternities are frequent in both invertebrates and vertebrates. In a polyandrous mating system, a female mates with several males within a single reproductive season. This may result in multiple paternities of clutches, which occur when several males contribute to the offspring in a single clutch. The paternity finding will provide an indirect approach to study turtle breeding biology that would otherwise be difficult at sea.

Female turtles store sperm in tubules found in the posterior part of the albumin-secreting region of the oviduct (Gist & Jones, 1989). Turtles are capable of long-term sperm storage within the upper oviduct (4 years record; Ewing 1943), sperm viability is expected to decline over time. Various hypotheses proposed to explain the frequent occurrence of multiple paternities in nature: i) the procurement of "good genes" if a better male is encountered subsequently and his sperm is successful, ii) fertility assurance if some males have poor quality sperm, iii) increased offspring viability through sperm competition, and iv) increased genetic diversity of offspring if sperm from several males are successful, that provides insurance against an uncertain future in a changing environment. The benefits of multiple mating of marine turtles are still unknown.

Microsatellite DNA analyses popularly known as DNA fingerprinting, can resolve the paternal contribution to a cluster of eggs. It is done by looking at the pattern of gel electrophoresis band which is one band equal to one allele. A single father will present one to two paternal alleles, while clutches with three to four paternal alleles represented offspring from a mating between one female and two male turtles. If more than four paternal alleles were present, the clutch was assumed to have a minimum of three fathers (Moore *et al*. 2002).

Objectives

The two major objectives of this study are to determine the level of multiple paternities and to estimate adult males stock sizes at nesting beaches in Redang Island, Terengganu.

Materials and Methods

A total of 300 tissue samples from ten clutches of Green sea turtle hatchlings were collected during the 2006 season at Mak Kepit Beach, Redang Island, Terengganu, Malaysia. Tissue samples were stored in 90 % of ethanol. The total genomic DNA was isolated using MasterPure™ DNA Purification Kit (EPICENTRE® Biotechnologies) and store at -20°C until used. The DNA microsatellite fragments were amplified by using five of primers; Cm 3, Cm 58, Cm 72, Cm 84 and Cc 117 (FitzSimmons et al. 1995). Template DNA were amplified in 25 µl total reaction volumes containing 30 ng template, 0.2 unit FailSafe PCR Enzyme Mix and 1 x FailSafe PCR PreMix E (EPICENTRE® Biotechnologies). PCR cycling parameters for green turtles was one cycle of 95 °C (2.5 min), 30 cycles of (95 °C, 45 s +55 °C, 60 s +72 °C, 60 s) and one cycle of 72 °C for 5 min. Standard precautions were taken to avoid contamination during the preparation for PCR.

Following PCR, the amplified fragments were checked for correct size by electrophoresis on 1.5% agarose gel. Amplified products were then resolved on 7.5 % polyacylamide gels run for 2 hours. Fragments DNA were visualized by fluorescence under UV light after staining with ethidium bromide. Products were run together with samples of adult females running adjacent to the samples of offspring. Any samples displaying unexpected alleles were re-amplified and re-run for confirmation.

Maternal genotypes were determined directly from the adult females sampled and maternally-derived alleles were determined in the offspring genotypes. Paternal alleles were inferred from offspring genotypes once maternal alleles were accounted for. Multiple paternities in a clutch was only inferred when more than two paternal alleles were observed at more than one locus.

Results

Table 1 shows the maternal genotypes, offspring genotypes and number of paternal alleles which are summarised from results obtained from maternal and hatchling genotypes. All the samples are not completely analysed. For samples from clutches A, H and J no mothers' samples were available but analysis could still be done as this project is still on-going.

Table 1: Maternal and offspring genotypes number of hatchlings identified to each sire as shown in brackets and bolded within green turtle clutches from Terengganu at five microsatellite loci. Allele designations refer to the base pair length of the alleles.

	Maternal genotypes					**Offspring genotypes**					**No. paternal alleles**	**Total no. Of males**
Female ID	**Cm3**	**Cm72**	**Cm84**	**Cm58**	**Cc117**	**Cm3**	**Cm72**	**Cm84**	**Cm58**	**Cc117**		
A	No mothers' sample											
B	170/196		-	136/156		146/170 **(8)** 158/170 **(6)** 162/170 **(4)** 170/196 **(2)**	-	-	136/144 **(2)** 136/156 **(11)**	-	**4**	**2**
C	157/171	250/272	343/356	131	242	157 **(8)** 171 **(1)** 157/171 **(17)** 171/190 **(4)**	240/272 **(1)** 250/296 **(1)** 250/290 **(3)** 236/250 **(1)**	343/356 **(2)** 356/378 **(4)** 343/378 **(3)** 356/394 **(1)**	131/151 **(10)** 131/138 **(4)** 129/131 **(1)** 131 **(1)** 131/158 **(3)**	242/272 **(4)** 322/242 **(3)**	**4**	**2**
D	167/185	271/305	348/368	-	-	167/185 **(8)** 152/167 **(6)**	271/305 **(5)** 271/310 **(3)** 237/271 **(6)** 305/310 **(1)**	348/380 **(5)** 348/368 **(9)** 348 **(1)**	-	-	**3**	**2**
E	-	-	333	130	-	-	-	333 **(2)** 333/356 **(9)** 333/377 **(2)**	130/142 **(4)** 130/149 **(1)** 130 **(2)**	-	**3**	**2**
F	-	-	348/377	-	-	-	-	377 **(6)** 348/377 **(1)**			**2**	**1**
G	161/179	259/298	367	-	239/267	158/161 **(2)** 152/161 **(2)** 161/179 **(6)** 152/179 **(1)** 179/190 **(3)**	259/298 **(12)** 298/315 **(2)**	346/367 **(8)** 367 **(19)**	-	239/257 **(14)**	**4**	**2**
H	No mothers' sample											
I	-	-	-	130/148	-	-	-	-	130/142 **(3)** 130/148 **(4)**	-	**2**	**1**
J	No mothers' sample											

Note: "-"shows the samples not analysed yet.

Discussion

All five microsatellite loci used in this study were polymorphic. The initial results show that the maximum numbers of paternal alleles are four which means the clutches contribute to two sires but it is still too early to draw any conclusion because only the same paternal allele was found at one time. Mutation may happen at that locus. A conclusion only can be drawn after all samples have been analysed.

Multiple paternities are evident that multiple mating occurs within a population and if identified can serve to highlight mating strategies. Multiple paternities can have important consequences especially for endangered species as it increases effective population sizes relative to single paternity, thus reducing the loss of genetic variability through drift (Sugg and Chesser 1994).

Despite the agreement of multiple paternities in Green turtles, all previous studies show widely different incidences of multiple paternities (Parker et al. 1996, Lee and Hays 2004 & FitzSimmons 1998). Several factors have been related to the incidence of multiple paternity in individual turtle populations such as breeding sex ratio (Bollmer et al. 1999) and sperm competition (FitzSimmons 1998).

Conclusion

It is still premature to draw any conclusion on the number of paternal contribution on each clutch in the study because the number of samples that have been analysed is small but from the initial results gave a good indication that multiple paternities occur in the Green turtles population in Redang Island, Malaysia.

Acknowledgement

The author would like to thank SEAFDEC for funding this project under the Japanese Trust Fund Program (Trust Fund IV, Research for stock enhancement of sea turtles). Thanks also to Dr. Juanita Joseph (University Malaysia Terengganu), Nurul Azrin Yusof and Nik Zuraini Omar, contract staff, Ms. Tengku Noor Aminah and last but not least to all practical students at Conservation Genetic Laboratory (UniSel, UPM, UMT and UNIMAS) for their assistance.

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Parker, P.G., T.A. Waite, and T. Peare. 1994. Paternity studies in animal populations. In: T.B. Smith and R.K. Wayne (Eds.) Molecular Genetic Approaches in Conservation. Oxford University Press, Oxford, 413-423.

Sugg, D. W. & Chesser, R. K., 1994. Effective Population Sizes with Multiple Paternity. Genetics, 137: 1147-1155.

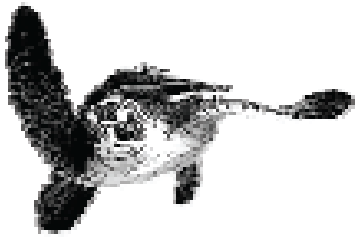
REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

INTERACTION BETWEEN SEA TURTLES AND FISHERIES

PROGRAM TITLE :
Stock Enhancement for Threatened Species of International Concern

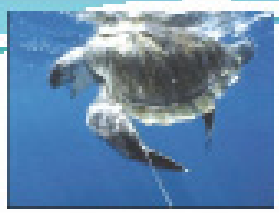
PROJECT TITLE :

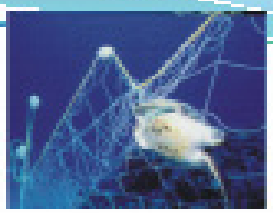
Interaction Between Sea Turtle and Fisheries in Southeast Asian Region



Prepared by :
Somboon Siriraksophon

PROJECT DURATION : SEPT 2005 - 2006



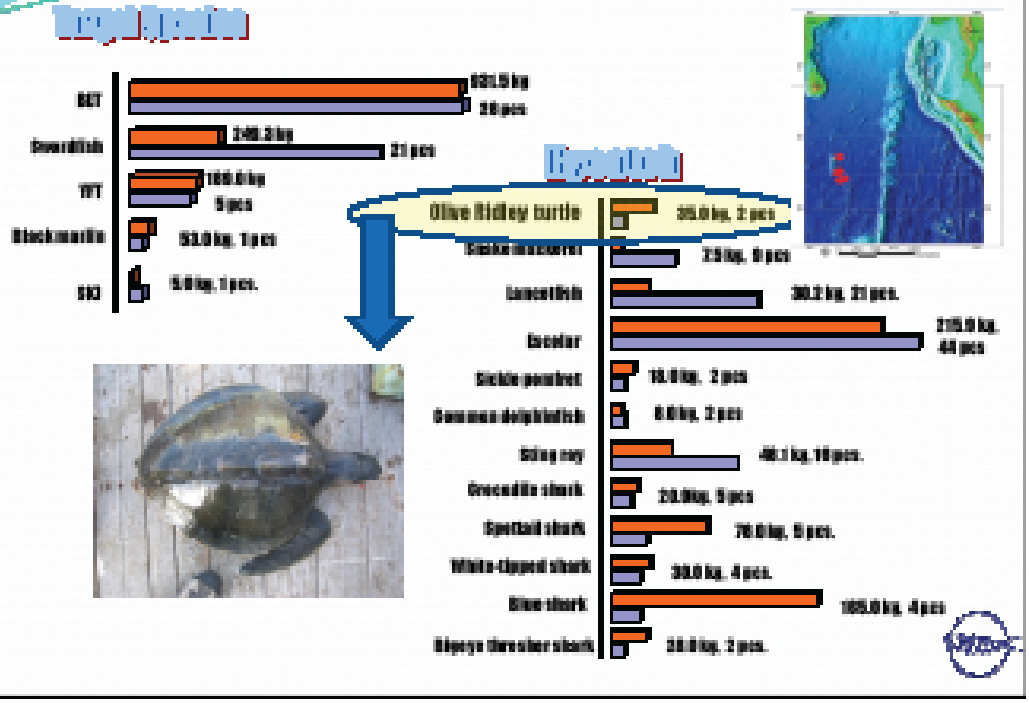


BACKGROUND :

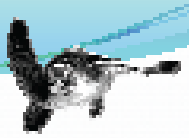
- Refer to Technical Consultation on Sea turtle Conservation and Fisheries held by FAO in late 2004
- Mortality of the Sea Turtle is one of the international concern issues (Sea turtle is as an indicator of marine ecosystem conditions)
- Pelagic Longline is one of the commercial fisheries that affects to the sea turtle mortality
- Fishing gear modification to reduce sea turtle mortality was introduced
- Limited information available on fisheries related sea turtle mortality

PLL vs Sea Turtle

Catch Composition of tuna longline in the Eastern Indian Ocean in 2003 Used J-hooks



MAIN OBJECTIVES :

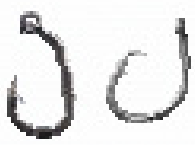


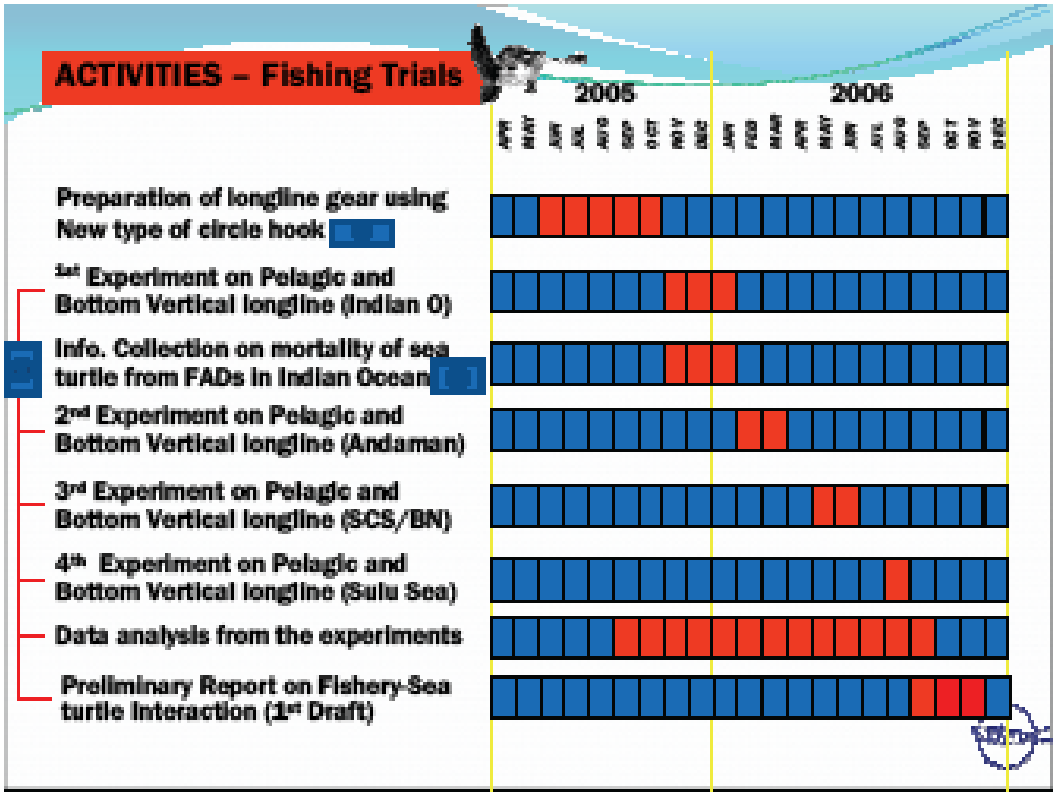
2005-7>>

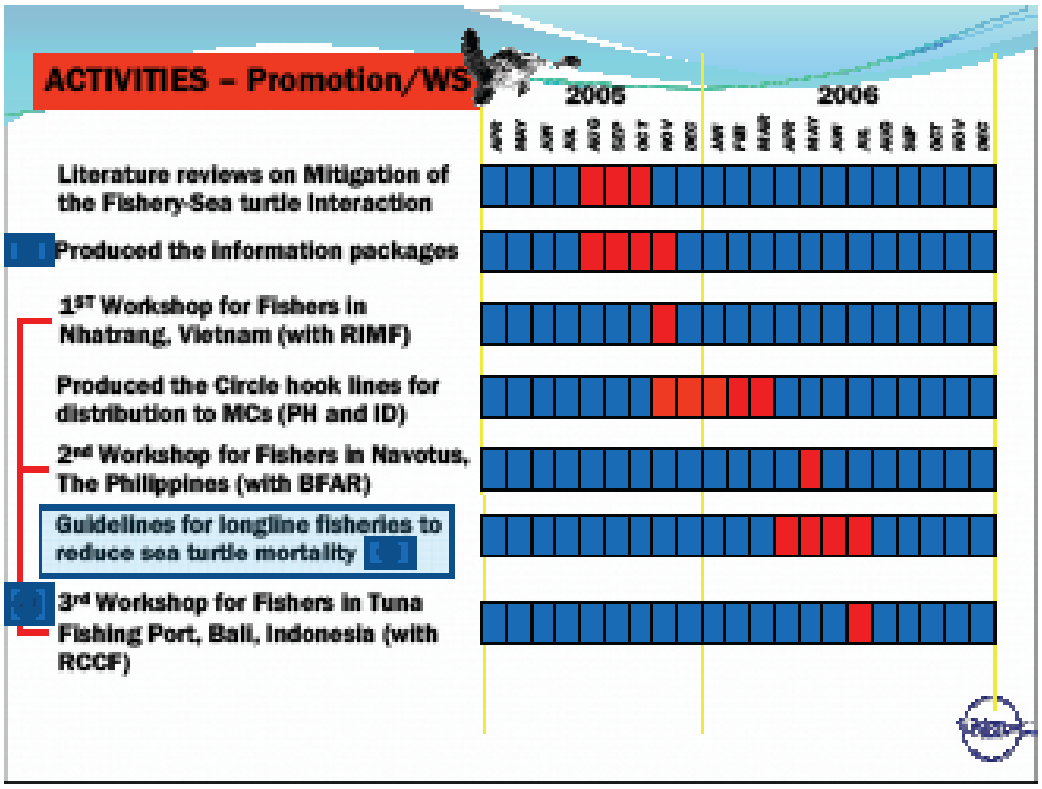
- To conduct the experiments on the efficiency of Circle hook in comparison with the J-Hooks in pelagic/tuna longline fishing
- To provide better understanding on the Sea turtle interaction from fishing activity through Onsite Training/workshop, as well as to introduce/promote the use of Circle Hook in Longline Fishing
- Information collection on Sea turtles interaction

2007-8>>

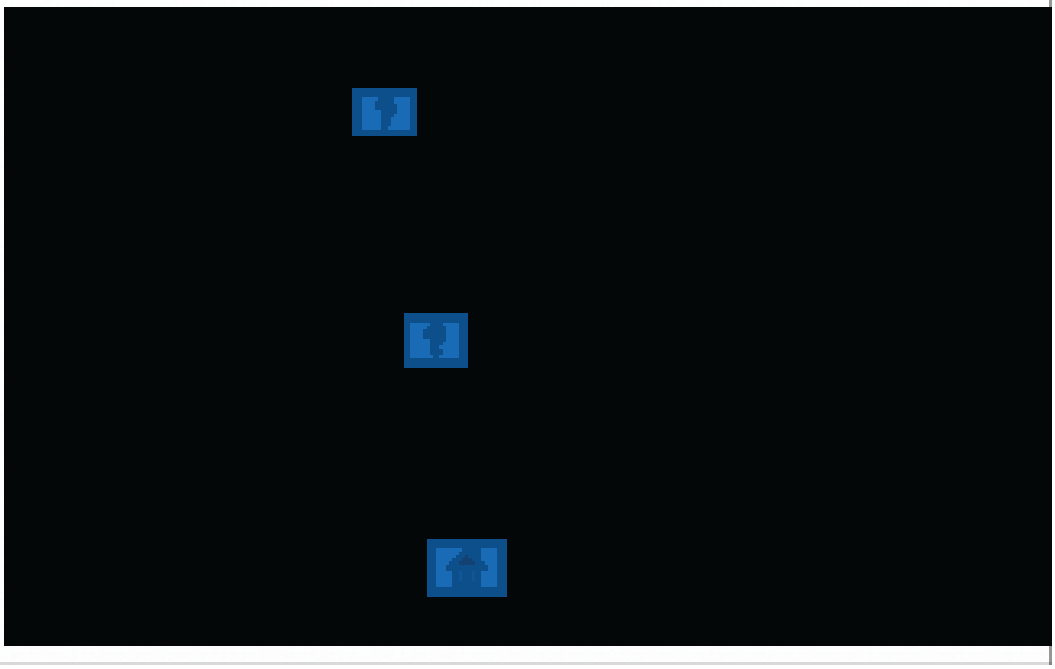
- To conduct the fishing trials and promotion on use of c-hook in bottom longline fishing in the coastal areas operated by small scale fishers
- Information collection on Sea turtles interaction from Gillnet fisheries



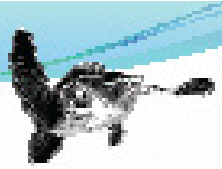

ACTIVITIES – Fishing Trials
2005
2006
Preparation of longline gear using New type of circle hook
1st Experiment on Pelagic and Bottom Vertical longline (Indian O)
Info. Collection on mortality of sea turtle from FADs in Indian Ocean
2nd Experiment on Pelagic and Bottom Vertical longline (Andaman)
3rd Experiment on Pelagic and Bottom Vertical longline (SCS/BN)
4th Experiment on Pelagic and Bottom Vertical longline (Sulu Sea)
Data analysis from the experiments
Preliminary Report on Fishery-Sea turtle Interaction (1st Draft)

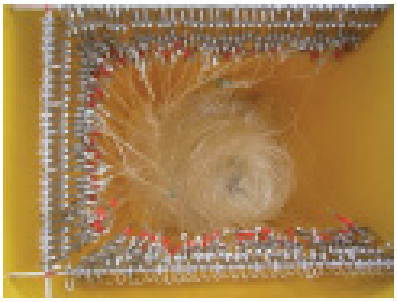

ACTIVITIES – Promotion/WS
2005
2006
Literature reviews on Mitigation of the Fishery-Sea turtle Interaction
Produced the information packages
1ST Workshop for Fishers in Nhatrang, Vietnam (with RIMF)
Produced the Circle hook lines for distribution to MCs (PH and ID)
2nd Workshop for Fishers in Navotus, The Philippines (with BFAR)
Guidelines for longline fisheries to reduce sea turtle mortality
3rd Workshop for Fishers in Tuna Fishing Port, Bali, Indonesia (with RCCF)

Implementation in 2007-2008



Preparation of longline gear using circle hook

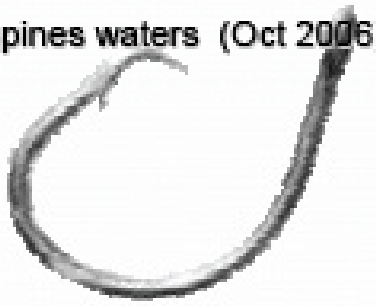




Fishing Trials on the Use of Circle Hook in LL Fishing:

Areas of the Trials

1) Indian Ocean: Eastern Indian Ocean (Dec 05)
2) Andaman Sea (Jan-Feb 2006)
3) The South China Sea : Brunei Darussalam waters (June 06)
4) Sulu Sea : The Philippines waters (Oct 2006)



Fishing Trials on the Use of Circle Hook in LL Fishing:

Objectives

1) To investigate the efficiency of 18/0 with minimum offset (0-10°) circle hook in comparison with J-hook
2) To investigate the hooking positions between two different types of hook
3) To investigate the impact of LL on sea turtle mortality

Fishing Trials on the Use of Circle Hook in LL Fishing:

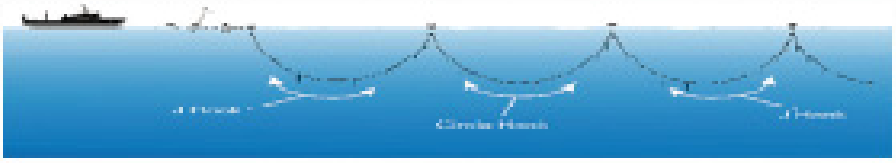
Materials &Methods

J-hook

Circle hook

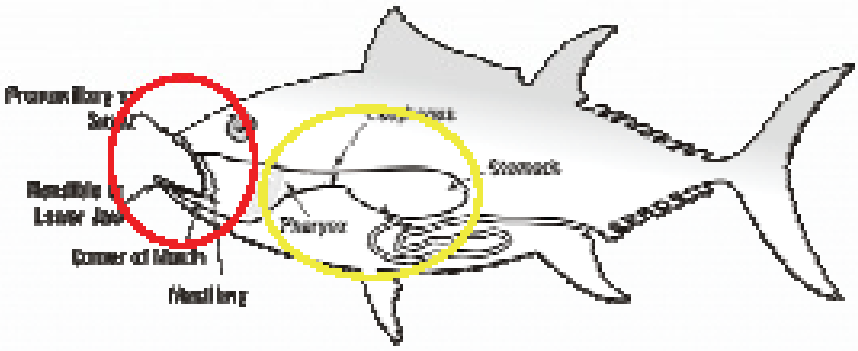
Milkfish

Mackerel



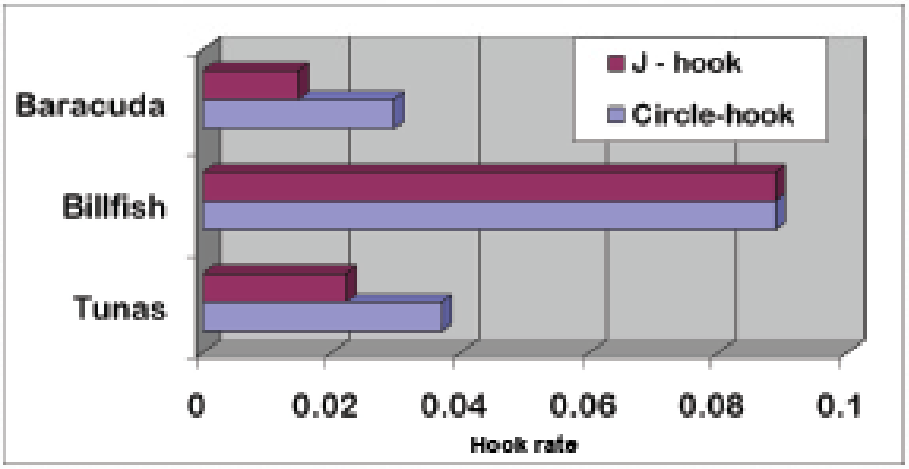
Fishing Trials on the Use of Circle Hook in LL Fishing:

Hooking Position Record



Fishing Trials on the Use of Circle Hook in LL Fishing:

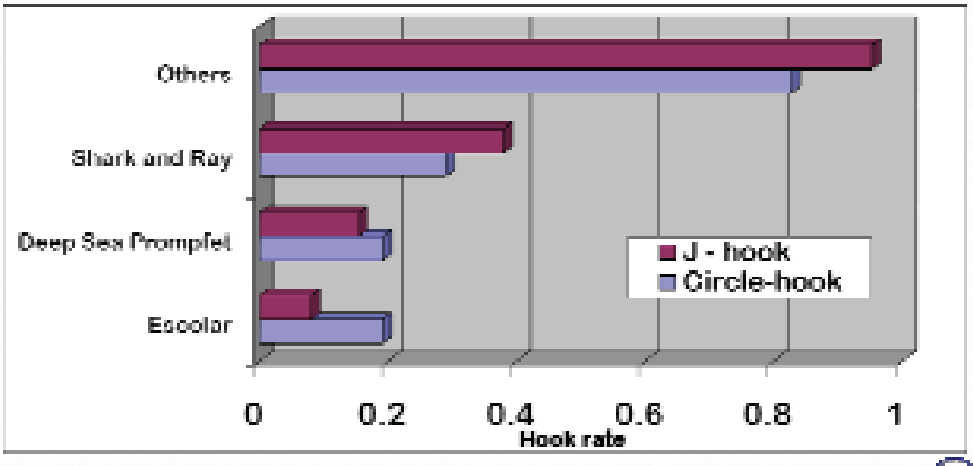
Results 1:Target species



1. C-hook have higher hook rate in comparison with J-hook

Fishing Trials on the Use of Circle Hook in LL Fishing:

Results 2: By-catch

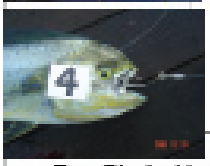


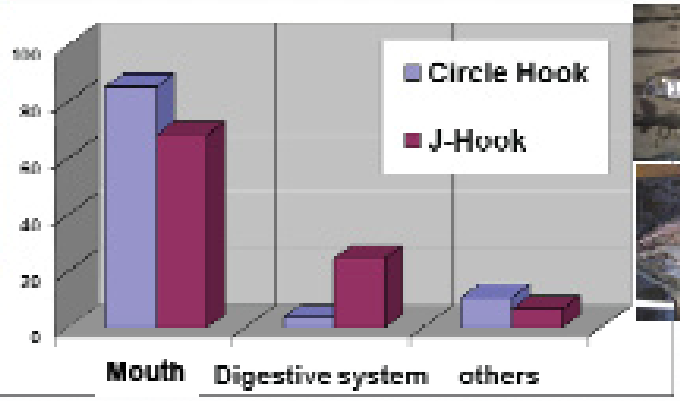
22% reducing of Shark-Ray and Others non valued by-catch when used Circle hooks

Fishing Trials on the Use of Circle Hook in LL Fishing:

Results 3: Hooking Position



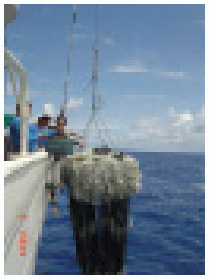


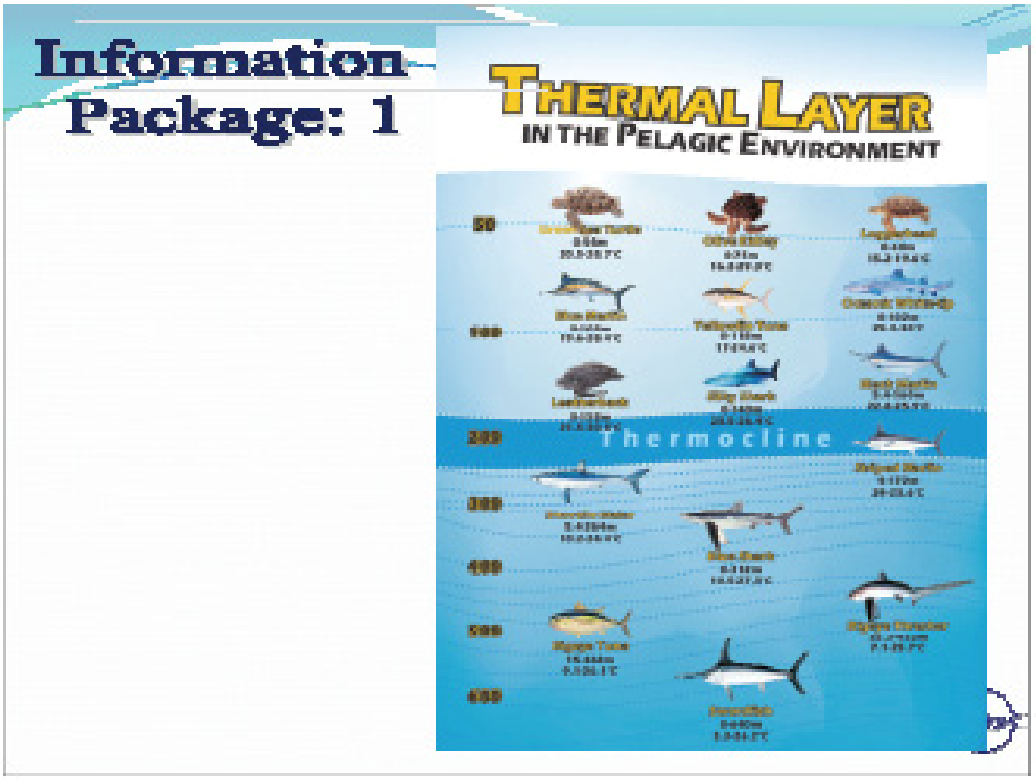


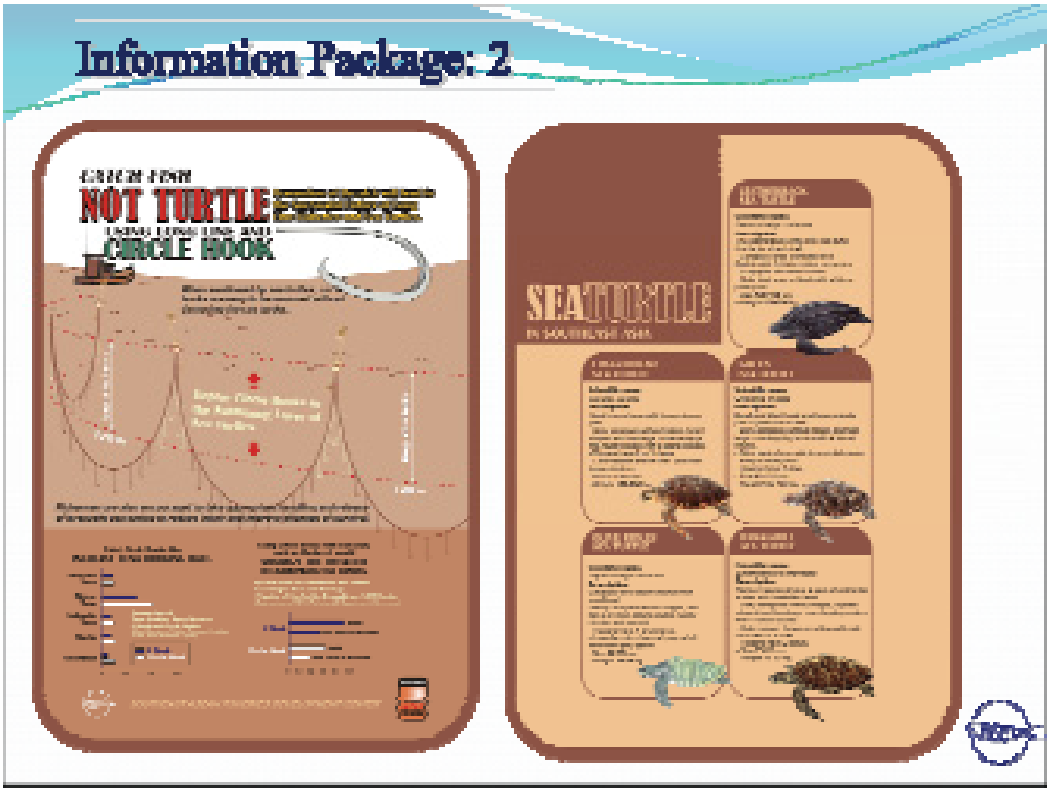

For Circle Hook: 80% of total fishes were caught at mouth position
For J-hook: 20% of hooks were swallowed into Digestive System

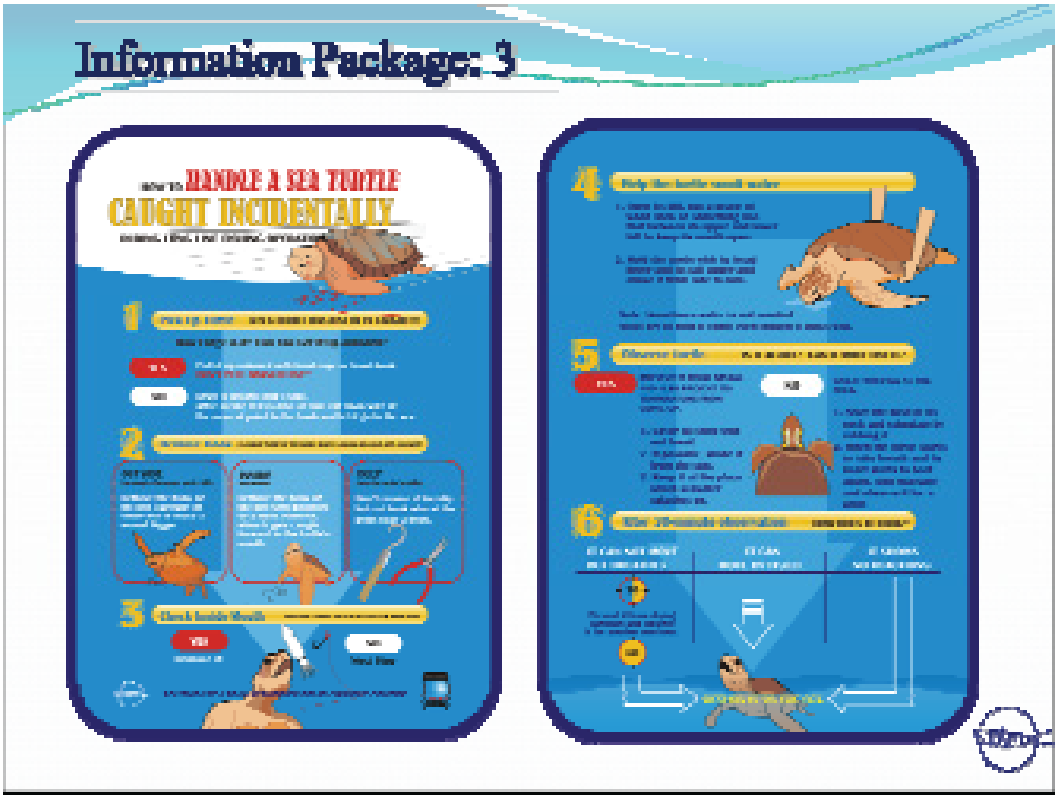
Solution to Reduce Sea Turtle Mortality

- Purse Seine :
  - Avoid encirclement of sea turtle to the extent practical
- FADs: Selected net materials
  - Avoid encirclement of sea turtle by using small mesh size



Information Package: 1
THERMAL LAYER
IN THE PELAGIC ENVIRONMENT
thermocline


Information Package: 2
NOT TURTLE
CIRCLE HOOK
SEA TURTLE


Information Package: 3
HANDLE A SEA TURTLE
CAUGHT INCIDENTALLY


Information Package: 4
The
ENDANGERED
SPECIES

Guidelines for Longliner

To Reduce Sea Turtle Mortality

a) Circle hook size 18/0 with minimum offset (0-10°) which significantly reduce the rate of hook ingestion by sea turtle should be used instead of the traditional J hook to reduce sea turtle interaction in the pelagic longline fishing.

b) De-hooker and line cutter device should be available on longline fishing vessel. De-hooker and line cutter facilitate the quick and efficient release of hooked and entangled sea turtle, thereby increasing their chance of post release survival.

c) The understanding and ability to comprehend each step of procedure to handle the hooked sea turtle which hauled aboard would help minimizing the mortality greatly.

d) One or more of the following avoidance measures should be applied, taking into account the situation of sea turtle is found in fishing ground.

i) Avoid unintentional catches of sea turtles by reducing the time their hooks are in the water during daylight hours.

ii) Use mackerel for bait rather than squid.

Which Gears affected Sea Turtle Mortality ?

Coastal Area :

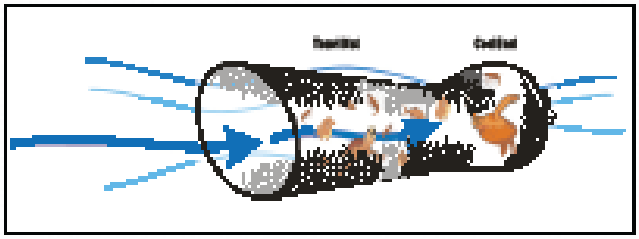
- Coastal Trawl
- Gill net
- Bottom Longline

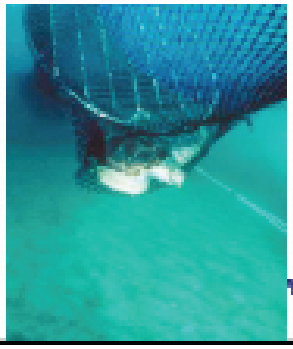
Offshore/ Deep Sea Area :

- Drift Gill Net
- Pelagic/ Tuna Longline
- Purse Seine with FADs

Solution to Reduce Sea Turtle Mortality

- **Coastal Trawl :** such as Shrimp Trawl
  - Promote the use of TED's for Shrimp Trawl
- **Other Trawl Fisheries**
  - Collect data to identify sea turtle interaction



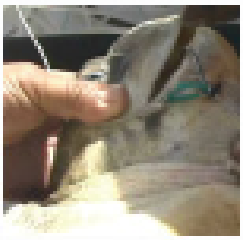


Solution to Reduce Sea Turtle Mortality

- **Purse Seine :**
  - Avoid encirclement of sea turtle to the extent practical
- **FADs: used net materials**
  - Avoid encirclement of sea turtle by using small mesh size

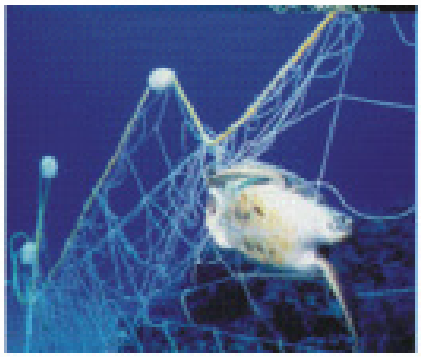
Solution to Reduce Sea Turtle Mortality

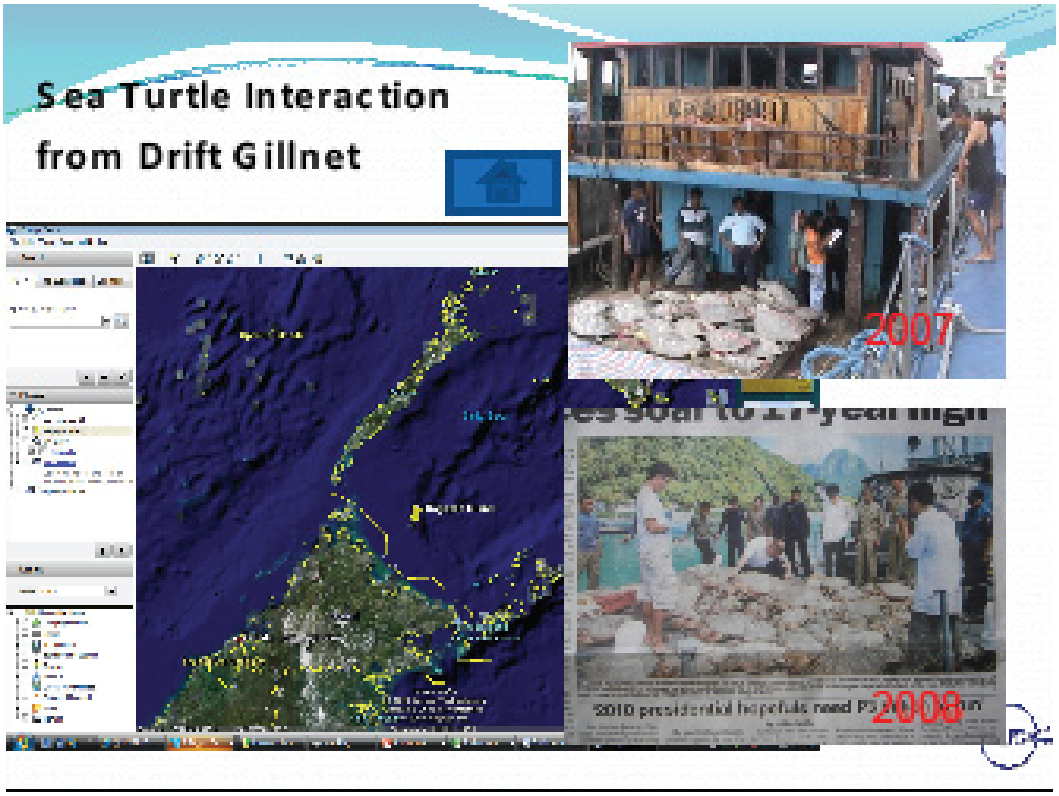
- **Longline :**
  - Use appropriate combination of hook design, type of bait, depth and other fishing practise
  - Retention and use of necessary equipment for appropriate release of Sea turtle

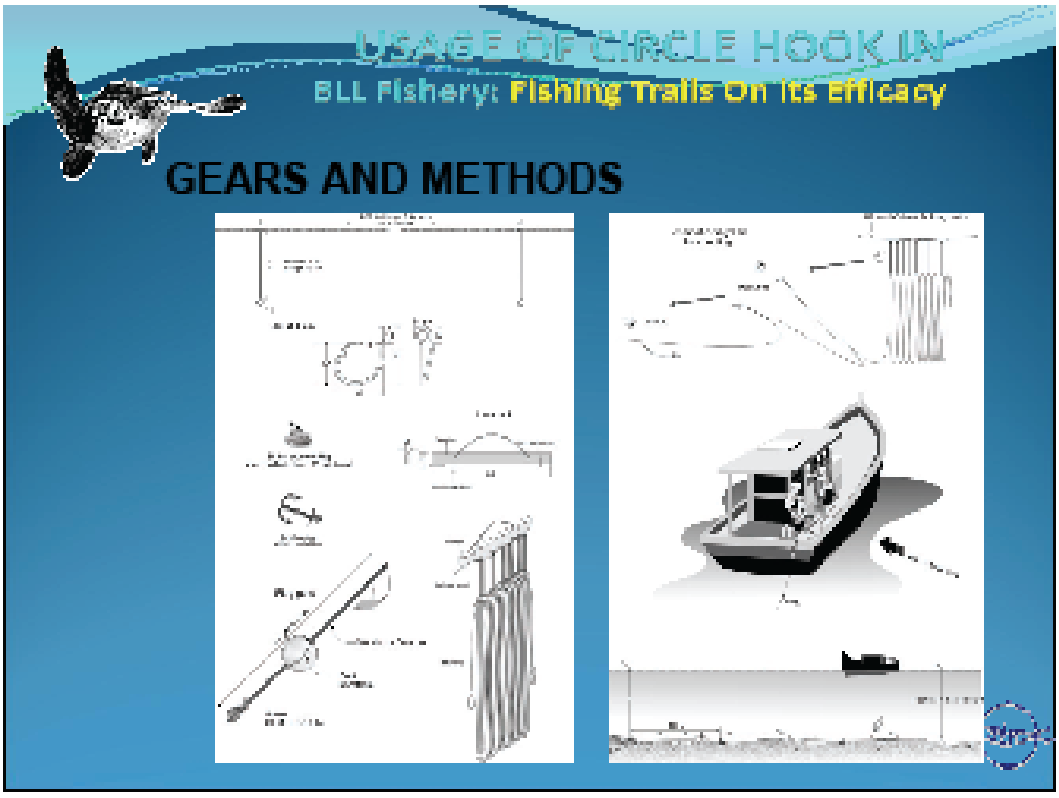




Solution to Reduce Sea Turtle Mortality

- **Gill Net :**
  - Refrain from fishing near turtle nesting beaches during turtle nesting season
  - Carefully set the turtle free from the net, if necessary use clippers to cut the net

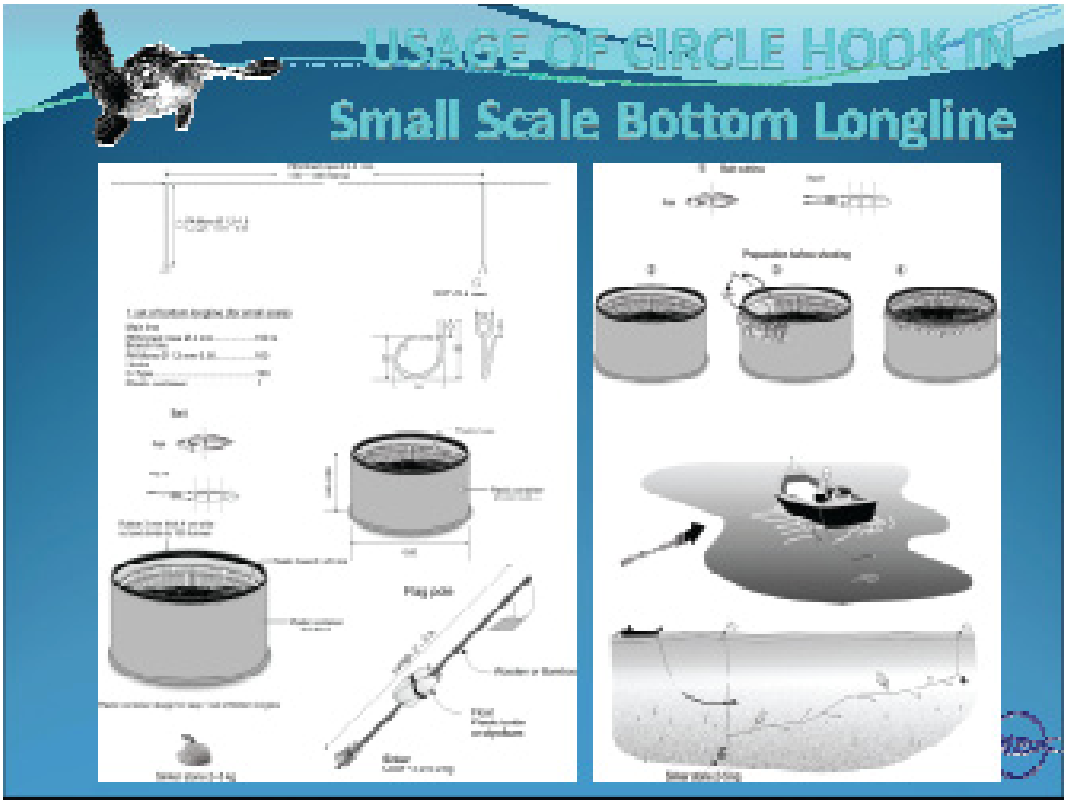


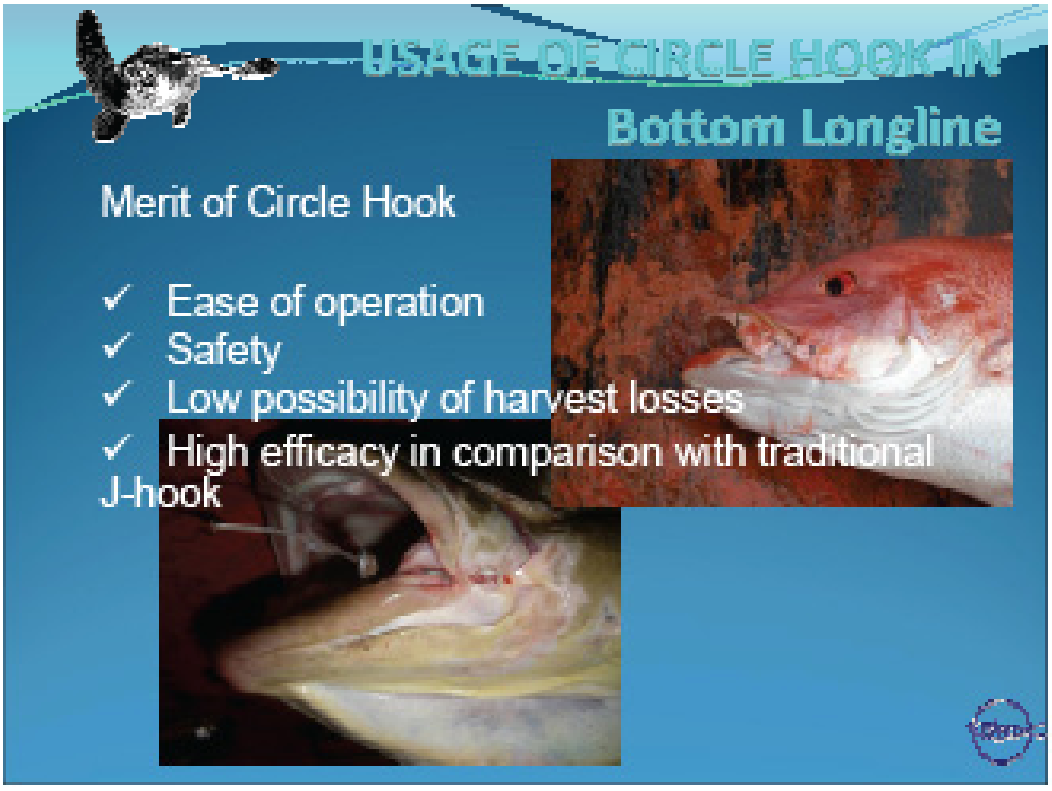

Sea Turtle Interaction
from Drift Gillnet
2007
2008


USAGE OF CIRCLE HOOK IN
BLL Fishery: Fishing Trails On Its Efficacy
GEARS AND METHODS


USAGE OF CIRCLE HOOK IN
BLL Fishery: Fishing Trails On its Efficacy
GEARS AND METHODS


RESULTS
USAGE OF CIRCLE HOOK IN
BLL Fishery: Fishing Trails On its Efficacy


USAGE OF CIRCLE HOOK IN
Small Scale Bottom Longline


USAGE OF CIRCLE HOOK IN
Bottom Longline
Merit of Circle Hook
✓ Ease of operation
✓ Safety
✓ Low possibility of harvest losses
✓ High efficacy in comparison with traditional J-hook

CIRCLE HOOK TRIAL ON THE BOTTOM LONG-LINE OF SMALL SCALE FISHERIES IN PAHANG WATERS, MALAYSIA

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Introduction

The commercial longline industry has long been in operation worldwide however, lately, its activities have endangered non-target species like the turtles and the sea birds. The sea turtles get easily attracted to the baited hooks used in longline operations that they swallow the hooks and eventually drown. Almost all species of sea turtles were caught accidentally by longline operations and these occurrences were reported in several studies conducted in the Pacific Ocean, North Atlantic and the Mediterranean Sea (Alvar Carranza, et. al. 2006).

At present, there is no official record of sea turtles being caught during longline operations in Malaysia. However, some operators of the bottom longline in Terengganu and Pahang claimed that there were isolated cases where sea turtles were being hooked. In this connection, the Department of Fisheries has taken the initiative to invite the SEAFDEC TD technical personnel to conduct a joint study on the use of Circle hooks (C-hook) in local waters.

The objectives of these studies are as follows:

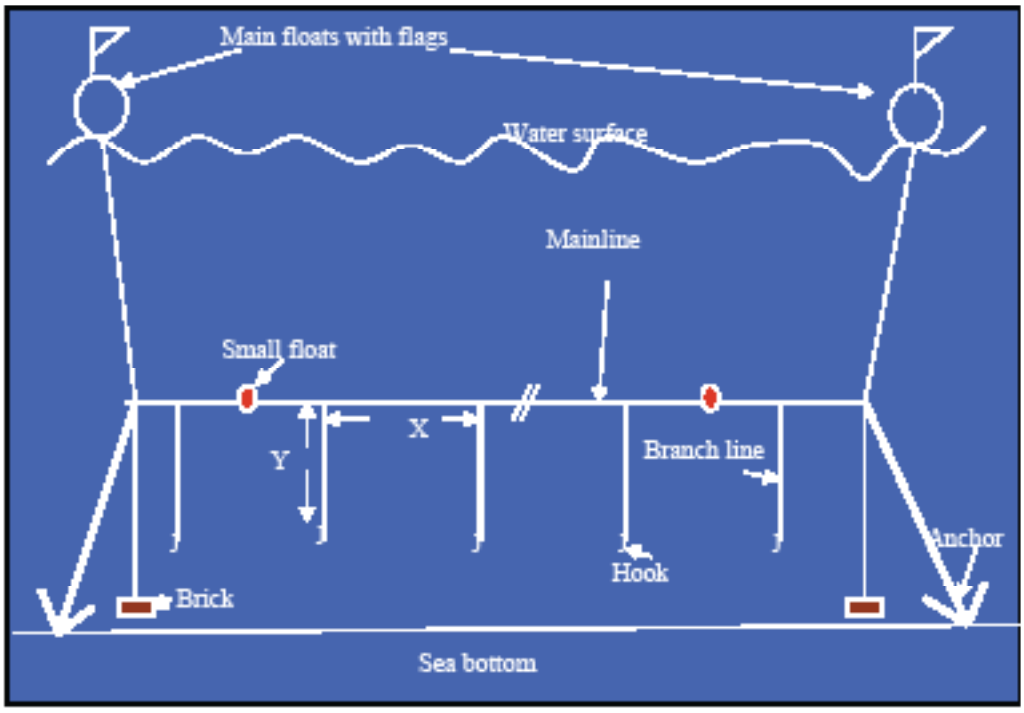
1. To compare the effectiveness of Circle hooks with ordinary hooks.
2. To observe the possibility of bottom longline operations in catching turtles or other endangered species.

Methods and Study locations

Methods

Two types of longline comprising the Circle hooks (C-hook) and the ordinary J-hooks were prepared on the same fishing boat. 30 sets of C-hooks size12/0 (3,000 hooks) and 4 sets of J-hook size 6/0 (1,000 hooks) were being used. Operation of the C-hooks was handled by SEAFDEC Training Department, Thailand personnel while the local fishermen operated the J-hook. Data on the date, shooting and hauling time, catches and position were recorded by researchers on board.

Fig. 1: Ilustration of bottom long-line stucture, the same for both type of hook.



The diffrence between the C-hook and J-hook longline structure is shown in Table 1.

Table 1: Structure of C-hooks and J-hooks used in longline operations for the study

Hook	Hook size	Type of mainline	Type of branchline	Distance between branchline (X)	Branchline length (Y)
Round (C)	12/0	PES crossrope 4mm	PA mono 1.20mm	2m	0.8m
Normal (J)	6/0	PA monofilamen	PA mono	4m	1m

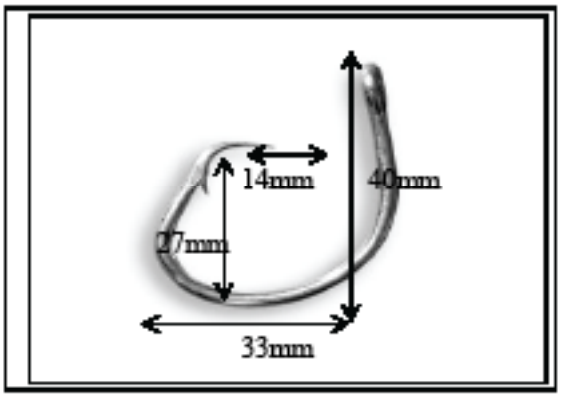


Fig. 2. Specification of the C-hook used for the study

Study Locations

The site chosen for the study was off the Kuantan waters approximately 30 nautical miles from the shore, as shown in Figure 3.

Fig. 3. Locations for the Study.

Figure 3 showed the three study locations where five longline operations were conducted. “The two types of hooks used in the study of longline fishing were deployed close to each other during the operations except for operation number 2 The weather and the sea condtions during the longline operations were fairly good. The sea bottom was sandy/rocky and the water depth was between 40-60 meter.

Results

Table 2. Information on the operation of longline fishing in three locations.

Operation No.	Area	Depth	Date	Soaking time	Location		Type of hook	No. Of hooks	Bait type (small fish)	Catch		
					Longitude (N)	Latitude (E)				Target	Bycatch	Weight(kg)
1	Near FAD	40 -60 meter	17/10/07	16.4 hr	03° 54’ 49.2”	103° 54’ 51.4”	C	400	Scad	-	1	1.2
			17/10/07	18 hr	03° 55’ 53.2”	103° 55’ 11.2”	J	300	Scad	3	1	4.0
2	Near FAD		18/10/07	4.5 hr	03° 35’ 42.7”	104° 04’ 18.0”	C	700	Scad	16	3	15.8
3	Near FAD		18/10/07	4.0 hr	03° 36’ 02.6”	104° 03’ 44.7”	C	700	Scad	35	-	38.4
				5.3 hr	03° 35’ 53.8”	104° 04’ 38.3”	J	450	Scad	5	-	4.7
4	Sandy/ rocky bottom		19/10/07	4.0 hr	03° 29’ 32.6’	104° 02’ 40.1”	J	350	Scad	-	10	2.8
				4.0 hr	03° 37’ 47.0’	103° 47’ 01.6”	C	800	Scad	3	13	21.3
5	Near FAD		19/10/07	3.6 hr	03° 31’ 00.7’	104° 02’ 16.9”	C	800	Scad	1	7	16
				3. 8 hr	03° 38’ 13.3’	103° 46’ 45.7”	J	300	Scad	-	4	0.5

The total number of fish caught was 102 (104.7 kg). The number of fish caught by Circle hooks was 79 (92.7 kg) and 23 (12 kg) for the normal hooks. The species caught by the two types of hook and other information is shown in Table 3.

Table 3. Types of fish caught by the two types of hooks

No.	Sciencetific name	English name	Local name	Type of catch
1.	*Saurida undosquamis*	Brushtooth lizardfish	Conor	Bycatch
2.	*Epinephalus areolatus*	Areolate grouper	Kerapu	**Target**
3.	*Latrinus lentjang*	Pinkear emperor	Landuk/Tambak	**Target**
4.	*Echeneis naucrates*	Sharksucker	Tapak kasut	Bycatch
5.	*Arius thalassinus*	Giant catfish	Duri	**Target**
6.	*Lutjanus malabaricus*	Malabar blood snapper	Merah	**Target**
7.	*Rachycentron canadum*	Cobia	Haruan tasik	**Target**
8.	*Chiloscyllium sp.*	Grey bamboo shark	Yu	Bycatch

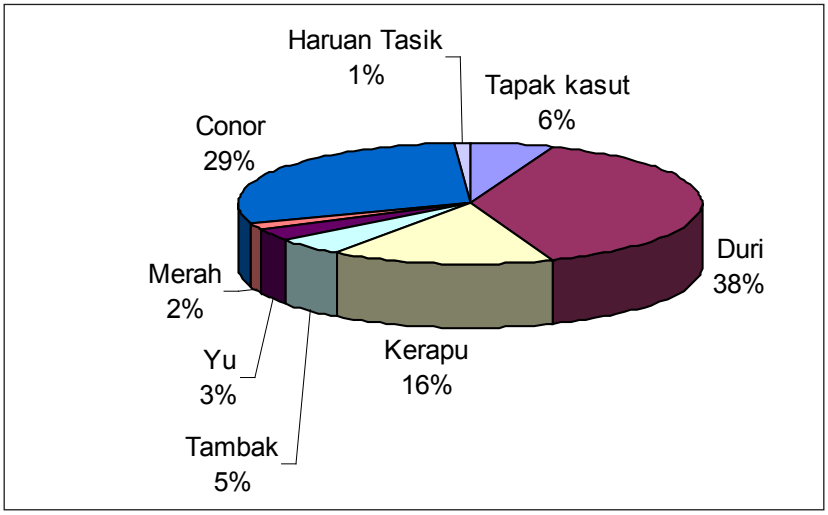


Fig. 4. Percentage of the fish caught (102)

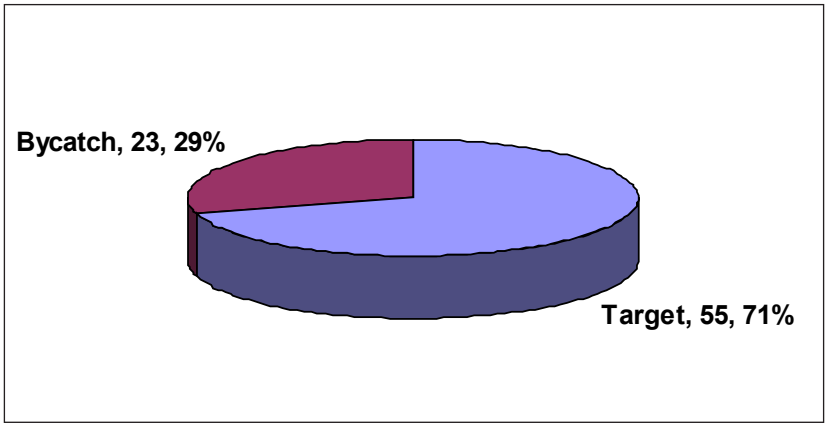


Fig. 5a. Types of fish caught by C-hooks

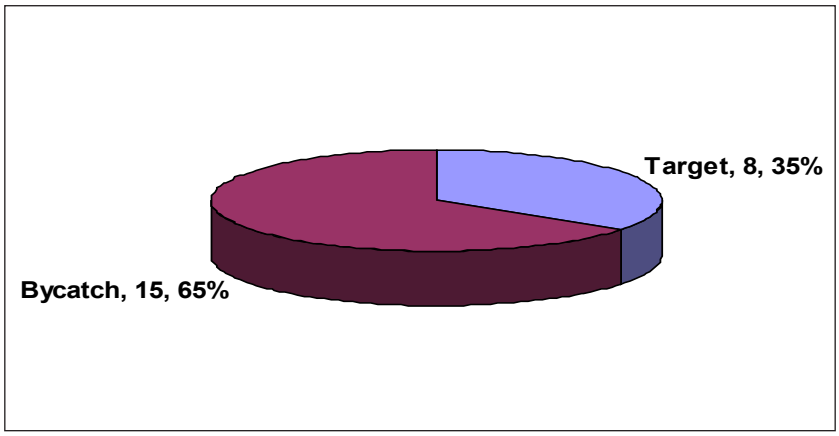


Fig. 5b. Types of fish caught by J-hooks

Discussion

Almost all the fish caught by the Circle hook were hooked around the mouth. It was also observed that the hooking position made it very difficult for the fish to free itself. The circle hook also caught more target fish than the ordinary hook. It was also observed that the Circle hook was very easy to work with and the way it was designed made it very difficult for the fishermen to get injured.

There are a lot of factors that can affect fish catches and one of them is bait. Many similar studies used squid but squid was not available during this study and the small fish used as bait tend to break apart after a few hours in the water.

The soaking time had to be shorten from 16 hours to just 4-5 hours as the baits would be eaten by other fish; therefore, the soaking time will be shortened for future studies if the area is full of fish.

Conclusion

Catches by Circle hooks were much better than the normal hook but further studies must be conducted to really determine the effectiveness of the Circle hook. No turtle or other endangered species was caught during the trial.

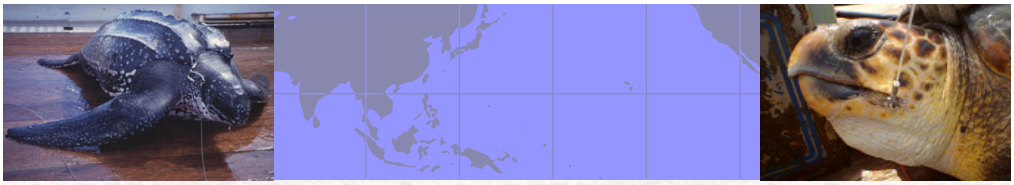
Recommendations

1. The Circle hook study must be continued to find out its effectiveness.
2. Studies should be condcted during turtle breeding season.
3. Cheaper hooks should be produced.

Referrences

Kerstetter, D.W., J.E. Graves. 2006. Effects of circle versus J-style hooks on target and non-target species in a pelagic longline fishery. Fisheries Research 80 (2006) pp 239-250. Science Direct.

Alvar Carranza, *et. al*. 2006. Pelagic longlines: A threat to sea turtles in the Equatorial Eastern Atlantic. Biological conservation 131 (2006) 52-57. Science Direct.



Case Studies on Interaction between Sea Turtles and Fisheries in Japan

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1: National Research Institute of Far Seas Fisheries, Fisheries Research Agency, Japan
2: SEAFDEC-MRRDMD

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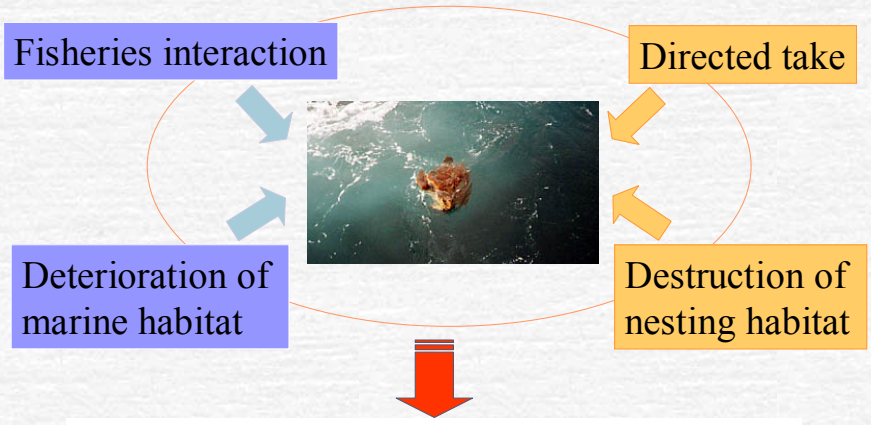
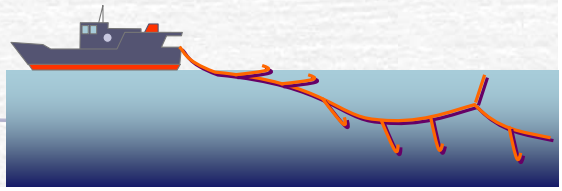
Sea turtle…

Holistic Management



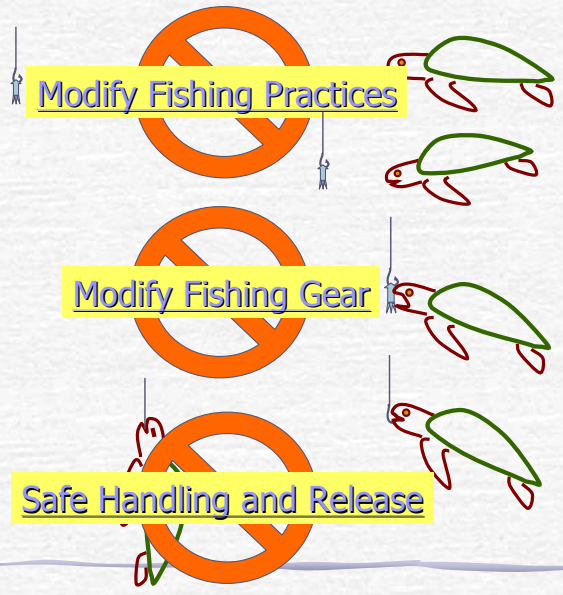
Holistic management of marine environment and nesting habitat is important for sea turtle conservation

Longline Fishery-Sea Turtle Interaction



Mechanism of incidental mortality – LL fishery

- Encounter
- Recognize
- Feed
- Hooked
- Die



I. Gear Modification

Modification of fishing gear to avoid incidental hooking of turtles

- Hook design
  - size, shape, offset, material

- Bait
  - type, color

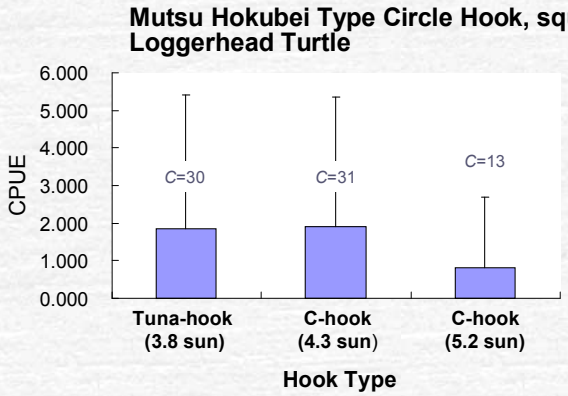
- Additional Device
  - Light sticks ? (not used in Japan)

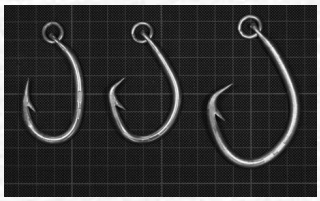
Hook modification

Experimental fishing operations to determine the effects of fishing hooks

- Modification of hook design
  - shape, size, offset, material
- Reduce hooking rate?
- Change hooking position?

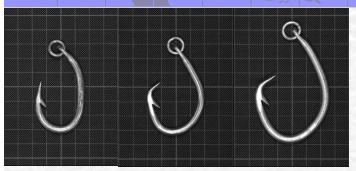
Effects of circle hooks - loggerhead turtle



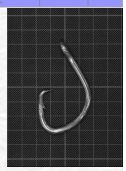


Tuna hook (3.8 *sun*) C-hook (4.3 *sun*) C-hook (5.2 *sun*)

4.3-sun: no difference, 5.2-sun: effective

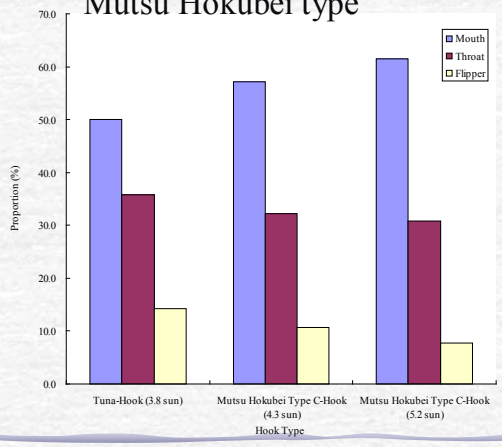


Effects of circle hooks loggerhead turtle

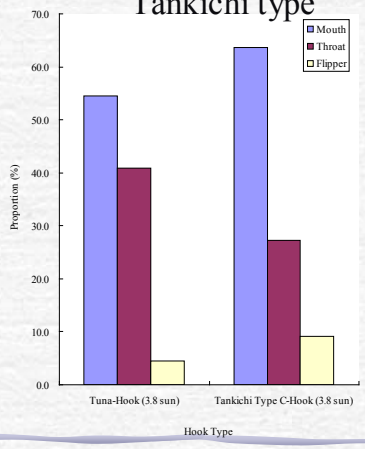


Hooking Position

Mutsu Hokubei type



Tankichi type



Less hooking ingestion

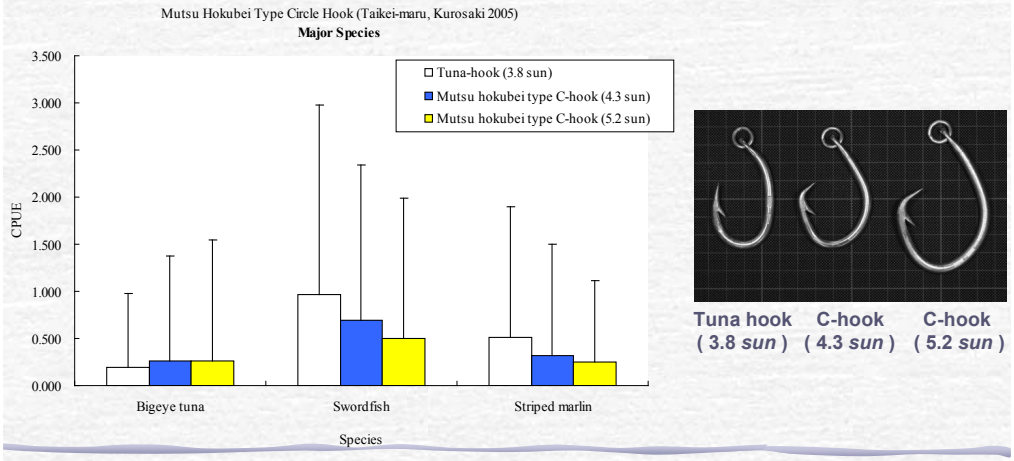
Circle hook - target species

- How does circle hook affect target and other non-target species catch?
- Assessment of the effect of circle hook on target (and other non-target) species.



Effects of circle hooks - major species

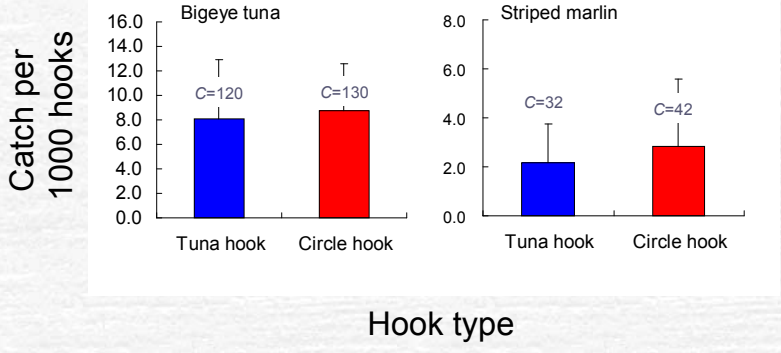
Shallow setting

Tuna hook (3.8 *sun*) C-hook (4.3 *sun*) C-hook (5.2 *sun*)

Bigeye tuna: little effect, Billfish: negative impact

Effects of circle hooks - major species
Deep setting



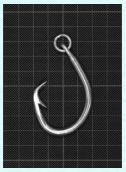
Bigeye tuna: little effect, Striped marlin: little effect

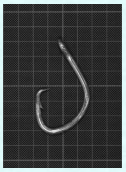
Circle hook - fishing experiments

- Circle hook has potential to reduce deep-hooking.
- Large-sized circle hook reduce catch rate of loggerhead turtle.
- Circle hooks had little effects on the catch rates of tuna.
- Some results indicated use of circle hooks have negative impacts on billfish catch.

Examination of hook size and shape

- Performance of circle hooks might be dependent on hook morphology.


Less effective?


Reduce deep-hooking?


Reduce catch rate?

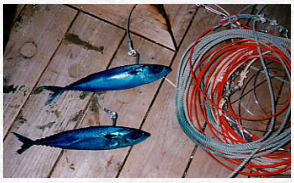
Examination of hook shape

- Captive experiments to explore better shape and size of circle hook

- With cooperation of fish hook company

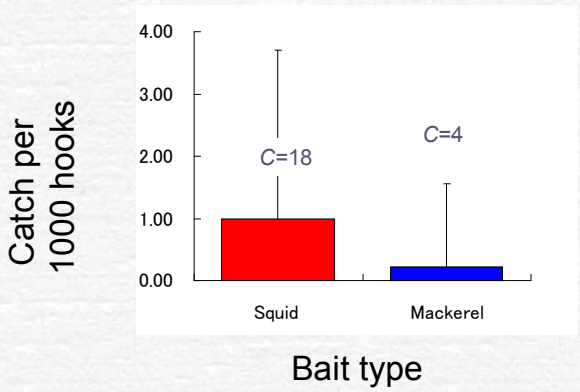
Bait modification

- Bait type
  - Food preference?
  - Hooking mechanism?
- Bait color
  - Detection / color discrimination?
  - Color preference?



Bait type (fish or squid?)

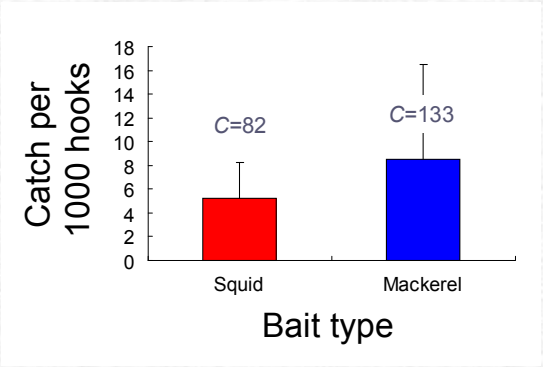
- Loggerhead turtle – Shallow setting



Fish baits catch less sea turtles than squid baits.

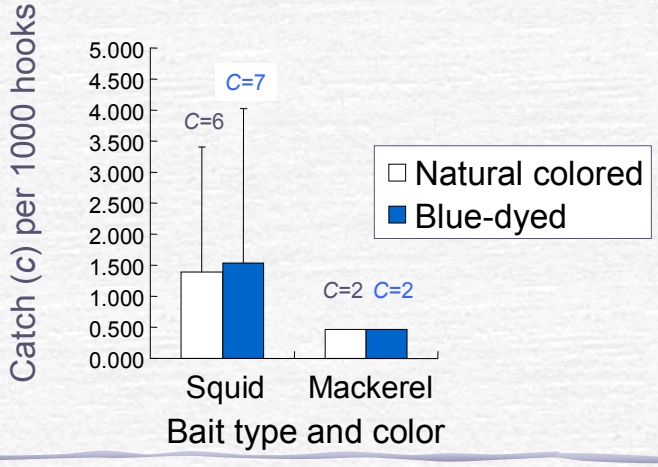
Bait type

- Bigeye tuna – Deep setting longline



Bait color

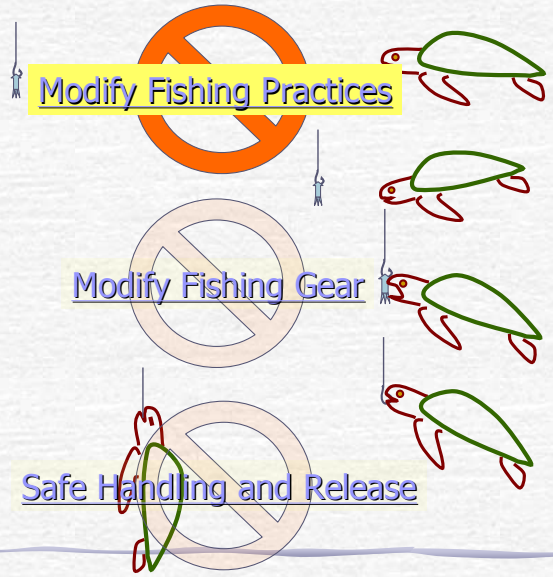
Are blue-dyed baits also effective in sea turtles?



Blue-dyed baits have little effects on sea turtle catch rates.

Mechanism of incidental mortality – LL fishery

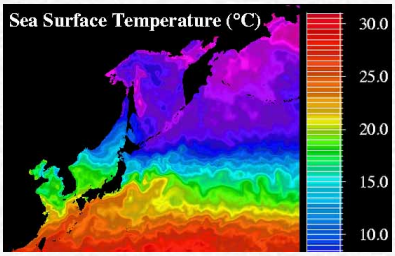
- Encounter
- Recognize
- Feed
- Hooked
- Die



II. Modification of Fishing Practices

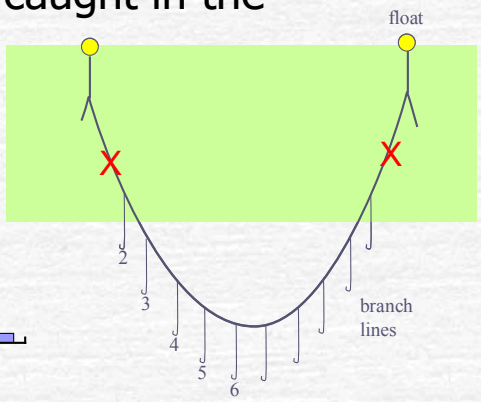
Avoid overlap in fishing gear and sea turtles

- Fishing depth (vertical)
- Fishing area (horizontal)
- Fishing time (temporal)



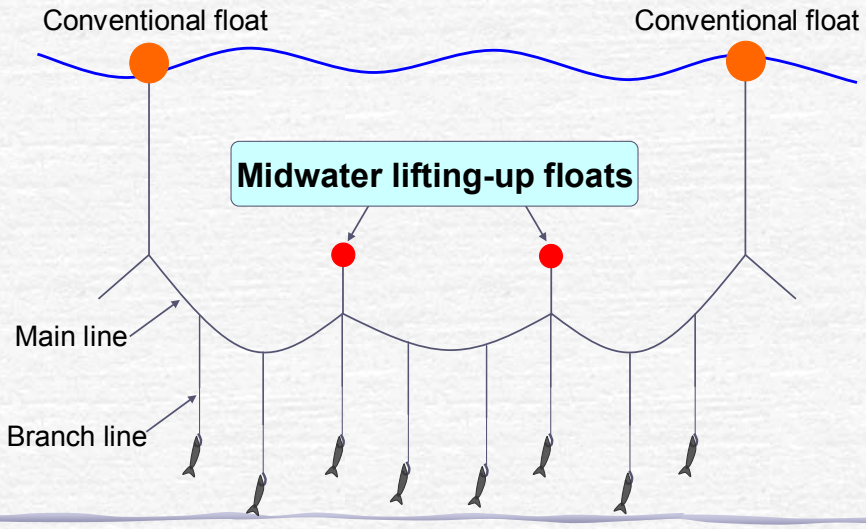
Fishing Depth

- Most of sea turtle are caught in the shallow zone



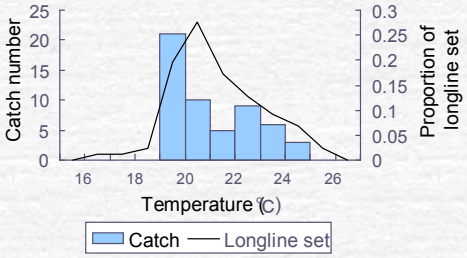
Removing shallow branchline is an effective method.

Midwater longline

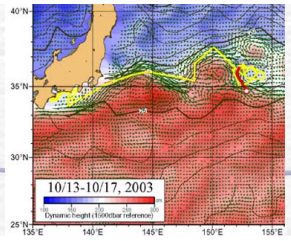


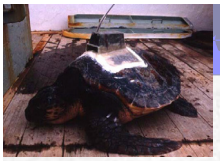
Water mass and temperature

- Sea turtles have specific preference for water mass.
- Incidental capture is common at WT >19° C
- Sea turtles are concentrated at the boundary of warm and cold water masses
- Sea turtles have specific migration pathway



Post-nesting migration of a female loggerhead sea turtle

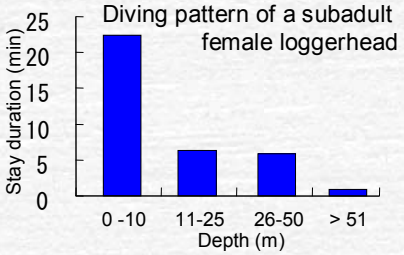


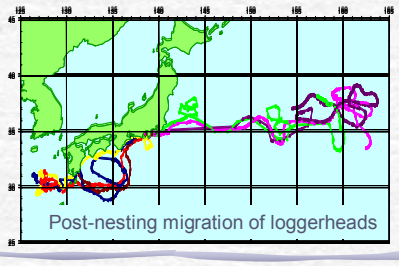


Bio-telemetry studies

Telemetry data can provide valuable information on...

- Habitat preference
- Migration pathway
- Diving pattern
- Activity (time budget)
- Post-hooking survival



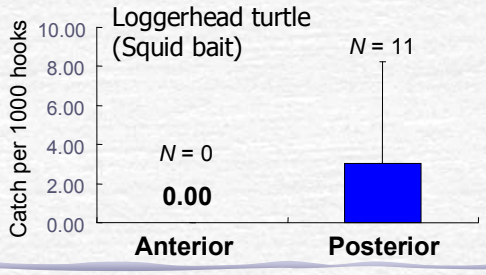


Effect of light and dark periods and total soak time on catch rates

Catch rate (Anterior vs. Posterior)

Anterior: Hauling began before sunrise (shorter soak time)

Posterior: Hauling began after sunrise (longer soak time)



- Loggerhead turtle catch rate increased with longer daylight soak time and total soak time.

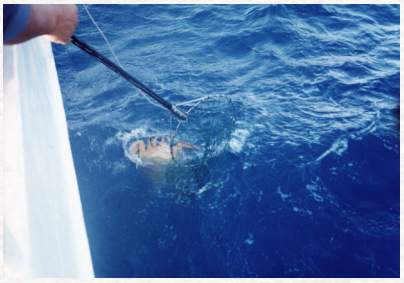
Mechanism of incidental mortality – LL fishery

- Encounter
- Recognize
- Feed
- Hooked
- Die

III. Handling and Release

Most sea turtles caught by shallow longlines are retrieved alive.

- Haul carefully
- Use rescue kits
  - Hoop net
  - line cutter
  - de-hooker



Development of De-hooking Device

- De-hooking devices were developed and tested
  - De-hooking pliers
  - Fisher's de-hooker

De-hooking pliers

Fisher's de-hooker

Post-hooking survival

Captive experiments on the fate of deep-hooking sea turtles

Post-hooking survival

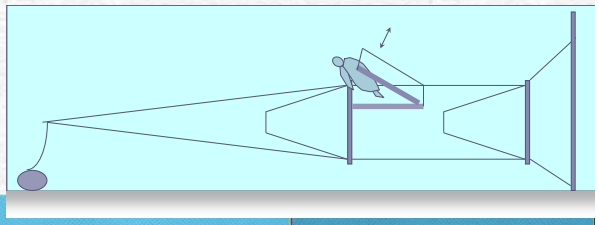
Captive experiments on the fate of deep-hooking sea turtles

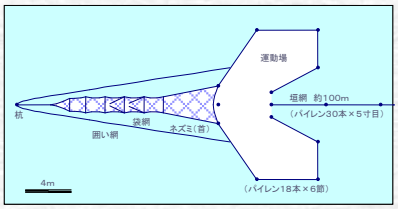
- Sea turtles survived for a prolonged period (>1 year, N=17).
- Remaining hooks of some turtles were discharged within about a year.

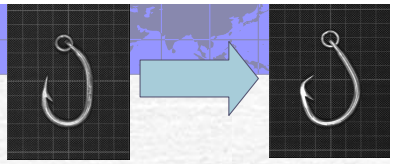
Safe handling and live release is effective in reducing incidental mortality.

Mitigation studies for Set-net

Escape gate at the bag net in a similar fashion as the TEDs







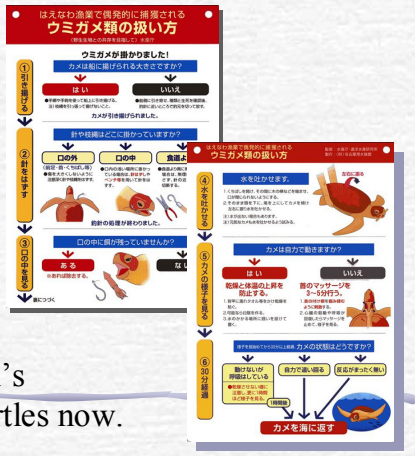
Educational activities

Educational programs are promoted by the Organization for the Promotion of Responsible Tuna Fisheries (OPRT), the commercial fishing industry and NGOs

-to promote a grant program for distributing circle hooks for Japanese longline fishers (OPRT)

-to raise awareness of fishermen

-to explain mitigation measures and handling technique



Japan is preparing for drafting the Japan's Guideline for the conservation of sea turtles now.

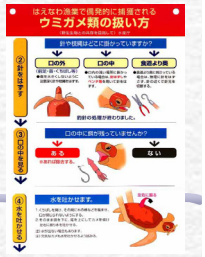
Summary

Possible mitigation measures

- Gear modification
  - circle hooks
  - fish baits
- Fishing Practices
  - deep setting
- Handling and release
  - safe handling and live release

Need more assessments on
- actual effectiveness
and
- economic feasibility

-Should be extended through educational programs



REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

TURTLE MIGRATION ROUTE AND INTERACTION WITH FISHERY ACTIVITIES AND ECOLOGICAL INFORMATION OF FORAGING HABITAT

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: BRUNEI DARUSSALAM

Nesting Beaches	Species	Inter-nesting Habitat				Migration Route				Foraging Habitat				Average Risk	Source (Tag / Satellite Telemetry / Reference)
		Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk		
Muara	*Lepidochelys olivacea* (olive Ridley) and *Eretmochelys imbricata* (Hawksbill)	Nov - June	Coastal area	Gill nets and trawls	2	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	3	Throughout the year	Brunei Bay	Gill nets	3	3	Communication with fishermen; tagging
Meragang	*Lepidochelys olivacea* (olive Ridley); *Eretmochelys imbricate* (Hawksbill) and *Chelonia mydas* (green)	Nov - June	Coastal area	Gill nets and trawls	2	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	3	Throughout the year	Brunei Bay	Gill nets	3	2.67	Communication with fishermen; tagging
Seri Kenangan	*Lepidochelys olivacea* (olive Ridley) and *Eretmochelys imbricate* (Hawksbill)	Nov - June	Coastal area	Gill nets and trawls	2	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	2	N/A	N/A	Gill nets and trawls	2	2	Communication with fishermen; tagging
Danau	*Lepidochelys olivacea* (olive Ridley) and *Eretmochelys imbricate* (Hawksbill)	Nov - June	Coastal area	Gill nets and trawls	2	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	1	N/A	N/A	Gill nets and trawls	1	1.33	Communication with fishermen; tagging

Sungai Liang	*Lepidochelys olivacea* (olive Ridley) and *Eretmochelys imbricate* (Hawksbill)	Nov - June	Coastal area	Gill nets and trawls	2	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	2	N/A	N/A	Gill nets and trawls	1	1.67	Communication with fishermen; tagging
Lumut	*Lepidochelys olivacea* (olive Ridley) and *Eretmochelys imbricate* (Hawksbill)	Nov - June	Coastal area	Gill nets and trawls	2	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	2	N/A	N/A	Gill nets and trawls	2	2	Communication with fishermen; tagging
Anduki	*Lepidochelys olivacea* (olive Ridley) and *Eretmochelys imbricate* (Hawksbill)	Nov - June	Coastal area	Gill nets and trawls	2	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	2	N/A	N/A	Gill nets and trawls	2	2	Communication with fishermen; tagging
Seria Terminal	*Lepidochelys olivacea* (olive Ridley) and *Eretmochelys imbricate* (Hawksbill)	Nov - June	Coastal area	Gill nets and trawls	1	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	1	N/A	N/A	Gill nets and trawls	1	1	Communication with fishermen; tagging
Penaga	*Lepidochelys olivacea* (olive Ridley) and *Eretmochelys imbricate* (Hawksbill)	Nov - June	Coastal area	Gill nets and trawls	2	N/A	South China Sea; most probably to Sabah and Serawak	Gill nets and trawls	2	N/A	N/A	Gill nets and trawls	2	2	Communication with fishermen; tagging

*Risk performance: 1or 2 (Low); 3 to 4 (Medium); 5 (High); NA (Not available)
*Average Risk: Average of R1, R2, and R3. NA should not be involved.
*Possible fishing gears in parenthesis
*** Turtle mortalities due to fisheries activities were sighted and reported by fishermen in the past years though the numbers are minimal

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: CAMBODIA

Nesting Beaches	Species	Inter-nesting Habitat				Migration Route				Foraging Habitat				Total Risk	Source (Tag/Satellite/ Reference
		Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	Season	Site	Type of Fisheries	Risk		
Beach Island	Green	September to November	Koh Kong Krao (Koh Kong province), and	1. small-scale gears operated by local fishermen (longline and gillnet),and 2. middium scale (trawlers with 100-200 horse power). These two fisheries caused catch by accident.	2	NA				Year-Round	Koh Kong, Kampot and Kep	as in internesting habitat, but operate inside seagrass meadow	4	2	Information ontainwd from fishermen
	Hawskbill		Koh Rong and Rong Sablem (Sihanoukville)							Rainy season	Koh Kong	as in internesting habitat, but operated nearby the reef habitat.	3	3	Information obtained from fishermen

Risk: 1 & 2 – Low, 3 & 4 – Medium, 5 &6 - High

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: INDONESIA

Nesting Beaches	Species	Inter-nesting Habitat				Migration Routes				Foraging Habitat				Average Risk
		Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	
Islands of Derawan Complex (Derawan,Sangalaki, Belambangan, Sambit, Bilangbilangan, and Mataha)	Chelonia mydas (green turtle) Eretmochelys imbricata (Hawksbill)	January – December NA	Around Pulau Panjang	Gillnet and Trawl	2	Throughout the year	Sulu Sea Sulawesi Sea, Banda Sea	Gillnet, tuna longline and trawl	3	Throughout the year	South China Sea of Sabah and Sarawak waters, Brunei Bay and Sulu sea, Arafura Sea	Gillnet. Shrimp Trawl, Fish Net	4	3
Pangumabahan	Chelonia mydas (green turtle) and	Throughout the year	Coastal of Indian Ocean (Southern part of West Java)	Gillnet Purse seine	2	Throughout the year	Indian Ocean, Australian waters	Gillnet, tuna longline and Purse seine	3	Throughout the year	Coastal waters of Australia, Arafura Sea	Gillnet. Shrimp Trawl, Fish Net, Tuna longline	3	3
Islands of Riau Province	Eretmochelys imbricata (hawksbill	January - May	Waters around Riau Province Islands	Fish Net, Small Pelagic Purse Seine, Gillnet	NA	June - November	Straits of Malacca to South China Sea	Gillnet, trawl, Small Pelagic Purse seine	3	Throughout the year	Riau Archipelago	Fish Net, Small Pelagic Purse Seine, Gillnet	NA	> 1
Jamursba Medi Beach (West Papua)	Dermochelys coreacea (Leatherback)	Throughout the year	Coastal water of Northern part of Papua Island	Tuna Longline, Large Pelagic Purse seine	2	Throughout the year	Pacific Ocean	Tuna longline, Large Pelagic Purse seine	4	Throughout the year	Coastal water of USA, Philippines and Japan	NA	NA	> 2

Warmon Beach (Papua)	Dermochelys coreacea (Leatherback)	Throughout the year	Coastal water of Northern part of Papua Island	Tuna Longline, Large Pelagic Purse seine	2	Throughout the year	Pacific Ocean, Banda Sea	Tuna longline, Large Pelagic Purse seine	4	Throughout the year	Coastal water of USA, Philippines and Japan and Arafura Sea	NA Shrimp Trawl and Fish Net	NA 3	> 3
Meru Betiri Natonal Park (East Java Province)	Chelonia mydas (green turtle) Eretmochelys imbricata (Hawksbill) Lepidochelys olivaceae (Olive Ridley)	Throughout the year	Coastal waters of southern part of Java (Indian Ocean)	Tuna longline, Gillnet, Large Pelagic Purse seine	NA	Throughout the year	Indian Ocean	Tuna longline, Gillnet, Large Pelagic Purse seine	4	Throughout the year	Arafura Sea Coastal waters of Northern Australia	Fish Net, Trawl Shrimp Trawl	3	> 2
Alas Purwo National Park (East Java Province	Chelonia mydas (green turtle) Eretmochelys imbricata (Hawksbill) Lepidochelys olivaceae (Olive Ridley) Dermochelys coreacea (Leatherback)	Throughout the year	Coastal waters of southern part of Java (Indian Ocean)	Tuna longline, Gillnet, Large Pelagic Purse seine	NA	Throughout the year	Indian Ocean	Tuna longline, Gillnet, Large Pelagic Purse seine	4	Throughout the year	Arafura Sea Coastal waters of Northern Australia	Fish Net, Trawl Shrimp Trawl	3	> 2

Risk: 1 & 2 – Low, 3 & 4 – Medium, 5 &6 - High

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: MALAYSIA (PENINSULAR MALAYSIA)

Nesting Beaches	Species	Inter-nesting Habitat				Migration Routes				Foraging Habitat				Average Risk
		Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	
Terengganu	Chelonia mydas (green turtle) Eretmochelys imbricata (Hawksbill) Dermochelys coriacea (Leatherback)	April - October	Coastal area of South China Sea and marine park island	Gillnet and Trawl	2	June - October	South China Sea	Gillnet, tuna longline and trawl	2	Throughout the year	South China Sea of Sabah and Sarawak waters, Brunei Bay and Sulu sea	Gillnet and Trawl	2	3
Cherating & Tioman Island (Pahang)	Chelonia mydas (green turtle)and Eretmochelys imbricata (Hawksbill	April to October	Coastal area of South China Sea and marine park island	Gillnet and Trawl	2	June - October	South China Sea	Gillnet, tuna longline and trawl	2	Throughout the year	Coastal area of South China Sea and marine park island	Gillnet and Trawl	2	3
Melaka	Eretmochelys imbricata (hawksbill	April - November	Straits of Malacca of Melaka waters	Gillnet, Longline and Trawl	2	June - November	Straits of Malacca to Riau Archipelago waters	Gillnet, tuna longline and trawl	2	Throughout the year	Riau Archipelago	NA	0	NA
Segari (Perak)	Chelonia myds (green turtle)	Throughout the year	Straits of Malacca of Perak waters	Gillnet, Trawl	1	May - December	Strait of Malacca to Riau rchipelago waters	Gillnet and Trawl	1	NA	NA	NA	NA	
Penang	Chelonia mydas (green turtle, Lepidochelys olivacea	April to November	Penang Island waters	Gillnet & Trawl	2	June - November	Straits of Malacca to Riau Archipelago wates	Gillnet and Trawl	2	Throughout the year	Riau Archipelago	NA	NA	NA

Risk: 1 & 2 – Low, 3 & 4 – Medium, 5 &6 - High

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: MALAYSIA (SABAH)

Nesting Beaches	Inter-Nesting Habitat					Migration Route				Foraging Habitat				Average Risk	Source (Tag/Satellite /reference)
	Species	Season (Month)	Site	Type of Fisheries	Risk	Season (month)	Site	Type of Fisheries	Risk	Season	Site	Type of Fisheries	Risk		
Sabah Turtle Islands Park	Green Turtle	Mac - Sept.	TIHPA islands water	Trawl, Bagang	2	Jan - Dec.	1. TIP to Philipines Turtle Islands, Sulu islands, Tawi-Tawi, Palawan in Philipines.	Trawl, Kelong (fishtrap)	2	No Information	1. TIP to Philipines Turtle Islands, Sulu islands, Tawi-Tawi, Palawan in Philipines.	Trawl, Kelong (fish trap)	2	2	Tag recoveries, Satellite study
							2. TIP to Biak Irian Jaya, Maginti Is., Indonesia	No Information	NA	No Information	2. TIP to Biak Irian Jaya, Maginti Is., Indonesia	No Information	NA		Tag recoveries
							3. TIP to Papua New Guinea.	No Information	NA	No Information	3. TIP to Papua New Guinea.	No Information	NA		Tag recoveries
Sabah Turtle Islands Park	Hawksbill Turtle	Mac - Sept.	TIHPA islands water	Trawl, Bagang	2	Jan - Dec.	1. Samarinda, Kalimantan, Indonesia	Trawl	2	No Information	1. Samarinda, Kalimantan, Indonesia	Trawl	NA	2	Satellite study
					2		2. Sandakan Bay, Sandakan, Sabah.	Trawl	2	No Information	2. Sandakan Bay, Sandakan, Sabah.	Trawl	2	2	Satellite study
					2		3. Banggi Island, Kudat, Sabah	Trawl	2	No Information	3. Banggi Island, Kudat, Sabah	Trawl	2	2	Satellite study

Risk: 1 & 2 – Low, 3 & 4 – Medium, 5 &6 - High

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: MALAYSIA (SARAWAK)

Nesting Beaches	Species	Inter-nesting Habitat				Migration Routes				Foraging Habitat				Average Risk
		Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	
Sarawak Turtle Islands (Pulau Talang-Talang Besar, Pulau Talang-Talang Kechil and Pulau Satang Besar)	*Chelonia mydas (green turtle)* *Eretmochelys imbricata (Hawksbill)*	Throughout the year	6km radius of nesting beach	Gill nets and fishing trawlers	4	Throughout the year	0.1-37 nm from shoreline along the coast of Sarawak	Fishing trawlers, gill and drift nets, long-line, direct hunting by foreign fishermen (Poachers	5	Throughout the year	Sea grass beds Kuala Lawas, Sarawak	Gill net, trawlers , poachers and fishing steak	3	4
Sarawak Turtle Islands (Pulau Satang Besar)	*Eretmochelys imbricata (Hawksbill)*	Sep-Mac	4 km radius of nesting beach	Gill nets and fishing trawlers	3	N.A.	14 nm from shoreline along the coast of Sarawak	Fishing trawlers, gill and drift nets, long-line, direct hunting by foreign fishermen (poachers)	N.A	N.A	Coral reef areas	Gill net and poachers	3	3
Tanjung Datu National park	*Lepidochekys olivacea* (Olive ridley)	Feb-May	N.A.	Gill nets and fishing trawlers	3	N.A.	N.A.	Fishing trawlers, gill and drift nets, long-line, direct hunting by foreign fishermen (Poachers)	3	N.A.	N.A.	Gill net, trawlers and poachers	3	3

*Risk performance: 1or 2 (Low); 3 to 4 (Medium); 5 (High); NA (Not available)
*Average Risk: Average of R1, R2, and R3. NA should not be involved.
*Possible fishing gears in parenthesis

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: MYANMAR

Nesting Beaches	Species	Inter-nesting Habitat				Migration Route				Foraging Habitat				Average Risk
		Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	Season (Month)	Site	Type of Fisheries	Risk	
Thameehla Island	Green	Jan-Dec		Trawl, Gill net, Trap	1									
Gayet Gyi Island	Olive ridley	Sep-Feb	Kadon Galay Island	Trawl ,Gill net, Stowed net (Tiger Mouth)	1									
Kadon Galay Island	Olive ridley	Sep-Feb	Gayet Gyi Island	Trawl ,Gill net, Stowed net (Tiger Mouth)	1									
Ma Sein Yone Island	Olive ridley	Sep-Feb		Trawl ,Gill net, Stowed net (Tiger Mouth)	1									
Nga Mun Thaung Island	Olive ridley	Sep-Feb	Gayet Gyi Island	Trawl ,Gill net, Stowed net (Tiger Mouth)	1									
Ashaet Phyar Beach	Olive ridley	Sep-Feb		Trawl ,Gill net, Stowed net (Tiger Mouth)	2									
Kaithaung Island (Wardawgone Beach)	Olive ridley	Sep-Feb		Trawl ,Gill net, Stowed net (Tiger Mouth)	2									
KwinpaukBeach (Amattgyi Beach and Amattkalay)	Olive ridley	Sep-Feb		Trawl ,Gill net, Stowed net (Tiger Mouth)	2									

Risk: 1 & 2 – Low, 3 & 4 – Medium, 5 &6 - High

Remarks; Interaction between Sea Turtles and Fisheries at Foraging Habitat and Migration Route are not Available.

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: THE PHILIPPINES

Nesting Beaches	Species	Inter-nesting Habitat				Migration Routes				Foraging Habitat				Average Risk
		Season (month)	Site	Type of Fisheries	Risk	Season (month)	Site	Type of Fisheries	Risk	Season (month)	Site	Type of Fisheries	Risk	
Turtle Islands Wildlife Sanctuary in the province of Tawi-Tawi	Green	All year round	Within the Philippine-Malaysia Turtle Islands Heritage Protected Area	Trawl, Purse seine, Danish seine, cyanide	4	All year round	Sulu Sea	Trawl	3	All year round	Tawi-Tawi, Jolo, Basilan, Palawan, Bicol region and Visayan waters	Trawl, set nets, drift gill nets, otoshi-ami	4	4
Turtle Islands Wildlife Sanctuary in the province of Tawi-Tawi	Hawksbill	All year round	Within the Philippine-Malaysia Turtle Islands Heritage Protected Area	Trawl, Purse seine, Danish seine, cyanide	4	All year round	Sulu Sea	Trawl	3	All year round	Balabac, Palawan Northern Sabah, Malaysia	Dynamite, Cyanide, Trawl	3	3
							Sulawesi			All year round	Derawan, East Kalimantan, Indonesia			

Risk: 1 & 2 – Low, 3 & 4 – Medium, 5 &6 - High

INFORMATION ON ECOLOGICAL AND FISHERIES INTERACTION OF SEA TURTLES
COUNTRY: THAILAND

Nesting Beaches	Species	Inter-nesting Habitat				Migration Routes				Foraging Habitat				Average Risk
		Season (month)	Site	Type of Fisheries	Risk	Season (month)	Site	Type of Fisheries	Risk	Season (month)	Site	Type of Fisheries	Risk	
Huyong Island	Green	Mar-Jul	5-6 km buffer from Huyong Island	Trawler outside 3 km from the shore line, coastal gill net	2	May-Sep	The middle part of Andaman Sea	Deep trawler, surround net .	1	Throughout the year	Coastal area of the Andaman Islands	(Artisanal fisheries e.g. coastal gill net)	4	2
Khram Island	*Green*	May-Aug	5-6 km buffer from Khram Island	Trawler outside 3 km from the shore line	3	Jul-Oct	The water body of the Gulf of Thailand and the South China Sea	Trawler, surround net	3	Throughout the year	Coastal area of CambodiaSouth Vietnam, Malaysia, Sulu and Cerebes Seas	Coastal gill net, trawler, illegal direct catch	5	4

*Risk performance: 1or 2 (Low); 3 to 4 (Medium); 5 (High); NA (Not available)
*Average Risk: Average of R1, R2, and R3. NA should not be involved.
*Possible fishing gears in parenthesis Risk:

REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

JAPANESE TRUST FUND IV PROGRAM (2009)

Proposal for Supplementary Japanese Trust Fund IV Program (2009)

Activities

1. Meeting/Workshop/Training
   - Regional Core Expert Meeting
2. Research
   i. DNA Studies
      - Multiple paternities
   ii. ea Turtle Tagging and Satellite Telemetry
      - Tagging of Sea Turtles
      - Satellite Telemetry of Sea Turtles
   iii. Interaction between Sea Turtles and Fisheries
      a. Information Collection on the Sea Turtle Interaction from Fishing Activities
      b. information Dissemination

Component 1:
Meeting/Workshop/Training

- Regional Core Expert Meeting
  - Responsible Research Officers from Selected Participating SEAFDEC Member Countries and Resource Persons will be invited,
  - To discuss and compile the results/outcomes in 2009,
  - To formulate the research plan for JTF V Program from 2010 to 2014,
  - To be held in October 2009 in Kuala Lumpur/Kuala Terengganu.

Component 2:
Research

- DNA Studies
  - Multiple Paternities
    - Remaining tissue samples of Green turtle hatchlings from 10 nesters in Mak Kepit beach, Redang Island of Terengganu, Malaysia will be analyzed.
    - The microsatellite DNA markers will be used to identify each individual male, which mates with the nesting females during nesting season.
    - The paternal bands will be sequenced to identify the paternal identity.

Component 2: Research (Cont')

- Sea Turtle Tagging And Satellite Telemetry
  - Tagging of Sea Turtles
    - To continue Inconel tagging of nesting females at the focused nesting sites in participating SEAFDEC Member Countries.
    - To monitor tag recovery,
    - To obtain ecological and biological information of sea turtles,
    - To estimate stock size of sea turtle resource for specified nesting beaches,
    - To collect tissue samples from nesting females and to preserve them for future analysis.

Component 2: Research (Cont')

- Sea Turtle Tagging And Satellite Telemetry
  - Satellite Telemetry of Sea Turtles
    - in Myanmar for Green turtles
    - in Malaysia for Leatherback turtles if available

Component 2: Research (Cont')

- Interaction between Sea Turtles and Fisheries
  - Information Collection on the Sea-turtle Interaction from Fishing Activities
    - To improve drift gillnet or alternative fishing gears replacing drift gill net as an option.
    - Research work based on information gathering will be used to improve fishing gears and to build awareness.
  - Information Dissemination
    - To publish and to disseminate the results from promotion on the use of C-hooks in hook and line fishing and the output from R&D on the modification/improvement of the gillnet.

Envisaged Outcomes

- To organize the Regional Core Expert Meeting to discuss and compile the outcomes of the program for 2009 and to formulate research plans for Japanese Trust Fund V program from 2010 to 2014,
- To continue evaluation of multiple paternities of nesting green turtles in the pilot nesting beach,
- To continue tagging studies in major nesting beaches in the region,
- To implement satellite tracking studies in selected Member Countries,
- To build awareness on sea turtle interaction from fishing activity,
- To promote the use of C-hooks in hook and line Fishing, and carry out R&D to modify/improve Drift gillnet to avoid sea turtle mortality.

Proposed Schedule & Budget for 2009

Program/Project/Activities	Budget	J	F	M	A	M	J	J	A	S	O	N	D
1: Meeting/Workshop/Training	USD												
1.1: The Regional Core Expert Meeting	20,500												
2: Research													
2.1: DNA studies	7,000												
2.1.1:Multiple paternities													
2.2 Sea turtles tagging and satellite Telemetry	14,300												
2.2.1: Tagging of sea turtles													
2.2.2: Satellite telemetry													
2.3 Interaction between Sea Turtles and Fisheries	13,200												
2.3.1 : Information Collection on the Sea-turtle Interaction from Fishing Activities													
2.3.2: Information dissemination													
TOTAL	**55,200**												

REPORT OF THE THIRD REGIONAL TECHNICAL CONSULTATION ON RESEARCH FOR STOCK ENHANCEMENT OF SEA TURTLES (JAPANESE TRUST FUND IV PROGRAM) 15-17 OCTOBER 2008, KUALA LUMPUR, MALAYSIA

JAPANESE TRUST FUND IV PROGRAM (2010-2014)

Proposal for Japanese Trust Fund V Program (2010-2014)

Conservation and Management of Sea Turtles in Southeast Asian Countries

JTF I - Establishment of Regional Fisheries Policy in Southeast Asia (1998-2003)

1. Sea Turtle Hatchery Management (2001-2003)
2. Sea Turtle Tagging Survey (1998-2002)
3. Study on the Conservation and Enhancement of Sea Turtle Resources
4. Implementation of the Turtle Excluder Devices (TED's)

Research for Stock Enhancement of Sea Turtles

JTF IV - Promotion of Environment-friendly Regional Developments in Southeast Asia (2004-2009)

1. DNA Study
    1. Identification of the stock/population
    2. Detection of multiple paternities in a pilot nesting beach
    3. Preliminary study on cloning sea turtles
2. Sea turtle tagging and satellite telemetry
    1. Tagging of sea turtles
    2. Satellite Telemetry
3. Head-starting study
    1. Feasibility study on head-starting techniques
4. Interaction between sea turtles and fisheries
    1. A research survey on information collection on sea turtle interaction with fishing operations
    2. A comparative study on the efficiency of the circle hook and J-hook in pelagic and bottom trawls

Research and Management of Sea Turtles in Foraging Habitat in the Southeast Asian Waters

JTF V Projects
- Promotion of "Environment-friendly resource enhancement" (2010-2014)

1. Regional Technical Consultation Workshop/Meeting
2. Identifying the Foraging Habitats of Sea Turtles in the Southeast Asian Region
3. Scientific Information on Population Status of Sea Turtles and Ecological Parameters in Selected Foraging Habitats
4. Identifying Stock Composition and Migration Patterns of Sea Turtles in Selected Foraging Habitats
5. Sea Turtle Interaction in Marine Capture Fisheries (TD)
6. Formulating the Management Plan on Fishing Activities and Other Threats of Sea Turtles in Selected Foraging Habitats

Objectives

- Identify and map foraging habitats of sea turtles in Southeast Asian waters.
- Obtain baseline scientific information on population status and migration patterns of sea turtles in selected forging habitats.
- Obtain the ecological parameters in selected foraging habitats.
- Determine the migration patterns of sea turtles from selected foraging habitats .
- Identify fishing activities near or in foraging habitats/areas.
- Review available information on effective and commercially viable methods for avoiding and reducing sea turtle mortality such as entanglement in artisanal coastal gillnet fisheries,

Objectives (cont')

- Develop partnerships to conduct commercial demonstrations and experimental trials of modified specific fishing gears, such as gill net included FADs, coastal longline
- Promotion of responsible fishing gears and practices
- To formulate management plans on fishing activities and other activities that threaten sea turtles in foraging habitats/areas.
- To enhance cooperation and collaboration among SEAFDEC member countries for protection and management of sea turtles in foraging habitats.

Activities 1:
Regional Technical Consultation Workshop/Meeting

1. Regional Planning Workshop
    1. To finalize the project proposal with SEAFDEC-MFRDMD, SEAFDEC-TD, participating Member Countries and relevant experts.
    2. To decide and to agree on the pilot projects which will be conducted in selected foraging habitats.
2. Regional Progress Meeting.
    1. To evaluate the progress of all activities in this program
3. Regional Technical Workshop
    1. To compile the regional information of sea turtles in foraging habitats.
    2. To formulate the management plan on fishing activities and other activities that threaten the sea turtles in foraging habitats.
4. Regional Technical Consultation Meeting.
    1. To present the entire output of the program.

Activities 2:
Identifying the Foraging Habitats of Sea Turtles in the Southeast Asian Region

1. Identifying the selected foraging habitats in the region.
    i. To identify the migration patterns of several specie of sea turtles in the Southeast Asian waters,
    ii. Based on inconel tagging and satellite tracking activities by SEAFDEC Member Countries and through JTF I and IV program.
    iii. To map the suspected foraging habitats of sea turtles in the region.
2. Scientific survey on selected foraging habitat.
    i. To decide and to agree on the pilot projects which will be conducted in selected foraging habitats during the Regional Planning Workshop.
    ii. To conduct scientific survey on selected foraging habitats.

Activities 3:
Scientific Information on Population Status of Sea Turtles and Ecological Parameters in Selected Foraging Habitats

1. Information collection on population status of sea turtles in foraging habitats.
2. Information collection on threats to sea turtles in foraging habitats.
3. Survey on ecological parameters in foraging habitats
   i. Interaction between sea turtle behavior and ecological parameters in foraging habitats' ecosystem still remains unknown or very limited.
   ii. Information on ecological parameters of foraging habitat is essential for better understanding on how these ecosystems enable attract sea turtles in their life cycle.
   iii. To understand the capacity of the effects of the ecosystem structure and function can be viewed as integration of turtle biology.
   iv. This study had important implications for the management and conservation of sea turtles and marine ecosystems in foraging habitats.
   v. The study will be carried out in selected foraging habitats based on suggestions during Regional Planning Workshop.

Activities 4:
Identifying Stock Composition and Migration Patterns of Sea Turtles in Selected Foraging Habitats

1 Population genetics study of sea turtles
1. Satellite telemetry study
2. Tagging study
   i. To investigate stock composition, migration and abundance of sea turtles in foraging habitats is very essential.
   ii. dentification of sea turtles populations throughout their life cycle is another area that deserves high priority.
   iii. Most sea turtles undertake complex developmental migration that carries them through a number of habitat types and many different national jurisdictions.
   iv. These complex migrations results in enigmatic distribution patterns with turtles from various nesting populations intermingling on foraging habitats.
   v. Thus it will affect the development of management plans for sea turtles in foraging habitats.

Activities 5:
Sea Turtle Interaction in Marine Capture Fisheries (TD)

1. Information gathering on sea turtle interaction in marine capture fisheries
   i. To gather information of all concerns on sea turtle interaction in marine capture fisheries such as sea turtles by catch from specific fishing gears in the Southeast Asian Region based on the existing data.
2. Fishing trails and demonstration of the modified specific fishing gears
   i. To develop and to modify specific fishing gears and devices which are harmful to sea turtles directly and indirectly.
   ii. To conduct fishing trails and demonstration on research vessels and in cooperation with commercial fishing vessels to improve and reduce sea turtles by catch.
3. Promotion and capacity building on the responsible fishing gears and practices
   i. To conduct Onsite Training Workshop for promotion and capacity building to fishermen and government officers on the use of responsible fishing gears and practices,
   ii. To build awareness on the use of non-responsible fishing gears and impacts to sea turtle mortality by users.

Activities 6:
Formulating the Management Plan on Fishing Activities and Other Threats To Sea Turtles in Selected Foraging Habitats

1. Compiling the population status, migration patterns of sea turtles and ecological parameters in selected foraging habitats.
   i. To compile the population status, migration patterns of sea turtles and ecological parameters in selected foraging habitats,
   ii. To compile the regional information of sea turtles in foraging habitats.
2. Formulate the management plan on fishing activities and other activities that threaten the sea turtles in selected foraging habitats.
   i. To organize the Regional Technical Workshop to compile the population status, migration patterns of sea turtles and ecological parameters in selected foraging habitats,
   ii. To invite external experts to assist in formulating the management plan.
   iii. To formulate the management plan on fishing activities and other activities that threaten the sea turtles in selected foraging habitats.

Schedule of Activities for 5 years (1)

Activities / Sub-Activities	2010				2011				2012				2013				2014			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. Regional Workshop/Meeting																				
1.1. Regional Planning Workshop																				
1.2. Regional Progress Meeting																				
1.3. Regional Technical Workshop																				
1.3. Regional Technical Consultation Meeting																				
2. Identifying the Foraging Habitat of Sea Turtles in Southeast Asian Region																				
2.1. Identifying the foraging habitats in the																				
2.2. Scientific survey on selected foraging																				
3. Scientific Information on Population Status and Ecosystem Parameters of Foraging Ground																				
3.1. Information collection on population status of sea turtles in foraging habitat																				
3.2. Survey on ecological parameters in foraging habitats.																				

Schedule of Activities for 5 years (2)

Activities / Sub-Activities	2010				2011				2012				2013				2014			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
4. Identifying Stock Population and Migration Pattern of Sea Turtles in Selected Foraging Habitat.																				
4.1. Population genetics study of sea turtles																				
4.2. Satellite telemetry study																				
4.3. Tagging study																				
5: Sea Turtle Interaction in Maine Capture Fisheries (TD)																				
5.1. Information Gathering																				
5.2. Fishing Trials and Demonstrations																				
5.3. Promotion and Capacity Building																				
6. Formulating the Management Plan of Foraging Habitat																				
6.1. Compiling the population status, migration pattern of sea turtles and ecological parameters in selected foraging habitats																				
6.2. Formulate management plan on fishing activities and other activities that threats the sea turtles in foraging habitats																				

Proposed Budget for 5 years (1)

Activities / Sub-Activities	Proposed budget				
	2010	2011	2012	2013	2014
1. Regional Workshop/Meeting					
1.1. Regional Planning Workshop	US 25,000				
1.2. Regional Progress Meeting		US 20,000	US 20,000		
1.3. Regional Technical Workshop				US 20,000	
1.3. Regional Technical Meeting					US 50,000
2. Identifying the Foraging Habitat of Sea Turtles in Southeast Asian Region					
2.1. Identifying foraging habitats of sea turtles in the region	US 5,000				
2.2. Scientific survey on selected foraging habitat	US 20,000	US 7,000			
3. Scientific Information on Population Status and Ecological Parameters of Foraging Ground					
3.1 Information collection on population status of sea turtles.		US 5,000	US 7,000	US 7,000	
3.2. Survey on ecological parameters in foraging habitat		US 7,000	US 7,000	US 7,000	

Proposed Budget for 5 years (2)

Activities / Sub-Activities	Proposed budget				
	2010	2011	2012	2013	2014
4. Identifying Stock Population and Migration Pattern of Sea Turtles in Selected Foraging Habitat.					
4.1 Population genetics study of sea		US 6,000	US 10,000	US 9,000	US 5,000
4.2 Satellite telemetry study		US 7,000	US 8,000	US 7,000	
4.3. Flipper tagging study		US 7,000	US 3,000	US 5,000	
5: Sea Turtle Interaction in Fisheries (TD)					
5.1. Information Gathering	US 10,000	US 6,000	US 5,000	US 5,000	
5.2. Fishing Trials and Demonstrations	US 10,000	US 10,000	US 10,000	US 10,000	
5.3. Promotion and Capacity Building			US 5,000	US 5,000	
6. Formulating the Management Plan of Foraging Habitat					
6.1. Compiling the population status, migration pattern of sea turtles and ecological parameters in selected foraging habitats.					US 10,000
6.2. Formulate management plan on fishing activities and other activities that threats the sea turtles in foraging habitats.					US 10,000
Total	**US 70,000**	**US 75,000**	**US 75,000**	**US 75,000**	**US 75,000**

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