Charting Multidisciplinary Research and Action Priorities towards the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean: A Focus on Malaysia

Edited by

M. Ahmed, S. Wagiman, K. Ibrahim, S.C. Ho, H.C. Liew,
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Executive Summary

The four sea turtle species found in Malaysia are the leatherback, olive ridley, green and hawksbill. The threats to these species are acute. Populations of leatherback, olive ridley and hawksbill turtles are on the brink of collapse – threatening a biodiversity crisis in Malaysia and the region.

However, it is still not too late to conserve the sea turtles. Recovery efforts have been shown to work in other parts of the world and the same could be done for Malaysian sea turtles. Nevertheless, this can only be realized with proper management, effective enforcement measures and community participation. Effective recovery efforts require concerted efforts of everyone.

On 16-17 August 2004, a workshop was convened in Kijal, Terengganu, to chart new directions in the conservation of Malaysia's critically endangered sea turtles and to reverse population decline. The workshop was entitled "Charting Multidisciplinary Research and Action Priorities towards the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean: A Focus on Malaysia". The workshop brought together over 40 specialists including policymakers, managers, researchers and practitioners from Malaysia, Philippines, Indonesia, Thailand, Australia and United States.

The workshop was organized by the Department of Fisheries (DOF) Malaysia, The WorldFish Center, the National Oceanography Directorate (NOD) of the Malaysian Ministry of Science, Technology and Innovation, the Maritime Institute of Malaysia (MIMA), the Sea Turtle Research Unit of Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM-SEATRU) as well as WWF-Malaysia.

The workshop aimed to:

- consolidate existing work and identify multidisciplinary research priorities towards effective conservation and management of sea turtles in Malaysia;
- review and examine national and regional policy instruments for effective conservation and management of sea turtles; and
- facilitate the development of a cross-sectoral action plan and strategy for implementation by key agencies and stakeholders.

As a result, the following outputs were developed:

1. a framework for future research and strategy for the conservation and management of sea turtles;
2. recommendations for reconciling policy objectives and future steps at the state, national, regional and international levels; and
3. a way forward for a National Action Plan in sea turtles conservation and management in Malaysia.

The workshop prioritized a **15-point Action Strategy** covering local people participation, effective laws and strategic polices, and management-oriented research (see below). This multipronged approach is a vital new development in charting new conservation efforts.

A. Policy, Legal and Institutional Aspects

1. Establish a Joint National Management Committee on Sea Turtles.
2. Review the effectiveness of sea turtle management and conservation under the present administration and explore the need and possibility of administering sea turtles under a conservation-oriented ministry.
3. Create a National Turtle Regulation which addresses gaps and loopholes and harmonizes federal and state legislations.

B. Priority Research Areas

4. Optimizing egg protection, eliminating egg harvest (which includes socioeconomic research of local communities) and optimizing hatchling production.
5. Assessment and reduction of turtle by-catch in coastal fisheries which include understanding relevant socioeconomic linkages and research on ways to increase the participation of fishers.
6. Determining the impacts of offshore fisheries on Malaysian turtles and research on international cooperations.
7. Studying the feasibility of restoring the Malaysian leatherback population.
8. Identifying and protecting key foraging and development habitats.

C. Management Strategies and Tools

9. Strengthen protection and ensure adequate management of main turtle rookeries in the country.
10. Identify mechanisms to ensure fishers do not lose out economically due to turtle by-catch mitigation measures.
11. Identify new arrangements for enforcement capacity to police waters, beaches and to enforce all provisions that are captured in existing legislations.
12. Translate current knowledge into proper awareness programs to get the message across to the right audience.
13. Assign a focal point in government empowered to lead sea turtle management and conservation.
14. Encourage partnerships and involvement of the local communities in research and management.
15. Establish innovative and sustainable sources of funding and enhance technical capacities.

The workshop was inspired by the “Roundtable Discussion on the Conservation of Sea Turtles in Malaysia” (held in Kuala Lumpur, Malaysia, in May 2003) as well as the “Bellagio Conference on Sustainable Management and Conservation of Sea Turtles” (held in Bellagio, Italy, in November 2003). It received strong support from the State Government of Terengganu, which hosted the event. Terengganu’s Deputy State Secretary (Development), Tuan Haji Mazlan bin Ngah, delivered the keynote address on behalf of the State’s Chief Minister, Y.A.B. Dato’ Seri Idris bin Jusoh.

Y.A.B. Dato’ Seri Idris bin Jusoh called for a review of current conservation efforts and better conservation programs through, among other things, improved information exchange. He reaffirmed the state’s commitment to adopt a more comprehensive approach to conservation and management of sea turtles.

As part of this effort, it was announced at the workshop that the state government has agreed to gazette 60 ha of beach and coastal habitat up to three nautical miles out to sea at the Ma’Daerah rookery as a turtle sanctuary. The rookery attracts nesting green turtles and is managed jointly by DOF, BP Petronas Acetyls Malaysia and WWF-Malaysia.

Building upon successful case studies around the world and by critically reviewing lessons learned from conservation efforts in the country, the workshop addressed sea turtle threats from a multidisciplinary perspective with the aim of garnering joint efforts towards restoring and safeguarding sea turtle populations in Malaysia. The challenge remains in translating the collective ideas into action and in securing sufficient resources and commitment to fund and implement the action points.

1. Background

Malaysia's sea turtles are in serious trouble. They face critical threats and have suffered severe decline. There is an urgent need to take stock of the approaches taken to protect them and to consolidate and redirect conservation measures to reverse the drastic decline of their populations.

After 40 years of efforts to protect the sea turtles, these gentle creatures are critically endangered. Populations of leatherback are nearing extinction, while those of olive ridley have sizably shrunk. Green and hawksbill populations are under increasing threat from human activities and environmental changes.

Nesting leatherback turtles, once found to nest annually in Rantau Abang by the thousands, have plummeted to less than a dozen or so. The east coast of Malaysia was one of only ten primary rookery sites in the world. The severe decline in leatherback landings – coupled with intense threats to other sea turtle species in the country – call for urgent attention and action by policymakers, managers, scientists and local communities.

Four species of sea turtle species are found nesting in Malaysia: green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*) and olive ridley (*Lepidochelys olivacea*). The nesting sites are distributed unevenly around the country. The green turtles are mainly found in Sabah, Terengganu and Sarawak while scattered in areas such as Pahang, Perak and Penang. Leatherback turtles were mainly found in Rantau Abang, Terengganu, while hawksbill turtles can be found in Sabah, Malacca and other places such as Terengganu, Pahang and Johor. Olive ridleys were found to nest in Terengganu and Penang.

The factors that have contributed to declining nesting populations (Chan 2004) include:

- egg exploitation;
- fisheries impact through incidental captures in fishing nets;
- negative impacts from tourism activities;
- habitat destruction due to unplanned development in the coastal zone; and
- commercial harvest and trade by foreign poachers.

All of these factors have combined to severely depress turtle landings and nesting. Turtle conservation, however, is anything but simple and more often than not involves other factors beyond our full understanding and control.

On the Horizon of Hope

There is, however, hope to recover Malaysia's sea turtle populations, as experiences in other parts of the world as well as in the country show. It is still not too late. Some examples follow:

- **St. Croix in the Caribbean.** Protecting eggs through beach protection resulted in an exponential increase in the number of nesting leatherbacks each year, from less than 20 in 1982 to almost 200 in 2001. The number of hatchlings produced jumped from just a few thousand to over 40,000, an amazing response to corrective action.
- **Oaxaca, Mexico.** Olive ridley turtle staged a rapid recovery in the 1990s following a total ban on sea turtle extraction in Mexico and the use of turtle excluder devices (TEDs) in shrimp trawls in Mexico and United States in 1991. Prior to that, a massive effort was mobilized in the 1970s to protect the last remaining nesting beaches. These suffered severe nesting population drops in the 1970s (Steering Committee, Bellagio Conference on Sea Turtles, 2004).
- **Sabah.** The state has accorded complete protection to all turtle eggs with banning of commercial egg collection and with collecting all eggs to be incubated in hatcheries. The efforts have been rewarded with an indication of an increase in the population of green turtles in the state. Sabah has also applied the lessons learned from the Rantau Abang episode in adopting "turtle-tourism" in the state with careful regulation of the activity.

Thus, experiences in other countries and Sabah show that positive turnabouts in sea turtle population trends are possible. However, this requires proper management and a turnabout in our way of thinking (see below):

- First, a review of the lessons learned by scientists, resource managers and authoritative agencies must transform how sea turtles are protected and managed.
- Second, it is now imperative for Malaysia to chart consolidated direction and strong commitment towards sustainable management and conservation of sea turtles in the country.

Turtle conservation in Malaysia is also affected by what is happening in other parts of the region since turtles nesting in Malaysia may travel to feeding grounds within the region. Experts have noted areas where leatherback and other species of turtles are still consumed for religious and cultural events. As such, the significance of regional cooperation in turtle conservation could not be understated.

Malaysia has been working with Philippines to conserve the turtles in the sea areas bordering the two countries. The establishment of the Turtle Islands Heritage Protected Area (TIHPA) is one of the regional efforts between Malaysia and Philippines undertaken to ensure that a common heritage is protected. Similarly, the Sulu-Sulawesi Marine Ecoregion (SSME) program ensures that bordering countries of Malaysia, Philippines and Indonesia work towards protection of marine ecosystems of Sulu-Sulawesi Seas.

These positive measures demonstrate the success of sea turtle restoration efforts and indicate hope for all Malaysian sea turtles. At present, only three areas in the country are legally accorded protection - Rantau Abang in Terengganu, Turtle Islands in Sabah and Turtle Islands in Sarawak. Recent efforts highlight the commitment of the State government of Terengganu in protecting more critical beach areas such as Ma'Daerah. With knowledge of nesting sites, protection of these areas, and hopefully other critical nesting beaches, will be an important first step towards realizing the benefits and long-term goal of sea turtle conservation. The challenge remains to secure long-term commitment and funding to ensure that conservation efforts can be continuously implemented through the involvement of both federal and state governments, nongovernment organizations (NGOs), Malaysian public and global community.

Workshop on Charting Multidisciplinary Research and Action Priorities towards the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean: A Focus on Malaysia

The serious threats to sea turtles underline the urgent need for strong commitment and collaboration to conserve Malaysia's sea turtles. These threats are complex and multifaceted. Hence new approaches need to build upon partnerships and long-term commitment for collective actions. Toward this end, the Workshop on Charting Multidisciplinary Research and Action Priorities towards the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean: A Focus on Malaysia was held on 16-17 August 2004 in Kijal, Terengganu.

The workshop was organized by the Department of Fisheries (DOF) Malaysia, The WorldFish Center, the National Oceanography Directorate (NOD) of the Ministry of Science, Technology and Innovation, the Maritime Institute of Malaysia (MIMA), the Sea Turtle Research Unit of Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM-SEATRU) and WWF-Malaysia.

Over 40 specialists from Malaysia and a number of invited resource persons from Philippines, Indonesia, Thailand, Australia and United States met to chart new directions in the conservation of Malaysia's sea turtles.

The workshop pursued the following objectives:

- consolidate existing work and identify multidisciplinary research priorities towards effective conservation and management of sea turtles in Malaysia;
- review and examine national and regional policy instruments for effective conservation and management of sea turtles; and
- facilitate the development of a cross-sectoral action plan and strategy for implementation by key agencies and stakeholders.

The outcomes and recommendations from the workshop are provided in the subsequent sections. Summary papers are included in Annex 2 and powerpoint presentations in Annex 3.

Participants of the workshop on Charting Multidisciplinary Research and Action Priorities towards the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean: A Focus on Malaysia, 16 and 17 August 2004, Terengganu, Malaysia.

2. Overview of Papers and Case Studies

A total of eight technical papers were presented during the workshop, representing a wide range of issues from aspects of biology to a review of 40 years of sea turtle conservation. A paper on the socioeconomic linkages and impacts of fisheries was also included as the workshop adopted a multidisciplinary approach to address the issues.

Two case studies, including successful restoration examples from international experiences and restoration efforts in Sabah, pave the way for enhancing turtle conservation in the country. The workshop also included presentations on various international initiatives and institutional efforts as well as summaries of the Bellagio Blueprint of Action, the Indian Ocean South-East Asian Marine Turtle Memorandum of Understanding and the Proposed Tri-national Sea Turtle Conservation Program for the Sulu-Sulawesi Marine Ecoregion (SSME).

The key points of the papers are highlighted below.

Aspects of Biology of Sea Turtles

H.C. Liew

Looking at today's sea turtle population and with over 40 years of conservation efforts, it is important to assess what went wrong with past practices. The paper briefly discusses points to the following issues: Do we know enough about our turtles? Where have they all gone? Have we managed our turtles based on good science?

This paper demonstrates that research and science are critical in guiding the direction and management of sea turtles. In order to understand effective ways to conserve Malaysian sea turtles and manage their threats, it is important to know their biology and life cycle.

Some of the research findings that have bearing on management approaches are listed below:

- Turtles are known to have long maturation periods taking over 30 years before they become reproductively active. This means that hatchlings released today would not return to nest until 30 years later. Hence, the impact of overharvesting eggs cannot be seen until it is too late.
- Studies on post-nesting migration of turtles showed that they nest at a particular location and fan out to different foraging grounds. This may often occur in different countries. It is clear from these studies that sea turtles do not recognize political boundaries, and regional cooperation among different countries is needed to manage them effectively (Liew et al. 1996).
- The major turtle conservation activity in Malaysia is usually hatchery-related, hence proper hatchery management practices based on good science are important. To move eggs, proper care in egg handling is important to avoid killing the embryos; the sooner the eggs are moved after laying, the better (Chan et al. 1985). Studies have also revealed that egg incubation temperatures are determinants of the sex of hatchlings, with higher temperatures producing more female hatchlings (Chan and Liew 1996b).

40 Years of Sea Turtle Conservation Efforts: Where did We Go Wrong? Lessons Learned for the Way Forward

K. Ibrahim and D.S.K. Sharma

This paper reviewed 40 years of conservation efforts in Malaysia and examined the threats and key lessons learned that resulted in the alarming decline of sea turtle populations in the country.

The main threats to sea turtles identified in the paper include fisheries impact, capture of turtles by foreign vessels, turtle harvest in neighboring countries, continuous egg exploitation and inconsistent regulation among states, various pollution sources and turtle-related tourism.

Key lessons include:

1. Strong political efforts to set aside critical turtle nesting areas as sanctuaries are crucial first steps towards safeguarding sea turtle populations.
2. Egg exploitation continues as the ban on commercial sale is limited to the eggs of leatherback turtle, and only in two states. i.e., Terengganu and Pahang. Addressing this issue would be important for the survival of future populations. One of the lessons from Sabah's success in restoring sea turtle population can be attributed to the fact that complete protection to nesting turtles and their eggs was accorded more than 30 years ago.
3. It is critical that every step is taken to ensure past mistakes in hatchery management are avoided.
4. Research on temperature-dependent sex determination on leatherback and green turtles show that incubation temperature affects the sex of turtles. It is important to integrate this scientific finding into new hatchery management practices.
5. Research data from tagging and satellite telemetry show that turtles are widely distributed and travel across seas to reach their foraging habitats, often outside Malaysia's political boundaries. This emphasizes the need for regional cooperation to address the issue of turtle population declines.

Overall key message for future management and way forward for sea turtles conservation includes the need to look "beyond the beach" and focus on all stages in a turtle's life cycle. Studies on demographic models indicate that the most efficient way to reverse the decline of a turtle population is through reduction in mortality in the older life stages (Crouse et al. 1987; Crowder et al. 1994).

The way forward for an integrated approach would need to combine elements of public awareness, integrated management measures, adequate funding for conservation programs, research and monitoring, capacity building, community participation and regional/international cooperation to ensure the survival of sea turtle populations in Malaysia.

International Case Studies of Sea Turtle Population Restoration

P. Dutton and D. Dutton

The paper highlighted various conservation strategies worldwide involving beach protection, “head-starting” and fisheries management. There are several examples of long-term recovering trends for once depleted sea turtle populations. These include Kemp’s ridley in Mexico, green turtles in the Hawaiian Archipelago and Costa Rica, Atlantic stocks of leatherbacks in the Caribbean and South Africa, and olive ridleys in Mexico.

The lessons drawn from these successful case studies showed the following:

- Beach protection and egg relocation can be effective management tools, as long as there is also high adult survivorship. This was shown through the increasing leatherback population nesting on St. Croix, United States Virgin Islands, in the Caribbean at a rapid rate of 13% annually with efforts beginning over 20 years (Dutton et al., in prep.).
- It was more effective to accelerate recovery by addressing fisheries-related mortality of subadults and adults than spending limited resources on head-starting as shown through the Kemp’s ridley head-starting program at Padre Island, Texas.
- The elimination of commercial harvest of adult and subadult olive ridleys through a ban in Oaxaca, Mexico, led to rapid recovery in the late 1990s to the present (Peñaflores et al. 2000). Mortality at the subadult and adult stages can profoundly affect sea turtle populations, and elimination of mortality at this critical life stage can promote rapid population recovery.

These cases illustrate that it is possible for severely depleted stocks to be restored, provided appropriate conservation and management measures are adopted. In the Pacific, leatherback populations, including the Rantau Abang population in Terengganu, Malaysia, have collapsed and continue to decline, despite conservation efforts on nesting beaches. It is imperative that nesting beach protection be coupled with at-sea measures to reduce adult and subadult mortality before recovery can take place.

Sea Turtle Conservation in the Turtle Islands Park, Sabah

P. Basintal

The Turtle Islands Park is composed of Pulau Selingaan, Pulau Bakkungaan Kecil and Pulau Gulisaan. The park together with six Philippines islands and Berau Island of Indonesia form one of nine remaining major nesting habitats for green turtles in the world. It is also the largest remaining hawksbill turtle nesting habitat in Southeast Asia. Turtle conservation efforts in Sabah began as early as 1928 and focused on regulating the harvest of turtles for trade. This continued with the banning of license to kill turtles, regulating egg collection and establishing hatcheries. Sabah Parks manages the hatcheries and initiates research on relevant sea turtles studies. The nesting populations of the green and hawksbill turtles have shown a remarkable recovery in the 1990s.

The success of nesting population recovery is attributed to the bold conservation measures taken by the Sabah Government since the 1970s including banning commercial egg collection and acquiring islands from private ownership. The outcome of research on turtle tagging contributed significantly to the development of a policy in establishing transboundary protected areas, resulting in the establishment of the Turtle Islands Heritage Protected Area (TIHPA) in 1996.

Socioeconomic Linkages and Impacts of Fisheries on Sea Turtle Populations

S. Wagiman, D.S.K. Sharma and H.C. Liew

This paper provides an overview of sea turtle species in Malaysia, relevant legislation and regulation followed by main fishing impacts to turtle population. The fisheries sector plays an important role in providing fish as source of food and protein. It contributed about 1.5% to GDP and provided direct employment to 82,000 fishers in 2002.

A comprehensive review of the impacts of coastal, offshore and riverine development on marine turtles and terrapins in Malaysia reveals that numerous anthropogenic activities encroach and impact their habitats. These factors include incidental capture and mortalities, illegal fishing in marine protected areas, illegal fishing by foreign fishers, illumination of fishing vessels, illegal and unlicensed harvest of eggs, land-based pollution, coastal armoring including structures, reclamation of land and sea, and coastal tourism.

The conservation of marine turtles presents daunting challenges including multiple threats and conflicting interests. A wide range of conservation and management actions are required to reverse the decline in marine turtles. Fishing impacts on turtles should be reduced through restrictions and regulations. A national policy must be formulated to address marine turtle conservation issues coupled with implementation of agreement.

What can be Done to Restore Pacific Turtle Populations? The Bellagio Blueprint for Action on Pacific Sea Turtles

M. Ahmed

The Bellagio Blueprint for Action on Pacific Sea Turtles is an outcome of the Conference on the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean held on 17–22 November 2003 in Bellagio, Italy. The workshop was organized based on the rationale that sea turtles (especially Pacific leatherbacks) are among the most threatened and endangered species. The conference concluded with four action points that formed the basis for the Bellagio Blueprint for Action (see Steering Committee, Bellagio Conference on Sea Turtles 2004). The four action points include: (1) protect all nesting beaches, starting with those of the Pacific leatherbacks; (2) reduce turtle take in at-sea and coastal fisheries; (3) establish pan-Pacific policy actions; and (4) encourage sustainability in traditional use.

Indian Ocean South-East Asian Marine Turtle Memorandum of Understanding[1]

Douglas Hykle

The presentation provided an overview of the Indian Ocean South-East Asian Marine Turtle Memorandum of Understanding (IOSEA-MOU) which is an agreement among governments with NGOs as partners developed under the Convention on Migratory Species (CMS). It applies to six marine turtle species and their habitats with a geographical scope of more than 40 states.

The IOSEA-MOU Secretariat is based in Bangkok, Thailand. The major core sponsors include Australia, United States, United Kingdom, France, CMS and the United Nations Environment Programme. The Conservation and Management Plan with its six objectives is central to IOSEA. The CMS/IOSEA supports various conservation projects in different parts of the world. The IOSEA applies various methods to advance sea turtle conservation efforts including multilateral sea turtle instruments, mapping tools and information/awareness raising materials. The IOSEA website is www.ioseaturtles.org

The Proposed Tri-national Sea Turtle Conservation Program for the Sulu-Sulawesi Marine Ecoregion

Jose Noel B. Dumaup

The paper reflected on the significance of the Sulu-Sulawesi Marine Ecoregion (SSME) for sea turtles particularly the importance of safeguarding sea turtle populations and habitats. The proposed tri-national sea turtle conservation program encompassing coastal areas of Philippines, Malaysia and Indonesia was developed under the WWF SSME Conservation Program which involved 62 stakeholders. The program has seven objectives to address issues and concerns among the relevant countries. Various research actions have been proposed including transboundary marine turtle tagging, identification and monitoring of turtle habitats in the SSME area, hatchery management, stock differentiation and migration, etc which would be more effective if implemented with coordination among the three countries.

[1] This and the following presentation were additional updates provided at the workshop. Only summaries and powerpoint presentations are included in these proceedings.

3. Charting the Future Direction for Sea Turtle Conservation and Management

The workshop presentations addressed sea turtle conservation issues and provided the participants with a broader perspective of relevant research and management aspects. Working groups were formed to discuss:

1. policy, legal and institutional issues in Malaysia and the region;
2. identification of knowledge gaps, research priority areas and framework for sea turtle conservation; and
3. management strategies and tools for sea turtle conservation (community-based involvement, education/awareness and other measures).

The working groups aimed to build on the lessons learned from 40 years of sea turtle conservation in the country towards charting a future for the critically endangered turtle species. The group participants were of eclectic background, composed of policymakers, resource managers, researchers and other stakeholders. Each working group identified related issues and their underlying factors, and realistic recommendations for followup actions. They also discussed relevant institutions and partnerships which can effectively implement the proposals.

Policy, Legal and Institutional Issues in Malaysia and the Region

This working group considered policy, legal and institutional gaps that dampen effective conservation efforts and actions to address these loopholes.

***Policy*.** First, a key issue that emerged emphasized that there are no adequate and consolidated policies that specifically address sea turtle issues effectively in guiding conservation efforts in the country. Sea turtles are mentioned in general in the National Biodiversity Policy, 1998. However, specific policies are critically needed and kept up-to-date to address real threats that are faced by sea turtle populations for example through the impacts of beach development and tourism-related activities. Second, with the continuous decline of sea turtle populations and with certain species, such as the leatherback and olive ridley, almost at the brink of extinction, the group highlighted that there is no recovery plan to revitalize turtle populations and halt the collapse of these populations. Third, funding and financing for sea turtle conservation, although very critical, are not sufficiently reflected in the country's policies. Hence, this results in inadequate funding for conservation efforts.

Legal. Gaps in existing legislation surface as a result of inconsistent enactment across the states as well as between federal and state levels. Hence, the loopholes continue to exist, affecting the survival of sea turtle populations. Examples of the loopholes include the fact that there is no provision for domestic trade in sea turtles and their body parts as not all states have legislations pertaining to protection and management of sea turtles.

Institutional. A key issue highlighted was that there was inadequate institutional framework as the jurisdiction with regard to sea turtle management and conservation is unclear. As a consequence, the roles and jurisdiction of relevant ministries and agencies are not clearly defined.

The group proposed the following recommendations for consideration in addressing the highlighted policy, institutional and legal issues.

- **Policy**: Develop a national policy on wildlife which includes sea turtles or a specific policy on sea turtles. At the same time, identify ways to optimize existing policies, for example, by relating to the National Biodiversity Plan. Some of the sea turtle policies could consider guidelines on turtle watching, development of turtle nesting beaches, egg collection system and handling, and turtle recovery plan for depleted populations.
- **Legal**: Review and address gaps and loopholes in existing legislations, particularly in terms of uniformity among states and federal and state legislative tools. Consider the inclusion of sea turtles in the Protection of Wildlife Act 1972. The group also highlighted the need to explore the possibility of complete egg protection by total ban on commercial egg sale and consumption of all species of sea turtles in Peninsular Malaysia (Sabah and Sarawak have accorded legal protection to eggs of all sea turtle species). The total ban should be complemented with education and awareness programs and adequate enforcement. The ban also needs to consider alternative livelihood for traditional egg collectors.
- **Institutional**: Establish a Joint National Management Committee on sea turtles for a more coordinated approach and review the need and possibility for administering sea turtles under a conservation-oriented ministry.

The working group also identified relevant key agencies with respect to policy and legal aspects, and which will be instrumental in bringing forward the recommendations from conception to implementation. These include: DOF Malaysia, Ministry of Natural Resources and Environment, state agencies, Attorney General's Chamber, Ministry of Science, Technology and Innovation, MIMA, Sabah Parks and Sabah Wildlife Department, Sarawak Forest Department Turtle's Board and Sarawak Forestry Corporation, Ministry of International Trade and Industry, Royal Customs and Excise Department and Ministry of Tourism.

Identification of Knowledge Gaps, Research Priority Areas and Framework for Sea Turtle Conservation

This working group discussed and focused on priority research areas to aid the development of sound and scientific-based policy and management initiatives in sea turtle conservation. Five priority issues were identified with its corresponding nonexhaustive list of research areas. These proposals considered life cycles of sea turtle populations and acknowledged the importance of addressing the threats both at nesting sites and at-sea. The group also discussed at length the feasibility of restoring leatherbacks. Followup action on research on leatherback restoration is included under point 4 below.

1. **Egg protection and optimizing hatchling production.** Examples include the need to understand the economic benefits, costs and incentives for egg and hatchling protection with the involvement of communities and also habitat protection. Improved hatchery management and in-situ incubation practices were also important research areas to consider. Biological knowledge of sea turtles, relevant genetic, climate change and pollution impacts were also important considerations.
2. **Reducing by-catch.** Existing studies show that maintaining populations at sea, in particular adults, is important for the regeneration of sea turtle populations. Hence, inshore and offshore fisheries need to be tackled. Studies need to deepen our biological knowledge of habitat and migration patterns. It is also critical to understand fisheries and sea turtle interactions and ways of reducing by-catch while considering socioeconomic implications on relevant stakeholders. As for offshore fisheries, emphasis needs to be given on the impacts and effectiveness of existing international agreements and on enhancing international cooperation. Understanding the effectiveness of legal framework and instruments for trade regulation is also important.
3. **Illegal trade (domestic and regional) of turtles and their derivatives.** Research areas include the extent, trade routes and impacts of trade on sea turtle populations.
4. **Population assessment: conservation and restoration.** Research areas include population modeling, stranding monitoring program, defining management units and assessing the feasibility of restoring leatherback populations.
5. **Socioeconomic assessment and valuation of sea turtles.** It is also important to link socioeconomic research with priorities and interests of relevant stakeholders to sea turtle conservation towards a participatory approach to ensure that long-term management goals are achieved. Understanding the economic benefits and values, including indirect use values such as ecotourism and existence values, demonstrates the importance of sea turtle conservation and its value to stakeholders, especially to policy and decisionmakers, local communities and the public.

Overall, the group stressed the need for joint partnerships and collaborative efforts among researchers, managers and policymakers to increase the relevance and effectiveness of research.

Management Strategies and Tools for Sea Turtle Conservation (Community-based Involvement, Education/Awareness and Other Measures)

The group acknowledged the importance of involving local communities in all stages and various aspects of conservation activities including habitat management and enforcement. The people element was key to defining the solutions. Effective and creative awareness programs were also identified to impart the right message.

Nine key areas in which management intervention is pivotal were identified:

1. **Terrestrial habitat management.** Issues include insufficient turtle sanctuaries due to lengthy gazettement process and conflicting land use demands; inadequate restoration of turtle nesting areas due to lack of funds; and inadequate best practice guidelines for sea turtle-based ecotourism.
2. **Information management.** Lack of reliable information, dissemination and communication strategy and focal point for compilation and integration.
3. **Coastal fisheries.** Focus on fishing practices in critical habitats including foraging and internesting areas to reduce incidental catch of turtles in coastal fisheries.
4. **Enforcement.** Lack of personnel, funding and equipment and cooperation among the authorities.
5. **Awareness programs.** The public is not fully aware of the impact of its activities on sea populations and the near extinction of certain turtle species. Hence, it does not appreciate the importance of conserving the species.
6. **Tourism.** Uncontrolled tourism in critical habitats causes loss of critical habitats, harassment and injuries to turtles, light disorientation to hatchlings and deterrent to nesting females.
7. **Management authority.** No proper coordination among government departments on management efforts and inefficient legislation.
8. **Funding.** Lack of funding.
9. **Pollution**.

Proposed solutions to address the above issues include the following:

- Establish a national sea turtle information center (homepage/website).
- Implement relevant management tools (time/area closure) of fisheries off critical nesting habitats, restrictions on fishing gears that catch sea turtles along with observer program and efficient enforcement; and encourage compensation for losses to fishers due to compliance with conservation methods.
- Increase the number of personnel for enforcement. Train enforcement personnel. Empower in enforcement efforts relevant stakeholders, including local community, and create working groups among authorities, NGOs and local community.
- Conduct awareness programs through fishers associations, tourist operators and local community. Increase mass media coverage on turtle status and issues.
- Involve community members in planning/monitoring tourism activities and integrated coastline development to incorporate sensitivities of turtle nesting biology.
- Establish a Turtle Task Force under the Biodiversity and Biotechnology Council at the national level and working groups among stakeholders at state level.
- Commit funding from relevant ministries/agencies and other self-sustaining mechanisms, and promote sponsorship from private sectors.

Working Group Plenary

The plenary discussions integrated the views and inputs of the three working groups. Various questions and issues raised included the following:

- Regional and international policies were not discussed in great length during the workshop. It was highlighted that Malaysia has yet to be a signatory to the IOSEA-MOU. Clarification was made that being a party to CMS is not a prerequisite to IOSEA-MOU.
- There is sparcity of information on the “lost years” – the first stage of development in a hatchling’s life in the open ocean. Similarly, the impacts of coastal fishing on turtles are insufficiently understood. There is need to initiate research in these areas.
- There is a need to conduct research on the effectiveness of existing awareness programs for the design of new and more creative awareness programs.
- It is important for relevant agencies which manage areas where sea turtles can be found (e.g., sea, land and species) to coordinate and address together relevant threats and to consider the inclusion of stakeholders in resource management.

4. Recommendations

As a followup to the working group discussions, the workshop prioritized 15 Action Points for the conservation of sea turtle populations in Malaysia. Followup actions and the roles of various organizations were also identified.

A followup entails refining and prioritizing research areas for wider dissemination at various avenues. Also needed is a review of areas with ongoing research and where gaps exist. It was agreed that the first round of prioritization and identification of the 15 Action Points provides the basis for developing further efforts on conservation and management of sea turtles in Malaysia. The workshop stressed, however, the need for wide consultations with relevant parties and individuals to crystallize and finalize the action points.

The 15 Action Points which integrate critical actions related to policy, research and management of sea turtles are listed as follows:

15 Action Points

A. Policy, Legal and Institutional Aspects

1. Establish a Joint National Management Committee on sea turtles.
2. Review the effectiveness of sea turtle management and conservation under the present administration and explore the need for and possibility of administering sea turtles under a conservation-oriented ministry.
3. Create a National Turtle Regulation which addresses gaps and loopholes and harmonizes federal and state legislations.

B. Priority Research Areas

4. Optimize egg protection, eliminate egg harvest (which includes socioeconomic research of local communities) and optimize hatchling production.
5. Assess and reduce turtle by-catch in coastal fisheries which include understanding relevant socioeconomic linkages and research on ways to increase the participation of fishers.
6. Determining the impacts of offshore fisheries on Malaysian turtles and research on international cooperations.
7. Studying the feasibility of restoring the Malaysian leatherback population.
8. Identifying and protecting key foraging and development habitats.

C. Management Strategies and Tools

9. Strengthen protection and ensure adequate management of main turtle rookeries in the country.
10. Identify mechanisms to ensure fishers do not lose out economically due to turtle by-catch mitigation measures.
11. Identify new arrangements for enforcement capacity to police waters, beaches and to enforce all provisions that are captured in existing legislations.
12. Translate current knowledge into proper awareness programs to get the message across to the right audience.
13. Assign a focal point in government that is empowered to lead sea turtle management and conservation.
14. Encourage partnerships and involvement of local communities in research and management.
15. Establish innovative and sustainable sources of funding and enhance technical capacities.

5. Conclusion and Next Steps

As a next step, the conference proceedings will provide the basis and framework for the development of a detailed National Action Plan for the conservation and sustainable management of sea turtles in Malaysia. It is also proposed that the proceedings be widely disseminated not only among various levels and agencies which deal with sea turtle conservation but also to key development/planning agencies so that sea turtle considerations and issues are integrated into future development plans and policies. Proposals for the next steps and agencies involved are provided in Table 1.

Table 1. Followup actions of the workshop.

Outputs	Who
15 Action Point Statements	The DOF was identified as the lead agency to finalize the Action Points, in collaboration with MIMA, WWF-Malaysia, NOD, KUSTEM-SEATRU, Sabah Parks, Sarawak Forestry and The WorldFish Center.
National Action Plan for conservation and management of sea turtles	KUSTEM-SEATRU was identified as the lead institution to formulate the Action Plan in collaboration with DOF, Sabah Parks, Sarawak Forestry and WWF-Malaysia.
Workshop Proceedings	The WorldFish Center was identified as the lead organization to compile, publish and disseminate the proceedings, in collaboration with the organizing committee of the workshop along with Sabah and Sarawak counterparts.
Communication strategy to build awareness about the workshop, followup initiatives and sea turtle issues.	WWF-Malaysia was identified as the lead organization, in collaboration with The WorldFish Center and DOF, to develop the communication strategy; to collate materials/articles from workshop participants and organizers; and to identify mechanisms for dissemination.

The workshop also provided a bridge for future collaboration among national participants and also with international resource persons. Some points of interest for collaborative research include the following:

- The uniqueness of the Malaysian leatherback in terms of genetic composition was highlighted. Past research indicated that the genetic diversity of leatherbacks originating from Malaysia was greater than those from the Pacific.
- Potential collaborative research areas include socioeconomic factors and fisheries, the potential for recovery of leatherbacks in Terengganu, costs involved and types of actions necessary for restoration, and financial mechanisms for the conservation of sea turtles.

Sea turtle populations in Malaysia could already be on the pathway towards restoration and survival. However, achieving such a future would require a fundamental change

to enhance present management practices. In conclusion, the following three points summarize key messages in bringing about this change:

- Understand and incorporate elements of sea turtle biology and life cycle in sea turtle management and conservation efforts. These include various anthropogenic impacts and interactions at the beach and at-sea. This in turn involves a deeper understanding of relevant socioeconomic linkages and participation of local communities and fishers in conservation efforts.
- Initiate and implement bold measures to achieve conservation goals and ensure the effective use of scarce resources. As shown in the Sabah case study, strong measures to acquire islands from private ownership, banning commercial egg collection and collecting all eggs to be incubated in hatcheries had resulted in a remarkable recovery of green turtle populations.
- Inspire future collective actions based on the fact that sea turtle populations are part of the local, national and global heritage. Shared responsibilities are needed from local communities, state and national governments, the Malaysian public, international institutions and the global community. Only through creative funding mechanisms that could sustain the proposed action priorities, coupled with collective actions by all parties, would the vision of viable sea turtle populations be realized.

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Annex 1.
Speeches

Welcome Remarks

TUAN HAJI IBRAHIM BIN SALLEH
Deputy Director-General
Department of Fisheries Malaysia

Yang Amat Berhormat Dato' Seri Idris bin Jusoh
Chief Minister of Terengganu

Dr. Mahfuzuddin Ahmed
Program Leader and Principal Scientist
The WorldFish Center, Penang, Malaysia

Distinguished guests and participants

Assalamualaikum w.b.t. and good morning

First of all, I wish to express my highest gratitude to Y.A.B Dato' Seri Idris bin Jusoh, the Chief Minister of Terengganu for his presence and consent to officiate this workshop in spite of his tight office schedule.

It is indeed my honor and pleasure to be invited to say a few words at the opening of this auspicious workshop. On behalf of the Department of Fisheries (DOF), The WorldFish Center and other co-organizers, I wish to extend my warmest welcome to all the distinguished participants of this workshop.

The existence of The WorldFish Center in Penang provides Malaysia with the necessary technical competence and support that are required to achieve sustainable fisheries management as well as for marine turtle research and conservation.

I sincerely hope that this workshop provides an important avenue for followup actions of the Bellagio Blueprint for Action on Pacific Sea Turtles. At the same time, it will continue the national initiative of the Roundtable Discussion on the Conservation of Sea Turtles in Malaysia.

This workshop has brought policymakers, managers, researchers and practitioners together to consolidate existing knowledge and initiatives related to sea turtle conservation in Malaysia. Therefore, this will enable the dissemination of workshop recommendations to wider stakeholder groups including the local communities.

The DOF is proud to be given the mandate and trust as the lead agency in coordinating activities for the protection and conservation of marine turtles in the country as well as in the Southeast Asian region. This is a challenging task and DOF Malaysia hopes that a strategy and an action plan that are beneficial to all the stakeholders will be developed. In this regard, I wish to express the gratitude of DOF to all the state governments, especially the Government of Terengganu, for their continuous support of human resource and financial assistance for the management and conservation of marine turtles in this country.

It is quite alarming to read in the newspapers the issues of poaching and illegal fishing of marine turtles in Malaysian waters by foreign fishers. There is a need to come up with concerted efforts to conserve and protect the marine resources as well as their aquatic environment. In this respect, I believe that the organization of this workshop is very timely and that the final outcome will contribute to the development of the action plan for the implementation of research and extension priorities. I believe that our continuous efforts in conserving marine turtles will result in a successful achievement recognized not only in this country but also in the international community.

On this note, once again I wish to express my sincere appreciation and heartfelt thanks to the State Government of Terengganu, National Oceanographic Department, Maritime Insititute of Malaysia, Sea Turtle Research Unit of the Kolej Universiti Sains dan Teknologi Malaysia, The WorldFish Center and WWF-Malaysia for co-hosting this important national workshop and to YAB Dato' Seri Idris bin Jusoh, Menteri Besar of Terengganu for his consent to officiate this workshop. Finally, I would like to take this opportunity to congratulate all the people who have contributed to the successful organization of this workshop.

I sincerely hope that all of you will have a pleasant and memorable stay in Terengganu.

Thank you.

Opening Address

Y.A.B. DATO' SERI IDRIS BIN JUSOH
Chief Minister of Terengganu[2]

Yang Berusaha Tuan Haji Ibrahim bin Salleh
Deputy Director-General
Department of Fisheries Malaysia

Dr. Mahfuzuddin Ahmed
Program Leader and Principal Scientist
The WorldFish Center, Penang, Malaysia

Distinguished guests and participants

Ladies and gentlemen

Assalamualaikum w.b.t. and a very good morning to everyone present

First, let us praise the Lord for His blessing, which allows us to get together in good health to participate in this workshop. I am indeed honored and delighted to be given the opportunity to inaugurate this workshop which is jointly organized and funded by various agencies, including the Department of Fisheries (DOF) Malaysia, The WorldFish Center, National Oceanography Directorate, WWF-Malaysia and Sea Turtle Research Unit of the Kolej Universiti Sains dan Teknologi Malaysia. It is a great honor for the State of Terengganu to be chosen as host in addressing the issues and plights of marine turtles not only in Malaysia but also in the Association of Southeast Asian Nations (ASEAN) region.

It is indeed a delightful sight to see a gathering of marine turtle experts from Malaysia and overseas at this meeting. Hopefully, in the spirit of cooperation you will be able to discuss the issues put before us. This is indeed a challenge but I know that all here in their own capacity will try their very best in coming to an agreement on the best approach on the conservation and management of marine turtles for the future.

Marine turtles have been classified as endangered animals and over the decades their population has severely declined in many parts of the world. Some are even facing the possibility of extinction within a few years. Numerous factors have contributed to the decline of these creatures. The greatest threats today are related to humans and their activities. Marine turtles are important for a variety of reasons. However, it is sad to say that until today there are still countries around the globe that allow the commercial exploitation of marine turtles for food, oil, leather and jewelry.

[2] Text read by Deputy State Secretary (Development), Tuan Haji Mazlan Bin Ngah.

In layman's term, conservation is about reducing and removing the threats. But in reality, the work of conservation does not lie principally with the animals, plants and ecosystems but actually lies in dealing with humans. Although conservation programs are in existence, results in general have not been encouraging. Are we doing the right thing or are the efforts insufficient? This would be an opportune time for us to update ourselves with new knowledge and review our efforts for more effective conservation programs.

Turtles are migratory animals; they drift or swim hundreds or thousands of kilometers during their lives. Consequently, conservation efforts in one country may not be sufficient to conserve a population.

Regional cooperation and programs in marine turtle protection and conservation are needed among the ASEAN member-countries in order to boost marine turtle population in the region. This is because marine turtles are transboundary animals. This sort of regional collaboration has taken effect in the ASEAN region since 1985 with the signing of the ASEAN Agreement on the Conservation of Nature and Natural Resources. Following the ASEAN Agreement, the first regional bilateral cooperation known as the Turtle Islands Heritage Protected Area between Malaysia and Philippines was officially launched and signed in May 1996. This bilateral initiative is structured to advance plans for joint management of marine turtles, and it is a unique model of international cooperation of shared marine resources.

On 12 September 1997, a Memorandum of Understanding for the Protection and Conservation of Marine Turtles was signed in Bangkok, Thailand, by all the ASEAN nations. The Government of Malaysia, in particular DOF, was given the mandate and trust to be the lead country to coordinate activities on the protection and conservation of marine turtles in the Southeast Asia region. To this effect, the Government of Malaysia established the Turtle and Marine Ecosystem Centre in Rantau Abang, Terengganu, so that a more focused effort in research and conservation of turtles can be done.

Efforts have been undertaken to increase the number of turtle sanctuary in Malaysia in general and in Terengganu in particular. One of the rookeries identified is in Ma'Daerah in Dungun. In 1991, the State of Terengganu gazetted 15 km beach of Rantau Abang as a turtle sanctuary.

The state government agreed to gazette 60 ha of beach and coastal habitat and up to 3 nautical miles out to sea. Currently the Ma'Daerah rookery is being managed jointly by DOF (a government agency), WWF-Malaysia (a nongovernment organization) and BP Petronas Acetyls Malaysia (a private corporate body).

The objectives of Ma'Daerah Turtle Sanctuary Centre focus on better protection for turtle eggs, better conservation awareness among community members, and stronger relationship among researchers and administrators.

In addition to that, I am very happy to inform that the state of Terengganu has been leading the effort in turtle conservation and management since the 1950s. We have enacted the Turtle Enactment of Terengganu in 1951 and established the first hatchery for leatherback turtle in the country. Contribution from the state government was not only in kind but also in monetary terms. In the Seventh and Eighth Malaysian Plan, about RM 875,000 have been allocated for marine turtle management and conservation. As a result, about 1.4 million hatchlings of marine turtles have been released to the sea from Terengganu beaches.

The need for further regional and international collaborative policies and programs in marine turtle conservation should be stressed and given priority, not only in terms of proper management of turtles and their habitat but also in reviewing existing regional and international policies, programs, conventions and treaties which are directly or indirectly applicable to marine turtles.

The government is convinced that effective conservation of marine turtles in our waters and other regions of the world requires discussion and collaboration among various parties. In order to manage turtles and other species that have very complex life cycles, we must develop more strategic ways to work together. We need to work together to gather information, undertake cooperative research and find the best practices needed.

Smart partnership with nongovernment bodies and private sectors must be enhanced in order to alleviate the mammoth task of conservation into a successful and fruitful affair. In Malaysia, we truly believe in this smart partnership concept and are actively pursuing it in our effort to impart knowledge and create awareness in marine turtle conservation. I sincerely hope other corporate bodies, besides BP Petronas Acetyls Malaysia as mentioned earlier, will come in joining efforts to conserve the turtles. This will be a gesture to society and humankind and of course to the turtles to continue their survival for another million years if not indefinitely.

For decades, the international scientific and conservation communities have dedicated enormous efforts and resources on programs to recover populations of endangered marine turtles around the world. Today the challenge of marine turtle conservation is to find and develop mechanisms to ensure that these highly migratory and late-maturing species survive in a world that is rapidly changing. Being shared resources, collaboration in conservation policies and programs among nations is essential if our efforts are to succeed, and for that a regional cooperation in the ASEAN region is especially important. It is my hope that the workshop presentations and discussion will be successful and that marine turtle research and management will be enhanced, both here in Malaysia and in the region, as a result of the cooperative efforts of the workshop participants over the next two days.

On that note, I wish to thank all co-organizers and sponsors for their tireless effort in organizing and making this workshop possible. I sincerely hope that a fruitful outcome can be achieved for the sake of the survival of marine turtles into the next millennium. This workshop, however, is only a step toward successful marine turtle management. The main work still remains to be done, in the field and in our office. Together, if resolute, dedicated and coordinated, we will succeed.

I also hope that all participants will take time off to visit sights of Terengganu. There are plenty of traditional crafts and food that can satisfy everyone's taste.

With that, in the name of Allah, the Most Gracious and Most Merciful, I officially inaugurate this Workshop on Charting Multidisciplinary Research and Action Priorities towards the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean: A Focus on Malaysia.

To all the participants, I bid you a warm welcome, and I sincerely hope that you will have a nice and pleasant stay in this beach resort. Thank you very much and I hope that you will enjoy your stay in Terengganu, Malaysia.

Wassalamu'alaikum Warahmatullah.

Annex 2.
Technical Papers and Case Studies

Aspects in Biology of Sea Turtles

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Sea turtles are Malaysia's unique heritage. Of the seven species of sea turtles existing today, four are known to nest in the country, namely, leatherback turtle (*Dermochelys coriacea*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and olive ridley turtle (*Lepidochelys olivacea*). The leatherback is the largest species of sea turtles in existence while the olive ridley is the smallest. Many of the sea turtle populations in Malaysia have been greatly decimated. In the once renowned leatherback population at Rantau Abang, Terengganu, nestings have dropped from 10,000 nests a year in the 1950s (Chan and Liew 1996a) to less than 10 nests in recent years. The olive ridley also suffered a similar tragedy with nestings along the mainland coast of Terengganu virtually gone. The hawksbill turtle population has largely been reduced to only a few individual nesters per year. Populations of green turtle have also declined significantly compared to the 1980s but the rate of decline has not reached a critical stage.

Terengganu has a long history of sea turtle conservation management programs, dating as far back as the 1950s for the leatherbacks (Wyatt-Smith 1960; Hendrickson 1962; Siow 1982; and Brahim et al. 1987). Looking at today's sea turtle population, it is important to assess what went wrong with past practices. Do we know enough about our turtles? Where have they all gone? Have we managed our turtles based on good science or was it influenced by politics?

In order to understand effective ways to conserve Malaysian sea turtles and manage their threats, it is important to know their biology and life cycle. Upon nesting, sea turtle eggs take 50-80 days incubation before the hatchling emerges (Limpus 1994). The hatchling will quickly run down the beach towards the sea and go on a swimming frenzy for about 2-5 days reaching offshore waters to avoid being preyed upon by coastal fish and sea birds. At the end of the swimming frenzy, the hatchlings would start to feed on whatever they can find in the open ocean surface. They have an oceanic existence for several years until they become dinner-plate-sized juveniles before deciding and settling at suitable feeding grounds to continue their existence into adulthood (Musick and Limpus 1997). It may take as long as 30-50 years or more for sea turtles to be reproductively active and be ready for their first breeding migration (Chaloupka and Musick 1997). Sea turtles are known to travel great distances back to their natal nesting grounds to breed and lay their

eggs. However, they do not breed every year but do so at intervals of two or more years. The males will also perform these reproductive migrations but will return to their feeding grounds after mating while females will stay around until they have finished laying their eggs. Female turtles lay several clutches of eggs, each clutch after an interval of about two weeks. Upon successful completion of laying all her egg clutches, the females would then migrate back to their feeding grounds.

Sea turtles face many threats at every stage of their life cycle. Many of them are accidentally killed in fishing nets. Can we prevent them from being killed? Where do our turtles go after nesting? To answer these questions, studies were conducted to determine the internesting movements of these turtles using radio and ultrasonic telemetry. Tracking devices attached on leatherbacks after nesting at Rantau Abang, Terengganu, showed that they would move to waters over 30 km offshore and would remain there until a few days before the next nesting (Chan et al. 1991). Green turtles at Redang Island, however, do not move offshore but remain close to the island throughout the internesting period (Liew and Chan 1994). The use of satellite-based telemetry has also enabled us to track the long distance migration of post-nesting female green and hawksbill turtles back to their foraging grounds. For example, female green turtles that nested in Redang Island would return to foraging grounds located from 669 km in the Natuna Islands of Indonesia to 1,744 km at Bugsuk Island in Philippines taking 13-28 days, respectively (Liew et al. 1995, 1996). A post-nesting female hawksbill from Redang Island traveled to Sumatra, Indonesia. Seven post-nesting green turtles from the Turtle Islands of Sarawak migrated to different locations in the Sulu-Sulawesi Seas (Bali et al. 2000). These studies clearly showed that turtles that nest at a particular location fan out to different foraging grounds, and this may often occur in different countries. It is clear from these studies that sea turtles do not recognize political boundaries and regional cooperation between different countries is needed to manage them effectively (Liew et al. 1996).

Tagging and tag recovery studies conducted on green and hawksbill turtles at Redang Island, Terengganu, confirmed that turtles seldom nest every year. They only do so after every 2, 3 or more years. It is believed that these turtles have to be healthy and must build up enough fat reserves in order to reproduce, and this may take a few years. Tagging studies also showed that female green turtles nest several times during each reproductive season, laying 6-7 clutches of eggs as the most frequent number of clutches. However, some individuals were known to lay as many as 11 or 12 clutches. The internesting period between clutches averaged around 10 days but may range from 9 to 14 days (Liew and Chan 2000). The reason why they split the eggs into clutches is because of the large number of eggs they need to lay. However, the female has limited capacity to carry shelled eggs at a time.

The major turtle conservation activity in Malaysia is usually hatchery-related, hence, proper hatchery management practices based on good science is important. Hatchery systems practiced in Malaysia are often the relocation of eggs into fenced hatcheries with a few “in-situ” hatcheries. To move eggs, proper care in egg handling is important to avoid killing the embryos; the sooner the eggs are moved after laying, the better (Chan et al. 1985). Studies have also revealed that egg incubation temperatures are determinants of the sex of hatchlings produced, with higher temperatures producing

more female hatchlings (Chan and Liew 1996b). Thus, the moving of eggs to fenced hatcheries with higher beach temperatures will severely cause the production of biased-sexed hatchlings. This could well have contributed to the decline of the leatherback population in Malaysia.

On emergence, hatchlings race to the sea often under the cover of darkness. They are easily disoriented with light. To determine where these hatchlings go, some leatherback hatchlings were tracked using radio-telemetry. The first hatchling was tracked over a distance of 39 km in 34 hours while the second hatchling was tracked over 82 km in 39 hours (Liew and Chan 1995). These hatchlings did not remain in coastal waters but headed straight into the open sea, presumably to avoid coastal predators like birds and fishes. Sea turtle hatchlings were also found to swim close to the sea surface to take advantage of the camouflage provided by the waves and ripples. On entering offshore waters, they would be transported by ocean currents.

Turtles are known to have long maturation periods taking over 30 years before they become reproductively active. This means that hatchlings released today would not return to nest until 30 years later. As such, the impact of overharvesting of eggs cannot be seen until it is too late. It is also difficult to determine how many turtles we have in our population. This is because we normally only count the nesting females within a nesting season but we never know how many are actually out there that are not breeding. In addition, different breeding units share regional food resources so even if we could count them in their foraging grounds, it does not guarantee that they belong to your breeding unit.

Sea turtle biology is complex. However, through research, we have gained better understanding of the turtles' biology and population dynamics so that we can manage them better and more effectively.

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Forty Years of Sea Turtle Conservation Efforts: Where did We Go Wrong? Lessons Learned and the Way Forward

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This paper provides a brief history of conservation initiatives on sea turtles and relevant legislations in the country. Conservation efforts on sea turtles in Malaysia started over 40 years ago. Unfortunately, sea turtle populations are on the decline and continue to be threatened. What are the key lessons learned? Where did we go wrong? This paper provides a nutshell picture of the lessons learned from 40 years of sea turtle conservation and presents the way forward for consolidated efforts and strengthened commitment in view of the drastic declining trends of sea turtle populations in the country.

Forty Years of Sea Turtle Conservation

The four sea turtle species found in Malaysian waters and that nest on their beaches are the green, olive ridley, hawksbill and leatherback turtles. Green turtles are mainly found in Sabah, Terengganu and Sarawak while scattered in areas such as Pahang, Perak and Penang. Leatherback turtles were mainly found nesting in large numbers in Rantau Abang, Terengganu and hawksbill turtles can be found in Sabah, Malacca and other places such as Terengganu, Pahang and Johor. Olive ridleys are found to nest in Terengganu and Penang.

For the last few decades, dramatic declines in populations have occurred for all the turtle species found in Malaysia (Chan and Liew 1995). Records show that the leatherback population has plummeted from 10,000 annual nestings in the early 1950s to less than a dozen in recent years (Chan and Liew 1996). Records from the Department of Fisheries (DOF) Malaysia show that olive ridley nestings declined by 96% in 1998 compared to 1991 figures while hawksbill nestings dropped by 27-60% in 1998 as compared to nesting in 1991 (Mohd. Najib et al. 1999). Anecdotal evidence on green turtle populations suggests declines of over 80% in Terengganu (Chan 2004).

A different trend can be seen from East Malaysia. The green turtle populations in Sabah Turtle Islands have staged a threefold increase over records in the early 1980s (Chan 2004). Nesting trends in green turtles of the Sarawak Turtle Islands over the last 30 years appear to be in equilibrium (Chan 2004).

Conservation of sea turtles in Malaysia over the last four decades has been conducted mainly by DOF Malaysia (via the Southeast Asian Fisheries Development Center [SEAFDEC] and the Turtle and Marine Ecosystem Centre [TUMEC]), Sabah Parks, Sarawak Forestry Department through the National Parks and Wildlife Office, Sarawak Museum, WWF-Malaysia and Universiti Pertanian Malaysia (its Terengganu branch is now independent and is known as KUSTEM). While there was some level of interaction between these bodies, coordination of efforts as a whole was not structured for effective collaboration. In Terengganu, the Terengganu Turtle Sanctuary Advisory Council was established by law in the late 1980s to protect and manage all turtle conservation projects in the state.

Past collective conservation efforts of the above bodies included:

- legal and institutional measures, such as the establishment of turtle sanctuaries and protected areas and the creation of federal and state legislation;
- management initiatives, such as hatchling production and monitoring via the establishment of hatcheries;
- research activities, such as tagging to obtain census data, migration, growth, mortality, internesting and turtle exploitation, understanding migration patterns, population monitoring, satellite telemetry and internesting areas;
- public awareness and education activities through school programs, brochures and setting up of various information centers (in Rantau Abang, Terengganu; Ma'Daerah, Terengganu; Cherating, Pahang; Pengkalan Balak, Malacca and Segari, Perak in Peninsular Malaysia); and
- regional/international cooperation with the creation of the ASEAN MOU, development of SEAFDEC and the creation of TIHPA, a transboundary turtle conservation program between Malaysia and Philippines.

Where did We Go Wrong? Threats to Sea Turtle Populations and Inappropriate Measures

Various threats have, over the years, collectively contributed to the drastic decline of sea turtle populations. While no single factor can be totally attributed to the declines, large quantities of eggs harvested and sold for human consumption have had an adverse effect in recruitment potential to turtle populations. In more recent years, experience and research have illuminated hatchery management practices that are inappropriate for the survival of hatchlings.

The threats to sea turtles over the years and some of the problems with conservation and management interventions in the past include:

- Fisheries impacts, such as destruction of turtle foraging habitat and use of destructive fishing gears/methods (e.g., bombing, *pukat pari*, trawling in sensitive areas that cause the incidental capture of turtles) – While a ban was instituted on *pukat pari* (gill nets with mesh size more than 10 in was banned in 1991), enforcement of the law is weak and banned nets continue to be used. Enforcement capacity is also not adequately funded.
- Capture of turtles by foreign vessels for their meat, shells and curio trade especially in the last five years – Malaysia has not been able to manage these illegal activities effectively and is also not able to make use of the Convention on Migratory Species to address this issue as it is not a party to this convention.
- Turtle harvest in neighboring countries (foraging grounds), e.g., leatherback harvest in Kai Islands, Indonesia (Suarez 2001) – This has gone undetected for many years and therefore proper actions could not have been taken.
- One hundred percent harvest of leatherback turtle eggs before hatchery operations started in 1961 – So much damage was already done to recruitment levels for decades. Even when in operation, the hatcheries only managed to procure 15% of all eggs laid for incubation and hatchling production; the rest were sold in the open markets.
- A ban on the harvest, consumption and sale of leatherback eggs in Terengganu was instituted in 1989 (Chan and Liew 1996) – In spite of this, leatherback nesting in the state continued to decline drastically because of insufficient number of eggs protected in past decades. The sale of leatherback eggs in other states was still possible as the ban was only in Terengganu. It took several years before its neighboring state, Pahang, instituted a similar ban. This inconsistency in the state legislation was not addressed early enough as federal laws allowed for state turtle management rules and regulations to vary.
- The various state governments have been rather slow to learn from the case of the declined leatherback population such that eggs of other species are still not banned, but only regulated via licensed egg collection. Most licensed egg collectors are required to sell eggs harvested back to state-run hatchery programs but enforcement of regulations has been very weak and a significant proportion of eggs collected yearly ends up in markets and shops in towns and villages.
- Various types of pollution, such as light pollution from coastal development, marine pollution from wastewater, industrial and agricultural discharge and beach pollution from domestic refuse and refuse from ships, have gone unmanaged.
- Turtle-related tourism, especially the experience from Rantau Abang, has shown that the promotion of rigorous tourism-related activities proved fatal for leatherback populations. There has been a lack of understanding on the nesting ecology of the turtles, and decisions on tourism were made with only tourism promotion, tourist pleasure and revenue in mind. This has been in spite of the fact that experience from Sabah has proven that controlled tourism resulted in a win-win situation with a stable and upward trend for green turtle populations with limited number of people going to islands and visitors only viewing turtles in a controlled manner.

As a conservation option, artificial incubation of hatchlings via beach hatcheries started in Peninsular Malaysia in Rantau Abang in 1961, Sarawak in 1951 and Sabah in 1966 (Ahmad et al. 2004). It has been used as a primary conservation tool in Malaysia to ensure an increase in hatchling production and recruitment. Three types of processes have been used for incubating eggs. These include beach hatcheries, styrofoam boxes and in-situ incubation. Hatcheries are cheap, use less human resource and solve the issue of poaching. However, it is also important to take into consideration the disadvantages of hatcheries as they undermine the efforts of conservation and in some cases amplify damage to sea turtle populations and, worse, still cause decline of populations.

Research has shown that certain inappropriate hatchery management procedures and techniques have had negative effects on incubation success and hatchling health. The following have been experienced in hatchery management techniques:

- low incubation success due to egg handling and transportation, sand temperature, shade and flooding due to high sea water;
- incorrect hatchling sex ratio which is brought about by inappropriate hatchery sand temperatures, i.e., most hatchery sands had high temperature and produced mainly female turtles;
- incorrectly imprinted hatchlings caused by their being released from boats instead of straight from the beach, use of metal-meshed cages versus plastic-meshed cages, and head-started release versus natural release;
- unhealthy hatchlings in relation to ex-situ nesting (such as reduced body size, abnormal hatchlings, poor vigor as shown in running performance and swimming performance experiments); and
- hatchling disorientation, i.e., lights in nearby hatchery areas disoriented hatchlings causing them to remain close to seashore or to not leave the beach.

Lessons Learned and Way Forward

The decline in sea turtle populations which were once thriving in Malaysia points to the need for drastic transformations in the way they are managed and conserved. Key lessons learned from 40 years of conservation show the following:

1. Strong political efforts to set aside protected areas in turtle nesting areas provide critical first steps for conservation opportunities. The important steps by state governments include legally according protection to turtles in Rantau Abang, Terengganu and Turtle Islands in Sabah and Sarawak. Remaining key turtle-nesting areas in the country need to be accorded protection immediately via gazettement of all major nesting beaches in the country, both on the mainland and on the islands.
2. Egg exploitation needs to stop immediately as it now continues, i.e., not all sea turtle egg species are banned. As it is difficult to enforce and ascertain eggs which are legally collected, the widespread sale of eggs continues. This continuously jeopardizes present conservation efforts and threatens future population numbers. The collection and sale of leatherback turtle eggs were banned in Terengganu in 1989 and after several years in Pahang. This did not curtail eggs to be sold in other

states. It created loopholes for leatherback eggs to be continually sold even up to the present. Strong measures by the Sabah government in banning all commercial egg collection and collecting all eggs to be incubated in hatcheries have shown positive impacts of increasing population numbers. Sustainably managed, these resources continue to provide opportunities for social and economic benefits in the state. Economic models to manage turtles and their eggs need to be made to demonstrate that nonconsumptive exploitation needs to happen soon to arrest this decline.

3. The experiences of various types of hatchling production in hatcheries have shown that in-situ method is the best approach. In-situ production involves hatchling of eggs in their natural condition. To avoid the fate of leatherback turtles in which hatchling rates have reached 0% in the last decade, it is critical that every step is taken to ensure that past mistakes in hatchery management are avoided. Conducting quality checks and implementing proper guidelines on hatchery management are crucial.
4. Research on temperature-dependent sex determination on leatherback and green turtles shows that incubation temperature affects the sex of turtles. Hatchery production could affect this ratio and produce more female hatchlings due to the location of nests and shading of incubating eggs. However, lessons show that in-situ incubation is more likely to produce a balanced male: female sex ratio for hatchlings produced.
5. Research on tagging and satellite telemetry shows that turtles are widely distributed. They travel across seas to reach their foraging habitats. This points to the need for regional cooperation to address the issue of population decline. The Malaysian government needs to immediately sign up to the Indian Ocean South-East Asian Marine Turtle Memorandum of Understanding (IOSEA-MOU) on sea turtle conservation and to the Convention on Migratory Species (CMS). It can then use these platforms to insist on greater collaboration in turtle conservation with its neighboring countries and in countries where Malaysia's nesting turtles go to feed.
6. Information and education centers in the country run on very limited technical capacity and resources. At most centers, resources are not sufficient and need more committed resources. Emerging trends of government-public-private (e.g., DOF-BP-WWF-Malaysia at Ma'Daerah, Terengganu) partnerships and the involvement of community groups increasingly provide an innovative approach for shared responsibility, creating real impacts for reaching out to the community in conservation measures.

The overall key messages for future management and way forward for sea turtles conservation are:

1. The need to look "beyond the beach" and focus on all stages in a turtle's life cycle. Studies on demographic models indicate that the most efficient way to reverse the decline of a turtle population is through reduction in mortality in the older life stages (Crouse et al. 1987; Crowder et al. 1994).

2. The need to ensure that halfway technology approaches are not repeated – Halfway technology is defined as "a management strategy which treats symptoms rather than causes of an environmental problem".
3. An integrated approach that combines the following elements would be the way forward to ensure the survival of sea turtle populations in Malaysia:
   a. integrated management measures based on sound science;
   b. funding commitment from federal and state governments;
   c. research and monitoring on all major turtle populations in the country;
   d. building capacity at all levels of government to better understand turtle conservation and management issues;
   e. regional/international cooperation is better used by the government via committing to international and regional biodiversity conventions;
   f. community participation in conservation; and
   g. public awareness, information and education in order to build public support.

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International Case Studies of Sea Turtle Population Restoration

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Conservation strategies for sea turtles worldwide have involved at least three different approaches: first, beach protection measures that stop harvest of eggs and enhance hatchling production; second, "head-starting", where hatchlings are reared and released after a few months or more in the hope of enhancing juvenile survival; and third, fisheries management has been used to reduce subadult and adult mortality as by-catch or directed take. There are several examples of long-term recovering trends for once-depleted sea turtle populations. These include the Kemp's ridley, *Lepidochelys kempii*, at Rancho Nuevo, Tamaulipas, Mexico (Marquez et al. 1999); Green turtles, *Chelonia mydas*, both in the Pacific at French Frigate Shoals in the Hawaiian Archipelago (Balazs and Chaloupka 2004), and in the Caribbean, at Tortuguero, Costa Rica (Troëng and Rankin 2004); Atlantic stocks of leatherbacks, *Dermochelys coriacea*, in the Caribbean (Boulon et al. 1996) and at Natal, South Africa (Hughes 1996); and olive ridleys, *Lepidochelys olivacea*, in the East Pacific at Escobilla, Mexico (Peñaflores et al. 2000). In this paper, three case studies are reviewed and the lessons learned from these are highlighted.

Leatherbacks on St. Croix: Population in Recovery

The leatherback population nesting on St. Croix, United States Virgin Islands in the Caribbean has been increasing rapidly at a rate of 13% annually (Dutton et al., in prep.). This recovery can be attributed to effective beach protection and egg relocation, which began over 20 years ago (Boulon et al. 1996; McDonald-Dutton et al. 2001). The study of this population also showed that there was high adult nester survivorship. The lesson learned is that beach protection and egg relocation can be effective management tools, as long as there is also high adult survivorship (Dutton et al., in prep.).

Kemp's ridley head-starting program at Padre Island, Texas

This program began in 1978, and involved collecting eggs from the only nesting beach for this species in Rancho Nuevo, Mexico, imprinting hatchlings on beaches at Padre Island in Texas in order to establish a second nesting beach there (Dutton et al. 2002). Hatchlings were also raised in tanks for one year, tagged and released in the Gulf of Mexico in the hope of enhancing juvenile survival. In 1996, the first head-started turtle was identified nesting at Padre Island, and the numbers of nests have increased slowly in recent years (Shaver and Caillouet 1998). Heppel et al. (1996) evaluated the results of this head-starting and concluded that efforts focused exclusively on improving survival in the first year of life are unlikely to be effective for long-lived species such as turtles. Recovery was accelerated only when fisheries-related mortality of subadults and adults was reduced by implementing turtle excluder devices (TEDs) in shrimp trawls (Dutton et al. 2002). One of the lessons learned was that limited resources are more wisely spent on reducing fisheries mortality (through TED development and enforcement in this case) than on head-starting.

Pacific olive ridleys in Oaxaca, Mexico

The elimination of the commercial harvest of adult and subadult olive ridleys was an effective management measure in restoring their population in Oaxaca, Mexico. The ban on harvest of turtles offshore in 1991 has led to their rapid recovery in the late 1990s through the present (Peñaflores et al. 2000). In this case, the lesson learned is that mortality at the subadult and adult stages can profoundly affect sea turtle populations, and elimination of mortality at this critical life stage can promote rapid population recovery.

Conclusion

These cases illustrate that it is possible for severely depleted stocks to be restored, provided appropriate conservation and management measures are adopted. In the Pacific, leatherback populations, including the Rantau Abang population in Terengganu, Malaysia (Chan and Liew 1996), have collapsed and continue to decline, despite conservation efforts on nesting beaches that have included hatcheries and ban on egg harvest. Mortality due to by-catch in coastal and high seas fisheries is most likely a significant factor preventing recovery. To address this current crisis in the Pacific, it is imperative that nesting beach protection is coupled with at-sea measures to reduce adult and subadult mortality before recovery can take place (Steering Committee, Bellagio Conference on Sea Turtles 2004). For the Terengganu leatherback population to be restored, and for beach protection measures to be effective, one critical element will be assessment and elimination of fisheries-related mortality in fisheries that impact females coming in nearshore during the nesting season.

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Sea Turtle Conservation in the Turtle Islands Park, Sabah, Malaysia

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The Turtle Islands Park (TIP) is composed of Pulau Selingaan, Pulau Bakkungaan Kechil and Pulau Gulisaan. The park, together with six Philippine islands and Berau Island of Indonesia, forms one of nine remaining major nesting habitats for the green turtles (*Chelonia mydas*) in the world. It also is the largest remaining hawksbill turtle (*Eretmochelys imbricata*) nesting habitat in Southeast Asia.

Turtle conservation efforts in Sabah began as early as 1928 and focused on regulating the harvest of turtles for trade. With the formulation of Fauna Conservation Ordinance of 1963, the issuance of license to kill turtles was banned and egg collection was regulated. Hatcheries were established at Pulau Selingaan in 1966 and at Pulau Gulisaan and Pulau Bakkungaan Kechil a couple of years later. Sabah Parks manages the hatcheries; initiates research on saturation tagging, monitoring of nestings, hatchery management; and monitors adult mortality. Research on population genetics, sex ratio of hatchlings, satellite telemetry on hawksbills and nearshore hatchling dispersal and predation has also been conducted in the parks.

The nesting populations of the green and hawksbill turtles have shown a remarkable recovery in the 1990s. The lessons learned from TIP showed that it was necessary for Selingaan, Bakkungaan Kechil and Gulisaan to be established as a protected area. The Sabah Government undertook bold conservation measures that included:

1. acquiring the islands from private ownership;
2. according the three major nesting islands as a Game and Bird Sanctuary in 1972 before being declared a national park in 1977;
3. banning commercial egg collection; and
4. collecting all eggs to be incubated in hatcheries.

Turtle tagging efforts led to the establishment of the Turtle Islands Heritage Protected Area (TIHPA) in 1996. The efforts provided the following learning experiences: (1) turtle populations at TIP are a shared resource and (2) a working cooperation with neighboring countries on conservation of turtles is required.

In conclusion, two key points summarize the experience from TIP. The success of nesting population recovery is attributed to the bold conservation measures taken by the Sabah Government since the 1970s while the outcome of research on turtle tagging contributed significantly to the development of a policy in establishing transboundary protected areas, resulting in the establishment of TIHPA in 1996.

Socioeconomic Linkages and Impacts of Fisheries on Sea Turtle Population

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Introduction

Malaysia is situated in the tropics within latitudes 1°- 8°N and longitudes 100°-119°E and consists of Peninsular Malaysia, and the states of Sabah and Sarawak. Peninsular Malaysia is surrounded by sea on both sides except in the north where it is joined to the Asia mainland via Thailand. Sabah and Sarawak are located on the northern part of Borneo Island. The two landmasses are about 1,200 km apart, separated by South China Sea. The East Coast of Peninsular Malaysia faces the South China Sea, and as does Sarawak and the western part of Sabah. The West Coast of Peninsular Malaysia, however, is bordered mainly by the Straits of Malacca.

The country has about 4,800 km of coastline covering several habitats including mangrove forests, rocky shores and sandy beaches. These coastal communities are home to a wide variety of plant and animal species, including many endangered and threatened species. Malaysia's national waters cover an area of approximately 550,000 km^2 under the exclusive economic zone (EEZ) and the country also has political jurisdiction from the mainland out to 200 nautical miles.

Within its waters, sea turtles and other large marine vertebrates occur. Sea turtles in particular have long fascinated people and have figured prominently in the mythology and folklore of many cultures. In the State of Terengganu, for example, the story of a kind "Turtle Princess – *Puteri Ulek Mayang"* still lingers. Unfortunately, the significance of sea turtles has not saved them from being exploited for both food and profit. The survival of sea turtles is being threatened by commercial exploitation, habitat destruction and alterations, fisheries interactions, marine debris and pollution. Subsequently, many populations that are once abundant worldwide have now become seriously depleted and the situation in Malaysia is no different. Nesting populations especially that of leatherback turtle have declined dramatically over the last few decades. This paper discusses briefly some of the main fishing impacts on turtle populations in Malaysia.

Sea Turtle Species in Malaysia

Four species of sea turtles, namely, leatherback turtle, green turtle, hawksbill turtle and olive ridley turtle, nest along the sand beaches of Peninsular Malaysia, Sabah and Sarawak. Siow and Moll (1982) provided an overview of the status of marine turtles after two decades of conservation efforts. The green turtle is the most extensively distributed species in Malaysia with about 10,000 nests recorded yearly in Sabah, 800 in Sarawak and 2,950 in Peninsular Malaysia (Liew 2002).

The highest concentration of green turtle in Peninsular Malaysia occurs on the islands of Pulau Redang and Pulau Perhentian Besar, off Terengganu. In Pahang, the green turtle rookeries are at Chendor, Cherating and Tioman Island. Pantai Segari of Perak is a major rookery for this species on the West Coast of Peninsular Malaysia. In addition, Green turtles are also found to nest on several beaches in Pulau Pinang, Kedah (Pulau Telur), Perlis and several islands off East Johor, namely, Pulau Mertang, Pulau Lima, Pulau Pemanggil and Pulau Simbang. However, the turtles' numbers of clutches are considered small (Mortimer 1990). There are few islands where turtle landings have been reported in Sabah, namely, Selingaan, Gulisaan, Bakkungaan Kechil, Tegapil, Lankayan, Billean, Koyan-koyan and Nunu Nunukan (Muhamad Saini 1996). The three main turtle nesting sites of Sarawak are located on the islands of Satang Besar, Talang-Talang Besar and Talang-Talang Kecil.

Hawksbill and olive ridley turtles do not nest in very large numbers in Malaysia. In Sabah Turtle Islands, there are approximately 500 nests laid per year. In Malacca, there are only about 250 nests reported per year with variations between years. Only a few nestings were recorded in other locations such as several islands in West Johor and Terengganu (Liew 2002).

The leatherback turtle is known to nest primarily on beaches of Terengganu. The major rookeries in Malaysia are found particularly at 1.5 km stretch of beach of Rantau Abang and Paka, in Terengganu and were recorded nesting at Chendor in Pahang and in Johor (Kamarruddin 1996; Mohd Najib and Hiew 1999). In the 1950s, about 2,000 nests were recorded but the number dropped drastically in the 1990s. Only 213 nests were recorded at Rantau Abang rookery in 1994. In 2003, only 14 nests were recorded in Terengganu. Leatherback turtles were also recorded to nest at Similajau National Park in 1998, Tanjung Lobang off Miri, and Bedaun and Siru off Semantan in Sarawak in 2000 (Oswald and Bali 2000).

Legislation and Regulation

Marine turtle legislation was reviewed (Gregory and Sharma 1996; Sharma and Gregory 1996) and several issues have been highlighted. Under the Federal Constitution, the rights to Malaysian laws are distributed to both federal and state governments, according to Federal, State or Concurrent Lists. Rules and regulations pertaining to turtles are within the purview of states; however, the Parliament is empowered to legislate on matters enumerated in the State List, for the purpose of promoting uniformity of law. In the case of Sabah and Sarawak, these states have special privileges under the Federation of Malaysia.

According to the Malaysian Constitution, turtles are the property of the 13 individual states. At federal level, the Fisheries Act of 1985 repealed the Fisheries Act of 1963 and the major contributions of the act are regarding the objectives of conservation, management and development of marine resources. It also provides a basic framework for subsidiary legislation to be enacted for the conservation and management of sea turtles, including the establishment of sanctuaries or other fishing prohibited areas. The legislation prohibits the capture, killing, injuring, procession or sale of turtles, collection of eggs and disturbing turtles during laying eggs. It also provides for the establishment of a turtle sanctuary. The import and export of turtle eggs are subjected to the restriction stated in the Customs (Prohibition of Imports) Order (1988) and Customs (Prohibition of Exports) Order (1988).

Recognizing the importance of protecting sea turtles, Terengganu amended the Turtle Enactment (1951) in 1987 and enacted both the Section 3A Notification under Turtle Enactment (1951) and the Turtle Enactment 1951 (Amendment) 1989. The first enactment set up the boundaries for the Rantau Abang Turtle Sanctuary, while the second focused on the breeding of leatherback turtle by prohibiting the possession or sale of eggs for consumption.

Currently, Malaysia is a party to the Ramsar Convention, Convention on International Trade in Endangered Speices of Wild Fauna and Flora (CITES), Bonn Convention and Convention on Biological Diversity. Malaysia became a party to CITES effective 18 January 1978. It is a responsibility of member parties to implement the resolution adopted by CITES in the protection of wildlife in Peninsular Malaysia and the States of Sarawak and Sabah.

International conservation ratings and resolutions serve to monitor critical issues and garner worldwide expertise to recommend appropriate action plans. The International Union for the Conservation of Nature and Natural Resources – World Conservation Union (IUCN) Red

Data Book represents the most comprehensive guide in evaluating the conservation status of selected species, supported by scientific research. All sea turtles in Malaysia have been categorized as either “critically endangered” or “endangered’.

The ASEAN Marine Turtle Conservation Program was approved by the ASEAN Working Group for Nature Conservation. The program held its first symposium in 1993. A joint project between Sabah and Philippines, namely, the Turtle Islands Heritage Protected Area (TIHPA), was established in 1996 to conserve and manage important foraging and nesting grounds of sea turtles.

Fishing Activities

The fisheries sector still plays an important role in providing fish as source of food and protein. In 2002, it contributed about 1.5% to gross domestic product (GDP) and provided direct employment to 82,000 fishers (Anon. 2004). From this figure, 38,628 fishers worked in trawlers and purse seiners and 44,002 used traditional fishing vessels. The West Coast of Peninsular Malaysia had 32,463 (39.3%) fishers; the East Coast had 19,309 (23.4%); while East Malaysia had 30,858 (37.3%) fishers. Over the years, the industry has succeeded in achieving a steady production from its marine inshore fisheries amounting of 1.08 million t of marine sourced protein.

The number of licensed fishing vessels in Malaysia stood at 30,751 units in 2002. The majority of the fishing vessels operate in coastal areas, which have been exploited at an optimum level. Normally each fishing vessel is licensed to operate one fishing gear.

Socioeconomic Linkages and Impact of Fisheries

A comprehensive review of the impacts of coastal, offshore and riverine development on marine turtles and terrapins in Malaysia (Sharma et al. 1996) revealed that numerous anthropogenic activities encroach and impact turtles and their habitats.

Incidental Capture and Mortalities

The incidence of mortality of sea turtles as a result of incidental capture in a certain type of fishing gear has been partially documented (Chan et al. 1985). There is a small number of turtles found ashore each year, believed to be bludgeoned to death and cut loose from fishing nets or boat propellers. The Fisheries Regulations (Prohibition of Method of Fishing Amendment 1990) attempts to reduce turtle deaths by prohibiting any net with a mesh size of more than 10 inch (25.4 cm).

As an additional measure to prevent accidental deaths, the Fisheries (Prohibition Areas) (Rantau Abang) Regulation 1991, restricts fishing within the protected area around the Rantau Abang Sanctuary, except for certain equipment designed to capture anchovies and squid.

Specific feeding grounds associated with adult sea turtles in the waters of Peninsular Malaysia are previously unknown. However, recent reports documented by the Marine Fisheries Resources Development and Management Department provided some indication of the potential location of these feeding grounds. The first report relating to this matter actually came from some fishers of Segari in October 1992. These fishers, while operating on fishing traps and hand lines, reported to have frequently observed some juvenile and adult turtles, most probably green turtles feeding on the marine mosses and plants in the vicinity of Pulau Perak, an island located around 35 nautical miles west of Tanjung Dawai, Kedah (Kamarruddin et al. 1996).

Illegal Fishing in Marine Protected Areas

Federal and state governments have gazetted several islands as marine protected island to protect marine resources including sea turtles. However, illegal fishing activities have been reported occurring in these protected areas, for example, in Pulau Tioman, Pahang and Pulau Tinggi in Johor. A number of illegal fishing gear including stingray drift nets (mesh size >24.5 cm) have been confiscated by the Marine Park Authority.

Illegal Fishing by Foreign Fishers

International trade in products, such as tortoise shell from hawksbill, green turtle calipee and leather from olive ridley, has exacerbated the direct taking of sea turtles. Over the past decades, Japan has emerged as the principal country buying shell from various exporting countries to produce costly crafts. In order to meet the demand, illegal fishing by foreign fishers in some countries has been reported. For example, early this year Malaysian authorities had confiscated 230 stuffed turtles from three illegal foreign fishing vessels. These illegally hunted turtles were believed to be exported to East Asian countries.

Illumination of Fishing Vessels

Lighted fishing vessels (purse seiners and squid jiggers) at sea may have negative impacts on nesting female turtles heading for a nesting beach. These vessels operate comparatively near to major nesting beaches. An approaching female turtle will see these lights which are often aligned in a long stretch, and may turn away, back to open waters. Hatchlings attracted to these lights may congregate around the fishing vessel especially purse seiners and be subjected to predation by fish.

Illegal and Unlicensed Harvest of Eggs

While egg harvesting is regulated in Malaysia, including buy-back programs for hatchling production, the pressure of licensed egg harvest placed on the survival of sea turtle population is through unlicensed egg collection. Even in states where egg collection requires a license and is well regulated, unlicensed collection still occurs, especially on the isolated islands and minor rookeries. Most of the eggs collected are consumed locally or sold in the local market. Even though the selling of turtle eggs is banned in Sabah, it is still possible to buy turtle eggs in the wet markets.

Land-based Pollution

Pollution can have serious impacts on both sea turtles and the food they eat. Marine turtles can mistake floating plastic materials for jellyfish and choke to death when trying to ingest these materials. Trash, particularly plastic bags thrown overboard from fishing vessels or tourist boats, or dumped from beaches swept out to sea can become a deadly meal for turtles. Discarded fishing gears are known to entangle marine turtles and can result in their drowning.

Pollution can have serious impacts on both sea turtles and the food they eat. Research in the last few years suggests that a disease (fibropapilloma) now killing many sea turtles may be linked to pollution in the oceans and nearshore waters. When pollution kills aquatic plant and animal life, it also likely takes away the food sea turtles eat.

Coastal Armoring

Coastal armoring includes seawalls, rock and concrete revetment, sandbags and other artificial structures that are installed in an attempt to protect beachfront property from erosion. Unfortunately, seawalls provide only temporary relief from the natural process of erosion and often increase its rate on adjacent section of beach. These structures often prevent female turtles from reaching suitable nesting habitats. Armoring is especially problematic along the coasts of Terengganu, Kuantan, Melaka and Pulau Tioman, where beach development is occurring in the very places where sea turtles come to nest.

Reclamation of Land and Sea

Reclamation works of land and sea can potentially destroy sea turtles' nesting beaches and feeding ground. The extensive reclamations on the west and east coasts especially in Melaka and Kuantan and also on the southern part of Johor, may have adverse impacts on turtle nesting and feeding sites. By filling up sandy beaches with rocks and laterite earth and building retaining walls along the waterfront, turtles are prevented from using these areas for nesting. In addition, sedimentation occurs during coastal construction and sediment will flow unabated to seagrass beds and fringing reefs causing smothering. This has a direct impact on turtle feeding habitats presumably but has largely gone unstudied and undocumented.

Coastal Tourism

Coastal tourism is an important industry in Malaysia, especially in areas where sandy beaches and coral reefs occur. This industry requires infrastructure, and in the planning of such, these are usually situated very close to the sea front. The obvious direct impact is the displacement of nesting beaches. This may result in turtle seeking new nesting sites that are not as suitable for egg survival and hatching success. The intensity of tourist facilities developed at several rookeries of Terengganu has had impact turtle nesting grounds, and examples are the leatherback turtle rookery at Rantau Abang and the hawksbill turtle rookery along Melaka coastline, especially at Padang Kemunting. Coastal tourism also contributes to light pollution (illumination of nesting site beaches from the tourist facilities, motorized vehicles and campfires for example), noise pollution and increased recreational activities along the beach especially at night.

Chan and Liew (1989) suggested that the thousands of tourists to Rantau Abang in the 1970s and 1980s were contributory to the decline of the leatherback turtle population.

Conclusion

The conservation of marine turtles presents some daunting challenges to conservationists due to the multiple threats that prevail and conflicting landuse interests. As a result, a wide range of conservation and management actions are required to reverse the decline in marine turtles. The fishing impacts on turtles should be documented appropriately, and the remedial actions to reduce mortality should be implemented across the country. A national policy must be formulated to address marine turtle conservation issues and to ensure implementation through new laws that are more conservation-oriented

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What can be Done to Restore Pacific Turtle Populations? The Bellagio Blueprint for Action on Pacific Sea Turtles

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The Bellagio Blueprint for Action on Pacific Sea Turtles is an outcome of the Conference on the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean held on 17–22 November 2003 in Bellagio, Italy. The conference was attended by a unique group of 25 experts from multidisciplinary backgrounds composed of economists; marine life policy experts; fishing industry and fisheries professionals; conservation, sea turtle and natural resource management specialists; and development assistance researchers from government, nongovernment and private institutions.

The workshop was organized based on the rationale that sea turtles (especially Pacific leatherbacks) are among the most threatened and endangered species. The catastrophic population decline in the last decades has been attributed to the escalating nature of human threats to turtles. This formed the need for new models of transnational and community partnerships, and a multisectoral approach to restore and manage the sea turtle populations.

The conference objectives were to:

1. provide a forum for neutral, independent and scholarly exploration;
2. provide the scientific and policy basis for a possible pan-Pacific model framework treaty or other international regime;
3. explore a set of pan-Pacific comprehensive and multidisciplinary policy options and instruments; and
4. develop a multidisciplinary and multilateral research agenda for the future.

The specialists at the conference concluded with four action points that formed the basis for the Bellagio Blueprint for Action (see Steering Committee, Bellagio Conference on Sea Turtles 2004). The four action points include:

1. Protect all nesting beaches, starting with those of the Pacific leatherbacks.
2. Reduce turtle take in at-sea and coastal fisheries.
3. Establish pan-Pacific policy actions.
4. Encourage sustainability in traditional use.

Following the conference, the Bellagio Sea Turtles Conference network of specialists and relevant parties have been disseminating the Bellagio Blueprint for Action at conferences and meetings, and through press releases, websites and various forms of communication avenues to continue to promote the multidisciplinary and multilateral research agenda. Also, a book is being finalized that includes a collation of multidisciplinary papers produced and presented at the conference.

Annex 3. Presentation materials

Charting Multidisciplinary Research and Action Priorities Towards the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean: A Focus on Malaysia

Overview of Workshop

16 - 17 August 2004

Nizam Basiron
Head, Centre of Coastal Development and Marine Environment
Maritime Institute of Malaysia

Background

1. Follow-up action of the Bellagio Conference on Sea Turtles and National Roundtable Discussion on Sea Turtles in Malaysia
2. Organized by the Department of Fisheries, WorldFish Center, NOD, MIMA, SEATRU of KUSTEM and World Wide Fund for Nature-Malaysia
3. Hosted by UPEN Terengganu

Workshop Objectives

1. Consolidate existing work and identify multidisciplinary research priorities for the conservation and management of sea turtles in Malaysia (i.e., explore feasibility of restoring declining sea turtles populations and identify knowledge gaps);
2. Review and examine national and regional policy instruments for effective conservation and management of sea turtles and;
3. Develop a cross-sectoral action plan and strategy for implementation by key agencies and stakeholders.

Workshop Outputs

1. A framework for future research and strategy to increase the relevance and impacts of research;
2. Recommendations for reconciling policy objectives and future steps at the state, national, regional and international levels; and
3. A National Action Plan for the Way Forward in sea turtles conservation and management.

Workshop Program

Monday, 16 August - Opening Session

Session 1. Background Presentations

9.50 **Introduction and Overview of Workshop** *Mr. Mohd Nizam Basiron, MIMA*

10.00 **Aspects in the Biology of Sea Turtles** *Assoc. Prof. Liew Hock Chark, KUSTEM*

10.25 **40 Years of Sea Turtle Conservation Efforts: Where Did We Go Wrong? Lessons Learnt for the Way Forward** *En. Kamaruddin Ibrahim, TUMEC, DOF*

10.50 **Impacts of Research in Policy Development and Actions**
- International Case Studies of Sea Turtle Population Restoration *Dr. Peter Dutton, NMFS, NOAA*
- Sea Turtle Conservation in the Turtle Island Park, Sabah *Mr. Paul Basintal, Sabah Parks*

11.30 **Socioeconomic Linkages and Impacts of Fisheries on Sea Turtle Populations** *Tn. Hj. Sukarno Wagiman, DOF*

11.55 **Bellagio Blueprint for Action for the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean** *Dr. Mahfuzuddin Ahmed, WorldFish Center*

12.15 **Discussion of Workshop Outputs and Working Groups** *Prof. Dr. Ho Sinn Chye, NOD*

Workshop Program

Session 2. Workgroup Discussion

1.30 **Working Group Session** *Group Facilitators*

4.45 **Summary of Day 1- Discussion and Wrap Up** *Group Facilitators*

Dinner hosted by the State Economic Planning of Terengganu at Awana Kijal at Banana Plantation

Tuesday, 17 August

Session 3. Workgroup discussion

9.00 **Workgroup Discussions** *Group Facilitators*

10.50 **Presentation of Working Group Findings** *Dr. Mahfuzuddin Ahmed*

12.20 **Working Group Discussion Wrap Up and Summary** *Dr. Mahfuzuddin Ahmed*

Session 4. Plenary

1.30 **Integration and Synthesis – Review Workshop Outputs** *Dr. Mahfuzuddin Ahmed*

1.45 **Action Plan Priorities and Implementation Strategy** *Dr. Mohd Taupek Mohd Nasir*

3.20 **Action Plan and Implementation Strategy** *Dr. Mohd Taupek Mohd Nasir*

4.30 **Final Discussions, Timelines and Wrap Up** *Group Facilitators and Chairs*

5.00 **End of Workshop and Word of Thanks** *Dr. Mahfuzuddin Ahmed*

6.00 **Dinner at Kampung Restaurant, Awana Kijal**

8.00 **Field Visit – Ma' Daerah Turtle Sanctuary**

Charting Multidisciplinary Research and Action Priorities towards the Conservation and Sustainable Management of Sea Turtles in the Pacific Ocean: A Focus on Malaysia

Aspects in the Biology of Sea Turtles

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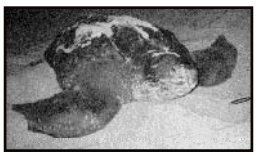
Malaysia's Natural Heritage



Leatherback turtle
Dermochelys coriacea

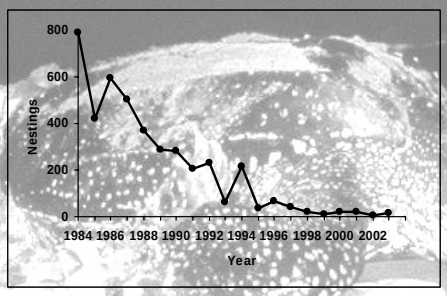
Green turtle
Chelonia mydas

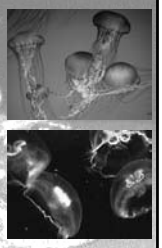
Hawksbill turtle
Eretmochelys imbricata

Olive-ridley turtle
Lepidochelys olivacea

Leatherback turtle

- Largest of the sea turtles, adults weigh 300 – 600 kg
- Feeds largely on jellyfish and other gelatinous invertebrates

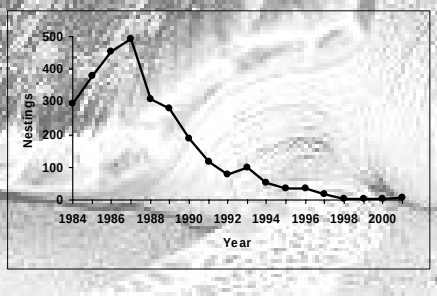




The once renowned population in Rantau Abang, Terengganu, dropped from 10,000 nests/year in the 1950s to less than 10 in recent years.

Olive-ridley turtle

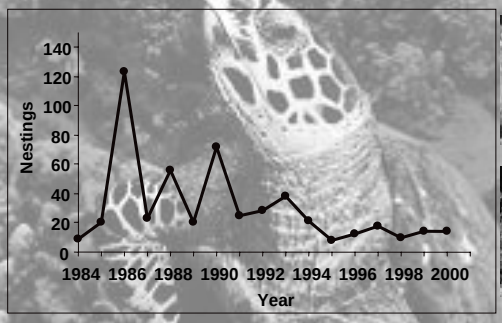
- Smallest of the sea turtles nesting in Malaysia (30 – 60 kg)
- Feeds largely on shellfish, crustaceans, and other invertebrates



Loss is as tragic as that of the leatherback turtle. Nestings along the mainland coast of Terengganu are virtually gone.

Hawksbill turtle

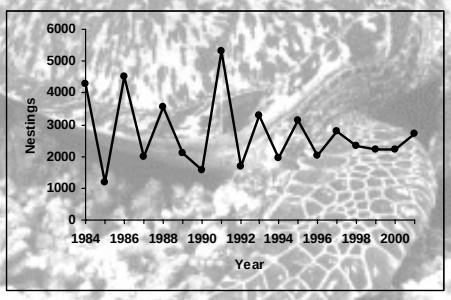
- Commonly seen in coral reef areas, feed largely on sponges
- Shell exploited for the Beko trade, adults weigh 40 – 90 kg



Largely decimated to only a few individual nesters per year

Green turtle

- Largest Malaysian hard shelled turtles, adults weigh 100 – 180 kg
- Adults feed largely on seagrass, algae, seaweed



Populations have also declined significantly though rate of decline has not reached a critical state.

Management Practices and Policies

Terengganu has a long history of sea turtle conservation management programs, dating back to the 1950's for the leatherbacks

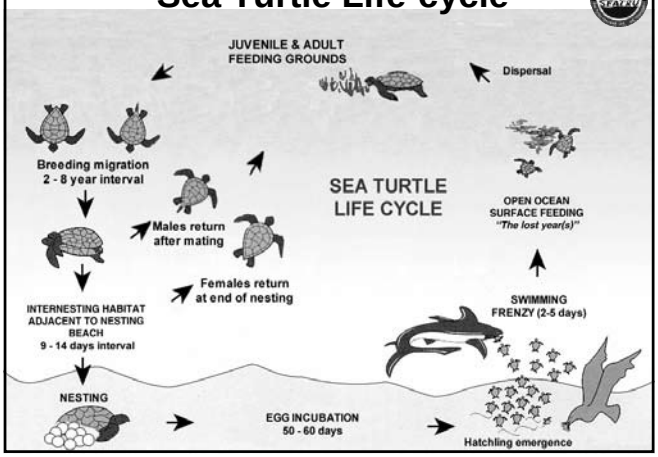
WHAT WENT WRONG?

What do we know about our turtles?
Where have all our turtles gone?

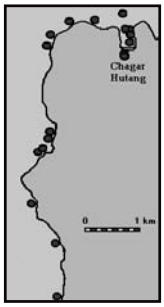
- Have they gone somewhere else to nest?
- Were they all killed by fishing nets?
- Did we take too many eggs?
- What happened to all the millions of hatchlings turtles do we have?
- How many turtles do we have?
- How often do they reproduce?
- How fast do they grow?
- .....

Have we managed our turtles based on good science or politics?

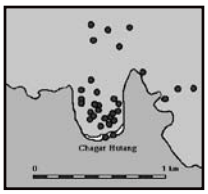
Sea Turtle Life-cycle



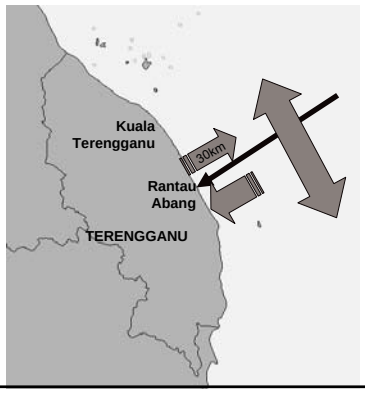
Where do our turtles go after nesting? Can we prevent them from being killed accidentally in fishing nets?



Internesting movements of green turtles determined using radio and ultrasonic telemetry



Internesting habitat of Terengganu leatherbacks

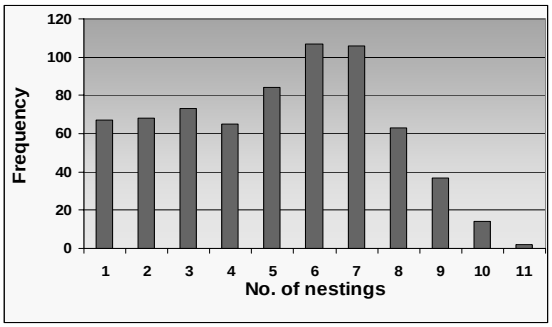


Radio-tracking the movements of leatherbacks after nesting

Tagging Studies

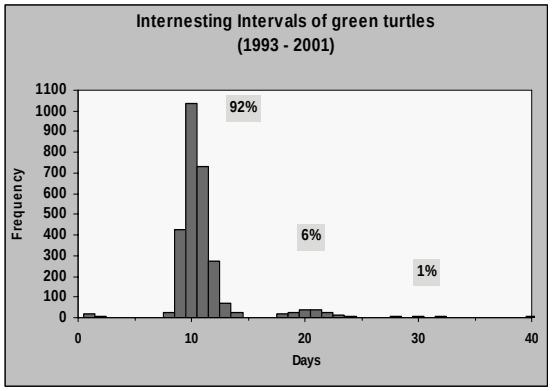
To tag and monitor every nesting turtle

Nesting frequency distribution of green turtles in Redang (1993 to 2001)

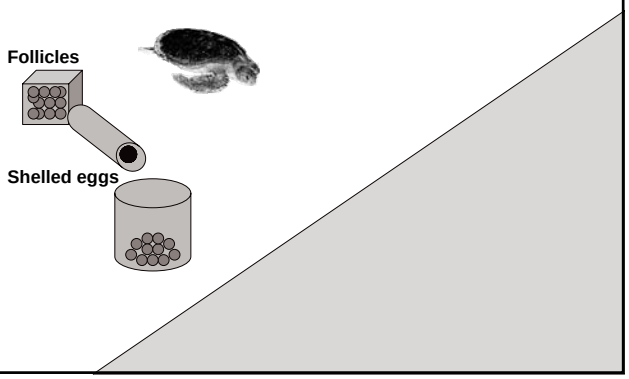


Female turtles next several times during her reproductive season

Internesting Intervals of green turtles (1993 - 2001)



Why nest so many times and at intervals of about 10 days?

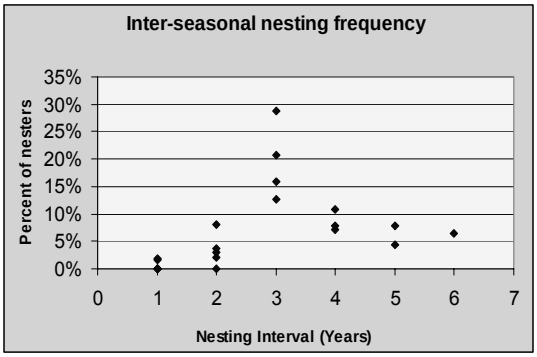


Tag recovery data of green turtles at Chagar Hutang, Redang (1993 - 2001)

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
1993	140	0	3	29	12	9	24	3	8	
1994		63	0	0	10	6	6	4	0	
1995			110	0	2	13	12	9	9	
1996				60	0	3	8	1	7	
1997					64	0	0	5	5	
1998						55	0	1	5	
1999							68	0	0	
2000								27	0	
2001									46	
Total	140	63	113	89	88	86	118	50	80	633

Turtles cannot afford to nest every year.

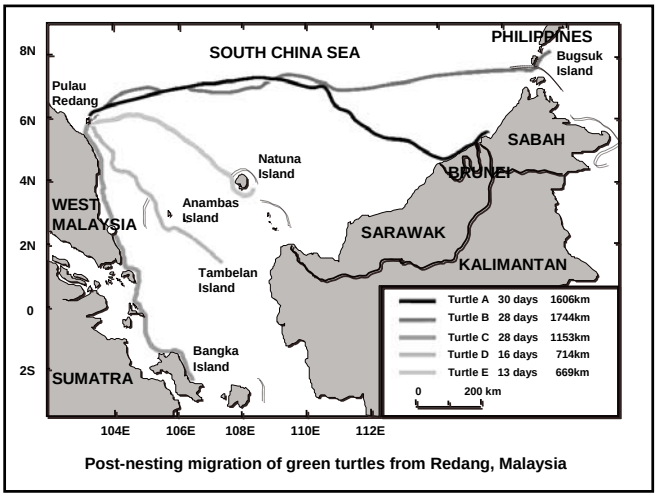
Inter-seasonal nesting frequency



Turtles have to be healthy and must have built up enough fat reserves to reproduce. This takes a few years.

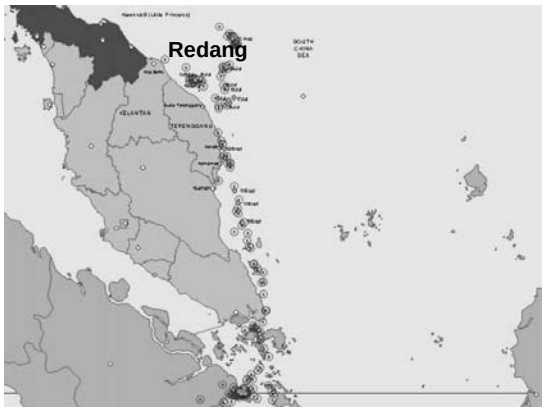
Where do our turtles go after they have finished nesting?

A turtle carrying a satellite transmitter released from its nesting beach at Chagar Hutang, Redang.

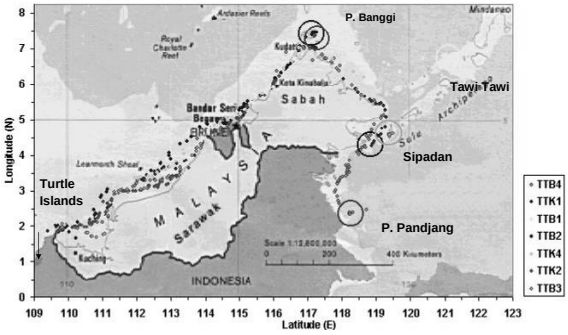


Post-nesting migration of green turtles from Redang, Malaysia

Migratory pathway and feeding grounds of a hawksbill turtle nesting at Redang, Terengganu



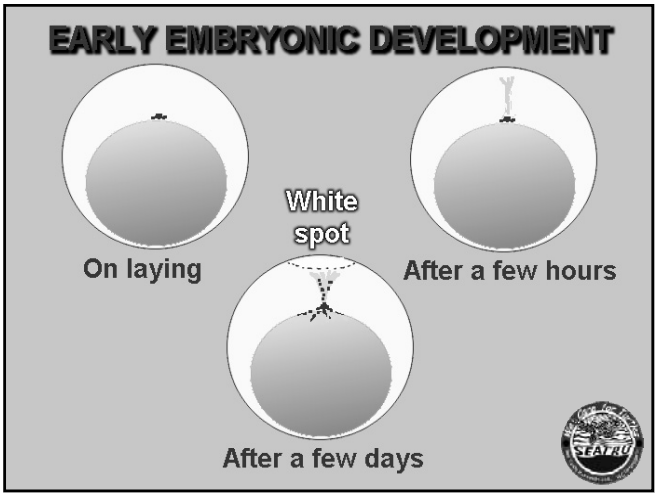
Migratory pathways and feeding grounds of green turtles nesting at Sarawak Turtle Islands

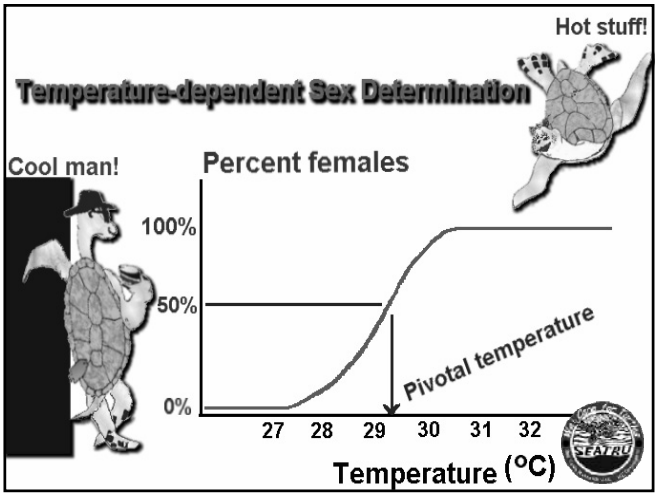


Hatchery management practices

In-situ hatchery

Relocated fenced hatchery





Hatchlings race to the sea

Disorientation with light

Swimming frenzy

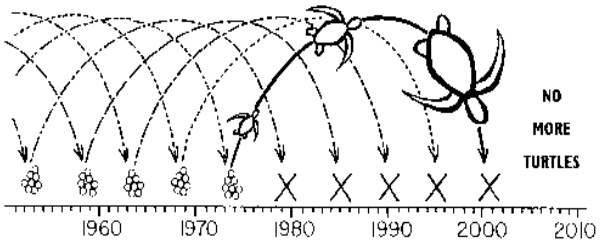
Tracking turtle hatchlings

1st hatchling tracked: covered distance of 39 km in 34 hours.

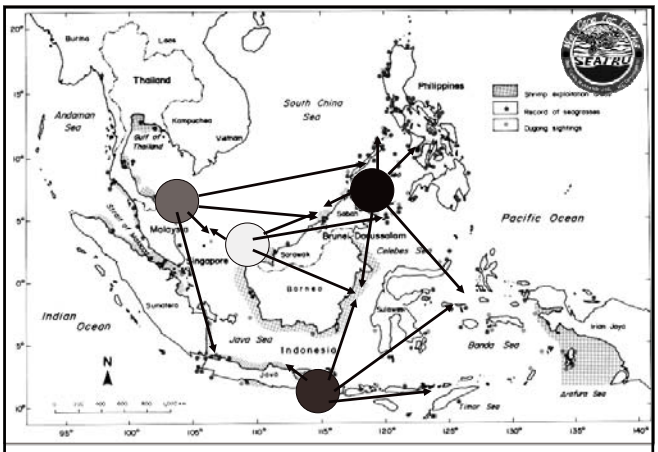
2nd hatchling: covered distance of 82 km in 39 hours.

Hatchlings do not remain in coastal waters but head straight into the open sea away from coastal predators

Long maturation periods



The impact of overharvesting eggs cannot be seen until it is too late!



Different breeding units sharing regional food resources

40 YEARS OF SEA TURTLE CONSERVATION EFFORTS: WHERE DID WE GO WRONG?

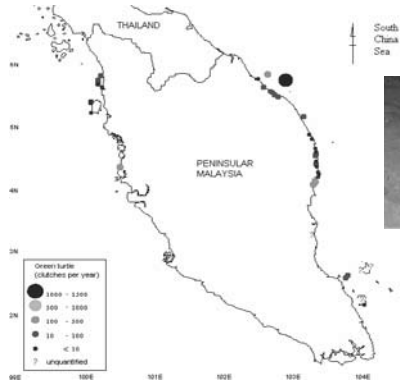
(Did we go wrong?)

Lessons learnt and the way forward

Kamaruddin Ibrahim (TUMEC, DoFM)

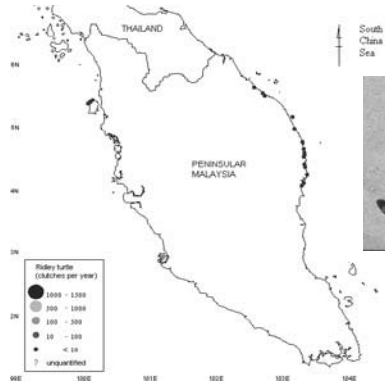
Dionysius S.K. Sharma (WWF-Malaysia)

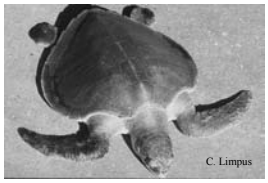
Green turtles in Peninsular Malaysia



KBI01

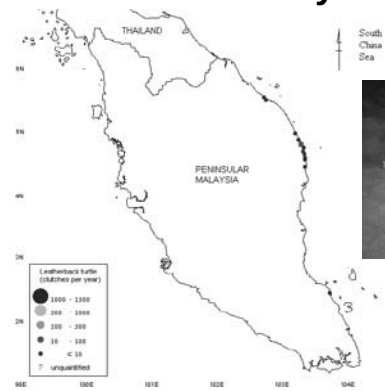
Olive ridley turtles in Peninsular Malaysia





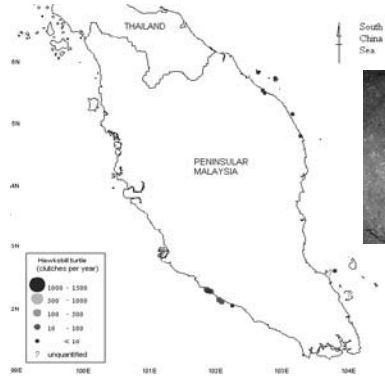
KBI01

Leatherback turtles in Peninsular Malaysia



KBI01

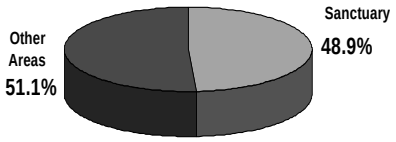
Hawksbill turtles in Peninsular Malaysia



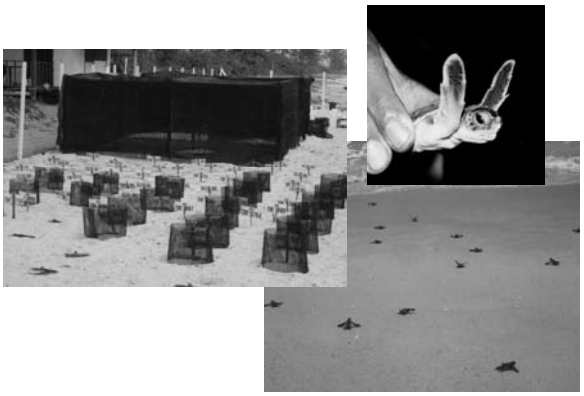
KBI01

Turtle sanctuaries and protected areas

Nesting numbers of leatherback turtles in Terengganu sanctuary vs. other areas: 1991-2002

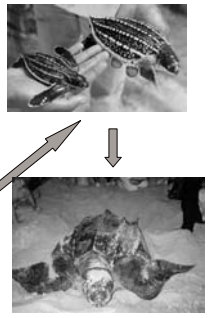


Hatchling production

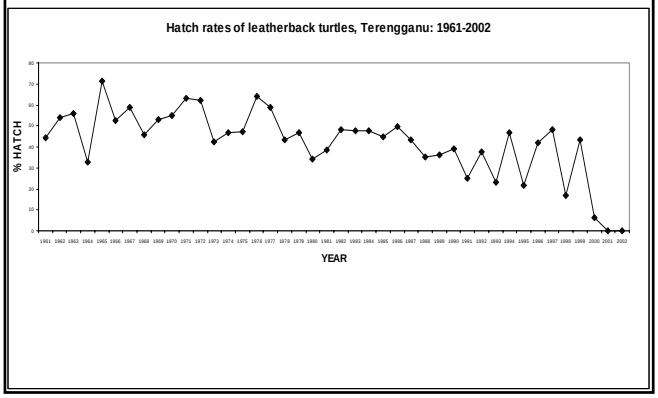


Leatherback hatchling production program

Year	Eggs incubated	Hatchlings released
1961 - 1970	177,090	86,534
1971 - 1980	524,183	273,867
1981 - 1990	248,354	105,358
1991 - 2000	92,469	33,691
2001 - 2002	3,395	115
Total	**1,045,491**	**495,565**



Hatchery monitoring



Research

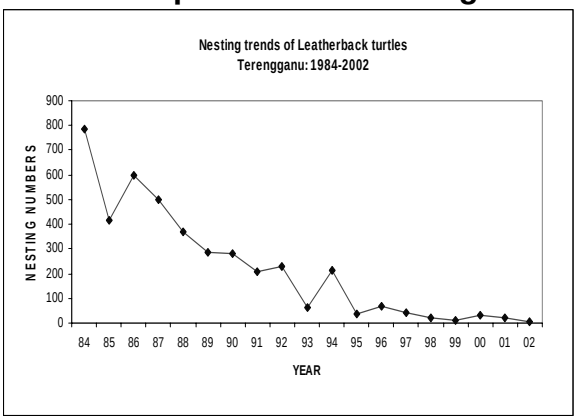
Leatherback tagging

Objectives:

- individual census data
- migration
- growth
- mortality
- internesting
- turtle exploitation

Leatherback migration

Population monitoring

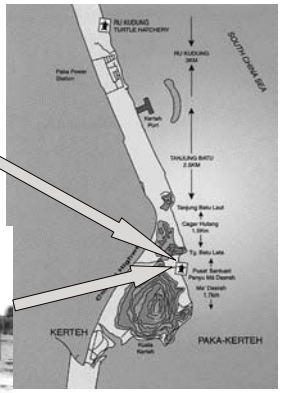


Satellite telemetry

Internesting Migration of green turtles at Ma' Daerah Sanctuary, Malaysia.

(Ibrahim et al. 2001)

Ma' Daerah Turtle Sanctuary

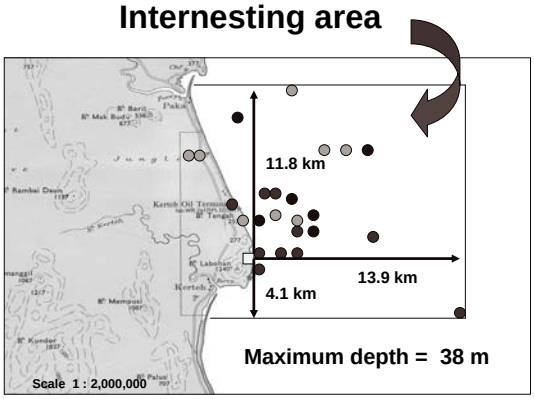


Nesting female

- **MELUR**
- **IF 2728 / IF 2729**
- **CCL = 104.2 cm**
- **CCW = 92.7 cm**
- **Total = 648 eggs (2001)**

Year	Date laid	Locality	Clutch size
1998	24 Aug 98	Ma' Daerah	100
2001	1 Jun 01	Ma' Daerah	96
2001	12 Jun 01	Ma' Daerah	95
2001	24 Jun 01	Ma' Daerah	67
2001	7 Jul 01	Ma' Daerah	93
2001	19 Jul 01	Ma' Daerah	112
2001	31 Jul 01	Ma' Daerah	88
2001	10 Aug 01	Cakar Hutan	97

Internesting area



Legislation and enforcement

Legislation

Federal:

- Fisheries Act 1985
- Customs (Prohibition of Export/Import) Order 1988
- Ban on *Pukat Pari* 1990
- Gazetment of Marine Parks 1988
- Trawl-free zone (5 nm)

Legislation

State:

- Turtle Sanctuary (Rantau Abang) 1988
- Ban on Consumption of Leatherback Eggs 1989 (in Terengganu)
- Fisheries Regulations (Prohibited Area) (Rantau Abang) 1991
- Turtle Enactment 1951 (Amendment) 1987

Public awareness, education and information

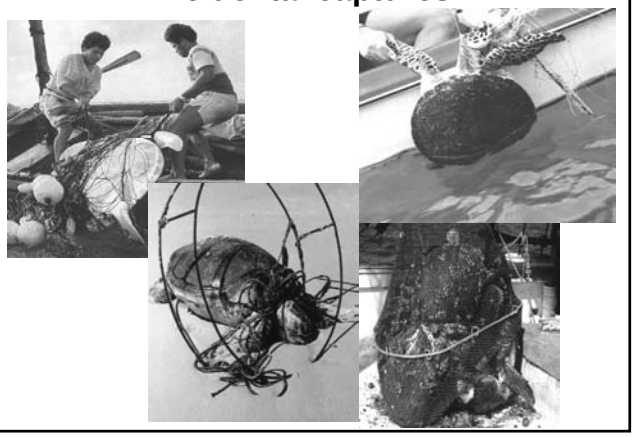
Regional/international cooperation

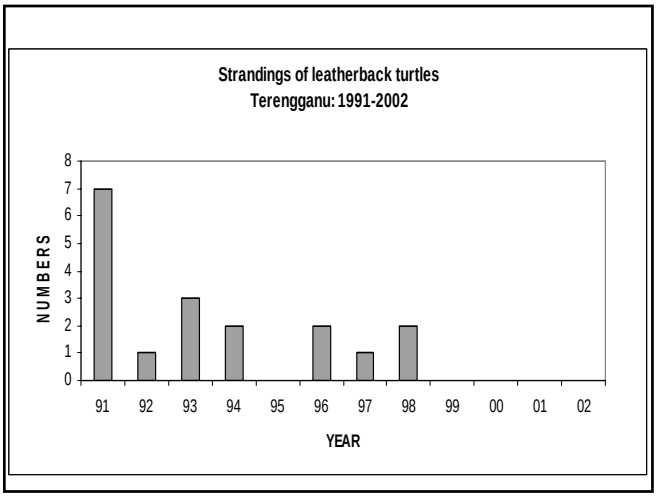
SEAFDEC

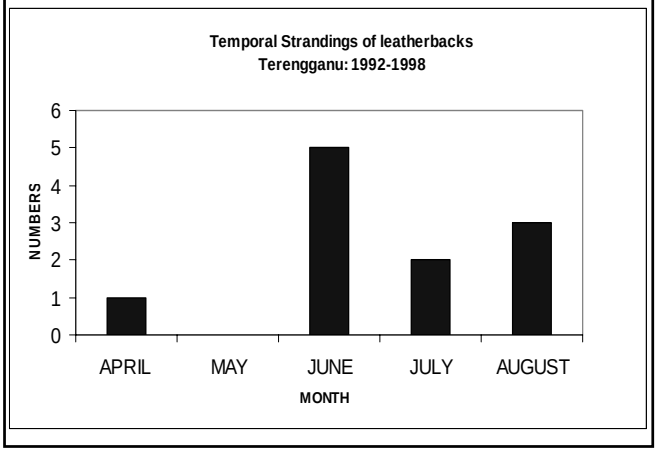
TUMEC

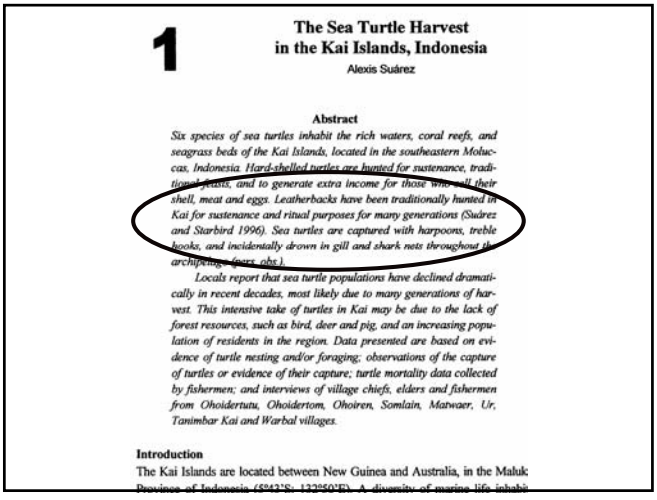
Irresponsible fishing

Incidental captures









1

The Sea Turtle Harvest in the Kai Islands, Indonesia

Alexis Suárez

Abstract

Six species of sea turtles inhabit the rich waters, coral reefs, and seagrass beds of the Kai Islands, located in the southeastern Moluccas, Indonesia. Hard-shelled turtles are hunted for sustenance, traditional feasts, and to generate extra income for those who sell their shell, meat and eggs. Leatherbacks have been traditionally hunted in Kai for sustenance and ritual purposes for many generations (Suárez and Starbird 1996). Sea turtles are captured with harpoons, treble hooks, and incidentally drown in gill and shark nets throughout the archipelago (pers. obs.).

Locals report that sea turtle populations have declined dramatically in recent decades, most likely due to many generations of harvest. This intensive take of turtles in Kai may be due to the lack of forest resources, such as bird, deer and pig, and an increasing population of residents in the region. Data presented are based on evidence of turtle nesting and/or foraging; observations of the capture of turtles or evidence of their capture; turtle mortality data collected by fishermen; and interviews of village chiefs, elders and fishermen from Ohoidertutu, Ohoidertom, Ohoiren, Somlain, Matwaer, Ur, Tanimbar Kai and Warbal villages.

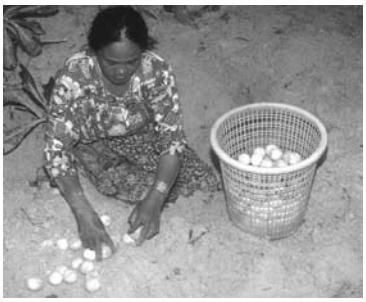
Introduction

The Kai Islands are located between New Guinea and Australia, in the Maluk Province of Indonesia (5°42'S; 132°50'E). A diversity of marine life inhabit

Turtle harvest

Where	Magnitude	Reference
Australasian	100,000 turtles/year (Greens)	Limpus (1955)
Kai Island, Indonesia	100 turtles/year (Leatherbacks)	Suarex (2000)
Bali, Indonesia	19,000 turtles/year (Greens)	Green Peace (1999)

Egg exploitation



Leatherback eggs conserved vs. exploited

Year	Egg production	Eggs conserved	% eggs conserved	Eggs exploited	% eggs exploited
1984	59,923	14,563	24	45,360	76
1985	36,022	16,100	45	19,922	55
1986	48,210	25,794	54	22,416	46
1987	41,976	30,211	72	11,765	28
1988	30,795	26,254	85	4,541	15
1989	25,592	25,089	98	503	2
1990	23,796	20,529	86	3,267	14
1991	17,483	17,210	98	273	2
1992	19,904	18,149	91	1,755	9
1993	5,315	1,886	35	3,429	65
1994	18,177	18,177	100	0	0
1995	2,928	2,928	100	0	0
1996	5,411	5,411	100	0	0
1997	3,177	3,177	100	0	0
1998	1,385	1,385	100	0	0
1999	586	586	100	0	0
2000	1,914	1,914	100	0	0
2001	1,586	1,586	100	0	0
2002	240	240	100	0	0

Habitat loss & degradation

Light pollution

Marine pollution

Beach pollution

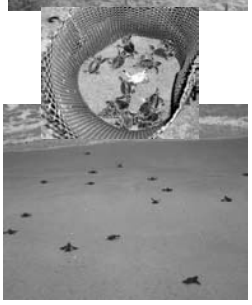
Tourism?

Inappropriate hatchery management?

- Artificial incubation
- 1961 - started in Peninsular Malaysia for leatherback turtles
- 1970s - other turtles

Hatchery …..

- A method in producing hatchlings
- A conservation tool in Malaysia
- 1961 - Peninsular Malaysia
- 1966 - Sabah
- 1950 - Sarawak



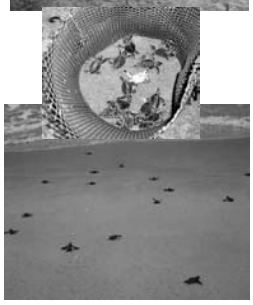
Hatchery …..

Advantages:

- cheaper, less manpower, solves poaching issue

Disadvantages:

- ISSUES …..



Issue # 1 …..

Low incubation success

Nest examination ...

to quantify incubation success

Hatchery incubation

• Before

• After (since 1997)

Issue # 3 …..

Incorrectly imprinted hatchlings

Issue # 3 …..

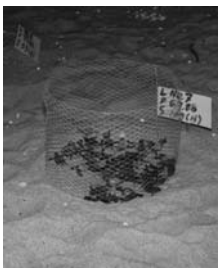
Incorrectly imprinted hatchlings

• Release from the boat Harrisson, T. 1962. *Sarawak* Mus. J. 10(19-20): 611

• Release straight from the beach

Issue # 3 …..

Incorrectly imprinted hatchlings



• Metal-meshed cages

• Plastic-meshed cages

Issue # 3 …..

Incorrectly imprinted hatchlings

•'Head-started' Release

• Natural Release/*in situ*

In Situ incubation

- Undisturbed nests
- 1992: 1st *in situ* in P. Redang, Terengganu
- 1993: 2 turtle beaches (MK + CH, P. Redang)
- 2002: 3 turtle beaches (2 P. Redang + 1 P. Perhentian)
- 2003 : 4 in situ beaches

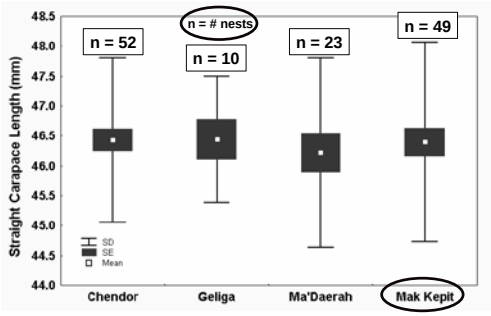
Issue # 4 …..

Unhealthy hatchlings

Measuring hatchling quality:

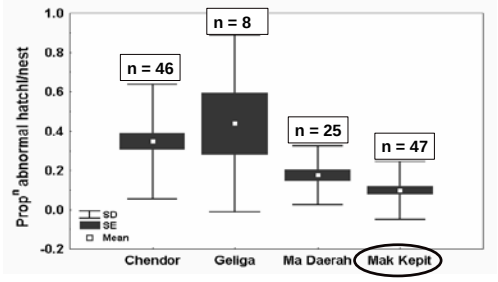
- Body size
- Scale counts
- Running performance
- Swimming performance

Body size



Hatchlings were of <u>similar</u> sizes at all locations

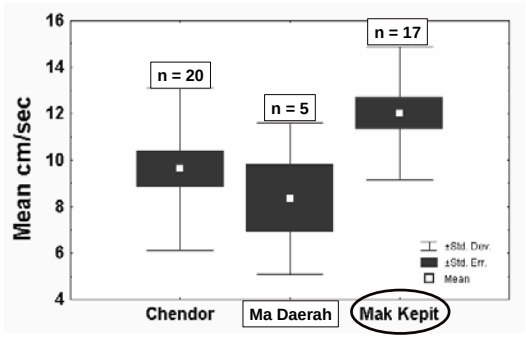
Scale counts



***In situ* nests had abnormal hatchlings less often, and fewer per nest.**

Running performance

- Speed over 1.6 m "runway"
- Each run 3 times
- Two observers



Hatchlings from *in situ* nests ran faster

Swimming performance

5 hatchlings/nest
6 hour trials
Speed & endurance

Video analysis

- **Rec. 3 minute/hour**
- **Count power stroke rate**

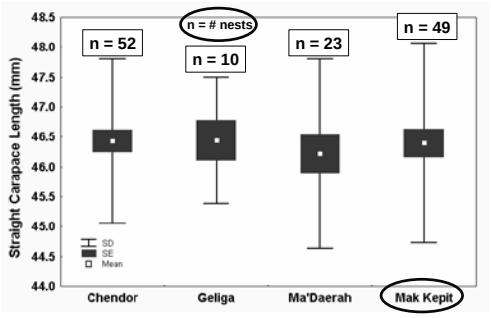
Issue # 4 …..

Unhealthy hatchlings

Measuring hatchling quality:

- Body size
- Scale counts
- Running performance
- Swimming performance

Body size



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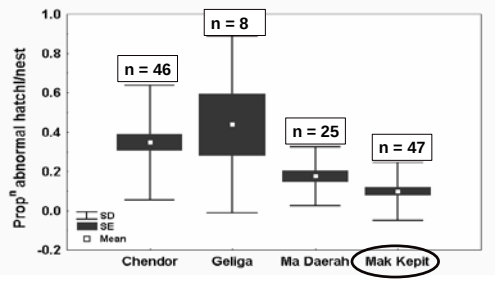

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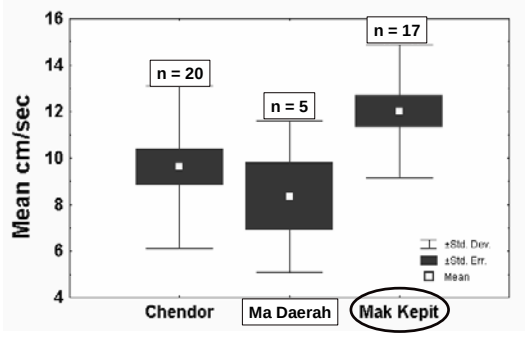

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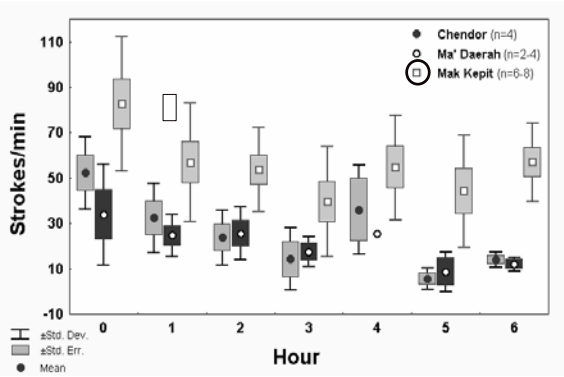


In situ **hatchlings swam faster too.**

Issue # 4 …..

Unhealthy hatchlings

• Hatchery ⇩

• *In situ* ⇧

Issue # 5 …..

Hatchling disorientation

Issue # 5 …..

Hatchling disorientation

- A simple experiment
- Hatchlings attracted to light
- Light in nearby hatchery disorientates hatchlings

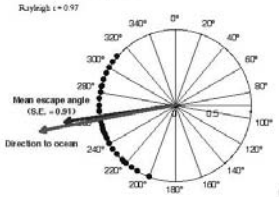
Issue # 5 …..

Hatchling disorientation

Hatchling orientation study

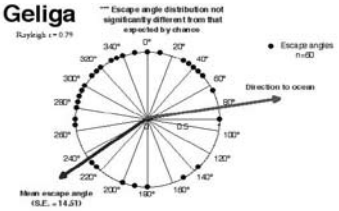
Mak Kepit

In situ



Hatchery

Geliga



Issue # 5 …..

Hatchling disorientation

Solutions

- Turn off unnecessary lights
- Reposition lights
- Shield light sources
- Replace lights on poles with low profile, low-level lamps
- Plant trees
- Replace fluorescent and high intensity lighting with low-pressure sodium vapor lighting
- Relocate hatchery to more appropriate site
- Stop hatchery, establish *in situ* incubation*

* P. Perhentian - in 2002

* Geliga - in 2003

Summary

Hatchery

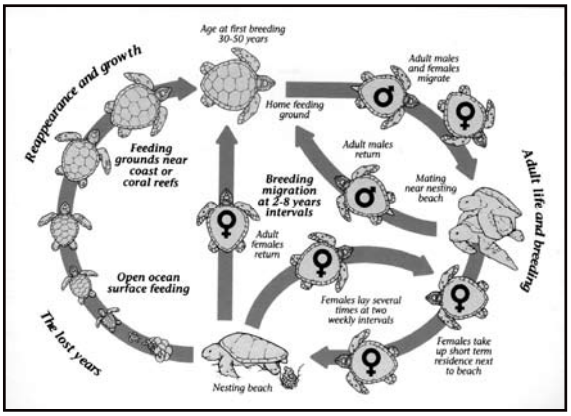
- Low incubation success
- Incorrect hatchling sex ratio
- Incorrectly imprinted hatchlings
- Unhealthy hatchlings
- Disoriented hatchlings

Half-way technology

Definition:

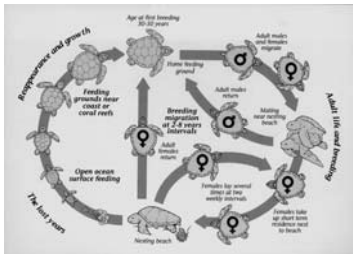
A management strategy which treats symptoms rather than causes of an environmental problem

Frazer (1992)



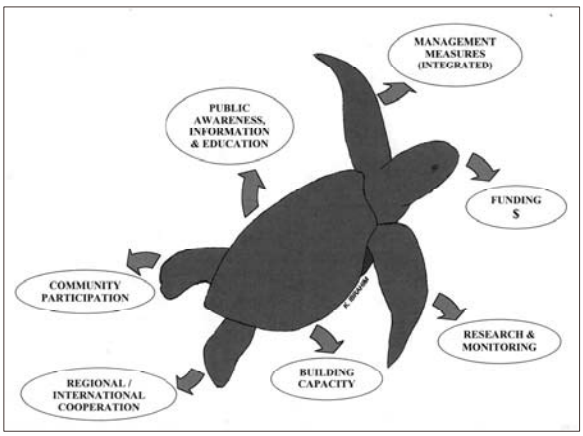
Focus on all stages in turtle life cycle

Demographic Model



The most efficient way to reverse the decline of a turtle population is through reduction of mortality in the older life stages

(Crouse et al., 1987 Crowder et al., 1994)



The way forward…integrated management