Collect Historical data from fisherman at sea observation by Department of Fisheries

1. Laws, regulations and policies related to Rare marine animals

Rare marine animals in Thai sea consist of three groups of marine animals: sea turtles, dugong, dolphins, and whales (Whales and Dolphins). All of these are classified as reserved wildlife and protected according to the Wildlife Preservation and Protection Act B.E.2562 (2019) regarding prohibition of hunting, trade, possession, and breeding, including occupying eggs and carcasses as well as various parts of those animals. In addition, these rare marine animals are protected according to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). All species of sea turtles, Dugong, and Irrawaddy dolphins are listed on CITES Account No.1 as Critically Endangered (CR). Other dolphins and whales, including whale sharks, are listed on CITES Account No.2.

Thailand has enforced laws in managing fishery resources, which have both direct and indirect effects on fisheries resource management and conservation. The objective is to make sustainable use of aquatic animal resources, including marine mammal resources. Laws and measures regarding the management of marine mammals in Thailand include:

1) Wildlife animal conservation and protection Act, 2019, which lists dugongs, Bryde's whales and Omura's whales as protected wildlife. and listed 21 other types of whales and dolphins as protected wildlife.

2) Royal Ordinance on Fisheries 2015 and Royal Ordinance on Fisheries (No. 2) 2017 (revised edition), which has amended the Fisheries Act 1947 to be in line with international principles of fisheries resource management and the changing fishing situation. As for the conservation of dugongs, whales and dolphins, there has been an announcement from

the Ministry of Agriculture and Cooperatives regarding the designation of aquatic mammals, Rare or endangered aquatic animals that are prohibited from catching or taking on fishing vessels, 2016.

3) Act on the Promotion of Marine and Coastal Resources Management B.E. 2558 (2015), according to Section 3, stipulates that the word "Marine and coastal resources" includes marine animals. Therefore, marine mammals are also protected under the Act whereas Section 17, Section 20, Section 22 and Section 23 of the said law Established for the protection of marine and coastal resources. It gives the authority to determine measures for the conservation, rehabilitation and utilization of resources. This includes the declaration of protected areas, which results in marine mammal habitats being protected to preserve the natural integrity of the area.

4) The National Parks Act 2019 is a law that affects the protection of the habitats of marine mammals living in marine national park and a zone adjacent to the coastline where fishing is prohibited. Currently, there are 24 national parks covering the marine areas of the Gulf of Thailand and the Andaman Sea, and 2 more areas that are being declared as national parks, representing a total marine area of more than 4,000 square kilometers.

5) Enhancement and conservation of National Environmental Quality Act, 1992 is a law that can be used as a tool to prevent or restrain the implementation of projects or activities that may have an impact on the environment. This affects the protection of marine mammal habitats in the area of environmental protection measures in a specified place and period of time.

2. Department of Fisheries data recording system on rare marine animal sightings

The Department of Fisheries has made a mandatory for all sightings of rare marine animals to be recorded in the fishing logbook while fishermen are out fishing. There are 4 species of rare marine animals that are listed in the fishing logbook: turtles, dolphins, whales, and whale sharks, as shown (Figure 1). If they see rare marine animals in the area where they will be fishing or while fishing to refrain from fishing in those areas and must move the fishing area to an area that does not have rare marine animals in that area.

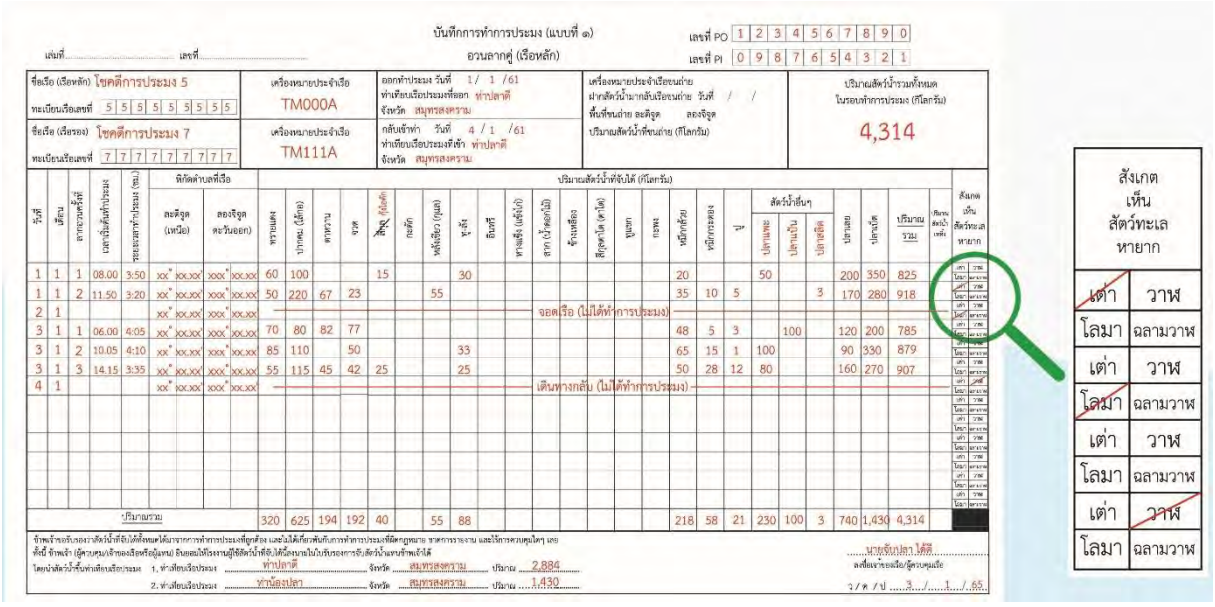


Figure 1: Example of a fishing logbook with the area to full in rare marine animals (on the right).

The Department of fisheries will record sightings of rare marine animals that were reported in the Fishing Logbook (Figure 2) into the Department of Fisheries' electronic reporting system (Thai Flagged Catch Certification System: TFCC). This will be done by the Department of Fisheries officials will inspect and import such information into the system. When the information has been recorded successfully, the system will display information on sightings of rare and endangered marine animals, as shown in Figure 3.

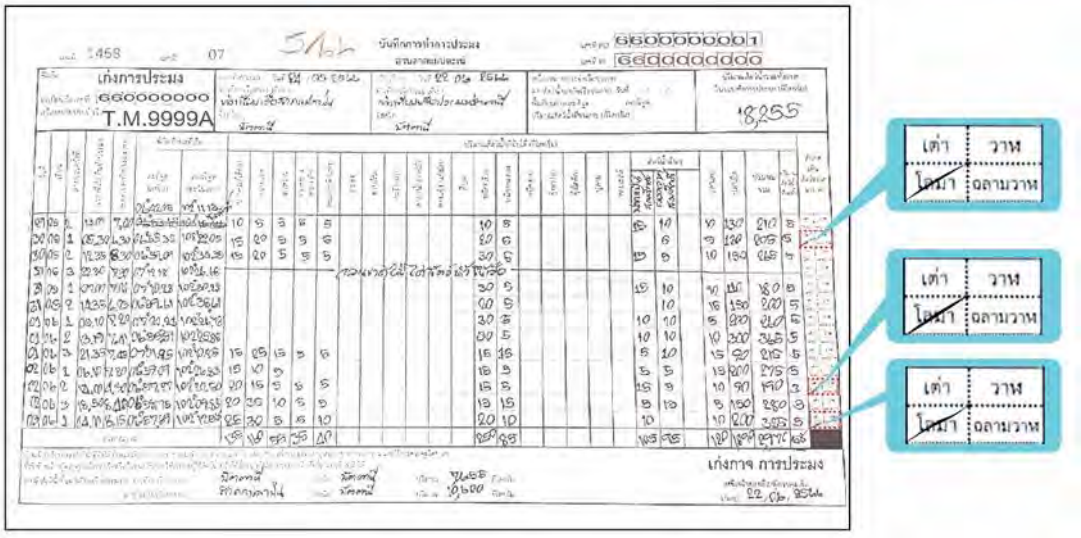


Figure 2: Fishing logbook showing rare and endangered marine species sightings.

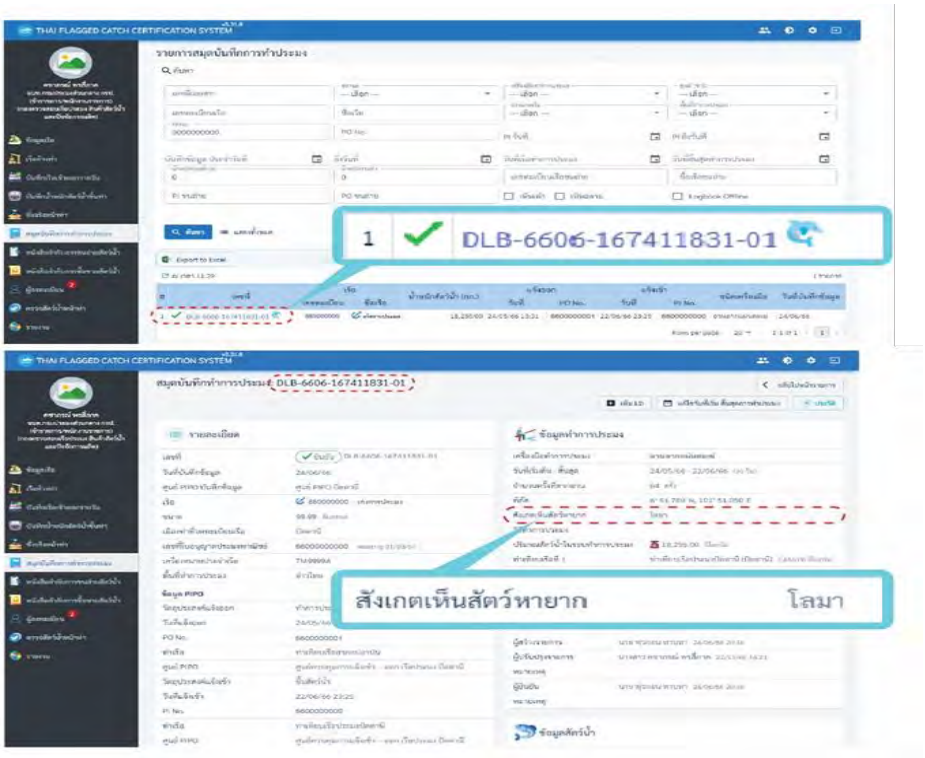


Figure 3: Data on sightings of rare marine animals in the TFCC system.

3. Summary rare and endangered marine animals' sightings of trawlers operation in 2023.

This information is gathered from the system that is recorded in the electronic reporting database system of the Department of Fisheries (Thai Flagged Catch Certification System: TFCC). In 2023, data on sightings of rare marine animals by trawl fishing boats from January-June 2023 in the Gulf of Thailand trawl fishing boats reported a total of 27,401 fishing trips. It was stated that the rare marine animals were seen on 15 trips from a total of 7 trawlers. When using data from fishing logbook to analyze the number of times rare marine animals were seen. The sightings summary is shown as below table.

Fishing Gear	ETP Species				Total (times)
	Turtle	Dolphin	Whale Shark	Whale	
Pair-trawler	1	34	-	-	35
Otter board trawl	6	97	-	-	103
Total	7	131	-	-	138

Database from the system as reference

No.	Port In. No	Fishing Gear	Date	latitude (°)	latitude (')	longitude (°)	longitude (')	ETP Species
1	6612204863	Otter board trawl	25-05-66	6	44.55	102	05.15	Dolphin
2	6612204863	Otter board trawl	26-05-66	6	49.84	101	52.44	Dolphin
3	6612204863	Otter board trawl	27-05-66	6	52.98	101	58.48	Dolphin
4	6612204863	Otter board trawl	28-05-66	6	45.81	101	49.53	Dolphin
5	6612204863	Otter board trawl	29-05-66	6	47.08	101	52.48	Dolphin
6	6612204863	Otter board trawl	30-05-66	6	55.35	102	22.05	Dolphin
7	6612204863	Otter board trawl	02-06-66	6	57.27	102	20.50	Dolphin
8	6612204863	Otter board trawl	03-06-66	6	57.69	102	12.08	Dolphin
9	6612204863	Otter board trawl	04-06-66	6	59.48	102	20.08	Dolphin
10	6612204863	Otter board trawl	05-06-66	6	59.85	102	17.88	Dolphin
11	6612204863	Otter board trawl	05-06-66	6	53.86	102	12.15	Dolphin
12	6612204863	Otter board trawl	06-06-66	6	58.18	102	18.81	Dolphin
13	6612204863	Otter board trawl	07-06-66	6	44.95	102	07.88	Dolphin
14	6612204863	Otter board trawl	08-06-66	7	01.18	102	11.49	Dolphin
15	6612204863	Otter board trawl	09-06-66	6	58.98	102	08.38	Dolphin
16	6612204863	Otter board trawl	10-06-66	7	02.28	102	17.01	Dolphin
17	6612204863	Otter board trawl	10-06-66	6	53.08	102	27.88	Turtle
18	6612204863	Otter board trawl	11-06-66	7	02.28	102	17.58	Dolphin
19	6612204863	Otter board trawl	12-06-66	7	00.38	102	17.39	Dolphin
20	6612204863	Otter board trawl	12-06-66	6	54.18	102	25.25	Dolphin
21	6612204863	Otter board trawl	13-06-66	7	00.78	102	17.25	Dolphin
22	6612204863	Otter board trawl	14-06-66	7	00.15	102	15.05	Dolphin
23	6612204863	Otter board trawl	14-06-66	6	56.18	102	25.05	Dolphin
24	6612204863	Otter board trawl	15-06-66	6	56.46	102	09.76	Dolphin
25	6612204863	Otter board trawl	16-06-66	6	55.31	102	18.18	Dolphin
26	6612204863	Otter board trawl	17-06-66	6	54.83	102	32.28	Dolphin
27	6612204863	Otter board trawl	18-06-66	6	51.28	102	18.08	Dolphin
28	6612204863	Otter board trawl	19-06-66	6	55.29	102	18.08	Dolphin
29	6612204863	Otter board trawl	20-06-66	6	53.22	102	18.12	Dolphin
30	6612204863	Otter board trawl	20-06-66	6	54.14	102	30.4	Dolphin
31	6612204863	Otter board trawl	21-06-66	6	53.188	102	18.13	Dolphin
32	6612204863	Otter board trawl	21-06-66	6	54.55	102	32.98	Dolphin
33	6612204863	Otter board trawl	22-06-66	6	45.05	102	10.05	Dolphin
34	6612204863	Otter board trawl	22-06-66	6	44.28	102	05.98	Dolphin
35	6612203888	Otter board trawl	27-04-66	6	43.44	101	48.38	Dolphin
36	6612203888	Otter board trawl	28-04-66	6	44.83	101	48.38	Dolphin
37	6612203888	Otter board trawl	29-04-66	6	35.09	101	57.88	Dolphin
38	6612203888	Otter board trawl	30-04-66	6	45.75	101	47.01	Dolphin
39	6612203888	Otter board trawl	05-05-66	6	59.42	101	20.33	Dolphin
40	6612203888	Otter board trawl	06-05-66	6	58.85	101	21.21	Dolphin
41	6612203888	Otter board trawl	06-05-66	6	59.41	101	22.14	Dolphin
42	6612203888	Otter board trawl	07-05-66	6	34.45	101	47.56	Dolphin
43	6612203888	Otter board trawl	08-05-66	6	35.18	101	47.21	Dolphin
44	6612203888	Otter board trawl	10-05-66	6	57.14	101	11.22	Dolphin
45	6612203888	Otter board trawl	11-05-66	6	57.58	101	08.19	Dolphin
46	6612203888	Otter board trawl	12-05-66	6	58.08	101	22.02	Dolphin
47	6612203888	Otter board trawl	14-05-66	6	58.98	102	08.34	Dolphin
48	6612203888	Otter board trawl	14-05-66	6	42.24	102	15.75	Dolphin
49	6612203888	Otter board trawl	15-05-66	6	58.04	102	09.38	Dolphin
50	6612203888	Otter board trawl	16-05-66	6	57.89	102	12.96	Turtle
51	6612203888	Otter board trawl	16-05-66	6	57.89	102	12.96	Dolphin
52	6612203888	Otter board trawl	17-05-66	6	54.42	102	20.75	Turtle
53	6612203888	Otter board trawl	17-05-66	6	54.42	102	20.75	Dolphin
54	6612203888	Otter board trawl	17-05-66	6	57.58	102	35.89	Dolphin
55	6612203888	Otter board trawl	18-05-66	6	54.74	102	22.32	Turtle
56	6612203888	Otter board trawl	19-05-66	7	02.03	102	43.38	Dolphin
57	6612203888	Otter board trawl	20-05-66	7	10.14	102	30.44	Dolphin
58	6612203888	Otter board trawl	21-05-66	6	57.89	102	40.08	Dolphin
59	6612202652	Otter board trawl	23-03-66	6	48.08	102	59.09	Dolphin
60	6612202652	Otter board trawl	24-03-66	6	57.64	102	18.58	Dolphin

61	6612202652	Otter board trawl	25-03-66	6	34.89	102	32.53	Dolphin
62	6612202652	Otter board trawl	26-03-66	6	54.98	102	33.04	Dolphin
63	6612202652	Otter board trawl	27-03-66	6	52.04	102	22.44	Dolphin
64	6612202652	Otter board trawl	28-03-66	6	58.20	102	24.58	Dolphin
65	6612202652	Otter board trawl	29-03-66	6	59.34	102	25.05	Dolphin
66	6612202652	Otter board trawl	30-03-66	6	53.62	102	25.05	Dolphin
67	6612202652	Otter board trawl	31-03-66	6	55.78	102	13.83	Dolphin
68	6612202652	Otter board trawl	01-04-66	6	55.83	102	34.89	Dolphin
69	6612202652	Otter board trawl	02-04-66	6	57.75	102	25.88	Dolphin
70	6612202652	Otter board trawl	03-04-66	7	11.83	102	37.24	Dolphin
71	6612202652	Otter board trawl	03-04-66	7	11.83	102	37.24	Turtle
72	6612202652	Otter board trawl	04-04-66	7	12.89	102	33.78	Dolphin
73	6612202652	Otter board trawl	05-04-66	7	07.78	102	35.39	Dolphin
74	6612202652	Otter board trawl	05-04-66	7	06.49	102	34.75	Dolphin
75	6612202652	Otter board trawl	06-04-66	7	07.18	102	33.44	Dolphin
76	6612202652	Otter board trawl	07-04-66	6	49.81	101	59.14	Dolphin
77	6612202652	Otter board trawl	07-04-66	6	49.68	102	14.04	Dolphin
78	6612202652	Otter board trawl	07-04-66	6	54.71	102	22.71	Dolphin
79	6612202652	Otter board trawl	08-04-66	6	57.89	102	37.08	Dolphin
80	6612202652	Otter board trawl	10-04-66	6	58.34	102	21.38	Dolphin
81	6612202652	Otter board trawl	11-04-66	7	00.95	102	25.38	Dolphin
82	6612202652	Otter board trawl	12-04-66	6	58.09	102	18.98	Dolphin
83	6612202652	Otter board trawl	12-04-66	6	55.25	102	33.88	Dolphin
84	6612202652	Otter board trawl	13-04-66	7	01.18	102	16.58	Dolphin
85	6612202652	Otter board trawl	13-04-66	6	56.06	102	32.08	Dolphin
86	6612202652	Otter board trawl	14-04-66	7	03.48	102	16.49	Dolphin
87	6612202652	Otter board trawl	15-04-66	6	59.49	102	18.08	Dolphin
88	6612202652	Otter board trawl	15-04-66	6	55.44	102	35.64	Dolphin
89	6612202652	Otter board trawl	16-04-66	7	00.18	102	18.08	Dolphin
90	6612200421	Otter board trawl	14-01-66	6	57.20	101	08.34	Dolphin
91	6612200421	Otter board trawl	21-01-66	6	58.91	101	21.67	Dolphin
92	6611200497	Otter board trawl	20-01-66	7	20.53	100	40.49	Dolphin
93	6611200497	Otter board trawl	30-01-66	7	22.00	100	39.67	Dolphin
94	6611200497	Otter board trawl	01-02-66	7	13.30	100	55.10	Dolphin
95	6611200497	Otter board trawl	02-02-66	7	16.50	100	42.50	Dolphin
96	6603200159	Pair-trawler	11-01-66	13	15.245	100	19.128	Dolphin
97	6603200159	Pair-trawler	13-01-66	12	50.411	100	16.250	Dolphin
98	6603200159	Pair-trawler	14-01-66	13	16.50	100	13.852	Dolphin
99	6624201409	Otter board trawl	06-02-66	9	49.80	100	33.20	Dolphin
100	6624201409	Otter board trawl	08-02-66	9	27.30	100	13.70	Dolphin
101	6624201409	Otter board trawl	10-02-66	9	13.70	100	08.65	Turtle
102	6624201409	Otter board trawl	13-02-66	8	40.10	100	04.60	Dolphin
103	6612203713	Pair-trawler	04-05-66	7	12.00	101	45.00	Dolphin
104	6612203713	Pair-trawler	10-05-66	7	29.00	101	38.00	Dolphin
105	6612203713	Pair-trawler	11-05-66	7	28.00	101	37.00	Dolphin
106	6612202959	Pair-trawler	04-03-66	7	31.00	101	35.00	Dolphin
107	6612202258	Pair-trawler	26-03-66	7	41.00	101	43.00	Turtle
108	6612202258	Pair-trawler	30-03-66	7	30.00	101	24.00	Dolphin
109	6612202258	Pair-trawler	30-03-66	7	48.00	101	25.00	Dolphin
110	6612202258	Pair-trawler	05-04-66	7	31.00	101	36.00	Dolphin
111	6612101490	Pair-trawler	28-02-66	7	02.00	102	08.00	Dolphin
112	6612101490	Pair-trawler	28-02-66	7	18.00	102	07.00	Dolphin
113	6612101490	Pair-trawler	02-03-66	7	39.00	101	46.00	Dolphin
114	6612101490	Pair-trawler	05-03-66	7	20.00	102	06.00	Dolphin
115	6612101490	Pair-trawler	06-03-66	7	13.00	102	14.00	Dolphin
116	6612101490	Pair-trawler	06-03-66	7	06.00	102	23.00	Dolphin
117	6612101490	Pair-trawler	10-03-66	7	41.00	101	45.00	Dolphin
118	6612200393	Pair-trawler	14-01-66	7	43.00	102	08.00	Dolphin
119	6612200393	Pair-trawler	16-01-66	7	29.00	101	59.00	Dolphin
120	6612200393	Pair-trawler	20-01-66	7	31.00	102	01.00	Dolphin
121	6612200393	Pair-trawler	21-01-66	7	18.00	102	13.00	Dolphin
122	6611200902	Otter board trawl	13-02-66	7	20.10	101	43.85	Dolphin
123	6611200902	Otter board trawl	01-03-66	7	25.00	101	35.27	Dolphin
124	6611200902	Otter board trawl	02-03-66	7	15.03	101	08.06	Dolphin
125	6612201596	Pair-trawler	10-03-66	7	04.30	102	07.48	Dolphin
126	6612201596	Pair-trawler	10-03-66	7	00.82	102	15.87	Dolphin
127	6612201596	Pair-trawler	11-03-66	7	50.38	102	14.89	Dolphin
128	6612201596	Pair-trawler	14-03-66	7	12.08	101	17.20	Dolphin
129	6612201596	Pair-trawler	15-03-66	7	35.61	101	15.04	Dolphin
130	6612201596	Pair-trawler	18-03-66	7	20.19	101	17.96	Dolphin
131	6628200458	Otter board trawl	17-04-66	6	29.176	101	52.669	Dolphin
132	6612201490	Pair-trawler	10-03-66	7	41.00	101	45.00	Dolphin
133	6612201490	Pair-trawler	06-03-66	7	13.00	102	14.00	Dolphin
134	6612201490	Pair-trawler	06-03-66	7	6.00	102	23.00	Dolphin
135	6612201490	Pair-trawler	02-03-66	7	39.00	101	46.00	Dolphin
136	6612201490	Pair-trawler	05-03-66	7	20.00	102	6.00	Dolphin
137	6612201490	Pair-trawler	28-02-66	7	2.00	102	8.00	Dolphin
138	6612201490	Pair-trawler	28-02-66	7	18.00	102	7.00	Dolphin

Monitoring populations of marine endangered animals by DMCR

The Department of Marine and Coastal Resources, Ministry of Natural Resources and Environment, has a mission to conserve rare marine animals. The status of these rare marine animals is studied and monitored across four groups: sea turtles, dugongs, whales, dolphins, and two types of cartilaginous fish-whale sharks and manta rays. All these species fall under the classification of reserved wildlife and are protected according to the Wildlife Preservation and Protection Act B.E.2562 (2019). This act prohibits hunting, trade, possession, breeding, as well as the acquisition of eggs and carcasses, and various body parts of these animals. Specifically, leatherback turtles, dugongs, Bryde's whales, Omura's whales, and whale sharks are among the reserved wildlife, while other rare marine animals are listed as protected wildlife.
Moreover, these rare marine animals are safeguarded under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). All species of sea turtles, dugongs, and Irrawaddy dolphins are categorized under CITES Account number one as Critically Endangered (CR). Other dolphins and whales, including whale sharks, are listed under CITES Account number two. Information regarding sightings, identity classification, and other relevant data are collected, stored in a database system, and analyzed to formulate suitable management and conservation plans.

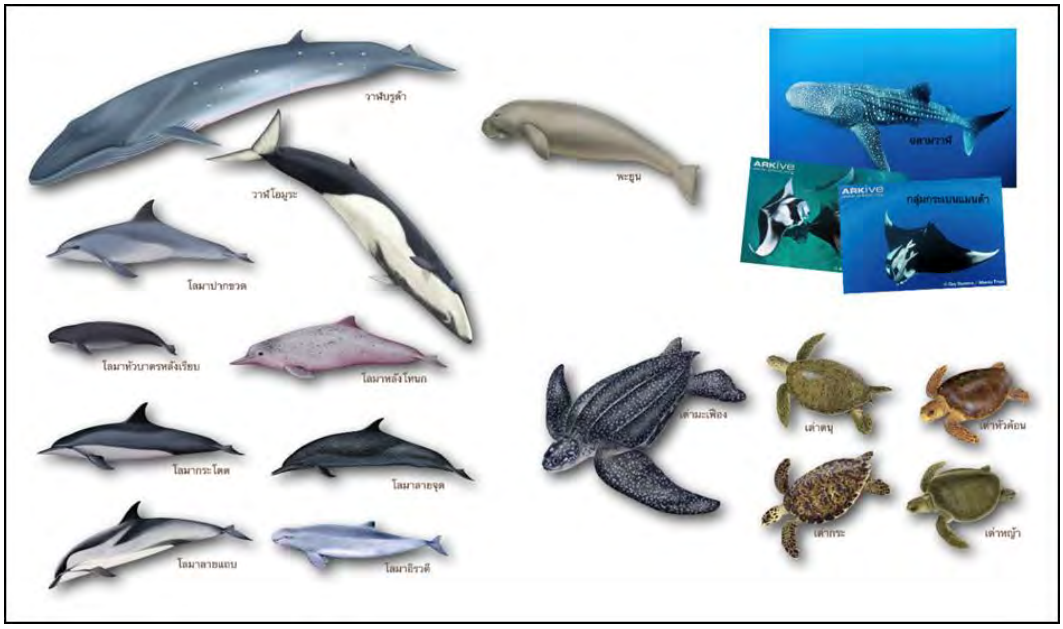


Figure 1 Rare marine species in Thailand that is available in this report on the status and distribution.
Source: Report on the situation of marine and coastal resources of the Country in 2022.

There are five species of sea turtles found distributed in Thailand:

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

Dugong (*Dugong dugon*) is the only species found in Thailand, predominantly inhabiting seagrass areas in both the Gulf of Thailand and Andaman Sea.

Dolphins and Whales Currently, 27 species of whales and dolphins have been found in Thailand. This is divided into groups of dolphins and whales that living close to shore (Residence/Nearshore) and populations living off the coast that migrate long distances (Migratory/Offshore). There are dolphin and whale species that are studied in terms of their

status, and population estimation. The spread is limited into 5 species of population near the coast as follow:

- Indo-Pacific Bottlenose dolphin (*Tursiops aduncus*)
- Finless porpoise (*Neophocaena phocaenoides*)
- Indo-Pacific Humpback dolphin (*Sousa chinensis*)
- Irrawaddy dolphin (*Orcaella brevirostris*)
- Bryde's whale (*Balaenoptera edeni*)

As for the group of 22 other species of dolphins and whales, most were reported sightings in nature and very little was found from the survey because it is a population that lives far from the coast and migrates long distances. The species as follow:

- Pantropical spotted dolphin (*Stenella attenuata*)
- Striped dolphin (*Stenella coeruleoalba*)
- Spinner dolphin (*Stenella longirostris*)
- Omura's whale (*Balaenoptera omurai*)
- Blue whale (*Balaenoptera musculus*)
- Fin whale (*Balaenoptera physalus*)
- Humpback whale (*Megaptera novaeangliae*)
- Sperm whale (*Physeter macrocephalus*)
- Pygmy sperm whale (*Kogia breviceps*)
- Dwarf sperm whale (*Kogia sima*)
- Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*)
- Cuvier's beaked whale (*Ziphius cavirostris*)
- Blainville's beaked whale (*Mesoplodon densirostris*)
- Killer whale (*Orcinus orca*)
- Short-finned pilot whale (*Globicephala macrorhynchus*)
- False killer whale (*Pseudorca crassidens*)
- Pygmy killer whale (*Feresa attenuata*)
- Melon-headed whale (*Peponocephala electra*)

- Rough-toothed dolphin (*Steno bredanensis*)
- Fraser's dolphin (*Lagenodelphis hosei*)
- Risso's dolphin (*Grampus griseus*)
- Long-beaked common dolphin (*Delphinus capensis*)

Cartilaginous fish Group: There are two species that have been studied in terms of status and distribution and are frequently seen in important dive sites as follow:

- Whale shark (*Rhincodon typus*)
- *Manta rays*

Rare marine animal's status

- **Sea turtles**

Sea turtle egg-laying information from 2022 (data as of July 2022) indicated the discovery of 604 instances of sea turtle egg-laying. This consisted of 348 green turtle nests and 256 Hawksbill turtle nests. There were no sightings of Olive ridley turtles or leatherback turtles laying eggs. The primary nesting grounds for sea turtles in the Gulf of Thailand were identified at Ko Kram Island, Chonburi province, and Koh Kra Island, Nakhon Si Thammarat province. In the Andaman Sea, nesting areas were observed at the Similan Islands in Phang Nga Province (refer to Figure 2). Comparing the recent egg-laying data with the records of the past five years, it was observed that:

- In 2017, 373 sea turtles were recorded laying eggs (296 Green turtle nests, 73 Hawksbill turtle nests, 2 Olive ridley turtle nests, and 2 Leatherback turtle nests).
- In 2018, 413 sea turtles were recorded laying eggs (246 Green turtle nests, 167 Hawksbill turtle nests; no Olive ridley or Leatherback turtle nests were found).
- In 2019, 434 sea turtles were observed laying eggs (226 Green turtle nests, 203 Hawksbill turtle nests, 2 Olive ridley turtle nests, and 3 Leatherback turtle nests).

- In 2020, a total of 491 sea turtles were recorded laying eggs (240 Green turtle nests, 234 Hawksbill turtle nests, 1 Olive ridley turtle nest, and 16 Leatherback turtle nests).
- In 2021, 502 sea turtle nests were discovered with egg-laying activity (199 Green turtle nests, 283 Hawksbill turtle nests, 2 Olive ridley turtle nests, and 18 Leatherback turtle nests).

Analysis of the data suggests that Green Turtles and Hawksbill turtles are observed laying eggs on both mainland and island beaches in both the Gulf of Thailand and the Andaman Sea. There appears to be an increasing trend in the number of times Hawksbill turtles are observed spawning, while Green turtles show a declining trend. As for Leatherback turtles and Olive ridley turtles, their egg-laying activities were observed solely on mainland beaches in the Andaman Sea. Olive ridley turtles exhibited minimal egg-laying, with only 1 - 2 nests per year, and a tendency towards a decrease in egg-laying activities. On the other hand, between 2020 and 2021, Leatherback turtles exhibited an increasing trend in egg-laying. In 2022, however, no instances of Leatherback turtles laying eggs were reported. This could possibly be attributed to the characteristic behavior of Leatherback Turtles, which tend to return to lay eggs every 3 - 5 years (Shanker et al., 2003).

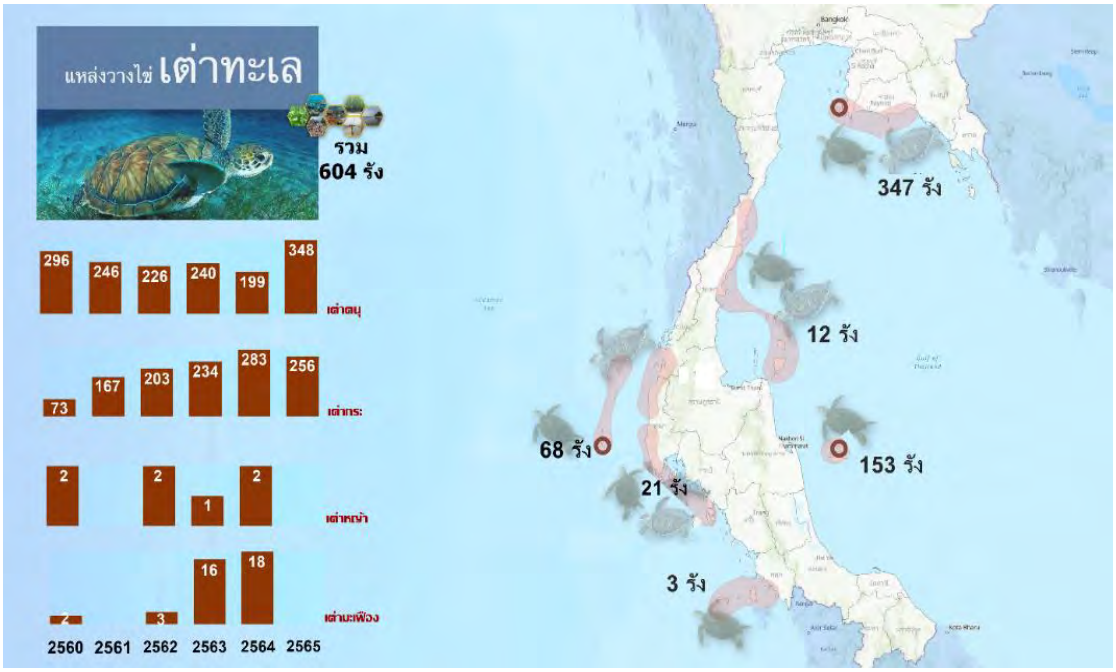


Figure 2 Statistics on the number of eggs laid by each species of sea turtle over the past 6 years (left picture). Number and spawning areas of Green turtles and Hawksbill turtles in the fiscal year 2022, the dark dots are the main egg-laying areas (right picture).
Source: Report on the situation of marine and coastal resources and coastal erosion of the Country in 2022.

- **Dugongs**

Dugongs are distributed in seagrass areas on both the western and eastern coasts of Thailand. Trang Province is the largest dugong population in Thailand. In fiscal year 2022, a survey found 273 dugongs, 31 dugongs found in the Gulf of Thailand area, and in the Andaman Sea 242 were found. When compared to past data, the trend of changes in the dugong population was found in 2 periods. The first period was between 2007 and 2014 and the dugong population tended to decrease. It was found that the number of dugongs on both the Gulf of Thailand and Andaman Sea coasts decreased from 240 to 200 in 2014. For the second period, the dugong population is trending in an increasing direction. In 2016 - 2017, a total of 221 dugongs were found. The increasing in 2018 was to 250 and increasing to 261 in 2019. Although the survey in 2020, the number of dugongs found decreased to 255, but in 2021, the dugong population is estimated to be 261 with 32 dugongs

found on the Gulf of Thailand and 229 on the Andaman side. There is the remark in 2021 that due to the outbreak of coronavirus disease (COVID-19), it was not possible to survey a dugong in the area of Trang Province, the source of the largest dugong population in Thailand. However, the population estimation method is implemented by evaluating the past survey date together with spread area.

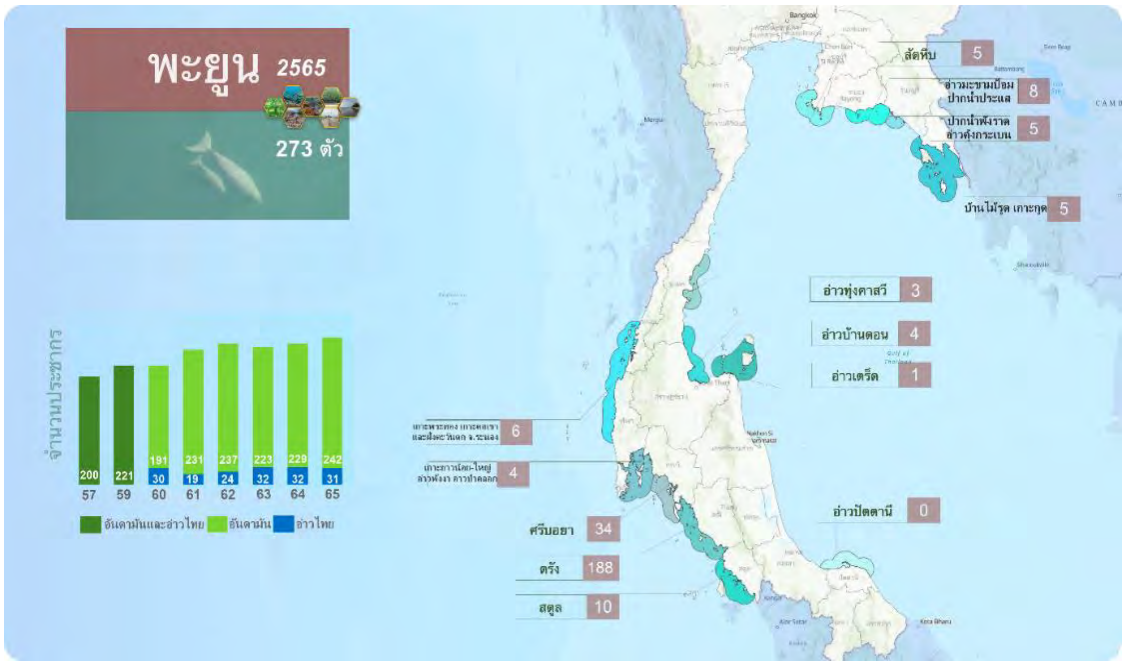


Figure 3 Number of dugongs found per year in Thailand, 2014 - 2022 (left picture), distribution area and number of dugongs in Thailand, fiscal year 2022 (right picture).
Source: Report on the situation of marine and coastal resources of the Country in 2022.

- **Dolphins and whales**

Dolphins and whales are estimated by the population, and the distribution. There are 5 species focus on nearshore populations: Indo-Pacific Bottlenose dolphin, Finless porpoise dolphin, Indo-Pacific Humpback dolphin, Irrawaddy dolphin, and Bryde's whale. In 2022, a survey could be made to assess the population of 2,310 dolphins and whales in important areas (hot spots). The species with the highest number was the Finless porpoise dolphin at 30.5 percent, followed by the Irrawaddy dolphin at 29.4 percent, the Indo-Pacific Humpback

dolphin at 26.7 percent, Indo-Pacific Bottlenose dolphin at 10.8 percent and Bryde's whale at 2.6 percent. When comparing data from the past five years, it was found that the Finless porpoise and Irrawaddy dolphin were the most numerous species, followed by the Indo-Pacific Humpback dolphin, Indo-Pacific Bottlenose dolphin, and Bryde's whale, respectively.

Dolphins and whales in close to shore, despite surveys and reported sightings in both the Gulf of Thailand and Andaman, but there are important areas (hot spots) for each species of dolphin and whale. The Irrawaddy dolphin was found in the area of Trat Bay, the upper Gulf of Thailand, also in Songkhla Lake. The Indo-Pacific Bottlenose dolphin was found around Surin-Similan Island, Phang Nga Province and Maiton Island Phuket Province. Indo-Pacific Humpback dolphins was found some areas and seasons in the Khanom Bay area (Nakhon Si Thammarat Province), Don Sak Bay (Surat Thani Province), Tase bay- Koh Libong (Trang Province), Koh Sarai - Koh Puyu (Satun Province), The Finless porpoise is a species found along the Gulf of Thailand coast from Trat province - Pattani Province, including the Andaman side from Phang Nga Province - Satun Province. The Bryde's whales have an Important area (hotspot) in the upper Gulf of Thailand and was found in certain seasons in the central Gulf of Thailand.

The populations of all five species of dolphins and whales are likely to increase between 2017 and 2020. Dolphin and whale population estimates were highest in 2020 due to a high frequency of surveys due to budget factors and decreased in 2021 due to the outbreak of the coronavirus (COVID-19), which was not possible full field exploration. For offshore populations of dolphins and whales migrate over long distances, most of them are reports of sightings in nature which were not found from the surveys. The status or population information will be based on the data of that type of dolphin and whale at the regional or global level.

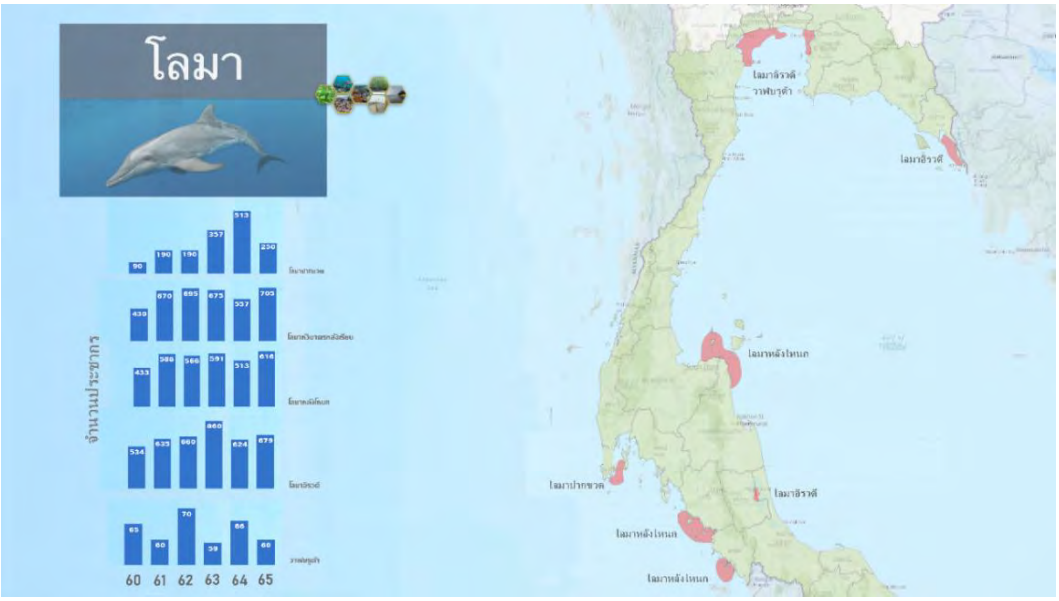


Figure 4 The number of dolphins and whales nearshore, fiscal year 2017 - 2022 (left picture) and hotspot areas (pink areas) of nearshore dolphins and whales (right picture)
Source: Report on the situation of marine and coastal resources of the Country in 2022.

For surveying Bryde's whales, the main population found in the Gulf of Thailand, especially the upper Gulf of Thailand in Samut Prakan Province, Bangkok, Samut Sakhon Province, Samut Songkhram Province, and Phetchaburi Province. In addition, some seasons have spread to the central Gulf of Thailand, Chumphon Province, Surat Thani Province.

In the fiscal year 2022, 56 unique can be identified and the trend of Bryde's whale's population in the Gulf of Thailand is increased. From data 2010 – 2022, It was found that the birth rate is approximately 10.09 percent (5 animals/year) and the death rate was approximately 5.08 percent (3 animals/year). On the Andaman Sea side, the Bryde's whales was found in Phang Nga Province and Phuket Province.

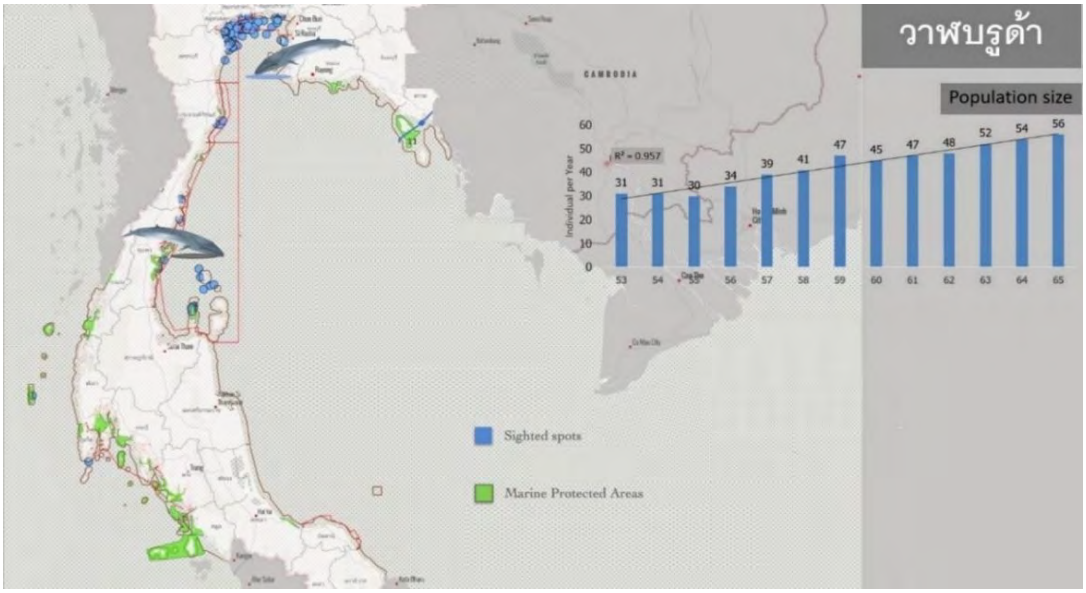


Figure 5 Number of Bryde's whales that have been identified from fiscal year 2010 - 2022 (right picture). Area of distribution of Bryde's whales (left picture)
Source: Report on the situation of marine and coastal resources of the Country in 2022.

- **Cartilaginous fish**

Cartilaginous fish are studied in terms of status, classification of individual identities and distribution. There are two types: whale shark and manta ray. Whale sharks are frequently seen in Thailand's important dive sites. Whale shark surveys rely heavily on a network of divers to report on the whale shark, including collecting information from social media to classify the identity of whale sharks.
In 2022 (information as of July 2022), 40 whale sharks were found, 21 on the Gulf of Thailand side and 19 on the Andaman Sea side. The area where whale sharks are most often found on the Andaman Sea side is “the scuba diving rocket point 8 Mile” in Satun Province, followed by Riseriu Rock in Phang Nga Province and Koh Ha in Krabi Province. For the Gulf of Thailand coast, the province where whale sharks are most frequently found is Surat Thani Province at Hin Bai deep dive site, followed by Kong Hin and Ngam Noi Island in Chumphon Province, respectively. From past data record, it was found that the spread of whale sharks can be found

throughout the year in both the Gulf of Thailand and the Andaman Sea. It has been seen along the coast and on islands in almost every province along the Gulf of Thailand from the eastern Gulf of Thailand (Chonburi Province, Rayong Province, Chanthaburi Province, Trat Province), Upper Gulf of Thailand (Samut Sakhon Province Phetchaburi Province) Central Gulf of Thailand (Prachuap Khiri Khan Province, Chumphon Province, Surat Thani Province), lower Gulf of Thailand (Nakhon Si Thammarat Province, Songkhla Province, Pattani Province Narathiwat Province). For the Andaman Sea, whale sharks can be found along the coast and islands from the upper Andaman (Ranong Province, Phang Nga Province, Phuket Province) to the lower Andaman (Krabi Province, Trang Province, Satun Province).

The trend of changing to the whale shark population is divided into two periods: between 2016 - 2019, there is a trend of the population increasing from 41 to 141 individuals, and in the second period, the whale shark population tends to decrease. In 2020 - 2022, it was founded whale shark populations were 89, 21, and 40, respectively. This is because the whale shark population relies mainly on information gathered from sightings and online media from diving networks and in the second period (2020 - 2022), during the outbreak of the coronavirus (COVID-19), tourists decreased and therefore received less information about whale sharks from data on repeated sightings between 2016 and 2022, there were an average of 5±2.9 repeated whale shark sightings per year.

Manta ray fish are more commonly seen in the Andaman Sea than in the Gulf of Thailand. Although getting proper photos of the belly of the Manta ray fish to classify their unique identity is quite difficult but this can be done in 2021. The data can distinguish the identity of Manta fish. There were 18 Manta ray fish found on the Andaman Sea coast, and in 2022 (information as of July 2022) the identities of 10 Manta ray fish were identified. All information was found on the Andaman Sea coast and mostly often found around Koh Bon in Phang Nga Province.

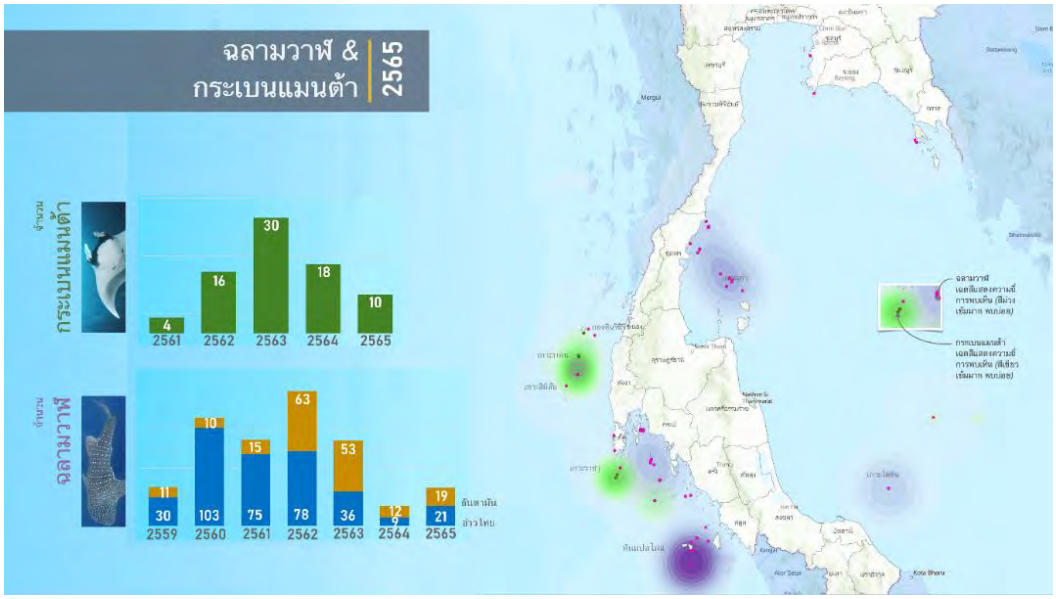


Figure 6 Number of identifiable whale sharks and manta rays in Thailand, 2016 - 2022 (left picture) and Distribution of whale sharks and manta rays in 2022 (right picture).
Source: Report on the situation of marine and coastal resources and coastal erosion of the Country in 2022.

Rare marine animals stranded.

The Statistics on stranding of rare marine animals in fiscal year 2022 (data as of September 2022) found 659 stranding, including 438 sea turtles (67 percent), 192 dolphins and whales (30 percent), dugongs 18 (3 percent), also 9 whale sharks and 2 manta rays were stranded. When comparing the statistics of stranding of rare marine animals in 3 main groups: sea turtles, dugongs, dolphins, and whales over the past 10 fiscal years, a total of 5,900 stranded animals were found (representing an average of 590±220 animals per year). From fiscal year 2013 - 2020, there has been a trend of stranding continuously increasing. The highest number of stranding of rare marine animals was found in fiscal year 2020 (905 times) and decreased in fiscal years 2021 - 2022. However, in the future, it is expected that each year, there may be an increased trend of rare marine animals stranding due to quality deterioration environment, including naturally occurring risk factors and human exploitation of marine activities. Moreover, due to advances in communication, it is convenient to report information about stranding

more quickly, and there is increasing awareness of coastal communities as well.

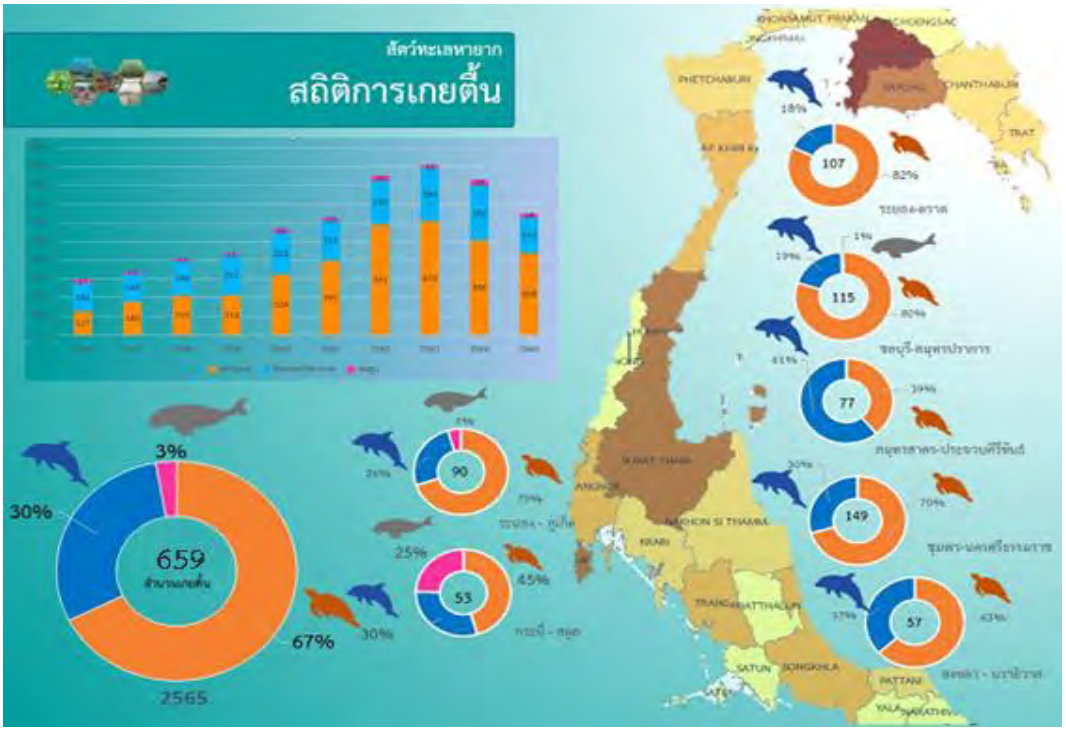


Figure 7 Stranding of rare marine animals in groups of sea turtles, dugongs, dolphins, and whales from fiscal year 2013-2022 (top left picture), Proportion of stranding of rare marine animals by group, fiscal year 2022 (bottom left picture) and Proportion of stranding of rare marine animals classified according to the area of responsibility of the Marine and Coastal Resources Research Center in fiscal year 2022 (right picture)

Source: Report on the situation of marine and coastal resources of the Country in 2022.

Stranding condition

Most of the rare marine animals found stranded in the fiscal year 2022 were already dead when the stranding was reported. Dugongs accounted for 89 percent of stranding that resulted in death or carcass. Dolphins and whales accounted for 93 percent of stranding that resulted in death or carcass. Sea turtles accounted 54 percent of stranding that resulted in deaths or carcass. However, 46 percent were stranded alive

for the group of cartilaginous fish. Most of alive condition from stranding are whale sharks with 89 percent and manta rays with 100 percent respectively

Stranding of dugongs

In fiscal year 2022 (data as of September 2022), 18 dugongs were stranded, 16 of which were stranded dead (89 percent). 2 dugongs were stranded alive (11 percent) and able to rescue and release them back into the wild. There were 7 dugongs stranded for unknown reasons due to decomposed carcasses (39 percent), and 11 causes could be identified (61 percent). The number that could be identified was found that the majority of stranding due to illness for 8 dugongs (73 percent). The stranding caused by fishing equipment, including 1 (9 percent) having a crab rope wrapped around its tail, 1 was ill from ate marine garbage (9 percent), and 1 marine accident (9 percent). The rate of stranding due to illness having a trend of increasing from 2021. When considering the stranding statistics of dugongs over the 10 fiscal years, a total of 165 dugongs were stranded representing an average of 17±6 dugongs per year, The stranding in fiscal year 2022 decreased compared to Fiscal year 2021.

Stranding of dolphins and whales

In fiscal year 2022 (data as of September 2022), 192 dolphins and whales were found stranded, 178 stranding with dead or carcass (93 percent), and 14 were stranded alive (7 percent). 7 dolphins and whales were successfully rescued and released back into the wild (50 percent), and 7 died during treatment (50 percent). Stranding of dolphins and whales mostly had an unknown cause due to the decomposed condition of 124 carcasses (65 percent), and the cause could be determined for 68 (35 percent). Most of them were caused by disease 23 (34 percent). 12 were suspected to be from fishing gear (18 percent) and 9 were seriously hit (13 percent). The 6 causes were from fishing gear (9 percent), and 18 from other causes (26 percent) such as, lost direction, marine debris, etc. The cause of stranding from illness tends to decrease while the cause of marine garbage is likely to increase from fiscal year 2021. The

statistics on stranding of dolphins and whales over the past 10 fiscal years found a total of 2,138 dolphins and whales stranded, representing an average of 214±49 per year, with a trend of increasing from 2013 - 2021 and decreasing in 2022.

Sea turtle stranding

In fiscal year 2022 (data as of September 2022), 438 sea turtles were found stranded, of which 237 died or carcass (54 percent) and 201 were stranded alive (46 percent). For the sea turtles stranded, the cause of the majority was unknown due to the decomposed condition of the carcass by 182 cases (42 percent). The 256 causes (58 percent) can identify the cause as follow. The stranding could be determined that the majority were caused by marine trash with 85 cases (33 percent). 81 cases (32 percent) were stranded due to illness. and 37 cases (14 percent) were caused by fishing gear. The fishing gear that most often affects sea turtles is the tools such as nets, hooks, and lures, and also caused by other causes such as boat accidents, Illness associated with marine trash and 53 cases lost directions (21 percent). The statistics of sea turtle stranding over the past 10 fiscal years showed a total of 3,597 sea turtles stranded, representing an average of 360±175 sea turtles per year, with a trend of increasing continuously between 2013 - 2020 and beginning to decrease in year 2021 and year 2022.

Stranding of cartilaginous fish

In fiscal year 2022 (information as of September 2022), 9 whale sharks were found stranded, 1 dead (11 percent), and 8 alive (89 percent). All 8 found alive were able to rescue and successfully released back into the wild. The cause of the whale shark's stranding was mostly by fishing gear (8 whale sharks), and the cause is unknown due to the decomposed condition of 1 carcass. The fishing gear that often affects whale sharks is purse seine For 2 cases of Manta ray stingrays, they were found stranded alive. Both were successfully rescued and released back into nature. The cause of the stranding was marine trash in the form of a rope tied around the body.

Saving rare marine animals stranded

Department of Marine and Coastal Resources is giving the first priority to rescuing rare marine animals stranded by setting up a rare Marine animal rescue center which has veterinary personnel marine academic, and medical equipment, total 7 locations covering the entire coastal area of Thailand. The work to rescue rare marine animals operate with the marine and coastal network more than 1,000 people which has completed a training course on basic rare marine animal rescue.

In the data record based on statistics on saving rare marine animals from the past 5 years, fiscal year 2018 – 2022 was found that the groups of sea turtles were stranded alive and received nursing care at a rehabilitation center of the Department of Marine and Coastal Resources with average of survival rate 90 percent while groups of dolphins and whales had an average of survival rate 50 percent and dugongs have an average of survival rate 55 percent.

For fiscal year 2022 (data as of September 2022), 201 stranded alive sea turtles were found, with a survival rate of 80 percent from rescue and medical treatment. In the group of dolphins and whales, there were 14 stranded alive, with a rate of survived by rescued and medical treatment, 50 percent For 2 dugongs found stranding alive, both were able to be rescued (100 percent), including 8 whale sharks and 2 Manta rays stranding alive. All was able to be rescued and released back into nature (100 percent).

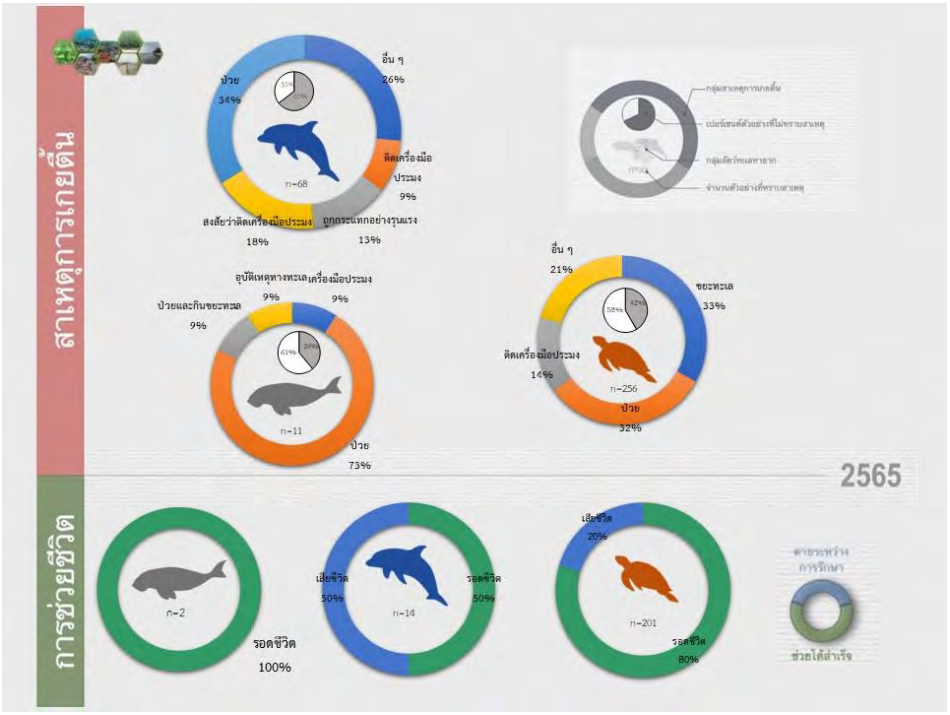


Figure 8 Causes of stranding of rare marine animals in fiscal year 2022 (upper picture) and results of saving rare marine animals' lives in fiscal year 2022 (lower picture)
Source: Report on the situation of marine and coastal resources of the Country in 2022.

Measures and plans for managing marine and coastal resources (short term 1 – 2 years)

Issues	Operational
1. Marine pollution and marine trash	1) Integrated management of pollution sources: 1.1 The source with a definite origin (Point Sources) include community, industrial plants, hotels, 2.2 The source with an uncertain origin (Non-Point Source) such as agriculture, etc., 2) Integrated waste management from

	the origin source.
2. Marine protected areas and spatial planning	Accelerating the announcement of marine protected areas as well as accelerating the implementation of spatial planning of Thailand's seas.
3. Coastal erosion	Accelerate the solution of coastal erosion problems in an integrated manner at the provincial and area levels.
4. Sustainable marine management through participatory processes	Create a mechanism for participation of communities and local government organizations in managing marine and coastal resources.

Measures and plans for managing marine and coastal resources (medium term 3 – 5 years)

Measures	Plans
1. Create knowledge and follow up on changes in resource status	Research, monitor changes, evaluate recovery and prepare media
2. Promote participation of citizens and the business sector	Establish a network, provide knowledge, awareness, and support activities create a community agreement
3. Protecting and monitoring marine and coastal resources for sustainable utilization	Inspect and monitor the area, create boundary lines, place mooring buoys, create artificial reefs, prosecute cases, and delimit space utilization areas
4. Restoring marine and coastal resources	Plant coral, seagrass and mangroves, restore sandy beaches and coastal dunes. Rescuing rare marine animals and placement of artificial corals
5. Protecting, monitoring and promoting the reduction of impacts from land and islands	Utilize the mechanisms stipulated in Articles 12 and 13 of the Provincial Marine and Coastal Resources Commission to express opinions on the impact of land activities and

Measures	Plans
	islands, such as garbage, wastewater, and sediment, on marine and coastal resources at the local level through reporting and regional management plans.
6. Announcement of conservation area and protect marine and coastal resources	Establish marine protected areas under the management of the Department of Marine and Coastal Resources, Department of National Parks, Wildlife and Plant Conservation, Department of Fisheries, and the Office of Natural Resources and Environmental Policy and Planning, both by law, community agreement, or any other effective means of conservation.
7. Improving relevant regulations	- Prepare guidelines for staff and volunteers - Prepare a seaside city plan and management in the beach cluster system - Inhibiting projects that create impacts on the coast
8. International cooperation	Support and participate in activities with international cooperation organizations

Section 2C –Habitats

(Research 1) Effects of trawl fishing on biological resources and marine environment in Eastern Gulf of Thailand.

The impacts on the marine and coastal environment from trawl fishing are considered as an important problem that cause the degradation of marine ecosystems around the world, including in Thailand. Key marine and coastal ecosystems that are often directly or indirectly affected by trawl fishing include seagrass, coral reefs, and ecosystems within the water column and sea bottom. In this case, the ecosystems that are often directly affected by fishing, especially trawl, are the ecosystems within the water column and sea bottom through the disturbance of seafloor, the diffusion of sediment and various solutions from the sediment into the water column. Meanwhile, seagrass and coral reefs are ecosystems that are indirectly affected by trawl fishing in the form of dispersed sediment, blocking of light from increased seawater turbidity. Also, Include the concentration of various solutions caused by the swep area of the fishing gear, especially the concentration of nutrients in seawater that may affect the abundance of phytoplankton and seaweed. This will result in the degradation of seagrass and coral reefs. The natural restoration may not help to maintain the ecosystem as a habitat for aquatic animals (Dawes et al., 1997).

The impacts from trawl fishing can also be considered as a cause of loss of marine ecosystems and restoration funds. However, the past studies shown that marine environmental data has not been linked to the impacts from trawl fishing. Therefore, this study of the effects of trawl fishing on biological resources and marine environment in Gulf of Thailand (Eastern part) aims to study the impact of trawl fishing on the quality of seawater and sediment in the Gulf of Thailand and impacts of trawl fishing on marine resources in the Gulf of Thailand. The result from the study will be used as a guideline for developing trawl fisheries in the Gulf of Thailand in accordance to international standard for sustainability practices.

Objective

To study the impact of trawl fishing on sediment, water mass, and fishery resources in the Gulf of Thailand.

Research methods

The study of the impacts of trawl fishing on biological resources and marine environment in eastern Gulf of Thailand was conducted by defining the study area based on the results of commercial trawl fishing areas analysis. Information regarding the time period and areas prohibited for fishing according to the Department of Fisheries announcement, the fishing patterns of trawlers, and the data from the fishing vessel tracking system (VMS) were used for analysis. Sampling in the target area was done using "Variable Radius Plot Sampling" starting from the densest trawl area and then set up sampling stations in 4 directions, 3 stations in each direction, with a distance of 4 kilometers between stations, totaling 13 stations to cover areas with trawl fishing and coastal areas without trawl fishing as a control (Figure 1). The time periods for data survey were October 2022 and December 2022.

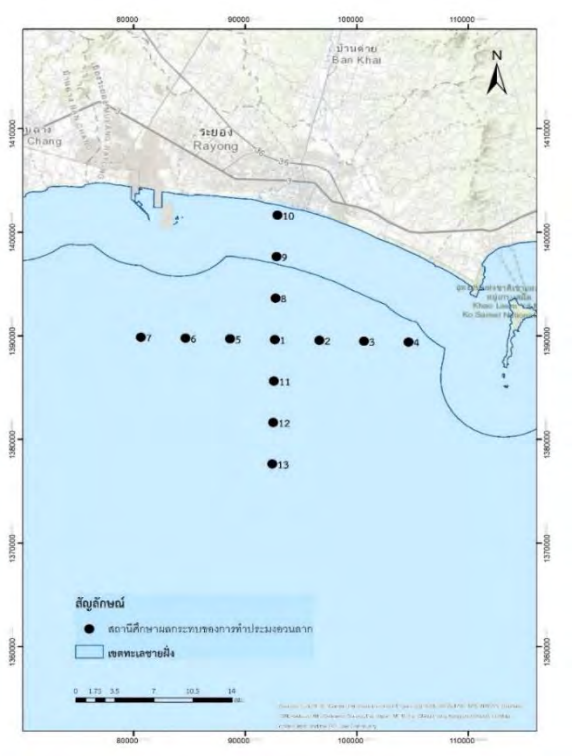


Figure 1: Surveyed station to assess the impact of trawl fishing on water quality, sediment quality, and fishery resources in the eastern Gulf of Thailand

Factors studied for the water quality are general water quality (temperature, dissolved oxygen (DO), and pH of water), Nutrient concentration (dissolved inorganic nitrogen (DIN), silicate-silicon ($Si(OH)_4$-Si) and orthophosphate-phosphorus (PO_4^{3-}-P)), chlorophyll *a* content and total suspended solids (TSS) . The study was conducted at 3 depth of water levels: the surface, the middle, and the bottom. For sediment quality, the factors studied are sediment particle size (grain size), acid volatile sulfide; AVS, total organic matter; TOM, pore-water nutrient, heavy metal content in sediment (Cd, Pb, Cu, Zn) and $\delta^{13}C$, $\delta^{15}N$ of sediment.

The impact of trawl fishing in the eastern Gulf of Thailand is analyzed using above-mentioned data in order to assess the impact of trawl fishing on the marine environment and biological resources of the Gulf of Thailand. The knowledge integration of physical oceanography, chemical oceanography, and marine biology was also used in the analysis to assess the impacts both directly and indirectly on resources in the eastern Gulf of Thailand.

Research results

General water quality: Water depth 8.7-29.1 m, transparency 4.7-19.5 m, temperature 28.1-30.3 °C, salinity 28.7-31.3 psu, pH 7.9-8.2, DO 5.5-7.7 mg/l.

Nutrient concentration: DIN 0.79-3.37 μM, $Si(OH)_4$-Si 8.19-75.75 μM, and PO_4^{3-}-P 0.20-2.27 μM.

Chlorophyll *a*: 0.13-5.74 μg/.

Total suspended solids content: 0.60-15.15 mg/l.

General characteristics of sediments: Most of sediment sample was mud mixed with shellfish fraction, the surface layer of the sediment is brown with gray and black color in the deeper layers., An indistinct

oxidized layer was observed at the sediment surface (0-1 cm) and there was no obvious sulfide odor.

Sediment particle size: Composition of sediment particle smaller than 63 microns at the sediment surface (0-1 cm) was 2.26-64.03% of the dry weight.

Acid volatile sulfide of the sediment: The concentration of acid volatile sulfide in the sediment at the surface level (0 -1 cm) was nd-0.039 mg/g dry weight.

Water content of the sediment: The water content of the sediment at the surface level (0-1 cm) was 16.99-69.76% of the wet weight.

Total organic matter of the sediment: TOM of the sediment at the surface level (0-1 cm) was 1.56-11.00% of the dry weight.

Pore-water nutrients: The concentration of inorganic nitrogen in the pore-water at the surface sediment (0-1 cm) is between 123.25-1,229.01 μM , $Si(OH)_4$-Si 44.05-482.46 μM, and PO_4^{3-}-P 17.86-124.95 μM.

Heavy metals in sediment: The concentration of cadmium in the surface sediment (0-1 cm) is between 0.589-4.507 ppm, lead 4.782-160.691 ppm, copper 8.019-71.181 ppm, and zinc 24.462-97.867 ppm.

Aquatic animal resources: Total of 12 phylum of benthic organisms were found: Phylum Cnidaria, Phylum Platyhelminthes, Phylum Nemertea, Phylum Mollusca, Phylum Annelida, Phylum Echiura, Phylum Sipuncula, Phylum Arthropoda, Phylum Nematoda, Phylum Echinodermata, Phylum Chaetognatha, and Phylum Chordata. Species of the Phylum Annelida was found to be the most abundance, followed Phylum Arthropoda. Total density of marine benthic organisms was varied among sampling stations and study areas.

Stable isotope in the sediments: The lowest value of $\delta^{13}C$ in the surface sediment (0-1 cm) was -27.45 ‰ (station 9) and the highest value was -2.24 ‰ (station 3). In general, sediment in coastal areas come from two sources: from terrestrial which flown to the sea by the, and from marine biogenous sediment. In the Gulf of Thailand, end member of $\delta^{13}C_{marine}$ and $\delta^{13}C_{terrestrial}$ were about -21.00 ‰ and -27.00 ‰, respectively. In the present study, it was found that the source of sediment in near-shore areas is mainly influenced by terrestrial (-27.45

‰ in station 9). Meanwhile, the source of sediment in areas further away from shore is from the sea. For the stable isotopesδ^{15}N, the lowest value was -7.03 ‰ and the highest value was 4.80 ‰.

Stable isotopes in aquatic animals: Stable isotope of δ^{13}C and δ^{15}N of 5 aquatic animals (splendid squid, blue swimming crab, scallop, purple-spotted bigeye fish, and sea bream fish) obtained from trawl fishing in the eastern Gulf of Thailand was analyzed. The study area is divided into 4 sub-areas: the upper west side (Zone 1), the upper east side (Zone 2), the lower west side (Zone 3), and the lower east side (Zone 4). The stable isotope δ^{13}C of each species were similar. δ^{13}C of the same species were similar among areas. δ^{15}N clearly reflected the differences of trophic level between species. The lowest values of δ^{15}N was found in scallops while the highest was found in squid. This indicated that splendid squid is the top consumer in the present study, followed by purple-spotted bigeye fish, sea bream fish, blue swimming crab, and scallop, respectively.

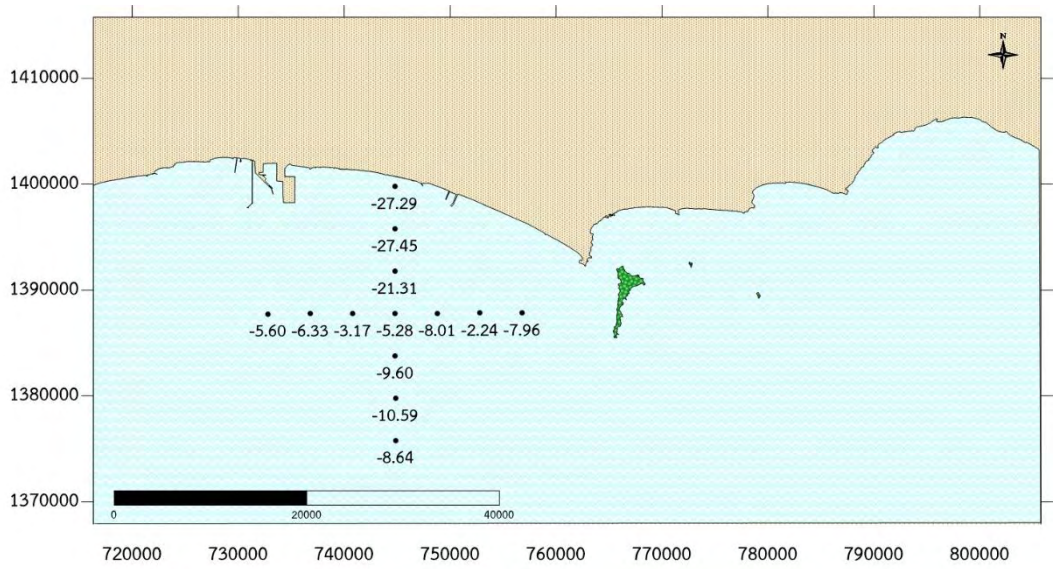


Figure 2: Stable isotope values δ^{13}C (‰) in sediment samples at a depth of 0-1 cm in the eastern Gulf of Thailand, October 2022.

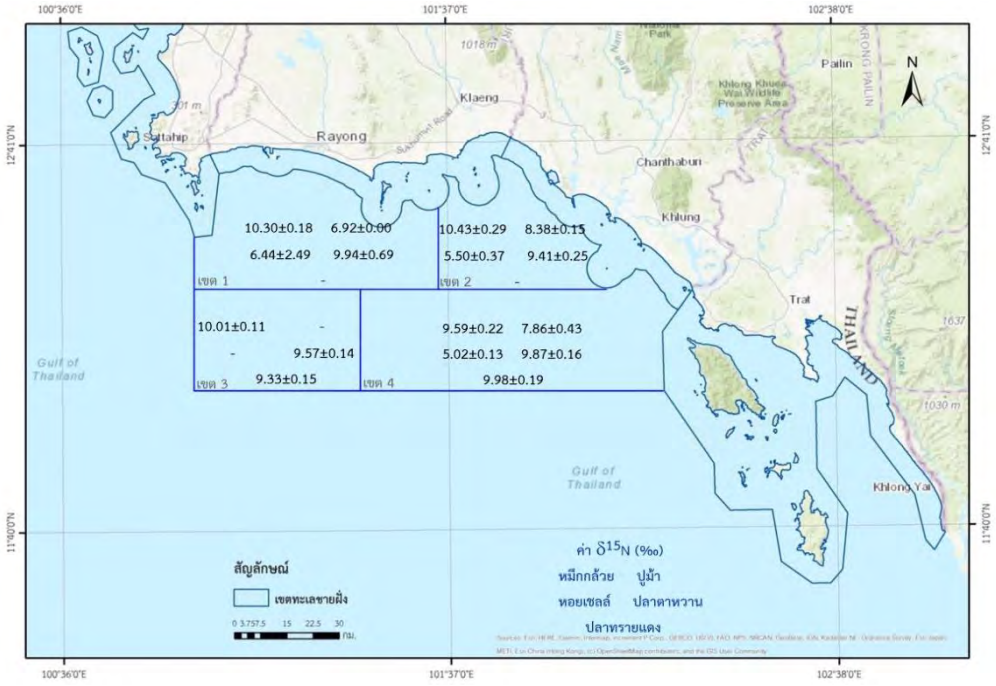


Figure 3: Stable isotope values of $\delta^{15}N$ (‰) in aquatic animal in the eastern Gulf of Thailand

The impact of trawl fishing on aquatic environmental quality: Field survey was conducted in February 2023 to collect environmental samples for trawl fishing impacts assessment. The studied variables are general water quality (water depth, transparency, temperature, salinity, pH, DO), total suspended solids content, nutrients concentration, and sediment particle size. The total 16 sampling station was divided into 6 and 10 stations where samples are collected before and after the trawler passed by, respectively. An interesting finding was that the total suspended solids content at the water surface before and after the trawlers passed by were similar, while the distinct changes of TSS content between pre- and post-trawling were observed at the bottom level. The range of TSS content at the bottom level after the trawler passed by was 2.75-12.68 mg/l (7.56±5.51 mg/l) which was clearly higher than that before the trawl passed by (1.85-8.40 mg/, median value 2.58±3.06 mg/) with the statistically significant difference at the significance level of 0.05; p-value=0.039. TSS content at the bottom level tended to be 2-5 times higher than that at the water surface as a result

of the dispersion of the sediment. This is corresponded with transparency of water which is found to be lower after the trawl passed by (pre-trawling 11.9±1.8 m and post-trawling 9.6±2.9 m) with the statistically significant difference at the significance level of 0.05; p-value=0.039.

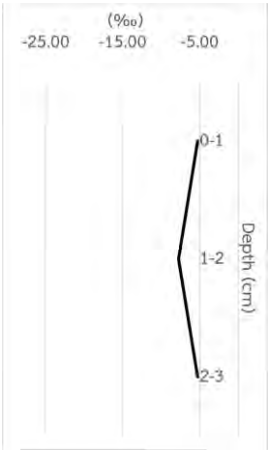
The stable isotope $\delta^{13}C$ in the sediment (0-3 cm) was found to be varied by increasing depth. (Figure 4).

Group 1: Stations with decreasing stable isotope values $\delta^{13}C$ with increasing depth are station 4 and station 8.

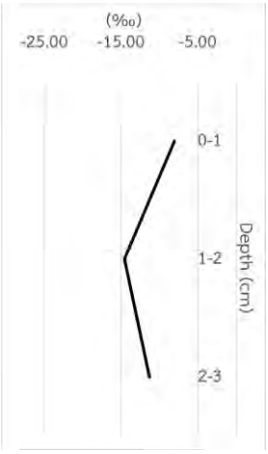
Group 2 : Station with relatively constant stable isotope value $\delta^{13}C$ with increasing depth is station 13.

Group 3: Stations with trendless stable isotope values $\delta^{13}C$ changing are stations 1-3, stations 5-7, and stations 9-12.

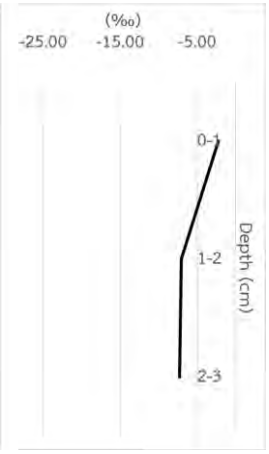
In general, stable isotope values of $\delta^{13}C$ in natural sediment is decreased with increasing depth (group 1) due to the decomposition of organic matter in the sediment. In cases where sediment have been disturbed by human activities, changes in the stable isotope values of $\delta^{13}C$ can be found increasing with increasing depth (not found in this study) or changes without trend (group 3), such as trawl fishing activities that cause the sediment to be unnaturally reversed from the bottom layer to the top. Meanwhile, the constant stable isotope values of $\delta^{13}C$ in sediment with increasing depth in group 2, could be attributed to the high sedimentation rate which surface sediment has not much been altered by the decomposition process.



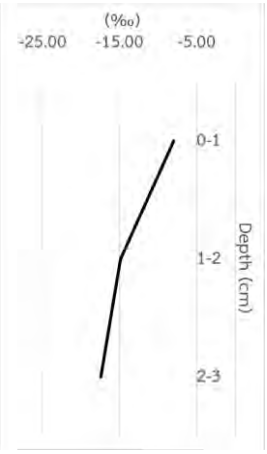
Station No. 1



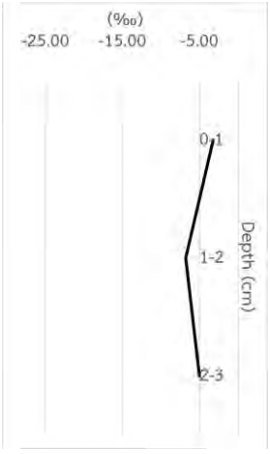
Station No. 2



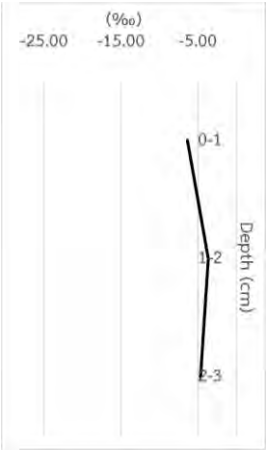
Station No. 3



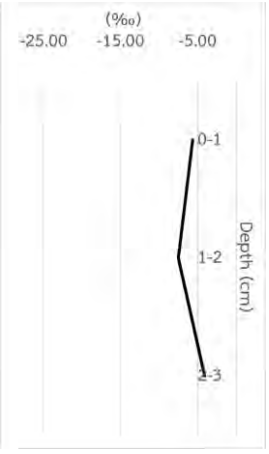
Station No. 4



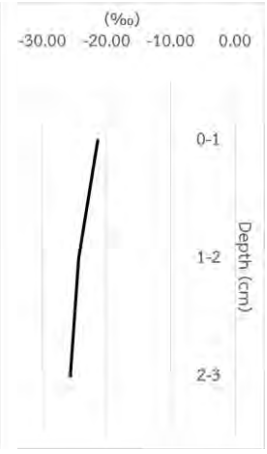
Station No. 5



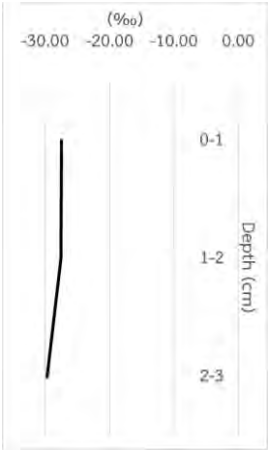
Station No. 6



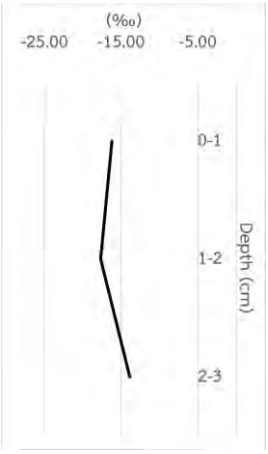
Station No. 7



Station No. 8

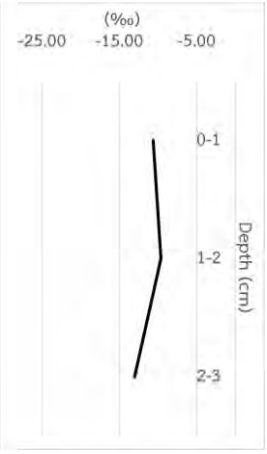


Station No. 9

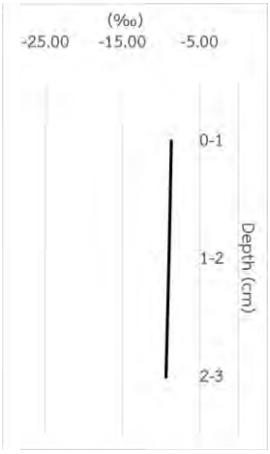


Station No. 10

Station No. 11



Station No. 12



Station No. 13

Figure 4: Stable isotope values of $\delta^{13}C$ (‰) in sediment in the eastern Gulf of Thailand (0-3 cm)

Conclusion

1. General water quality, nutrient concentration, and sediment quality (AVS and TOM) in most study areas remained within normal limits based on the water quality standards of Thai seawaters (seawater quality for aquaculture according to the announcement of the National Environment Board 2021)

2. The accumulation of AVS in the surface sediment (0-1 cm) was low. TOM in surface sediment (0-1 cm) was low in some areas, especially the area close to the shore (station 9-10). Meanwhile, areas farther from shore (station 11-12) had higher TOM in surface sediment.

3. The source of the organic substances in the sediment in this study was confirmed by stable isotopes of $\delta^{13}C$ in the sediment. The stable isotope values $\delta^{13}C$ of the sediments in the nearshore area (stations 9-10) clearly reflect the source of organic substances coming from land which was flushed into the sea from the Rayong River. Meanwhile, $\delta^{13}C$ in sediment further from shore, indicated organic matter originates mainly from marine life with little coastal influence.

4. The amount of heavy metals in the sediment (Cd, Pb, Cu, Zn) was found to be higher than that in the coastal sediment quality criteria specified in the Pollution Control Department's announcement, 2021.

5. Trawl fishing clearly affects the TSS, transparency, and the stable isotope value $\delta^{13}C$ in the sediment. The TSS was increased and water transparency was decreased after the trawler fishing passed by. Including the discovery of unnatural changes with depth of the stable isotope value $\delta^{13}C$ in the sediment as a result of the fishing method which the nets are positioned at sea bottom and in contact with the sea floor. This causes the sediment to be turnover, disturbed, and dispersed into the water column.

Suggestions

1 . Guidelines for solving the problem of pollutant contamination in the coastal area of Rayong Province (study area) should be carried out under the development of an eco-industrial city, including the prevention of pollution problems, together with the restoration the environment according to the principles of sustainable utilization management of natural resources and the environment. Focusing on the delivery of natural resources and a good environment to the next generation with the concept of bio-economy, circular economy, and green economy development which places the importance on the application of scientific knowledge, modern technology, and creativity in order to create additional economic value along with maintaining a balance between conservation and utilization of the natural resource and biodiversity.

2. Research and development of appropriate trawl fishing methods with minimal impact on the sea bottom ecosystem will lead to sustainable use of fishery resources further.

Section 2C –Habitats

(Research 2) Analysis of trawl fishing ground in the eastern Gulf of Thailand:

In the group of fishing equipment, trawling is a challenging tool for proper fisheries management planning. It's estimated that trawl fishing equipment can catch a variety of aquatic animals, including cartilaginous fish, bony fish, shrimp, crabs, mollusks, and echinoderms. Collectively, there are more than 800 species in trawl fisheries across Asia (FAO, 2014) and more than 360 species in the Gulf of Thailand (Pornsin et al, 2018). This creates the need to find a comprehensive management approach to achieve fisheries balance in all types of catches, both for the main economic species and low-value aquatic animals (by-catch) which the proportions vary according to the gears type and fishing location of the trawl. For example, trawlers in the Gulf of Thailand, the by-catch can reach approximately to 60-70% from the Pair Trawl, 30-40% and 0.5 -1% from the Otter Board Trawl and Beam Trawl, respectively (Ponsin et al., 2018; Ahmed et al., 2007)

The impact of trawl fishing on the fishing grounds environment can be divided into four issues (Jones, 1992): 1. Scraping and plowing, which occur from various components of the trawl such as ropes, chains, buoys, and the nets to touch the sea floor by scraping or plowing along the sea floor, 2. Dispersion of sediment will affect the turbidity of the seawater and cause the physical, chemical, and biological composition of the sediment to change. Palanques et al. (2001) reported that small-sized sediment will disperse and begin to aggregate after 1 hour of trawling. In addition, a study of water turbidity found high values in the lower water areas which has changed from the first hour to 2 -5 days after trawling 3. Destroy benthic animals that are not the target group, which results from scraping and plowing, such as the breaking of corals and sponges or causing the shells of bivalves to crack. This Includes the impact on the abundance of benthic animals on trawl fishing routes and the stressful of aquatic animals in the area. This continues to affect the diversity of species and ecosystems in the area (Smith, 2000; Izaskun et

al., 2019; Saygu et al., 2020), and 4. The waste deposition process, including disturbing the natural nutrient cycling process and trawling. This results in a decrease in the amount of organic matter (Bhagirathan et al., 2008).

Vessel Monitoring System (VMS) is a system that combines the technology of the Internet, GPS, and Global Service Mobile (GSM) into a Vessel Positioning System (VPS) to help locate fishing vessels. It is a vessel tracking system developed in Thailand by the Department of Fisheries in collaboration with the National Electronics and Computer Technology Center (Department of Fisheries, 2011). In addition, if data from the fishing vessel tracking system is applied together with information from the fishing information recording system by the Port-In Port-Out Control Center (PIPO), it can be useful in assessing the impacts of trawl fishing.

Objective

To study the pattern of trawl fishing in the eastern Gulf of Thailand and to prepare a map of trawl fishing sites in the eastern Gulf of Thailand for use in determining measures for further management of trawl fishing, in case found an impact on important aquatic animal habitats (Critical Habitat).

Research methods

The data used in this study consists of 2 types of data: primary data and secondary data. The Important of secondary data used to calculate the transit area and catch volume comes from the Port-In Port-Out (PIPO) database and the Department of Fisheries fishing Vessel Tracking system data from 1st January 2021 – 31st December 2022. In addition, data collected using In-depth interviews to collect data on fishing patterns of Pair Trawl, Otter Board Trawl, and Beam Trawl from operators or vessel owners with experience in fishing to study factors affecting vessel speed during trawl fishing and calculating the trawl swep area for mapping the trawl fishing in the eastern Gulf of Thailand.

Research results

The study of trawl fishing in the eastern Gulf of Thailand covers fishing zone 1 and 2 of the vessels survey of the Department of Fisheries and fishing area 1 according to the zoning division of commercial fishing statistics of the Fisheries Department. The areas in which commercial trawlers can go fishing are totals 23,304.83 square kilometers, estimate from the speed during fishing of trawl vessels in the eastern Gulf of Thailand. In the Year 2022, fishing vessels face the problem of high oil prices due to the war situation between Russia and Ukraine. Therefore, this is one of the factors affecting the use of speed in fishing. In addition, besides to the factors of tides (base on the season), horsepower, gear reduction, and propeller size (engine size), the results of the statistical test found that the movement speeds of the pair trawl, beam trawl, and otter board trawl between 2021 and 2022 are significantly different at the significance level of 0.05. The median speed of pair trawl, beam trawl, and otter board trawl in 2022 being less than the median speed of vessel movement in 2021 (Table 1). Therefore, in estimating the speed during fishing this time, the analysis separated between 2021 and 2022. In 2022, Beam Trawl and Otter Board Trawl vessels size 60-<150 GT, and the Pair Trawl vessel has a speed reduction while fishing, especially the 30-<60 GT, Pair Trawl vessels have a reduced speed during the off-monsoon season (Between February and May) continues into the southwest monsoon period (Table 2). While many vessels use the method of refraining from fishing, the number of fishing vessel trips that go out to fishing with Port-In Port-Out notifications in the eastern Gulf of Thailand in 2022 is 5,349 trips, decreased from Year 2021 with a total of 6,746 trips or a decrease of 18.35 percent, affecting the amount of swep area and the quantity of aquatic animals caught in 2022 also decreased (18.61% and 13.21%, respectively).

Table 1: The average movement speeds of Beam Trawl, Otter Board Trawl, and Pair Trawl between 2021 and 2022.

Vessel speed information	Beam Trawl	Otter Board Trawl	Pair Trawl
Year 2021	2.06 ± 0.82	2.32 ± 0.27	2.38 ± 0.59
Year 2022	1.99 ± 0.83	2.26 ± 0.26	2.23 ± 0.53

Table 2: Overview of vessel speeds while fishing in the eastern Gulf of Thailand, classified by type of equipment.

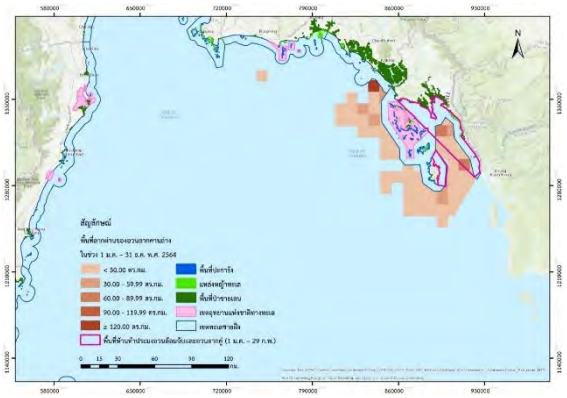
Vessel size	Season	Fishing time	Vessel speed while fishing (knots)					
			Beam Trawl		Otter Board Trawl		Pair Trawl	
			Year 2021	Year 2022	Year 2021	Year 2022	Year 2021	Year 2022
30 - <60 GT	Outside the monsoon season (dry season)	Day	1.51-2.50	1.51-2.50	2.00-2.49	2.00-2.49	2.01-3.00	1.51-3.00
		Night	1.51-2.50	1.51-2.50	2.00-2.49	2.00-2.49	2.01-3.00	1.51-3.00
	Southwest monsoon	Day	1.51-2.50	1.51-2.50	2.00-2.49	2.00-2.49	2.01-3.00	1.51-3.00
		Night	1.51-2.50	1.51-2.50	2.00-2.49	2.00-2.49	2.01-3.00	1.51-3.00
	Northeast Monsoon	Day	1.51-2.50	1.51-2.50	2.00-2.49	2.00-2.49	1.51-3.00	2.01-3.00
		Night	1.51-2.50	1.51-2.50	2.00-2.49	2.00-2.49	2.01-3.00	2.01-3.00
Overview of size 30 - <60 GT			**1.51-2.50**	**1.51-2.50**	**2.00-2.49**	**2.00-2.49**	**1.51-3.00**	**1.51-3.00**
60 - <150 GT	Outside the monsoon season (dry season)	Day	1.51-4.00	1.51-2.50	2.00-2.99	2.00-2.49	2.01-3.50	2.01-3.00
		Night	1.51-4.00	1.51-4.00	2.00-2.49	2.00-2.49	2.01-3.00	2.01-3.00
	Southwest monsoon	Day	1.51-2.50	1.51-4.00	2.00-2.49	2.00-2.49	2.01-3.00	2.01-3.00
		Night	1.51-2.50	2.51-4.00	2.00-2.49	2.00-2.49	2.01-3.00	2.01-3.00
	Northeast Monsoon	Day	1.51-4.00	1.51-4.00	2.00-2.49	2.00-2.49	2.01-3.00	2.01-3.00
		Night	1.51-4.00	1.51-2.50	2.00-2.49	2.00-2.49	2.01-3.00	2.01-3.00
Overview of size 60 - <150 GT			**1.51-4.00**	**1.51-4.00**	**2.00-2.99**	**2.00-2.49**	**2.01-3.50**	**2.01-3.00**

Note: Northeast Monsoon (October-January); Outside the monsoon season (February-May); southwest monsoon (June-September)

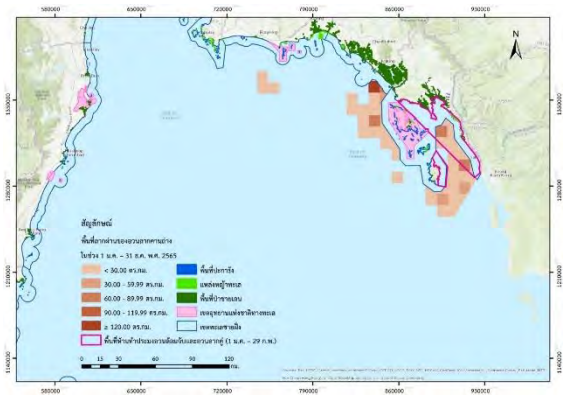
The average swep area during the study (2021-2022) is 35,175.80 squarekilometers per year (Table 3), representing 1.51 times the total area that can used for fishing, which has less fishing density than the inner Gulf of Thailand (Area that can use for fishing is 8,171.268 square kilometers, the average swep area is 23,091.72 square kilometers per year, equivalent to 2.82 times the total area that can used for fishing). Pair Trawl vessels are still the main influence on fishing in the eastern Gulf of Thailand as well as the inner Gulf of Thailand, followed by Otter Board Trawl and Beam Trawl but in the inner Gulf of Thailand, Beam Trawl vessels have more swep area than Otter Board Trawl vessels or have more fishing than Otter Board Trawl vessels (Table 3 and Figure 1).

Table 3: Swep area of fishing vessels in the eastern Gulf of Thailand

Year	Swep area (sq.km.)				%			
	Beam Trawl	Otter Board Trawl	Pair Trawl	All types	Beam Trawl	Otter Board Trawl	Pair Trawl	All types
2021	827.71	11,055.33	26,902.29	38,785.33	2.13%	28.50%	69.36%	100.00%
2022	829.08	8,948.19	21,788.99	31,566.26	2.63%	28.35%	69.03%	100.00%
+/-	1.37	(- 2,107)	(- 5,113)	(- 7,219)	0.17%	(- 19%)	(- 19%)	(- 18.61%)
average	828.40	10,001.76	24,345.64	35,175.80	2.36%	28.43%	69.21%	100.00%



Year 2021



Year 2022

Beam Trawl

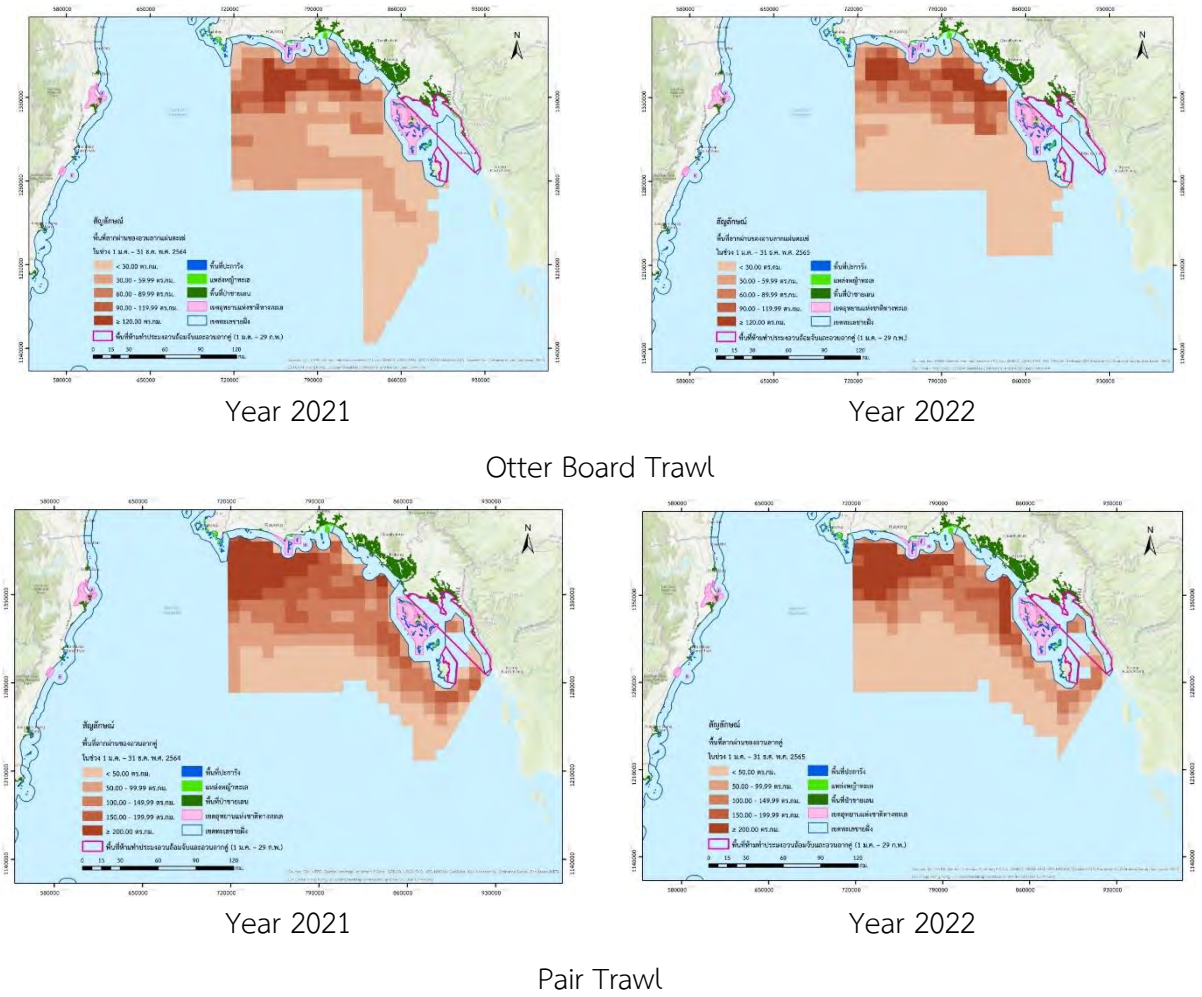


Figure 1 Swep area of the trawl in the eastern Gulf of Thailand

To clearer picture in this study, the fishing area in the eastern Gulf of Thailand was divided into 4 zones, perpendicular to the coastal edge and classified in each zone according to the distance from shore 15-30 nautical miles, using the line of latitude in dividing the area from the shoreline into 5 distance (I being the distance closest to the coastal, and V being the distance farthest from the coastal). This results in a total of 15 sub-areas (Figure 2)

The results of the study found that, overall, the proportion of fishing vessel swep area is mostly in Zone I-II (52.79-57.42 percent), However, if considered separately by type of fishing gear, **the proportion of the Beam Trawl swep area is mainly along the II line of almost all zones (Zone II-II, Zone III-II and Zone IV-II) and in the I line of Zone II (Zone II -**

I). This means that the area mentioned above is an important fishing area for the Beam Trawl. Furthermore, the importance fishing area for the Otter Board Trawl is along II and III line of Zones I and II (Zone I-II, Zone I-III, Zone II-II, and Zone II-III) while the important fishing areas of Pair Trawl will be in I, II, and III line of Zone I, Zone II, and Zone III (Zone II, Zone I-II, Zone I-III, Zone II-II, Zone III-II, and Zone III-III).

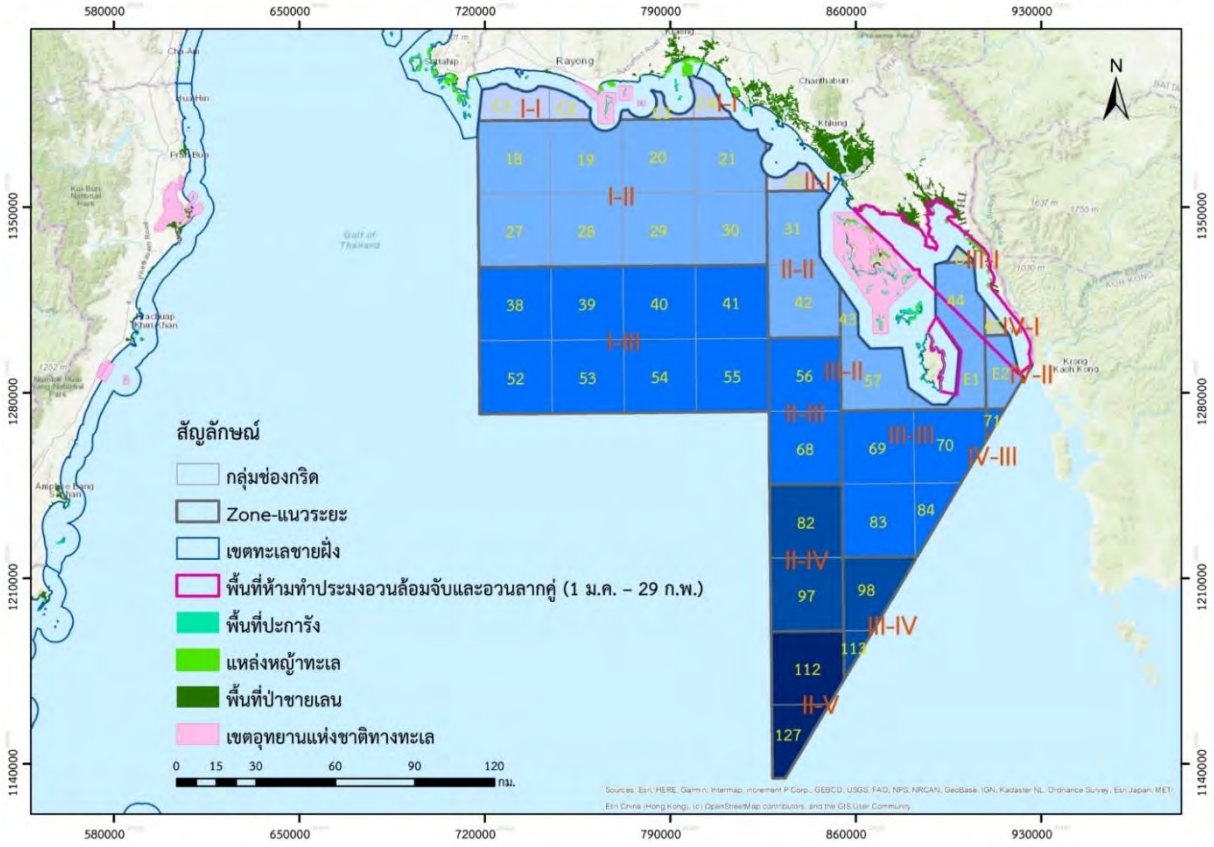


Figure 2 The area division according to zones and distance from coastal in the study area of the eastern Gulf of Thailand

When considering the amount of swep area, the number of aquatic animals caught, and the rate of aquatic animals caught per swep area together (Table 4-6) from the data year 2021-2022, the overall picture divided by zones found that the Zone I area has a high amount of swep area (23,189.92-29,537.19 square kilometers), and the number of aquatic animals caught (29,941.63-37,209.05 tons) is the most, followed by Zone II (swep area 5,217.26-5,232,81 square kilometer and Quantity of Aquatic animals caught 7,631.69-7,743.75 tons). **The areas with a**

highest rate of aquatic animals caught per swep area is Zone IV (1,935.10-2,578.40 kilograms per square kilometer or 1.93-2.57 tons per square kilometer), followed by Zone III (1,890.55-2,567.27 kilograms per square kilometer or 1.89-2.56 tons per square kilometer) both areas are near islands and bays that have protected areas where commercial fishing vessels are prohibited.

In addition, in the overall picture of the distance from shore (commercial area) was found that the line II is the line with the highest swep area (23,594.02-25,682.53 square kilometers) and the number of aquatic animals caught (32,913.02-34,450.68 tons) is the most, followed by the line III (swep area 4,218.03-8,902.46 square kilometer and Quantity of Aquatic animals caught 7,343.17-12,516.30 tons). However, the area with a highest rate of aquatic animals caught per swep area is the line III (1,405.94-1,740.90 kilograms per square kilometer or 1.40-1.74 tons per square kilometer), followed line I (1,365.77-1,439.20 kilograms per square kilometer or 1.36-1.43 tons per square kilometer), **When considering the quantity of aquatic animals caught, classified by area and distance from shore together, it was found that areas near the Chang Islands line and surrounding protected areas will have a greater abundance of aquatic animals than areas further from coastal and islands. These are Zone II-I, Zone II-II, Zone II-III, Zone III-I, Zone III-II, Zone III-III, Zone IV-II, and Zone IV-III.**

Table 4: Swep area of fishing vessels in each zone and distance from coastal

Unit: square kilometer

Line	Zone					% Zone				
Distance	I	II	III	IV	รวม	I	II	III	IV	Total
2021	29,537.19	5,217.26	3,501.02	529.86	38,785.33	76.16%	13.45%	9.03%	1.37%	100.00%
I	3,012.92	736.95	46.26	0.36	3,796.49	7.77%	1.90%	0.12%	0.001%	9.79%
II	20,476.64	2,974.18	1,751.31	480.40	25,682.53	52.79%	7.67%	4.52%	1.24%	66.22%
III	6,047.63	1,125.38	1,680.35	49.10	8,902.46	15.59%	2.90%	4.33%	0.13%	22.95%
IV		355.99	23.10		379.09		0.92%	0.06%		0.98%

Line	Zone					% Zone				
Distance	I	II	III	IV	รวม	I	II	III	IV	Total
V		24.76			24.76		0.06%			0.06%
2022	**23,189.52**	**5,232.81**	**2,571.83**	**572.10**	**31,566.26**	**73.46%**	**16.58%**	**8.15%**	**1.81%**	**100.00%**
I	2,442.25	1,094.19	150.80	1.34	3,688.58	7.74%	3.47%	0.48%	0.00%	11.69%
II	18,126.31	3,582.43	1,349.15	536.12	23,594.02	57.42%	11.35%	4.27%	1.70%	74.74%
III	2,620.96	490.55	1,071.88	34.63	4,218.03	8.30%	1.55%	3.40%	0.11%	13.36%
IV		65.64	0.0		65.64		0.21%	0.0%		0.21%
V		0.0			0.0		0.0%			

Table 5: Quantity of aquatic animals caught in each zone and distance from coastal

Line of distance	Number of aquatic animals captured (tons)					Percentage				
	Zone									
	I	II	III	IV	รวม	I	II	III	IV	รวม
Year 2021	**37,209.05**	**7,743.75**	**6,618.87**	**1,025.33**	**52,597.00**	**70.74 %**	**14.72 %**	**12.58 %**	**1.95 %**	**100.00 %**
I	3,994.27	1,130.83	59.55	0.49	5,185.14	7.59%	2.15%	0.11%	0.00%	9.86%
II	24,771.93	4,616.53	4,116.26	945.97	34,450.68	47.10%	8.78%	7.83%	1.80%	65.50%
III	8,442.85	1,579.02	2,415.56	78.87	12,516.30	16.05%	3.00%	4.59%	0.15%	23.80%
IV		388.98	27.50		416.49		0.74%	0.05%		0.79%
V		28.39			28.39		0.05%			0.05%
Year 2022	**29,941.63**	**7,631.69**	**6,602.59**	**1,475.10**	**45,651.01**	**65.59 %**	**16.72 %**	**14.46 %**	**3.23 %**	**100.00 %**
I	3,140.15	1,602.90	564.14	1.42	5,308.60	6.88%	3.51%	1.24%	0.00%	11.63%
II	22,774.87	5,211.66	3,586.40	1,340.09	32,913.02	49.89%	11.42%	7.86%	2.94%	72.10%
III	4,026.61	730.91	2,452.06	133.59	7,343.17	8.82%	1.60%	5.37%	0.29%	16.09%
IV		86.22	0.00		86.22		0.19%	0.00%		0.19%
V		0.00					0.00%			

Table 6: Ratio of aquatic animals caught per swep area of trawlers fishing in the eastern Gulf of Thailand classified by area and distance from coastal

Line	Ratio of aquatic animals caught per area towed through (kilograms per square kilometer)				
Distance	Zone I	Zone II	Zone III	Zone IV	Total
2021	1,259.74	1,484.26	1,890.55	1,935.10	1,356.11
I	1,325.71	1,534.47	1,287.29	1,361.11	1,365.77
II	1,209.77	1,552.20	2,350.39	1,969.13	1,341.41
III	1,396.06	1,403.10	1,437.53	1,606.31	1,405.94
IV		1,092.67	1,190.48		1,098.66
V		1,146.61			1,146.61
2022	1,291.17	1,458.43	2,567.27	2,578.40	1,446.20
I	1,285.76	1,464.92	3,740.98	1,059.70	1,439.20
II	1,256.45	1,454.78	2,658.27	2,499.61	1,394.97
III	1,536.31	1,489.98	2,287.63	3,857.64	1,740.90
IV		1,313.53	0.00		1,313.53
V		0.00			0.00

The elements of aquatic animals caught by trawlers

In studying the accordance of the composition of aquatic animals caught in each zone, the proportion of by-catch fish to aquatic animals consumed, the ratio of aquatic animals caught per swep area, and the rate of aquatic animals caught per fishing area. The study results indicate that the highest by-catch fish mostly caught is in Zone IV, areas near Chang Island, which has a ratio of by-catch fish and aquatic animals for consumption (1.41), a ratio of aquatic animals caught per swep area (2,269.07 kilograms per square kilometer) and the rate of aquatic animals caught per fishing area (3,089.92 kilograms per square kilometer). Followed by Zone I and II areas that are important areas for Pair Trawl and Otter Board Trawl fishing in the group of aquatic animals for consumption. **The composition of aquatic animals caught in each zone, the rate of aquatic animals caught per swep area and the rate of aquatic animals caught per fishing area. The data shows the consistent**

and indicates that the Pelagic fishes are most likely to be caught in Zone III (near the Chang Islands). Squid and shell groups are caught the most in Zone I, and the group of crabs, shrimp, and crayfish are caught the most in Zone IV (near the Chang Islands), except for the Demersal fish group. Indicators for the composition of aquatic animals caught in each zone, the rate of aquatic animals caught per swep area, and the rate of aquatic animals caught per fishing area may not be consistent as in the case of other groups of aquatic animals. If in the case of considering the composition of aquatic animals caught in the proportion of demersal fish, it is more than 50 percent of fish were found in all 4 areas (Zone I-IV). Rate of aquatic animals caught per swep area indicates the demersal fish group was caught in greater numbers in zone III (671.41 kilograms per square kilometer) while the ratio of fish caught per fishing area indicates that the Demersal fish group are abundant in zone I (790.28 kilograms per square kilometer) and Zone IV (767.22 kilograms per square kilometer).

In addition, when considering the abundance or fishing grounds of aquatic animal groups along the distance of the coast from the aquatic animal elements caught in each zone, the proportion of catch-fish fish to aquatic animals for consumption, Rate of Aquatic animals caught per swep area and rate of aquatic animals caught per fishing area, the results indicate that pelagic fish, squid, crabs, shrimp, and crayfish are mostly caught closer to the coast (line I-II) and begin to decline farther from the coast, except for the Demersal fish group. The proportion of catches was greater in the distances away from the coast (from stages III-IV), but the rate of aquatic animals caught per fishing area indicates that the abundance of Demersal Aquatic animals is more abundant along coast distances I and II than along coast distances III, IV, and V. The proportion of by-catch fish is greater in areas near the coast (within the commercial area) and proportion of catch fish will decrease when fishing farther from coastal. **These data indicate that areas near the coastal are**

important resources especially pelagic fish, squid, crabs, shrimp and crayfish.

Among the pelagic fish caught by trawlers in the eastern Gulf of Thailand that are classified in the fishing logbook for the period 2021-2022, there are a total of 25 species. First, 5 species of Pelagic fish are most commonly caught are *Stolephorus* spp., *Clupeidae* sp., *Selaroides* sp., *R. brachysoma* and *R. kanagurta*. **The catching rate of aquatic animals per swep area in the overall of pelagic fish decreased from 2021 by 11.77 kilograms per square kilometer. Among the 25 Pelagic fish species, 12 species had a decrease in catch per swep area in 2022, with *Stolephorus* spp. having a decrease of 17.71 kilograms per square kilometer. Monitoring the situation of fish resources of *Stolephorus* spp. may need to continue to monitor how this decline continues or this is just a change in the resources according to the life cycle. The squid, crab, shrimp, and crayfish groups had a decrease in the rate of fish caught per swep area in 2022 from 2021, as same as the pelagic fish group (reduced 0.65, 1.49, 3.13 and 0.46 respectively)**

For the Demersal fish group, which is the main aquatic animal of the trawl fishery, the study in the eastern Gulf of Thailand found a total of 30 species of demersal fish that are classified in the fishing logbook, except for other fish (which are unclassified). **Demersal fish that caught in large quantities during 2021-2022 and have an influence on trawl fishing in the eastern Gulf of Thailand are *Mullidae* sp., *Sphyraena* spp, *Leiognathidae* sp., *Priacanthus* spp., *Nemipterus* spp. and *Saurida* spp. Among the 30 demersal fish species, 15 species had a decrease in catch per swep area in 2022, especially *Priacanthus* spp., *Saurida* spp. which decreased to 23.64 and 3.15 Kilograms per square kilometer, respectively.**

Suggestions obtained from the study are as follows:

1) The catch rate per swep area of many aquatic species is higher in the vicinity of coastal areas and areas near islands; it shows that the conservation of these areas is important to help protect nursery areas and habitats for aquatic animals to have a better chance of survival before entering to the fishing grounds.

2) The use of speed while fishing affects the amount of swep area and the number of aquatic animals caught, including the rate of aquatic animals caught per swep area. As the factor effects of the use of speed while fishing by engines, machinery used and the season is an important factor for all gear types of trawlers, Oil prices are also an important factor that drives decisions about trawl fishing (stop/reduce/increase). Monitoring of trawl fishing using the swep area and the quantity of aquatic animals caught should therefore be continuous to create an indicator for predicting or monitoring the situation of utilization the resources used for benefits from trawlers, including determining management measures more accurately.

3) High-risk fish groups such as *Saurida* spp., and relatively high-risk aquatic animal groups such as *Stolephorus* spp., *Priacanthus* spp., Squid groups (such as *Sepiida* sp., *Octopoda* sp., *Sepioteuthis* sp.) Shrimp groups (such as *Fenneropenaeus* sp., *Metapenaeus* sp.) and crab groups (such as *Portunus pelagicus*) groups had a decrease in the ratio of fish caught per swep area, especially *Stolephorus* spp., *Priacanthus* spp., and *Saurida* spp. are of high economic importance. The combined analysis of biological data helps to reveal qualitative information, such as the size of aquatic animals caught in the area. This will help to analyze the data more clearly and make the determination of fishery management measures effective.