In the over all, the national data collection system is constrained by limited number of enumerators especially in remote areas, inadequate understanding on the part of fishers on the importance of collecting fishery data and statistics, and large amount of time and effort needed to compile the necessary fishery statistical data considering the huge number of fishers spread all over the countries (*e.g.* Indonesia has recorded more than 2 million fishers in 2009 with more than 600,000 fishing vessels). The major challenges in tuna data collection are therefore hinged on the number of fishing boats and landing size, and size of the countries' management areas as well as the number of fishers to be managed coupled with inadequate capable personnel in the field (**Box 2**).

In 2010, the tuna catch from the EEZ of the Philippine waters was 574,836 MT, of which commercial tuna fisheries accounted for about 65% while the remaining 35% was contributed by the country's municipal tuna fisheries. The country's commercial tuna fisheries make use of a variety of fishing gears that include purse seine, ring net and hand line while the municipal fisheries employ much larger variety of gears with line gears accounting for about 60% of the municipal catch. The major tuna species caught are the yellowfin tuna, skipjack, eastern little tuna or kawakawa, and frigate tuna (*Auxis thazard*). Earlier, bigeye tuna (<60 cm) which is also caught had been classified as small size yellowfin tuna. In 2005 however, efforts were made to separately classify the catch of bigeye from the yellowfin tuna. As a member of the WCPFC, the Philippines submit tuna catch by species based on data from the country's waters.

In the Southeast Asian region, the production of neritic tuna has gained more economic importance because of the high price of tuna offered by tuna canneries especially in Thailand. The tuna catch of Thailand from the Gulf of Thailand and landed in Thailand comprises three major species of neritic tuna such as frigate, little and long-tail tunas that are mainly caught by tuna purse seine. The catch data also indicates that the most abundant species is long-tail tuna followed by kawakawa.

For the tuna catch from the Andaman Sea landed in Thailand, the main tuna species mainly caught by light luring purse seine are the frigate tuna, kawakawa, bullet, and long-tail tunas, the most abundant of which is bullet tuna followed by frigate and kawakawa. Considering that Thailand is the main supplier of canned tuna in the world market, the demand for tuna by canneries in Thailand has been increasing and could have some impacts on the country's tuna fisheries. It is therefore encouraged that studies on tuna stocks should be urgently conducted to identify the problems, concerns and status of tuna fisheries especially in the case of Thailand.

Box 2. Recommendations from the Special Meeting on Improvement of Tuna Information and Data Collection in Southeast Asia, Songkhla, Thailand, 7-9 September 2011

Aimed at improving the methods of collecting data and information by identifying the gaps in the collection of the data taking into consideration the importance of tuna fisheries in the region especially to the small-scale fishers, the Meeting identified four common issues and concerns in the improvement of collecting tuna data and information:

- inadequate budget and human resources for data collection;
- non-systematic coordination among data collecting/ reporting agencies, private sector and NGOs;
- insufficient efforts on tuna stock assessment in Southeast Asia and database system still scanty; and
- national data collection system needs improvement for the compilation of good quality data (*e.g.* from logbooks, observer program, transshipment reports, tuna cannery records, fishing grounds).

Specially noted on the major gaps and constraints in collecting information on tuna catch data in Southeast Asia were:

- The difficulty of identifying the species of tunas especially in landing sites, considering that most of the catches are small sizes including yellowfin and bigeye tuna. It was therefore recommended that a special training should be conducted on the identification of tuna species especially the juvenile stages of the species, to be able to assess the tuna stocks. As for the appropriate method of stock assessment, it was suggested that existing models that are now being used could be adapted but should take into account the available validated data on total catch, fishing effort, fishing grounds, oceanographic conditions, among others.
- Insufficient number of staff in terms of number and capability for data collection, inadequate financial resources to fund any tuna survey, and the absence of appropriate and cost effective data collection systems.

SEAFDEC was therefore requested to undertake various activities in response to the need of improving the collection of tuna information and data, which include:

- consultation with countries on possible continuation of the development of regional tuna fisheries database;
- improvement of the quality and timeliness of data through capacity building programs, such as data collection onboard tuna fishing vessels (*e.g.* logbooks, observers onboard), from landing sites (catch unloading, species identification), and from cannery (accuracy in species identification);
- conduct of study on reduction of juvenile tuna catch from purse seine, pole and line, FADs, and by-catch in tuna fisheries;
- translation of existing relevant information materials (*e.g.* guidebooks, posters, brochures) issued by countries into English language for dissemination to the other countries in the region; and
- consultation with experts on stock assessment in order to come up with appropriate plan of activity to support the countries in the improvement of their respective information collection systems.

1.3.3 Sea Turtles

Six of seven species of living sea turtles in the world were confirmed to nest or inhabit the Southeast Asian waters. These are the leatherback (*Dermochelys coriacea*), green turtle (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), and the flatback turtle (*Natator*

depressus) which can be found only in eastern Indonesian waters (**Table 53**). The flatback turtle is restricted to Australian territories for nesting, but it forages within Indonesian waters (Limpus, 2002), where green turtles are the most dominant species in the Southeast Asian Region.

Sea turtles are important marine animals as traditional living resources in the Asian region. For centuries, people in this region have exploited this resource and some still do until the present. Sea turtles have also been cheap source of protein for poor people especially those living in the coastal areas. During recent decades the demand for its eggs, meat and carcasses had significantly increased considering that sea turtles provide many products for human consumption such as meat and eggs, as well as for commercial purposes such as the carcasses (for souvenirs, accessories) and oil (for traditional medicines), and as important part in religious ceremonies in some countries of this region.

In order to conserve, manage and exploit this resource sustainably, countries in the Southeast Asian region (except Lao PDR and Singapore) have established their own national programs on the conservation, management and enhancement of sea turtles. These include enforcement of gazetted laws and regulations, strengthening of the enforcement agencies, establishment of sea turtle sanctuaries, setting-up of hatcheries, conduct of national and regional tagging programs, tracking of the migration routes using satellite technology, implementation of public awareness activities through education and campaigns, and conduct of relevant R&D activities.

It has been reported that each year thousands of hatchling turtles emerge from their nests in the shores of the Southeast Asian countries (SEAFDEC/MFRDMD, 2004). Sadly, only an estimated one in 1,000 to 10,000 will survive to adult turtles. The natural obstacles confronting the young and adult sea turtles are staggering but the most increasing threats are caused by humans that drive the turtle populations to extinction. Today, all sea turtles found in Southeast Asian waters are federally listed as threatened and endangered. The most common issues that cause the decline of sea turtle population include natural threats and human-induced activities.

In nature, sea turtles face a host of life and death obstacles during their survival. Predators such as raccoons, crabs and ants raid eggs and hatchlings still in the nest. The hatchlings emerging from nests form bite-sized meals for birds, crabs and a host of predators in the ocean. Upon reaching adulthood, sea turtles are relatively immune to predation except for occasional attacks by sharks. Such natural threats are not the only reasons for the plummeting sea turtle populations towards extinction. Human activities have also been recognized as major threats contributing the global declining population of sea turtles. Human-induced activities could include accidental catch by fisheries, illegal trading of sea turtle shells, failure to control and collect marine debris that causes ingestion and entanglement, use of artificial lightings in nesting beaches, coastal armoring, beach nourishment and dredging, pollution in marine areas, insufficient education and public awareness programs, inadequate skills on hatchery management, and economic exploitation of turtles, as well as the impacts of climate change.

Each year hundreds of thousands of adult and immature sea turtles are accidentally captured in fisheries around the world ranging from highly mechanized operations to small-scale fisheries. Global estimates of the annual capture, injury and mortality are overwhelming: about 150,000 turtles of all species killed in shrimp trawls, more than 200,000 loggerheads and 50,000 leatherbacks captured, injured or killed by long lines, and large numbers of all species drowned in gill nets. Although the extent of gill net mortality is not really known, sea turtle capture is significant in study areas while incidence of drowning of sea turtles in gill nets could be comparable with that of trawl and long line mortality. However, deaths in gill nets are particularly hard to quantify because the nets are set by uncounted numbers of local fishers in tropical waters around the world. Other fisheries that accidentally take turtles include dredges, trawls, pound nets, pot fisheries, and hand lines.

Table 53. Sea Turtles which are confirmed to nest in Southeast Asian countries

Country	Leatherback Turtles	Green Turtles	Hawksbill Turtles	Loggerhead Turtles	Olive Ridley Turtles	Flatback Turtles
Brunei Darussalam		√	√		√	
Cambodia		√	√		√	
Indonesia	√	√	√	√	√	√
Malaysia	√	√	√		√	
Myanmar	√	√	√	√	√	
Philippines	√	√	√	√	√	
Thailand	√	√	√	√	√	
Vietnam		√	√	√	√	

Source: *Ahmad et.al, 2004*

It has therefore become a challenge to ensure that fishers develop new methodologies and gears to reduce turtle by-catch which do not necessarily prevent them from making a living. By modifying gears and techniques to protect endangered sea turtles and other non-target species, fishers can improve their efficiency and help in safeguarding the marine ecosystems. For example, the Turtle Excluder Devices (TEDs) had been designed to release turtles trapped beneath the surface in shrimp trawls as well as reduce the capture of unwanted fishes, shorten sorting time on deck and minimize fuel consumption. In addition, TEDs exclude logs and other debris, thus, help in extending net use. In long line fleets, the use of large circle hooks and fish as bait instead of squid reduces sea turtle capture while improving swordfish catch.

Hawksbill turtles are recognized for their beautiful gold and brown shells, and thus have been hunted for centuries to create jewelry and other luxury souvenir items. As a result, these turtles are now critically endangered and scientists estimate that hawksbill population declined by 90 percent during the past 100 years.

To improve their survival, CITES has declared it illegal to trade turtle shells, however, the demand for shells continues until today in the black market contributing to the continued declining population of sea turtles. In many countries, tourists continue to purchase products derived from sea turtles thus, unwittingly support the international trade of these endangered species because of inadequate information on conservation of sea turtles. Presently however, buying, selling or importing sea turtle products have been strictly prohibited by law in many countries around the world. Although the illegal trading of sea turtle products is primarily focused on the hawksbills, other sea turtle species are also killed for their skin to be transformed into leather goods while some beauty products are also known to contain sea turtle oil.

Reports claimed that more than 100 million marine animals are killed each year due to ingestion of and entanglement with marine debris especially plastic materials strewn by humans, more than 80% of which comes from land and washed into the waterways. The debris travels through storm drains into streams and rivers or from landfills into the seas. As a result, thousands of sea turtles accidentally swallow these plastic materials which are usually mistaken for food. Specifically, leatherbacks are unable to distinguish between floating jellyfish which is a main component of their diet or floating plastic materials. The most recognizable debris includes plastic bags, balloons, bottles, degraded buoys, plastic packaging, and food wrappers. Being small, most plastic materials are difficult to see, in fact, some could be invisible to the naked eye. If sea turtles ingest these particles, they become sick or even starve and eventually die from ingestion. Moreover, turtles are also affected to an unknown but potentially significant degree of risk from entanglement in various forms of marine debris such as discarded or lost fishing gear including steel and monofilament lines, synthetic and natural ropes, plastic onion sacks, and discarded plastic netting materials.

Nesting turtles depend on dark and quite beaches to deposit their eggs successfully. Turtles these days are at risk and in danger, in part, because they must compete with tourists, businesses and coastal residents for the use of beaches. Many man-made coastal development activities use a lot of artificial lightings on beaches discouraging the female sea turtles from nesting. As a result, turtles opt for less-than-optimal nesting spots, which could affect the chances of producing viable eggs. In addition, near-shore lightings could make sea turtle hatchlings getting disoriented after coming out from the eggs and wander towards the inland areas where more often than not the hatchlings die of dehydration, predation and being run over by vehicles on busy coastal streets.

In many countries, nesting beaches of sea turtles everywhere have been substantially altered by urbanization and development. Coastal areas are considered prime real estate properties for development and as a result, many of the world's beaches have been heavily developed. Moreover, coastal property owners build armoring structures such as seawalls and rock revetments to help protect their land and properties from erosion. In fact, most governing bodies often address problems on erosion by constructing state-funded coastal armoring projects that include the excavation of inlets and construction of jetties along the coast altering the natural course of the sand.

Man-made structures in coastal areas also prevent sea turtles from continuing their innate life cycles and directly threaten their existence by reducing their suitable nesting habitats and displacing turtles into less-than-optimal nesting areas. Although armoring is intended to decrease sand erosion and, therefore protect the beaches, studies have suggested that areas protected by armoring are more likely to create severe erosion by interrupting natural sand shifts. This means that while property owners are protecting their habitats using coastal structures, sea turtles are losing theirs.

Beach nourishment consists of pumping, trucking or otherwise depositing sand on beaches to replace what has been lost to erosion. While beach nourishment is often preferable to armoring, it can negatively impact the habitats of sea turtles especially when the sand becomes too compact for turtles to nest or in cases where the imported sand is completely different from the original

beach sediments, thereby potentially affecting nest-site selection, digging behavior, incubation temperature, and moisture contents of nests.

When re-nourishment takes place during the nesting season, nests can also be buried far beneath the surface or run over by heavy machinery. Dredging can also cause direct threats to sea turtles and their nearshore marine habitats. As recorded, hopper dredges have been directly responsible for the incidental capture and death of hundreds of sea turtles.

Pollution has serious impacts on both sea turtles and their food, and as suggested in recent research studies, a new disease now killing many sea turtles known as fibropapillomas could be linked to pollution in the oceans and in near-shore waters. When pollution contaminates and kills aquatic plants and animals, it also destroys the feeding habitats for sea turtles. Oil spills and urban runoffs such as chemicals and fertilizers contribute to water pollution, where an estimated 36% of all marine pollution from oil comes from cities through drains and rivers. Sea turtles are affected by pollution in more ways than one. For example, turtles do not have to directly ingest a tar ball but the small marine animals on the lower levels in the food chain, like zooplanktons, absorb these chemicals which are then accumulated in their bodies, making the toxins much more concentrated than in the surrounding waters. The zooplanktons are then consumed by larger animals including sea turtles, and thus, the concentration levels of chemicals and pollutants would continue to increase.

Awareness building of the direct stakeholders such as fishers, village folks, tourist operators, and chalet and hotel operators is still insufficient. The inadequate knowledge and awareness on the biology, conservation, protection and other practices relevant to sea turtles have often lead to certain negative attitude towards the plight of turtles, indiscriminate manhandling of turtles and destruction of their habitats. The stakeholders' inadequate knowledge in biological sciences and improper handling of incubation techniques for sea turtles could also cause low hatching rates of incubated eggs and in some cases producing unbalanced sex ratio of the hatchlings. The unbalance sex ratio in turtle hatchlings attributes to the imbalance proportion of adult male and female population of sea turtles. As a result, more infertile eggs are produced by turtle nesters during the nesting season which eventually leads to the declining population of sea turtles in the future.

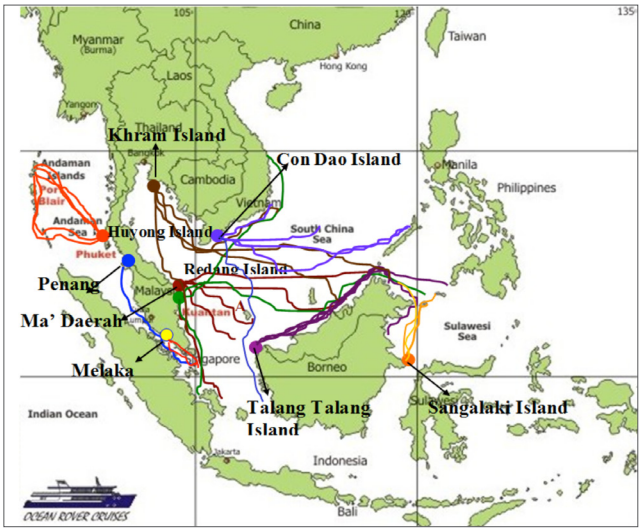
Turtles are exploited for their eggs and meat. The persistent practice of excessive egg harvesting contributes to the dramatic decline in the nesting population of all species. During the past few decades, coastlines have been regarded as common property. This implies that harvesting of turtle eggs is open to all leading to unregulated harvesting of eggs or partially regulated with little restriction to harvest the eggs. To date, consumption and selling the turtle eggs is still common in many Southeast Asian countries. It is therefore necessary that turtle eggs harvested for consumption and commercial purposes should be totally banned in all Southeast Asian countries to ensure the stability of the population of sea turtles in the future. Furthermore, illegal poaching of sea turtles in their foraging habitats is also major issue in the region. Every year, several cases of sea turtle poaching had been reported especially in sea turtle foraging habitats of Sabah and Sarawak waters off Malaysia. Regional agreement and cooperation are indeed substantially important in order to address the turtle exploitation issues and prevent turtle eggs harvesting.

Table 54. Estimated number of sea turtles recorded in the Southeast Asian countries

Country	Number of Individuals	Duration of Monitoring Study
Brunei Darussalam	53 (major sp.; Olive Ridley)	2005-2009
Cambodia	43 (major sp.; Green)	2007-2009
Indonesia	737 (major sp.; Green)	2007-2009
Malaysia		
• Peninsular Malaysia	1,272 (major sp.; Green)	1999-2008
• Sabah Sarawak	26,386 (major sp.; Green)	1999-2009
• Sarawak	7,668 (major sp.; Green)	1999-2008
Myanmar	643 (major sp.; Green)	2001-2009
Philippines (Morong-Bataan, Bagac-Bataan, and Turtle Islands Wildlife Sanctuary (TIWS))	4,249 (major sp.; Green)	1999-2009
Thailand	195 (major sp.; Green)	1994-2009
Vietnam	3,370 (major sp.; Green)	1998-2009

Source: *SEAFDEC/MFRDMD (unpublished report)*

Since sea turtles use both marine and terrestrial habits during their life cycles, the effects of climate change are likely to have devastating impacts on these endangered species. Climate change impacts on the sea turtle nesting beaches which are their reproductive habitats. Sea turtles easily recollect their nesting areas from memory which "imprints with magnetic map" the sandy beach where their eggs are deposited, giving them the unique ability of returning to that same site decades later to repeat their ancient nesting ritual. However, with melting polar ice caps and rising sea levels, these beaches are beginning to disappear. The direct impacts of sea level rise include losing beaches, ecologically-productive wetlands and barrier islands as well as increase in nesting beach temperatures. Considering that the gender of sea turtles is determined by the temperature at which the eggs incubate, increasing nest temperatures had been predicted by scientists to have influenced the production of more female than male hatchlings, creating a significant threat



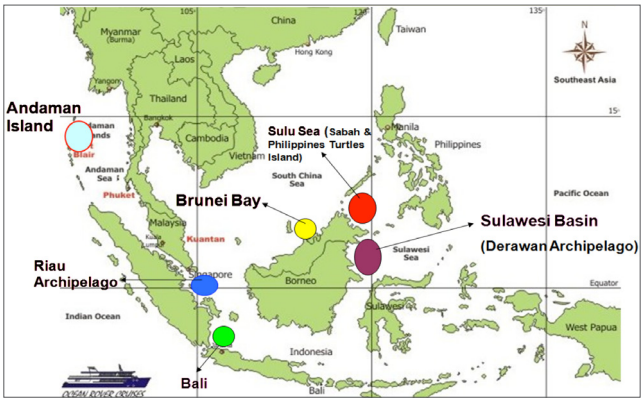


Figure 34. Migration routes of green turtles in the Southeast Asian waters determined through satellite telemetry studies (left) and location of 11 genetically distinct breeding stocks or management units of green sea turtles in Southeast Asia (above)

to genetic diversity.

Climate change which increases water temperatures also changes ocean currents that are critical to migrating turtles, especially for hatchlings that are mostly transported by Sargassum seaweeds traveling with the water currents. Warmer ocean temperatures are also likely to negatively impact on the food resources for sea turtles and virtually all marine species. Coral reefs, which comprise the important food source for sea turtles, are also in great danger from the impacts of climate change.

SEAFDEC Initiatives in Conservation and Management of Sea Turtles

SEAFDEC has played important role in the conservation and management of sea turtles in the Southeast Asian region (Mohd Isa *et al*., 2008). The first regional program on conservation of sea turtles in Southeast Asia was started during the First ASEAN Symposium - Workshop on Marine Turtle Conservation in Manila, Philippines in 1993. Thus, starting in 1996, SEAFDEC/MFRDMD and SEAFDEC Training Department (TD) in collaboration with the ASEAN Member Countries conducted a series of programs in addressing the need to conserve the region's sea turtles species. Starting in 1998, more R&D programs were also implemented with funding support from the Japanese Trust Fund as shown in **Appendix 1**. From the results of the studies, the number of sea turtles recorded in the Southeast Asian countries had been estimated (**Table 54**), of which the green turtles have been recorded with the most number of species.

Based on the results of research studies conducted by SEAFDEC/MFRDMD in the Southeast Asian region, the migratory routes of and the genetically distinct breeding stocks or management units of green turtles are shown in **Fig. 34** while the possible foraging habitats of sea turtles are mapped and shown in **Fig. 35**.

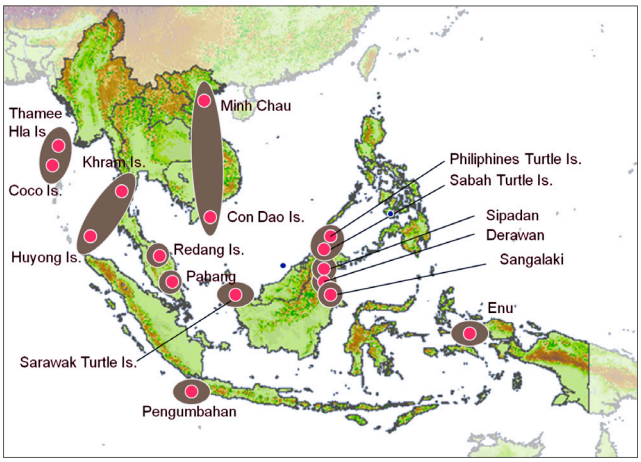


Figure 35. Possible foraging habitats of sea turtles in the Southeast Asian waters based on results of satellite telemetry studies

1.3.4 Sea Cucumbers

Sea cucumbers, especially those belonging to families Holothuriidae and Stichopodidae, form important parts of the multi-species invertebrate group, the products of which support international market demands. Based on the statistics of sea cucumber production of the Southeast Asian countries from 2000 to 2009, total production is highly fluctuating and ranges from about 4,000 to 29,700 MT annually. While the total marine capture fishery production of the region in 2009 was reported to be 14.1 million MT, about 0.033% of the total production was provided by sea cucumbers (**Table 55**). Indonesia and Philippines are the Southeast Asian countries that reported considerable amount of sea cucumber production, however, only the total production figures were reported without further classification to species level (SEAFDEC, 2009). Some countries such as Malaysia, Myanmar, Thailand, and Vietnam, are also known to have certain levels of sea cucumber production, but their reports do not reflect such production and are grouped instead under the "invertebrate group" or "miscellaneous marine aquatic group", probably because the volume of production is not