

An Assessment of Fishing Gears that Contribute to Increased Sea Turtle Mortalities: A Case Study in Rayong Province, Thailand

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Since early 1996, all species of sea turtles have been considered endangered in the Red List of Threatened Animals by the World Conservation Union (WCU, formerly the International Union for the Conservation of Nature and Natural Resources (IUCN)). Thus, the Southeast Asian Fisheries Development Center (SEAFDEC) in collaboration with its Members Countries has been conducting projects to conserve the sea turtles, specifically by evaluating the commonly-used fishing gears that could incidentally capture sea turtles as by-catch, compiling and disseminating information on the conservation and management of the sea turtles, and establishing a mechanism for regional collaboration and research on conservation of sea turtles. Along this vein, the Department of Fisheries (DOF) of Thailand collaborated with SEAFDEC Training Department (SEAFDEC/TD) to conduct activities that aim to minimize if not avoid sea turtles as by-catch from trawl fisheries and promoted the mitigation of sea turtle mortalities from trawl fisheries. Given such mission, the DOF invented the Thai Turtle Free Device (TTFD) which had been assembled with the trawl nets as a tool to release the sea turtles from trawl nets during fishing operations. The efforts of Thailand had been strengthened when experts from Southeast Asia confirmed during the Regional Workshop on the Impact of Fishing in Coastal and Sea Environment in the Southeast Asian Waters organized by SEAFDEC/TD in January 2009, that certain fishing gears adopted by the region's fishing industry, continue to increase sea turtle mortalities, *e.g.* gillnet, trawl, longline, etc.

As a means of addressing the dramatic decline of sea turtles population, the DOF of Thailand through a Ministerial Decree, had been authorized to implement Article 32 (7) of the country's Ministerial Decree on Wild Animal Reservation and Protection Act, B.E. 2535 (1992) which prohibits sea turtle fisheries and imposes a certain fine and/or imprisonment for offenders. This is also in conjunction with the IUCN Red List of Threatened Species accessed by the Convention on International Trade in Endangered Species (CITES), which the Government of Thailand had ratified in 1983. Nevertheless, in spite of the particular regulations to protect sea turtles, stranding of turtle carcasses had been observed along the coasts of the Gulf of Thailand

as well as in the Andaman Sea. Many Thai scientists have observed that mortality of sea turtles could be due to a number of causes, *e.g.* collision with sea vessels, swallowing of plastic bags and other trash, irresponsible fishing activities, etc. Moreover, the scientists also confirmed that stranding occurrences of sea turtles in the coasts of Thailand (Andaman Sea and Gulf of Thailand) had been caused by fishing operations that employ such fishing gears as gillnet, trawl, bamboo stake traps, etc., and that the observed lower stranding record of sea turtles along the coast of the Gulf of Thailand could be due to the presence of a conservation center for sea turtles at Man-nai Island in the eastern part of the Gulf of Thailand.

Nevertheless, many fishers operating various fishing gears along the coast of the Gulf of Thailand also confirmed that the statistical data on stranding occurrences of sea turtles are quite scattered and difficult to compile. Information gathered through the interviews conducted with fishers, fisheries officers, NGOs and other concerned stakeholders, suggested that the use of large-mesh bottom gillnet (also known as sting-ray bottom gillnet) and sting-ray bottom longline could have contributed to increased sea turtle mortalities in the coast of Rayong Province and its adjacent areas. Since the fishing grounds for such fishing gears are also located near the sea turtle conservation center of the Province, such fishing gears could pose high potentials in increasing the mortality of sea turtles. In the absence of results of relevant fishing experiments as of the present, this study was conducted to collect relevant secondary data on the aforementioned fishing gears considering that sea turtles have been reported as by-catch from fishing operations employing such gears (Isara Chanrachkij *et al.*, 2010). The study was also envisaged to pursue an initial process of ascertaining that future operations of such gears should aim to mitigate sea turtle mortalities.

The survey conducted in December 2009 by Isara Chanrachkij *et al.* (2010) attempted to assess the construction of the aforementioned fishing gears and the practices adopted by the small-scale fishers along the coast of Rayong Province in Thailand, where it has been reported that a number of sea turtles have been captured as by-catch. Located along

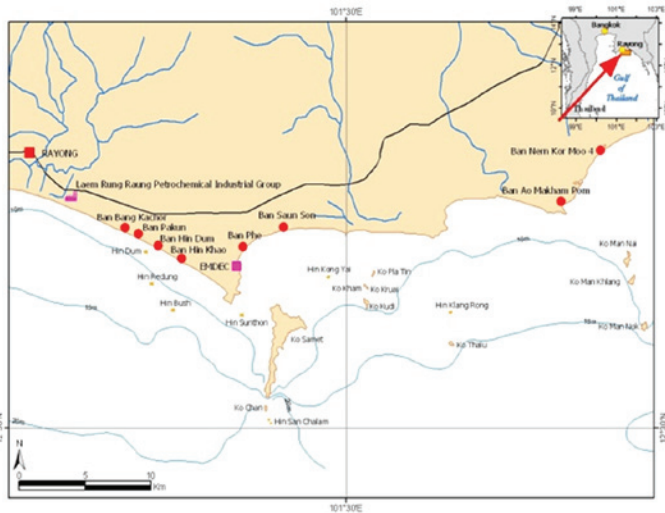


Fig. 1. Survey area of small-scale fishing communities along the coast of Rayong Province, Eastern part of Gulf of Thailand (Illustrated by Siriporn Pangsonn)

the coast of Rayong Province in the eastern part of the Gulf of Thailand, the survey area involved six (6) main fishing communities, namely: 1) Ao Makhampom fishing port, 2) Crab Bank of Ban Moo 4, 8 and 9 at Nern-klor Sub District, 3) Laem Rung-raung fishing community, 4) Hard Mae Rumphueng Beach fishing communities, 5) Suan Son beach, and 6) fishing area near the Eastern Marine Fisheries Development Center (EMDEC). The location of the fishing communities in the survey area is shown in Fig. 1.

Design and Construction of the Relevant Fishing Gears

The results of the survey revealed that two types of fishing gears which target the sting-rays and being operated around the coast of Rayong Province may have direct impact on the mortality of sea turtles, *i.e.* the large-mesh bottom gillnet or sting-ray bottom gillnet and the barbless sting-ray bottom longline. These gears are operated by artisanal fishers using boats 5-8 m LOA (length over all) which are usually equipped with inboard engine 18-24 HP or outboard (long-tail model) with 5-8 HP engine.

Large-mesh Bottom Gillnet (Sting-ray Bottom Gillnet)

As observed during the survey, the large-mesh bottom gillnet (Fig. 2) had been used in Par Khun (or Ek-ka-nek) of Hard Mae Rumphueng Beach fishing communities as well as in the fishing area near the EMDEC of the DOF, and in the area near the Ban-phe and Ao Makhampom fishing ports.

The respondents reported that the large-mesh bottom gillnet had been used in Trat Province since the last decade. However, after observing that incidental catch of the gear included a number of dugongs, the local fishers and the communities around the coast of Trat Province agreed to stop using such fishing gear. This resulted in the complete banning of the use of the large-mesh bottom gillnet or sting-ray bottom gillnet in the coast of Trat Province. On the other hand, the fishers also reported that the large-mesh bottom gillnet or sting-ray bottom gillnet had been used by some fishers in the survey area for the past few years. Most fishers believed that the original net was first introduced in Jao-loaw fishing community in Chantaburi Province as a modified gear of the giant catfish (*Pangasinodon gigas*) gillnet used in the Mekong River in the northeastern part of Thailand. Moreover, construction of the large-mesh bottom gillnet and the materials used in the construction varied according to the fishing communities, but the most common specifications of the large-mesh bottom gillnet or sting-ray bottom gillnet used in Rayong Province, are shown in Table 1.

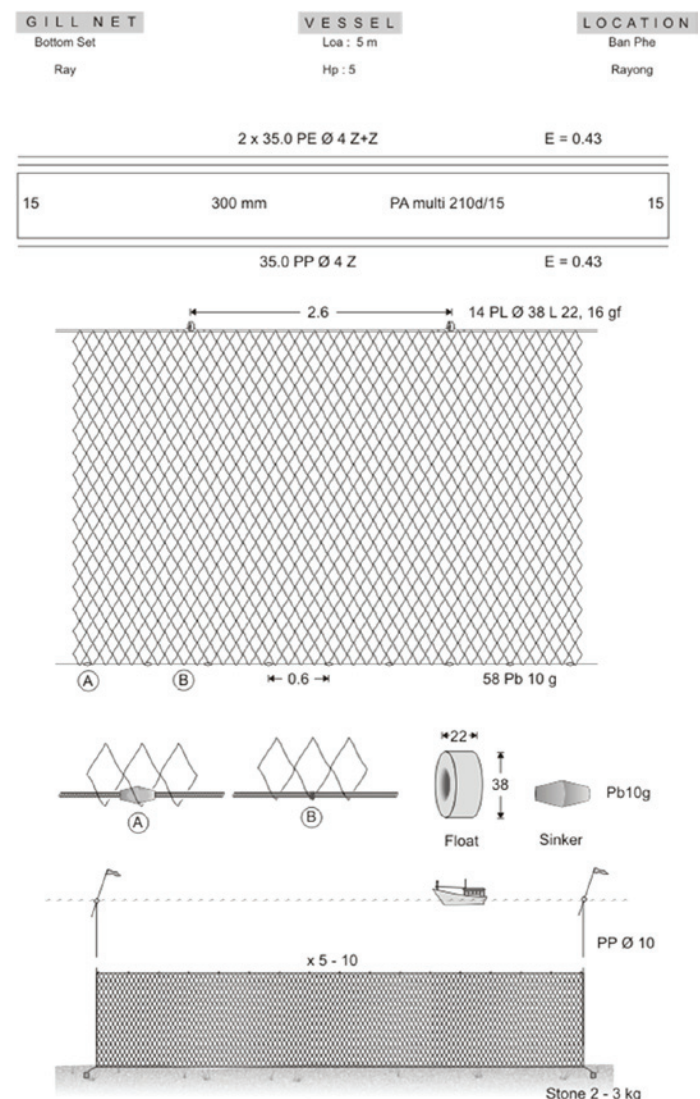


Fig. 2. Large-mesh bottom gillnet observed at the vicinity of Ban Phe, Rayong Province (Illustrated by Nakaret Yasook, 2009)

Table 1. Specifications of the large mesh bottom gillnet used in Rayong Province

Name	Material	Twine Size/ Mesh Size	Remarks
Net panel	Nylon multifilament	210d/15 Mesh size: 300 mm 15 meshes (depth) 270 meshes (length)	5-10 net panels/set
Float rope	Polypropylene (PP) Z twisted	Dia.: 4 mm, 2 pcs. Length: 35 m	Hanging Ratio: 0.43
Float	Plastic Cylindrical shape	38 × 22 mm (Ø x length) Buoyancy: 16 gf	Interval: 260 cm Total: 14 floats
Sinker	Lead	20 mm (length) Weight: 10 g	Interval: 50 cm Total: 58 sinkers
Sinker rope	Polypropylene (PP) Z twisted	Dia.: 3 mm, 1 pc. Length: 35 m	

Source: Isara Chanrachkij *et al.* (2010)

The target catch of the large-mesh bottom gillnet is mainly all sizes of sting-rays. The capturing mechanism starts with the entangling of the sting-rays' caudal spine with the net panels finally entangling the whole fish. During the fishing operations, some by-catch could also be captured such as sea turtles that swim in the sea bottom, where the sting-ray fishing operation is taking place.

In Rayong Province, the fishing ground of the large-mesh bottom gillnet could expand from Ao Rayong Bay to the western part of Ko Man Island (**Fig. 1**), particularly in water depths ranging from 2 to 20 m. The fishing grounds of sting-rays although far from the fishing village or about 3-5 nm from Ao Rayong, fishing operations are conducted around the artificial reefs off Hin sun cha Iarm Rock beyond Ko Samet Island. Fishing operation is done manually without any hauling device and daily from the evening for around 30 minutes and hauling the net the following morning for around two (2) hours. It was also noted that, the fishing gear could be operated during the whole year from the southwest to the northeast monsoon. However, different fishing seasons had been reported in the Province by fishers from different fishing communities, *e.g.* the southwest monsoon as the marked fishing season for the fishers in Suan-son, while the fishers in Hin-Dum in Hard Mae Rumphueng Beach fishing communities reported that the marked fishing season is during the northeast monsoon. The fishers from Ao Makhampom fishing community, however, have ceased the use of large-mesh bottom gillnet around Ko Man Archipelago as they have been requested by the Department of Marine and Coastal Resources (DMCR) Office in Paknam Pra-sae to stop such fishing operation around the area due to the fact that some sting-ray bottom gillnets have been found to also ensnare the sea turtles.

Meanwhile, the fishers near the EMDEC fishing pier and in Hin-Dum area have already stopped operating the large-mesh bottom gillnet for the same reason. Thus, only the fishers from Par Khun (or Ek-ka-nek) community have continued to operate this type of bottom gillnet. During the survey, some 22 sets of nets were still noted in the aforesaid community, and each set was believed to consist of 5-7 net pieces. The fishers at Par Khun explained that they continue to operate the sting-ray bottom gillnet because the population of sea turtles around their fishing ground is almost nil and that they operate their bottom gillnets away from the Ko Man Archipelago, considered as one of the main habitats of sea turtles in the Gulf of Thailand.

Sting-ray Bottom Longline

During the survey, a sting-ray bottom longline was observed at EMDEC fishing pier, indicating that some fishers still continue to operate this type of fishing gear as observed also at the Ao Makhampom fishing port. There was also an evidence that fishers in Ao Rayong still operate the sting-ray bottom longline as well because some hooks of sting-ray bottom longline had remained entangled with bottom gillnets observed at the Par Khun (or Ek-ka-nek) of Hard Mae Rumphueng Beach fishing communities. The fishers reports that the original sting-ray bottom longline was introduced from Petchburi and Trat Provinces at the Upper Gulf of Thailand. The specifications of the sting-ray bottom longline, observed from the area near the EMDEC fishing pier, are given in **Table 2** and **Fig. 3**. Fishing operation of the sting-ray bottom longline is done without bait, and the gear is set at the sea bottom by obstructing the sting-ray/fish migratory pathways. The fishing operation could be carried out manually without any line haulers. Fishing is operated on a daily trip basis with only 2-3 fishers participating. The gear is set in the evening and hauled in the morning of the next day.

Table 2. Specifications of the sting-ray bottom longline operated in Rayong Province

Name	Material	Size/Number	Remarks
Mainline	Polyethylene (PE) Z twisted	Dia.: 4 mm Length: 90 m/set	10-15 set/operation
Branch line	Polyethylene (PE)	380d/60 (Dia.: 2 mm) 30 cm length	Interval: 30 cm
Hook	Iron wire	Dia.: 3.0 mm Shrank: 5.0 cm Gap: 1.6 cm	Barbless hook Total hooks: 300 hooks/set
Float	Synthetic rubber Cylindrical shape	Dimension: 35×10 mm (Ø x length) Total: 75 floats	Interval: 1.20 m
Sinker	Stone	2 pcs.	

Source: Isara Chanrachkij *et al.* (2010)

Although its fishing season was not definitely described, sting-ray bottom longline is operated throughout the year with the best fishing season during the southwest monsoon from July to August. The main criterion used by fishers to determine the fishing season is when abundant sting-rays are sighted in the fishing ground.

The fishing ground for the sting-ray bottom longline expands from Ao Rayong Bay to the western part of the Ko Man Archipelago. The depth of the waters ranged from 7 to

12 m. Meanwhile, the fishing ground of sting-rays is around Ko Samet Island and near artificial reef areas. However, some fishers at Ao Makham Pom fishing community are presumed to be catching sting-rays around the Ko Man Archipelago using the bottom longline because four (4) big sting-rays were noted during the survey. Nevertheless, the fishers have already been requested by the DMCR Office in Paknam Pra-sae since 2009, to stop operating around the Ko Man Archipelago in order to avoid the capture of sea turtles during the fishing operations.

Following the request of DMCR, fishers near the EMDEC fishing pier and Hin-Dum area have already stopped operating the sting-ray bottom longline. A fisher at the EMDEC fishing pier described and reported that sea turtles are usually caught when these are hooked around the origin of their pectoral flippers. Moreover, if few branch lines of the gear are cut from the mainline, the swimming sea turtles could also get strangled.

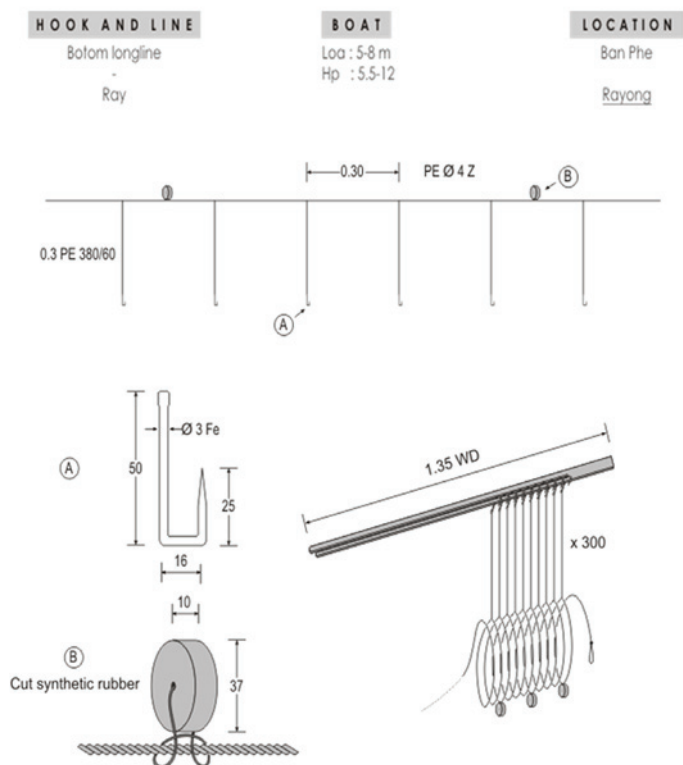
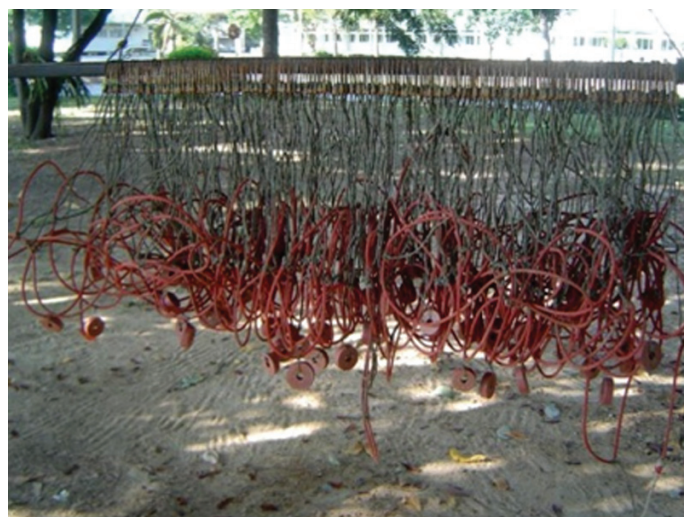


Fig. 3. Specifications of sting-ray longline observed at the vicinity of Ban Phe, Rayong Province (Illustrated by: Nakaret Yasook, 2009)



Sting-rays suspected to have been caught by bottom longline, landed at Ao Makhampom fishing port (Photos by Isara Chanrachkij on 2 December 2009)



Sting-ray hooks entangled with a local fishers' gillnet at Par Khun fishing community (left) and complete set of sting-ray longline (right)

Discussions

In the survey area, two (2) types of small-scale fishing gears, *i.e.* large-mesh bottom gillnet (sting-ray bottom gillnet) and sting-ray bottom longline, have been found to also capture sea turtles resulting in mortalities. It was noted that while before large-mesh drift gillnet was used to catch the sting-rays as reported by DOF (1969), this kind of gillnet is no longer used in most Thai fishing activities as indicated in the results of the fishing gear survey conducted by SEAFDEC (1986, 2004).

Large-Mesh Bottom Gillnet (Sting-ray Bottom Gillnet)

The fishers confirmed that the operation of the large-mesh bottom gillnet in the coastal areas of Rayong Province originated from the former fishing practices of Chantaburi and Trat Provinces. Nonetheless, there had been an unclear evidence that the origin of the large-mesh bottom gillnet in Thailand came from Malaysia as referred to in the Malaysian fishing gear information, which indicated that there are two (2) types of fishing gears targeting sting-rays, although the same information was also provided by Thai fishers (SEAFDEC, 1989 and 2002). The construction of the bottom gillnet with 30 cm mesh size, and sting-ray bottom longline without bait in Malaysia (SEAFDEC, 2002), appeared to be similar to the fishing gear construction in Thailand. Additionally, the large-mesh bottom gillnet being operated in the coast of Rayong Province may have also originated from Trat Province as a modified version of the freshwater gillnet in Mekong River of the northeastern part of Thailand. On the other hand, considering also that some Thai purse seiners operating in Malaysian waters have their fishing bases in Rayong, it is possible that the large-mesh bottom gillnet fishing techniques might have been transferred from Malaysia to Thailand particularly through Rayong Province.

Nevertheless, the fact is sting-ray bottom gillnet or large-mesh bottom gillnet fisheries still remain in operation in Rayong, Chantaburi, Prachaub Kirikarn and Nakhon Si Thammarat, and Phuket Provinces (SEAFDEC, 2004).

Sting-ray Bottom Longline

Sting-ray bottom longline is also widely operated in the coastal areas of Thailand. There has been a very long history of this fishing gear as described in the survey conducted by then Division of Fisheries (1935) of Thailand. This kind of longline has not been significantly modified from its original design for a long period of time, but in the current practice the number of deployed hooks in one operation has been recently changed. The use of this fishing gear is reported to have spread well to the neighboring countries of Thailand (SEAFDEC, 2007).

Conclusion and Recommendations

In spite of the fact that sting-ray is the target species of the aforementioned fishing gears, some sea turtles are incidentally caught during the fishing operations using such gears. From the economic point of view, sting-ray is one of the fishery resources utilized for direct human consumption or as raw materials in fishery products processing. In fact, large sting-rays could command a good price of 30-40 Baht/kg. Thus, if sting-ray fishers can catch 1 or 2 sting-rays/trip/day, they can earn an additional income of 900-1200 Baht/trip/day. The additional income from catching sting-rays has in fact been the mobilizing factor that pushes the local fishers to continue operating the large-mesh bottom gillnet fishing gear. The fishers also reported that they usually operate such gears while the population of sting-rays appears abundant while during off sting-ray fishing season they change to crab or fish bottom gillnet.

However, the DMCR Office in Paknam Pra-sae has continued to encourage the fishers to mitigate the impacts of using the large-mesh bottom gillnet on the sea turtles that are captured as by-catch. The DMCR has already convinced some fishers operating in the fishing ground around the Man-nai Archipelago and adjacent areas, to stop using the large-mesh bottom gillnet. Even though such measure initiated by the DMCR is not legally binding, almost all fishers have agreed to comply with such regulation. During the survey, it was found that only the fishers in Par Khun (or Ek-kanek) of Mae Rum Paung Beach fishing community have continued to use such gear for the reason that they can only catch few fishes using the other kinds of gillnets, *i.e.* various fish gillnet, crab gillnet and large-meshed bottom gillnet.

It is important to note that the practice of the using the large-mesh bottom gillnet and sting-ray bottom longline has already changed. Currently, the number of fishers using the sting-ray bottom longline is much less than those adopting the sting-ray bottom gillnet, even considering that bottom longline fishing targeting the sting-rays has a very long history in Thai fisheries (Division of Fisheries, 1935). Thus, it can be said that the campaign initiated by the DMCR Office at Paknam Pra-sae aimed at mitigating the impacts of the sting-ray bottom longline and the large-mesh bottom gillnet on the sea turtles, may have fallen on some deaf ears as this has not been very successful.

It is the long history of sting-ray longline operations in Rayong Province that could have resulted in some form of hesitance on the part of some fishers from cooperating with the DMCR and complying with the implementation of the DMCR policy. In this connection, the information gathered from studies conducted on the distribution and abundance of sea turtles in the coastal areas of Rayong Province, *i.e.* in 1) Rayong Bay from Koh Samae-sarn Island to Cape of Kao Laem Ya, 2) Around Samet Island and Ao Phe, 3) From Samet Island to Talu Island, 4) Around Talu Island, Kudi Island and Plateen Island, 5) Around Koh Man Archipelago, and 6) Chantaburi waters, could be useful in developing measures prohibiting the fishing operations of the sting-ray bottom gillnet and sting-ray bottom longline fisheries near the habitats of sea turtles in the future. In fact, such information could also be used as basis for possible zoning of the coastal areas as a measure to conserve the sea turtles in the Gulf of Thailand. This does not necessarily mean an outright restriction of the use of the aforementioned fishing gears in the coast of Rayong Province as this could lead to thorough prohibition of such gears in all fishing grounds, which could affect the livelihood of the artisanal fishers.

In addition, studies on the classification, biology and distribution of large sting-rays targeted by the sting-ray bottom gillnet and sting-ray bottom longline, should be conducted since the targeted sting-rays caught by such fishing gears could be very large (10-40 kg/fish), leading to the overfishing of a single species, particularly the sting-ray parental stocks. Furthermore, for conservation and management purposes of other by-catch especially the group of endangered species *e.g.* sharks, dolphins, dugong, etc., close surveillance especially in terms of frequency and the areas where such incidentally caught species had been reported is also very crucial. Even though the attitude of fishers around the survey area has been positive towards the conservation measures for the sea turtles and other by-catch species, study on the attitude of the fishers' in other fishing communities around eastern part of the Gulf of Thailand, *i.e.* Chonburi, Rayong, Chantaburi and Trat Provinces, on sea turtles conservation should also be conducted in order to assess the perceptions of the fishers.

As noted in Trat Province, the prohibition of endangered fishing gears to catch the vulnerable sea species, *i.e.* dugong, sea turtles, and dolphins has been successfully adhered to by the local communities. A study should therefore be conducted on the collection of basic information on various conservation measures adopted elsewhere in the country and in the Southeast Asian region, to increase the awareness of local fishers throughout the country on the significance of protecting and conserving the endangered sea species.

Finally, actual fishing trials/experiments or direct observation onboard local fishing boats should be carried out in order to fully understand the capturing mechanism of the aforementioned fishing gears. Based on the information gathered from such experiments, fishing gear technologists should develop the most appropriate fishing techniques for adoption in other parts of the country in particular, and in the Southeast Asian region in general, in order to finally mitigate the mortality risks of sea turtles from various fishing gear operations.

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Map of Thailand showing the Provinces relevant to the study as well as the Gulf of Thailand and Andaman Sea

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