Milestone 38 Review the status and management measures in place of ecosystem.

Committee for Sustainable Management of Blue Crab Resources in Thailand.

December 2023.

On 16th March 2023 at the Department of Marine and Coastal Resources, TFFA met with the Director-General of the Department of Marine and Coastal Resources to report on the progress of the Fishery Improvement Project (FIP) and discuss the implementation of the Fishery Action Plan (FAP) activities related to Endangered, Threatened, and Protected species (ETP Species).

the Director-General of the Department of Marine and Coastal Resources appointed the Director of the Marine and Coastal Resources Research Institute to discuss and clarify information on Endangered, Threatened, and Protected species (ETP Species). The meeting discussed the issue of requesting information on the rescue of ETP Species both from beached and reporting of these species and invite the DMCR to participate in the Fishery Action Plan (FAP) implementation activities, such as organizing a practical training meeting operations rescuing marine animals with stakeholders and the Department of Fisheries that plan to continue in the future. The Department of Marine and Coastal Resources was pleased to provide the information requested by the working group and was willing to participate in activities according to the development plan.

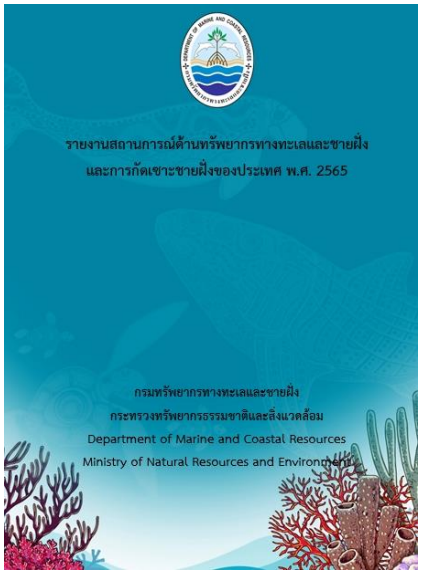
After that, on September 12, 2023, (TFFA, Department of Fisheries and Department of Marine and Coastal Resources) A preparatory meeting was held for the ETP Species workshop, with plans to hold the workshop in 2 areas: Samut Songkhram Province. and Surat Thani Province

and the Department of Fisheries and the Department of Marine and Coastal Resources are pleased to send their agencies' speakers to give lectures.

On September 25th, 2023, at Mae Klong Fishery Cooperative Limited, Mae Klong Subdistrict, Mueang District, Samut Songkhram Province, TFFA in collaboration with the Department of Fisheries and the Department of Marine and Coastal Resources Organized a workshop to develop guidelines for endangered, threatened, and protected species (ETP species) during trawl fisheries. There is a desire to organize a workshop to develop guidelines for endangered, threatened, and protected aquatic animals. During trawl fishing with trawl, fishermen choose the area where trawl fishing is the main of gear are the upper Gulf of Thailand area and some southern regions, such as fishermen representatives from Samut Sakhon Province, Samut Prakan Province, Prachuap Khiri Khan Province, Fisherman's Association Ban Laem District, Songkhla Province, etc., The results from the workshop on the issue of ETP Species included information on sightings of ETP species, impacts of fishing on ETP Species, and animal rescue including various suggestions from the meeting will be used to prepare a report on the fishery to ETP Species and create a manual for the specific fishery.

On October 31, 2023 at the meeting room of Phumriang Municipality Office, Surat Thani Province. TFFA by Mr. Treerat Chaonthawee, Advisor to the Sub-Committee, Crab Products Group and Mr. Thawatchai Poonchuay, chairman of the subcommittee, attended a workshop to develop guidelines for rescuing and recording rare marine animals and marine mammals. The objective of this workshop is to create knowledge and understanding for fishermen about life-saving methods for ETP Species and recording sightings of rare marine animals and marine mammals. From the workshop, fishermen informed that in fisheries in Surat Thani province, turtles, dolphins, and dugongs were mostly found in fishing areas and there were some turtles caught in fishing gear. However, fishermen still do not know how to inform relevant government agencies when they see ETP species. The Department of Marine and Coastal Resources further clarified that the Department of Marine and Coastal Resources has created a LINE group together with fishing community leaders. If fishermen wish to report sightings of ETP Species, they can report them through this channel. Furthermore, they can also notify the local fishing community president to coordinate with the Department of Fisheries and the Department of Marine and Coastal Resources. The Department of Fisheries has further clarified guidelines for recording sightings of ETP Species that may be used with local fisheries in the future. Local fishermen reported that fishermen may not be comfortable recording themselves and using electronic systems for reporting. But if recording is necessary in the future, it is proposed to provide training to fishermen first.

Most recently, on November 1, 2023, the TFFA, Department of Fisheries and Department of Marine and Coastal Resources held a meeting to discuss to consider preparing information on the marine ecosystem status of blue swimming crab fishing according to international sustainable fishing standards. From the meeting it was suggested that there is a need for an overall review of the status of the marine ecosystem. Especially Surat Thani Province Including checking whether each part of the ecosystem has a plan or measures for management and restoration. A representative from the Department of Marine and Coastal Resources informed that The Department has completed preparing a report about marine and coastal resources in 2022. Along with this, a dugong plan and marine mammals' protection act (MMPA) were prepared, the details are as per the attached document.



A summary of the situation reports on marine and coastal resources in 2022 from the Department of Marine and Coastal Resources is as follows:

Thailand

1.1 Marine Resources

1.1.1 Coral Reef Resources

Thailand has a total coral reef area of 149,182 rai, spread across 17 coastal provinces. From the survey of coral reefs in Thailand by the Department of Marine and Coastal Resources found about 280 coral species

from 18 families and 71 genera. (About 800 coral species found worldwide) The dominant coral species are mountain coral (Porites lutea) and staghorn coral (Acropora spp.), etc. Most of the coral reefs surveyed are coral reefs that form along the shores of islands or along the mainland coast (fringing reef), which are distributed in 2 main areas: Coral reefs in the Gulf of Thailand, it has a total area of 75,426 rai, consisting of the eastern Gulf of Thailand scattered around various islands, including about 100 islands from Trat, Chanthaburi, Rayong and Chonburi. Most of the coral reefs in the central Gulf of Thailand are found around 150 islands in Chumphon, Surat Thani, and Nakhon Si Thammarat Province and the lower Gulf of Thailand, which are scattered a few islands, mostly small islands and various rock mounds in Songkhla, Pattani, and Narathiwat Province. Coral reefs on the Andaman Sea have a total area of 73,756 rai, consisting of coral reefs on the coast and islands from Ranong, Phang Nga, Phuket, Krabi, Trang, and Satun Province. There are also some coastal coral reefs and coral reefs in underwater mounds, especially those far offshore and deep waters that have not been explored.

Coral reef status was assessed using the coverage ratio of life coral (LC) and dead coral (DC), which is a percentage of total area. There are 5 criteria for assessing the status of coral reefs as shown in Table 1.1.

Table 1.1 The ratio of the coverage between life coral (LC) and dead coral (DC).

Area Coverage Ratio (LC: DC)	Coral Reef Status
≥3 : 1	perfect very good
2 : 1	perfect
1 : 1	medium complete
1 : 2	damaged
1 : ≥3	very damaged

Changing the Long-Term Status of Coral Reefs in Thailand

Long-term data on the status of coral reefs at the national level (Figure 1.1 and Table 1.2) were initially reported during 1995-2015, obtained from surveys using the Manta tow technique which is a survey of the status of coral reefs covering a wide area. Subsequently, since 2016, coral reef status reporting has been changed to using survey data by Line Intercept Transect method. This is a detailed survey to obtain in-depth academic data that can be used to compare long-term data in the same area. Data were collected in representative areas of coral reefs in some areas only, and in the past, coral reef surveys completed all areas in all provinces had a period of approximately 4-6 years. However later in 2018, the National Marine and Coastal Resources Management Policy and Plan Committee resolved for the Department of Marine and Coastal Resources and the Department of National Parks, Wildlife and Plant Conservation to jointly develop a plan and

guidelines for surveying and monitoring the status of the coral reefs of Thailand to be able to report results at all stations within 1 year. There are 336 coral resource status monitoring stations in the country by The Department of Marine and Coastal Resources conducted 176 survey stations in areas outside the park boundaries and the Department of National Parks, Wildlife and Plant Conservation conducted 160 survey stations in its responsible areas.

Data from surveys during 1995 – 1998 showed that Thailand had coral reefs that were in good, moderately intact and damaged in a similar proportion. There are 31.5%, 32.1% and 36.4%, respectively same as during the years 2006 - 2008, the coral reefs have not changed much by coral reef areas that are in perfect condition slightly increased from the original to 34.0%. The number of moderately coral reefs decreased to 28.9%. Damaged coral reefs slightly increased to 37.1%.

Between 2011 and 2015, there was a significant increase in damaged coral reef areas by increasing to 78.4%. While coral reefs in perfect and moderately coral reefs decreased to only 5.7% and 15.9%, respectively. The main cause of coral reef degradation during this period was the coral bleaching phenomenon that occurred throughout Thai waters. In 2010, the coral reefs were affected so badly that most of the coral reefs were damaged. For example, coral reefs in the eastern Gulf of Thailand and western Gulf of Thailand have an average of 45-50% and 70% of corals surviving after coral bleaching, respectively. while the coral reefs in the northern Andaman Sea (Phangnga-Phuket provinces) on average 25% of the coral survived after bleaching. In the Southern Andaman Sea (Trang and Satun Provinces), on average, 60% of the corals survived after bleaching. In addition to the coral bleaching phenomenon, human activities also contribute to increasing coral reef degradation or slower recovery from damage from various causes. Especially marine tourism activities and coastal development to support tourism activities. Including sediment from the coast, which is the main cause of coral reef degradation in many areas. Because of the status of coral reefs during 2011-2015, most of them are in a damaged state.

Survey data from 2016 to 2017, which is a continuation of changes in survey methods and survey cycles of coral reef areas. From the original survey that had to be repeated using a survey of 4 years, the survey area was divided between the Department of Marine and Coastal Resources and the Department of National Parks, Wildlife and Plant Conservation which must complete surveys at all stations across the country within one year. But due to the unavailability of manpower and budget, some areas must use the same data from the previous survey since 2015 to cover enough coral reefs to be used as a representative coral reef status of each province. However, it was found that coral reefs were recovering with coral reefs in perfect condition. Coral reefs in

moderate status increased to 11.5% and 27.5%, respectively, while coral reefs that were damaged decreased to 61.0%.

Data from surveys during 2018 – 2019 are the periods where a detailed survey of the coral reef status is carried out at all stations across the country simultaneously by the cooperation between the Department of Marine and Coastal Resources and the Department of National Parks wild animals and plants found that coral reefs returned to a similar status to the period 1995 – 1998 again.

Data from surveys during 2020 - 2021 found that coral reefs are in a similar status to coral reefs during 2018 - 2019 and tend to improve slightly. It was found that most of the coral reefs were in a status of moderate to perfect fertility and the proportions were similar. For the years 2020 - 2021, coral reefs were found to be in perfect condition and moderately fertile, which is 38%. In 2018 - 2019, coral reefs were in perfect condition and moderately, equal to 36% and 33%, respectively.

According to the latest survey in 2022, coral reefs are in perfect condition than in 2020-2021, and there is a slight improvement trend. In 2022, 53% of coral reefs were in perfect condition, 22% in moderate condition, and 25% in damaged condition.

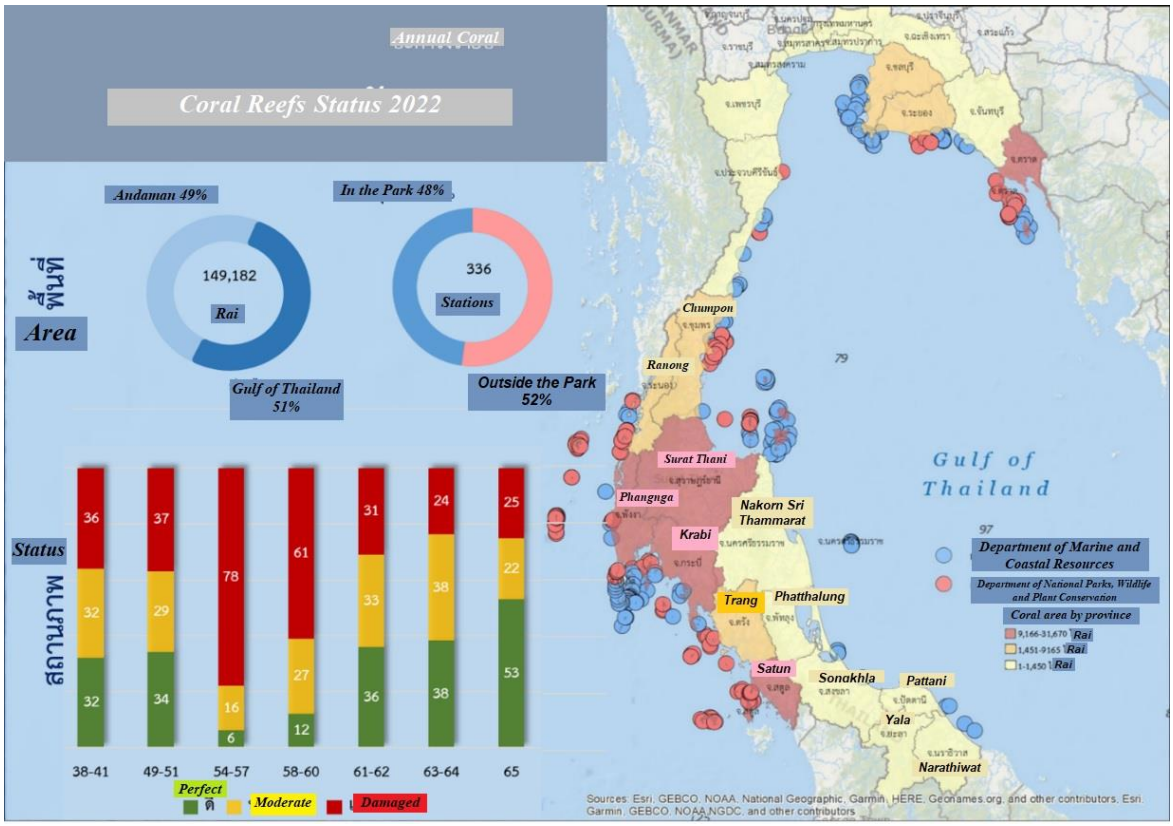


Figure 1.1 Coral Reef Study Area in Thai Waters Coral Reef Status Trends

The status of coral reefs in 17 provinces in Thai waters in 2022 (Figure 1.2) found that overall coral reefs in the Andaman Sea are slightly more perfect than those in the Gulf of Thailand. It was found that in the Andaman Sea, coral reefs were in perfect condition 56.7%, moderately 22.8% and damaged 20.5%. As for the Gulf of Thailand, coral reefs were in perfect condition, 50.0%, moderately 21.3%, and 28.7% damaged. Overall, the coral reefs in the Andaman Sea are slightly more complete than those in the Gulf of Thailand.

When comparing the coral reef status data between the Andaman Sea and the Gulf of Thailand between 2021 and 2022, it was found that the overall coral reef status of the country tends to be more complete. There are better changes in both the Andaman Sea and the Gulf of Thailand. In the year 2022, there are coral reefs that are in good condition 53% (area 79,951 rai) more than the year 2021, which is 52.3% (area 78,002 rai). The status of coral reefs in the Andaman Sea increased from 54.9% to 56.7%, while the coral reefs in the Gulf of Thailand in perfect increased from 49.7% to 50%.

The trend of change in coral reef status compared to the status in 2021 (Figure 1.2) is generally stable both in the Andaman Sea and the Gulf of Thailand. Many provinces on the coast of the Andaman Sea tend to be stable, except for Ranong and Phang Nga provinces, which have changed for the better. The same goes for the Gulf of Thailand. Most of them were unchanged except in Chanthaburi and Songkhla provinces where the damage increased.

The coverage of life corals in Thai waters in 2022 (Figure 1.3) found that the coral reefs on both coasts had a high coverage of life corals at about 40% – 60%. In the Andaman Sea, Satun and Phuket coral reefs have the highest coverage of life corals, Gulf of Thailand Coral reefs in Suratthani, Chumphon and Pattani provinces had the highest coverage of life corals.

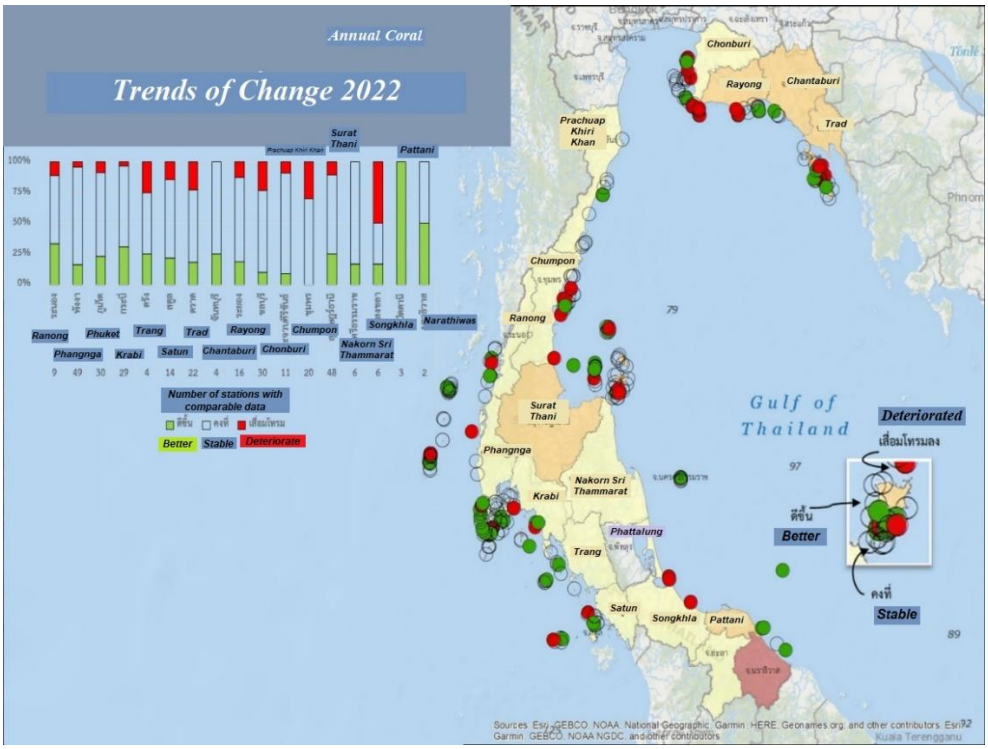


Figure 1.2 Proportion of coral reef status in each province from the survey in 2022

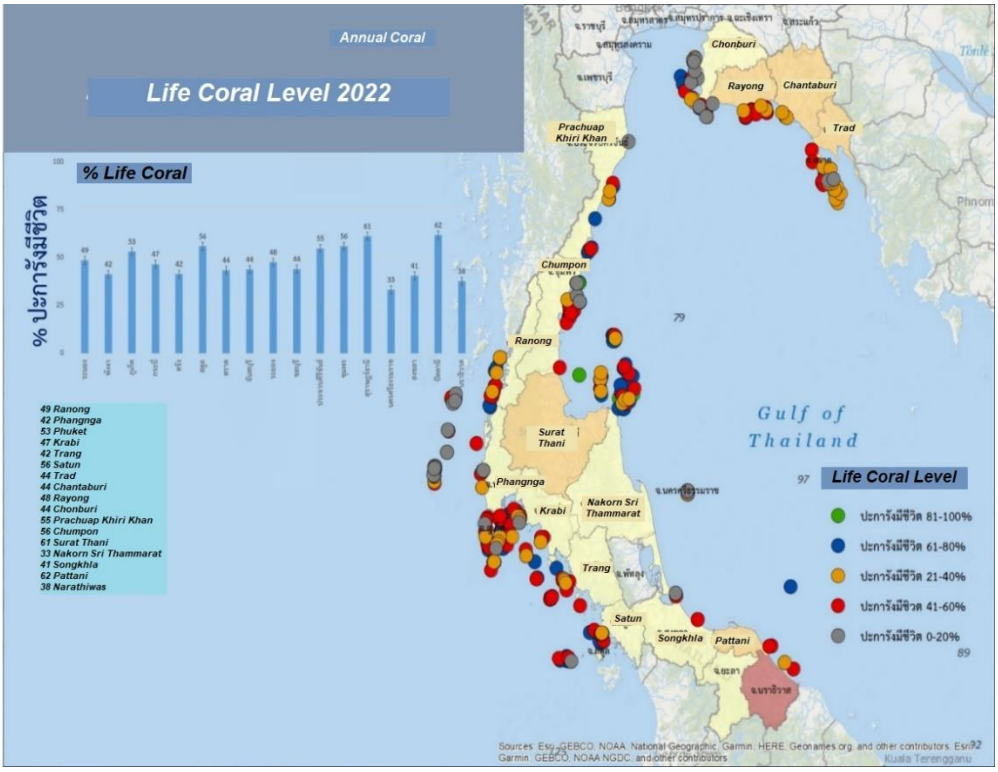


Figure 1.3 Percentage of live coral cover in each coral reef province from the survey in 2022.

The status of coral reefs in many areas tends to improve, for example: Coral reefs in many areas of Koh Kood, Trat Province, Khai Islands, Phang Nga Province, Racha Yai Island, Panwa Cape and Maiton Island Phuket Province Kra Islands Nakhon Si Thammarat Province both from natural recovery of coral reefs and restoration of coral reefs, as well as increased life coral area from coral replanting (Figure 1.4). However, the process of implementing the Coral Restoration Project through integrated augmentation in all sectors still has operational problems in various aspects. Therefore, it is necessary to closely control and tighten the operation of operators.

Figure 1.4 Rehabilitation of coral reefs by planting (on the sand off the reef)

In addition to the naturally occurring recovery, many areas of coral reefs have been managed and systematically controlled, allowing coral reefs to recover despite intensive tourism, for example, coral reefs in the Khai Islands group, Phang Nga province, where coral reefs began to recover naturally. After the management of the Department of Marine and Coastal Resources placed mooring buoys to reduce anchoring in coral reefs, controlling activities that may damage coral reefs since 2016. However, the recovery of coral in many areas is still at an early level, which may not see a clear change in status. Consequently, proper management is required to ensure that recovery continues. However, it was found that coral reefs in some areas are still deteriorating or tend to be more deteriorated, such as the coral reefs in front of Tai Mueang Beach, Phang Nga Province, and Bang Tao Bay, Kamala Bay, and Bon Island, Phuket Province.

Most of the causes of degradation are caused by human activities such as wastewater from community areas, coastal sediments Garbage left on coral reefs, such as nets that cover coral reefs at Losin Island, coral damage from coral migration in sea walker diving activities such as the area of Koh Larn and Koh Sak, Chonburi Province. Fishing causes the trampling of coral reefs in shallow waters and anchoring in coral reefs, Intensive tourism without proper academic management makes the local environment unfavorable for coral reef recovery. Most

coral reefs in the Andaman Sea are affected by waste from fishing and navigation activities and tourism. They found both old and new garbage, such as seine nets, ropes and fishing line. For example, coral reefs around Khai Nai Island, Khai Nok Island, Khao Na Yak and Lipi Island, etc. But the corals are not affected much. In addition, the current increase in tourists may be a risk factor for coral impacts if no good management measures are taken (Figure 1.5 – 1.6).

Figure 1.5 Examples of garbage found in coral reefs.

The status of coral reefs in many areas tends to improve due to the natural recovery of coral reefs. Observed from found coral larvae scattered around the survey line were observed, such from coral reefs around Ko Ka, Ko Sriboya, Ko Ma and Ko Por in Krabi Province.

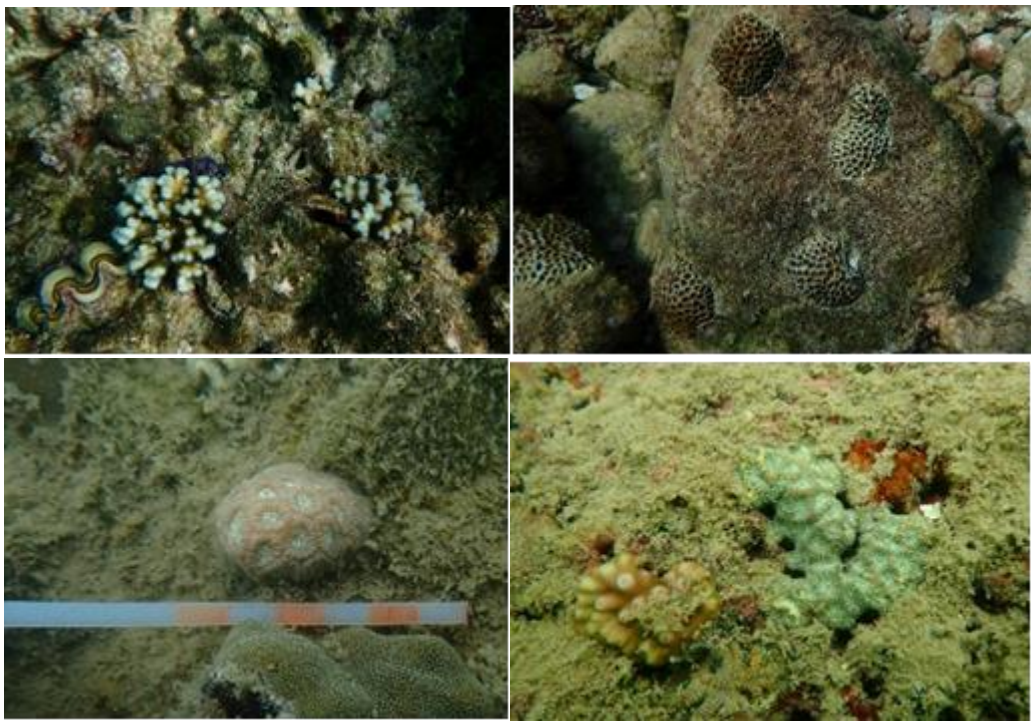


Figure 1.6 Coral larvae around Koh Ma Krabi Province (top picture left-right)
Coral larvae around the crab cap area Krabi Province (Bottom left picture)
Coral larvae around Koh Ya, Trang province (Bottom right picture)

When considering the total coral reefs of Thailand with approximately 149,182 rai, it was found that the province with the most coral reefs was Surat Thani Province with an area of 35,982 rai, followed by Phang Nga Province with 26,691 rai. Compared to data surveyed during 2021, it was found that the coral reef status in 2022 tends to be slightly more perfect. The coral reefs are in perfect, increasing from 52.3% to 53%. The coral reefs that are in the best condition of the country are the coral reefs of Koh Samui and Koh Phangan in Surat Thani Province and the coral reefs of Adang-Rawi Islands in Satun Province. The most damaged coral reef areas were in Trat and Phang Nga provinces (Table 1.2).

Table 1.2 Coral Reef Area Size and Coral Reef Status in 2022

Province	Coral Reef Area Size (Rai)	Coral Reef Status (Rai)		
		Perfect	Moderate	Damaged
Ranong	2,828	1,036	688	1,104
Phangnga	26,691	10,941	6,708	9,042
Phuket	13,757	6,615	6,364	778
Krabi	14,039	9,107	721	4,211
Trang	3,015	2,000	1,008	7
Satun	13,426	12,113	1,313	0
Trad	17,757	882	439	16,436
Chantaburi	766	316	430	20
Rayong	3,151	927	1,756	468
Chonburi	6,478	4,377	1,994	107
Prachuap Khiri Khan	1,421	1,179	108	134
Chumpon	9,143	8,135	850	158
Surat Thani	35,982	21,649	10,316	4,017
Nakorn Sri Thammarat	412	123	39	250
Songkhla	167	18	118	31
Pattani	108	108	0	0
Narathiwas	41	25	16	0
Area Total (Rai)	**149,182**	**79,551**	**32,868**	**36,763**
Percentage		**53**	**22**	**25**

Coral Situation in 2022

From studying the status of coral reefs in the Gulf of Thailand and Andaman seas, a total of 336 study stations, it was found that the status of coral reefs in many areas tended to be more perfect, such as in Ranong Province. and Phang Nga Province. The main problems that still occur with coral reefs in Thailand are those caused by natural factors namely the coral bleaching phenomenon, which occurred the latest in the year 2021 and is likely to increase in frequency from the past or may occur every year and Pabuk storm that occurred in early 2019. At present, there are still threats caused by human activities, which are clearly caused by waste on coral reefs. Especially the waste such as seine nets. Illegal fishing near coral reefs or in the reefs of remote islands, sediment from coastal development, such as construction with open topsoil, dredging coastal areas for various businesses, Illegal discharge of wastewater into the sea, dumping of garbage into the sea, smuggling of coral and catching ornamental fish for commercial purposes, illegal dismantling of coral on the beach to make a sandy surface for tourists to swim in or dredging coral reefs to form a channel for coral reef tourism or the detrimental effects of skin diving tourists, anchoring in coral reefs, problems caused by sea walkers and try dives, standing on corals, trampling and turning over corals to find different creatures such as clams, octopus, sea cucumbers. Oil spills into the sea, oil leaching from fishing boats, discharge of wastewater from cruise ships, wastewater from the coast, such as Koh Tao, Koh Phangan, Koh Samui, etc. However, the most severely destructive impact that covers almost the whole country is the impact of coral bleaching in 2010.

1.1.2 Seagrass resources

The seagrass ecosystem is an important system for marine life and abundance of the sea. It is a nursery, spawning, living, refuge and growth of aquatic larvae. Many economic aquatic animals have a life span that is associated with seagrass beds, such as black tiger prawns, Banana shrimp, and grouper, etc. The sea grass area is also a habitat and food for rare marine animals such as dugongs and sea turtles. There is also an economic importance from fisheries in the grass such as collecting grouper fry to be reared in cages. Other fishing activities such as crab sinking nets, crab traps, and traps, etc.

In Thailand, seagrass beds grow well in shallow coastal waters, spreading in many areas such as brackish water around river mouths, shallow shores with sandy or muddy bottoms, or mixed with coral reefs. A total of 13 seagrass species were found: Cymodocea rotundata [Ascherson & Schweinfurth 1870], Cymodocea serrulata [(R. Brown) Ascherson & Magnus 1870], Enhalus acoroides [(Linnaeus f.) Royle 1839], Halophila beccarii (Ascherson 1871), Halophila decipiens (Ostenfeld 1902), Halophila major [(Zollinger) Miquel 1856], Halophila minor [(Zollinger) Hartog 1957], Halophila ovalis [(R. Brown) J.D. Hooker 1858], Halodule pinifolia [(Miki) Hartog

1964], Halodule uninervis [(Forsskål) Ascherson 1882], Syringodium isoetifolium (Ascherson) Dandy 1939), Thalassia hemprichii [(Ehrenberg) Ascherson 1871], Ruppia maritima (Linnaeus 1753). From the seagrass resources database of the Department of Marine and Coastal Resources in 2020, summarizes the scope of potential areas as seagrass sources. * (Marine and Coastal Resources Research and Development Institute, 2020) It has an area of approximately 160,628 rai in 17 coastal provinces with the Gulf of Thailand having a total area of 54,148 rai and the Andaman coast having an area of 106,480 rai. Currently, there are 12 seagrass species found (Table 1.3). In the Andaman Sea, all 12 types of seagrasses can be found, with Enhalus acoroides and Halophila ovalis being the dominant species that can be found everywhere. On the Gulf of Thailand, there were 11 types of grasses, with Halophila ovalis and Halodule pinifolia being the dominant species that could be found everywhere. No Halophila major was found, which was recently reported only in the Andaman coast of Thailand. The Ruppia maritima was reported to be found only in natural places in the mangrove forest plantations of Phetchaburi Province. But at present, seagrass has not been found to spread in the same area that was previously found.

*** Potential areas for seagrass beds** are areas where seagrass is found and used to be reported and have suitable environmental factors for seagrass growth. The area of seagrass in each source can always be moved according to the environment. If any surveyed area fails to find seagrass in two survey cycles (more than 8 years), it will be excluded as a potential seagrass beds area.

Table 1.3 Potential areas for seagrass beds (Rai) and seagrass species found in seagrass beds in various areas of Thailand.

Province	Area(Rai)	Cr	Cs	Ea	Hb	Hd	Hj	Hm	Ho	Hp	Hu	Si	Th
Trad	5,903	(/)	/	/	(/)	(/)		(/)	/	/	/		(/)
Chantaburi	2,892			/*		(/)		(/)		/	/*		
Rayong	7,447			(/)	(/)	/		/	/	/*	/		
Chonburi	5,209		(/)	(/)		/*		/	/*	/	/		/
Prachuap Khiri Khan	4								(/)	(/)	/		
Chumpon	11,425			/	/	/			/	/			
Surat Thani	16,480	/		/	/	/		/	/*	/	/	/	/
Nakorn Sri Thammarat	163			/					/	/	/		/
Songkhla	1,727				/				/	/			

Pattani	2,364				/				/	/			
Narathiwas	534				/					/*			
Gulf of Thailand Total	54,148	/	(/)	/	/	/		/	/	/	/	/	/
Ranong	2,924		/	/*	/	/	/	/	/*	/	/	/	/
Phangnga	26,600	/	/*	/*	/	/	/	/*	/*	/	/*	/	/*
Phuket	4,883	/	/*	/*	/	/	/*	/	/*	/	/*	(/)	/
Krabi	34,236	/	/	/*	/	/	/	/	/*	/*	/	/	/
Trang	34,870	/*	/	/*	/	/	/	/	/	/	/	/	/
Satun	2,967	(/)	(/)	/*	/	/	/	/	/	/	/	/	/
Andaman Total	106,480	/	/	/	/	/	/	/	/	/	/	/	/
Total	**160,628**												

Remark: The seagrass species found are as follows: *Cymodocea rotundata*: Cr, *Cymodocea serrulata*: Cs, *Enhalus acoroides*: Ea, *Halophila beccarii*: Hb, *Halophila decipiens*: Hd, *Halophila major*: Hj, *Halophila minor*: Hm, *Halophila ovalis*: Ho, *Halodule pinifolia*: Hp, *Halodule uninervis*: Hu, *Syringodium isoetifolium*: Si, and *Thalassia hemprichii: Th by / shows presently found seagrass species, (/) shows grass species found in the past, and * seagrass species that are commonly found in almost every source of the province.*

The survey of the status of seagrass beds was carried out by inspecting seagrass line points to see the extent of each seagrass area, types of seagrasses, and to assess the percentage of area cover. The operation can be divided into 2 parts:

- Exploration during low tide; Record the coordinates along the edge of the area where seagrass cover is found. Then set a survey line perpendicular to the coast until the end of at least 3 seagrass lines. Four 50x50cm quadrats were placed at every equal distance along the survey line according to the Line Transect Method of UNEP (2004). Record the survey point coordinates with the Global Positioning System (GPS) and take note of the variables including the percentage of seagrass cover and the open area or algae cover. The ground is sand, gravel, or a type of seagrass that can be seen with the naked eye. Record seagrass species. Collect sampling of indistinguishable seagrass species for laboratory identification, record seawater quality data and other environmental data.
- Exploration during high tide; Use the diving method to explore. By specifying a survey line that is perpendicular to the coast until the end of at least 3 seagrass lines. Four 50x50cm quadrats were placed at every equal distance along the survey line. In case the survey line cannot be determined, spot check dives are used to cover the entire seagrass reservoir in that area. Record the survey point coordinates and the surveyor will record the variables, including the percentage of seagrass cover and

the open area or algae cover. The ground is sand, gravel, or a type of seagrass that can be seen with the naked eye. Record seagrass species. Collect sampling of indistinguishable seagrass species for laboratory identification, record seawater quality data and other environmental data.

These seagrass beds resource areas have been surveyed to see how healthy they are. In the past, there have been repeat surveys in the same area rotated over a period of 4 years or maybe more frequently and conduct surveys in the areas representing provinces and 13 seagrass areas according to the National Dugong Plan annually. (Trang District, Koh Sriboya District, Koh Phra Thong District, Phang Nga Bay District, Satun District, Bandon District, Khung Krabaen Bay District, Paknam Prasae-Paknam Phangrad District, Koh Kood District, Sattahip Bay District, Thung Kha Bay – Sawi District, Pattani Bay District, and Taled Bay District) By studying the status of seagrass beds to explore the boundaries of each seagrass beds, types of seagrass beds, and assess the level of fertility from the percentage of seagrass area cover, categorizing the level of fertility into 4 levels.

Very good	means	There is more than 75% seagrass cover.
Good	means	There is 51-75% seagrass cover.
Moderate complete	means	There is 25-50% seagrass cover.
Slightly complete	means	There is less than 25% seagrass cover.

This is because environmental factors such as wind wave intensity, seafloor characteristics, drying and seasonality have an important effect on the distribution of seagrass species and amounts in each area. In addition, since seagrass is a flowering plant, it can reproduce both asexually and sexually, allowing seagrass to grow in areas far from the original seagrass beds. Therefore, during each survey year, although it is often found that each seagrass source has changes (status) occurring in 3 characteristics as follows: Changes in distribution extent (area), species composition and abundance level (percentage of seagrass cover). Comparison of data to determine the trend of change will only consider changes in the extent of the spread, whether the seagrass area in each area has changed or not.

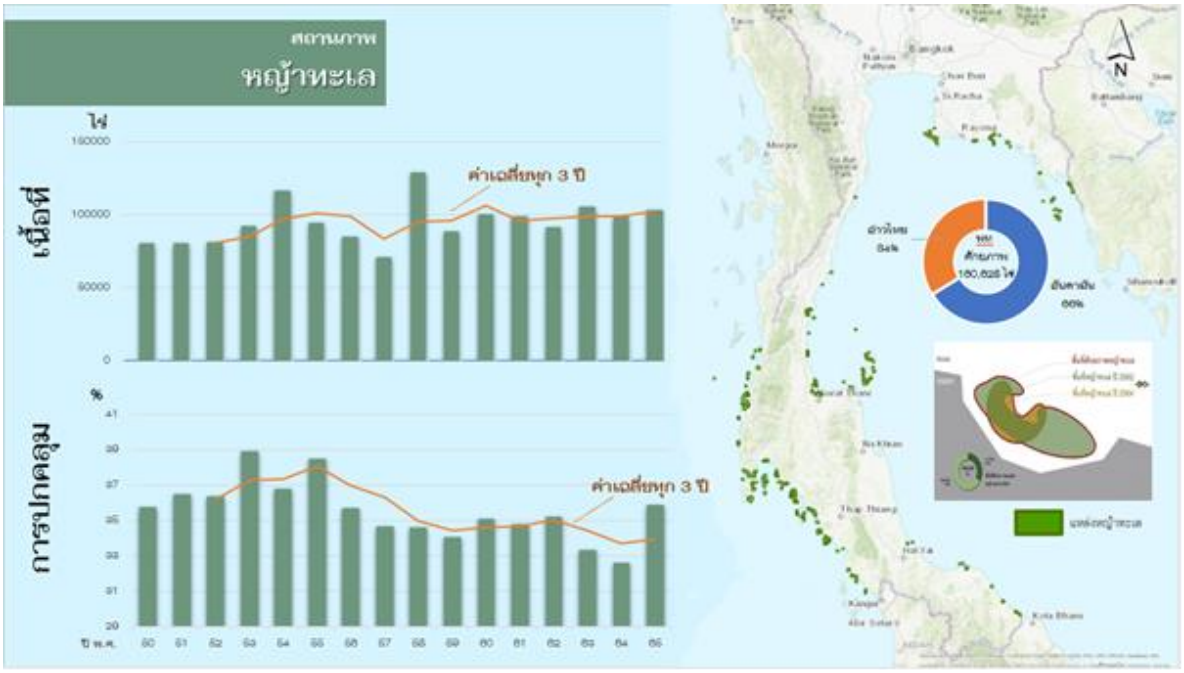


Figure 1.13 Diffusion Map and the proportion as a percentage of the seagrass area in 2022

Assessment of changes in seagrass area by comparing the current year's seagrass area with that of the previous year. There are 4 types of trends as follows:

-More completemeans an increase of more than 10%.

-Stable means the area increases or decreases by less than or equal to 10%.

-Seasonal decline means an area reduced by more than 10% due to natural changes but not due to human activities.

-Degraded means the area has decreased by more than 10% caused by human activities.

Status of seagrass beds in 2022

The Department of Marine and Coastal Resources has surveyed and monitored the status of seagrass beds. Both in the area that is the current source of seagrass, the place where the survey has been reported, and the new area besides the one that was previously discovered, although not a large one. In 2022, seagrass

was found in a total area of 103,580 rai, divided into the Gulf of Thailand 31,954 rai (31%), and the Andaman Sea 71,626 rai (69%) representing 64% of the country's potential seagrass area (160,628 rai), 4% increase from seagrass area reported in 2021 (99,325 rai), covering 17 coastal provinces, consisting of 11 provinces along the Gulf of Thailand, namely Trat, Chanthaburi, Rayong, Chonburi, Prachuap Khiri Khan, Chumphon, Surat Thani, Nakhon Si Thammarat, Songkhla, Pattani, Narathiwat and 6 provinces on the Andaman coast, including Ranong, Phang Nga, Phuket, Krabi, Trang, and Satun.

The overall seagrass beds of Thailand found that seagrass beds in 4% very good condition, 25% good, 36% moderate, and 35% slightly complete. Status of sea grass beds resources by province and the average coverage percentage of each province (Figure 1.14).

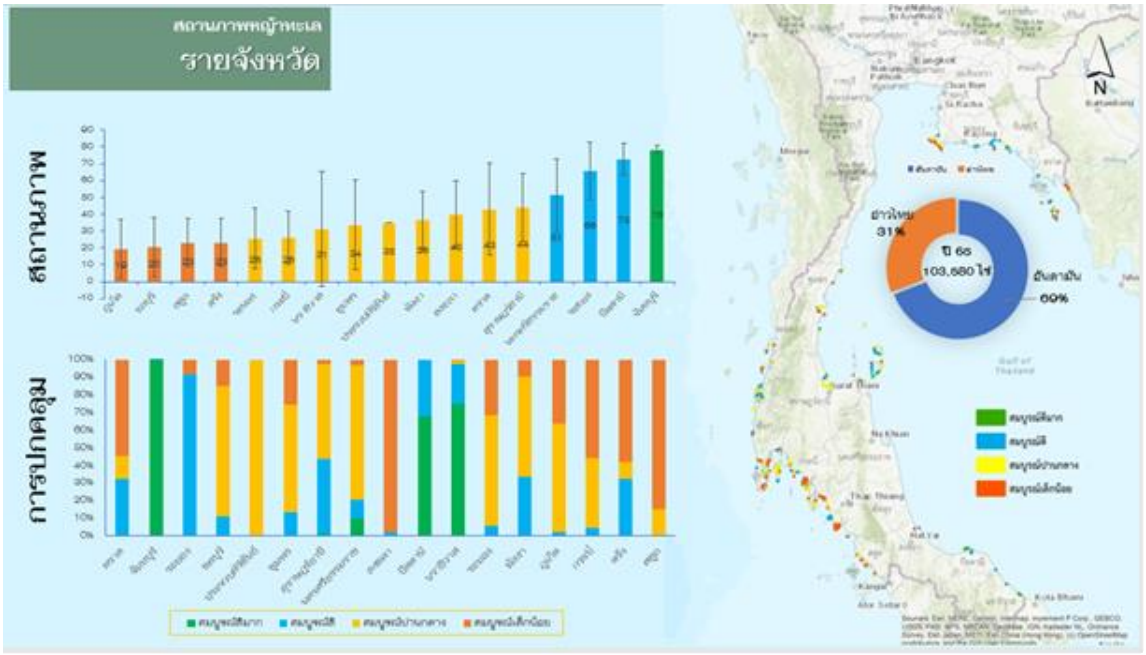


Figure 1.14 Status of seagrass beds sources in 2022, separated by provinces

The levels are categorized as very good, good, moderately, and slightly complete.

Change direction of seagrass beds

From monitoring the status of seagrass beds in different areas from 2007 to the present, it was found that each year, seagrass beds vary in spatial and area cover percentages. From 2007 to 2010, the area tends to increase. In 2011 - 2014, the area has a decreasing trend. And in 2015 – 2022, seagrass areas were found to be relatively stable. The status of seagrass beds from the overall picture of the country showed that overall, there was a steady trend with an increase in area from 99,325 rai in 2021 to 103,580 rai in 2022, representing an

increase of 4%. When considering the changes in each province, it was found that most of them were stable as well, 51%, improved by 39%, seasonally decreased by 8%, and deteriorated only by 2% (Figure 1.15).

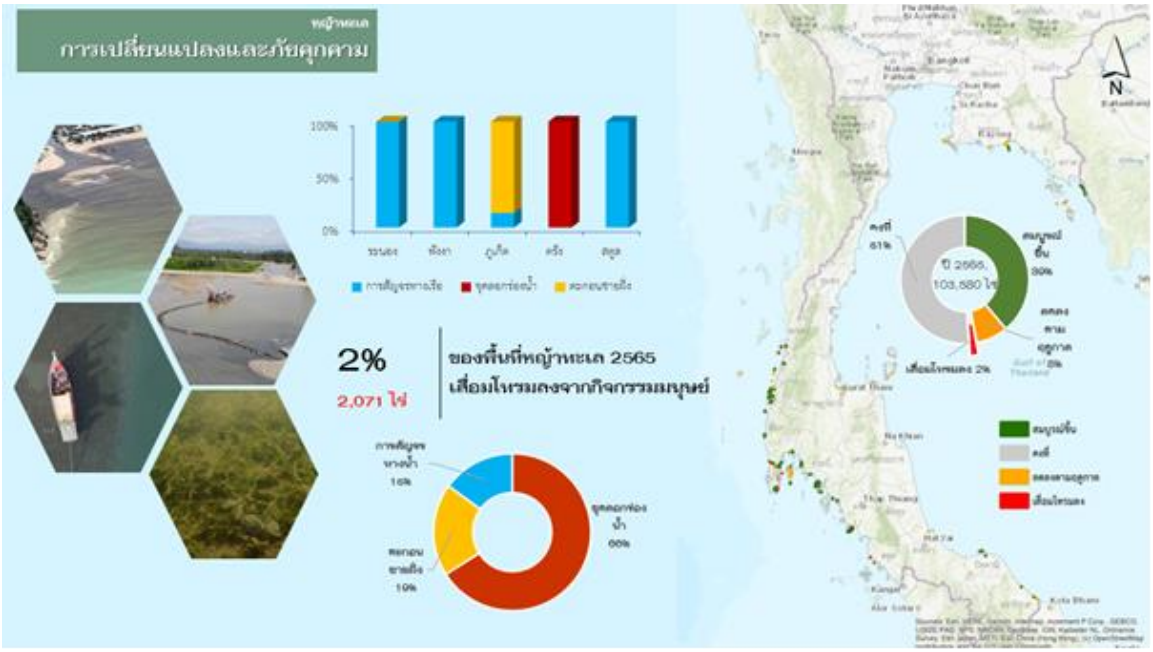


Figure 1.15 Changes in seagrass beds Compared to 2021

Problems and threats to seagrass resources

The degradation of seagrass beds is caused by the following important factors:

1) Caused by Natural: Seasonal changes in which seagrasses change throughout the year are quite evident. If surveyed in late summer, the above-ground seagrass will disappear from the area, leaving only roots and underground parts. The leaves will re-sprout during the end of the southwest monsoon and return to full growth at the end of the northeast monsoon. And the changes caused by strong monsoon waves cause the movement of sand dunes and natural sediments to pile up in the grass.

2) Caused by human activities: Any form of coastal development that increases sedimentation in the sea, dredging of maritime channels, including the development of areas in the sea to support tourism, building bridges, marinas, in bays with seagrass beds, effluent discharge from industrial factories, houses, large communities near the coast and from the shrimp farms, the quality of the sea water deteriorated.

According to the trend of seagrass change in 2022, there is a small proportion of degraded seagrass resources (2%) but most of them are affected by various human activities for example, in some areas of Ranong, Phang Nga, Phuket, Krabi, Trang, and Satun. The main cause of activities that directly affected seagrass beds was dredging of waterways (66%), followed by coastal sediments from area development (19%). And the cause of vessel traffic, which many areas of sea grass are near or are the access routes of ships. Both fishing vessels and tour vessels result in the impact of sediment diffusion from navigation. Causing the loss of seagrass area, accounting for 15% (Figure 1.14) by sediment that flows into the sea. If there is a large amount and continuously, it will result in the sea water being turbid all the time. This causes the seagrass to recover more slowly to the point that it may cause the seafloor to change to become unsuitable for the growth of the seagrass (Table 1.4).

Table 1.4 Change trends of seagrass beds compared to seagrass beds Capability and seagrass beds in 2021 together with problem conditions and solutions in each area summarized as of 2022.

Province	Seagrass Beds Area (Rai)			Current Status	Currently found Grass Species	Changing Trends	Summary of Issues/ Cause of Deterioration	Spatial Feedback
	Capability	2021	2022					
Trad	5,903	1,654	3,536	Moderate	Ea, Cs, Ho, Hd, Hu	More Complete		
Chantaburi	2,892	2,424	2,196	Very Good	Ea, Hp, Hu	Stable	Pak Nam Phang Rad and Kung Krabaen Bay have discharged water and mud from shrimp farming, Channel dredging and seasonal changes.	Control the sediment from various coastal activities to flow into the sea.
Rayong	7,447	2,520	2,195	Good	Ho, Hp, Hd, Hu	Stable	Phala Beach and Sai Kaew Beach are covered with sediments.	Control the discharge of wastewater and sediment into the sea.
Chonburi	5,209	4,992	2,850	Slightly Complete	Hp, Hd, Hu, Ho, Hm	Seasonal Decline		
Prachuap Khiri Khan	4	4	4	Moderate	Hu	Stable		
Chumpon	11,425	7,671	6,808	Moderate	Hb, Ea, Hp, Ho	Stable		
Surat Thani	16,480	12,618	11,854	Moderate	Ea, Hu, Hp, Si, Ho, Hm, Hd, Cr, Th	Stable		
Nakhon Si Thammarat	163	118	116	Moderate	Ea, Hu, Hp, Cr, Ho	Stable		
Songkhla	2,364	1,386	1,978	Good	Hb, Ho, Hp, Ea	More Complete		

Table 1.4 Change trends of seagrass beds compared to seagrass beds Capability and seagrass beds in 2021 together with problem conditions and solutions in each area summarized as of 2022. (continue)

Province	Seagrass Beds Area (Rai)			Current Status	Currently found Grass Species	Changing Trends	Summary of Issues/ Cause of Deterioration	Spatial Feedback
	Capability	2021	2022					
Pattani	534	393	329	Moderate	Hb, Ho, Hp, Ea	Stable		
Narathiwas	534	393	329	Moderate	Hb, Hp	Stable		
Ranong	2,924	1,945	1,993	Moderate	Ho, Hm, Hb, Cs, Th, Hd, Hu, Hp, Si, Hj, Ea	Stable		
Phangnga	26,600	15,940	17,305	Moderate	Ho, Hm, Hb, Cr, Cs, Th, Hu, Hp, Hd, Si, Ea, Hj	Stable	Ban Thung La-Ong has the degradation of seagrass due to vessel traffic.	There should be protection against the impact caused by vessel traffic.
Krabi	34,236	17,325	21,724		Ho, Hm, Hj, Hb, Cr, Cs, Th, Hu, Hp, Hd, Ea, Si	More Complete		

Table 1.4 Change trends of seagrass beds compared to seagrass beds Capability and seagrass beds in 2021 together with problem conditions and solutions in each area summarized as of 2022. (continue)

Province	Seagrass Beds Area (Rai)			Current Status	Currently found Grass Species	Changing Trends	Summary of Issues/ Cause of Deterioration	Spatial Feedback
	Capability	2021	2022					
Phuket	4,883	2,242	2,542	Slightly Complete	Ho, Hd, Hb, Hm, Cr, Cs, Th, Hu, Hp, Ea, Hj	More Complete	- Ao Nam Bo, Pak Phra Bang Strait, where seagrass fertility is reduced due to coastal sediments. - Naka Yai Island, Taphao Yai Island, Thanan Island, in some areas the fertility of sea grass has decreased due to vessel traffic. - Laem Sai – Bang Duk is deteriorated because it is disturbed by vessel traffic and coastal construction.	- Measures should be taken to prevent human impacts in areas where seagrass remains. - There should be a demarcation of the shipping route. - Measures should be taken to prevent the potential impacts of coastal development.
Trang	34,870	25,768	26,124	Moderate	Ho, Hm, Cr, Cs, Th, Hu, Hp, Ea, Hj, Hb, Si, Hj	Stable	Ao Thung Chin: - Affected by sediment dumping near seagrass beds causing changes in the sea floor. Contains increased sand composition. Degraded seagrass at Thung Jean Bay (Ju Yo Cape – Had Tub) Particularly, some sea grasses look like small plants, short leaves, and dead trees with sediment covering the leaves. - There are natural changes and sandbar changes.	- Appropriate techniques for seagrass restoration in degraded seagrass areas should be studied. - The recovery of degraded seagrass should be continuously monitored. Refrain from activities that may affect the degraded seagrass area so that the seagrass can recover to its potential.
Satun	2,967	1,989	1,938	Moderate	Hd, Hj, Hu, Hp, Hb, Si, Ea, Th	Stable	Vessel traffic	- There should be a demarcation of the shipping route.
รวม	**160,628**	**99,325**	**103,580**			Stable		

1.1.3 Rare marine animals' resources

Rare marine animals refer to marine animals that are under threat and are likely to be extinct. The report categorizes rare marine animals into 4 groups: Sea turtles, dugongs, whales and dolphins and 2 types of cartilaginous fish, whale sharks and manta rays. (Figure 1.20) All of which are classified as reserved and protected wildlife according to the Wildlife Preservation and Protection Act 2019, which prohibits hunting, trade, possession, and breeding including covers eggs, carcasses and other parts of those animals as well. Leatherback turtles, dugongs, Bryde's whales, Omura's whales and whale sharks are listed as protected wildlife and other rare marine species are listed as protected species. The rare marine species are also protected under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). All sea turtles, dugongs and Irrawaddy dolphins are on the CITES List 1 because they are Critically Endangered (CR). Other dolphins and whales, including whale sharks, are listed on CITES List 2.

Sea Turtles, there are 5 species distributed in Thailand: Green turtle (Chelonia mydas), Hawksbill turtle (Eretmochelys imbricata), Olive ridley turtle (Lepidochelys olivacea), Leatherback turtle (Dermochelys coriacea) and Loggerhead turtle (Caretta). But it found that there are only 4 types of sea turtles laying eggs, which are green turtles, hawksbill turtles, olive ridley turtle and leatherback turtles.

Dugong, there is only one species of Dugong (Dugong dugon) in Thailand. It was found spreading in the seagrass beds in both the Gulf of Thailand and the Andaman Sea, divided into 13 sub-population groups consisting of:

1) Libong Island, Mook Island and Sikao Bay, Trang Province

2) Koh Sriboya, Koh Pu, Koh Jum and Ao Nang, Krabi Province

3) Koh Yao Noi, Koh Yao Yai, Phang Nga Bay, Phang Nga Province, Pa Klok Bay, Phuket Province

4) Lidi Island, Sarai Island, Satun Province

5) Phra Thong Island, Phang Nga Province

6) Koh Kood Island, Trat Province

7) Khung Krabaen Bay Chanthaburi Province

8) Pak Nam Prasae, Rayong Province

9) Sattahip Bay, Chonburi Province

10) Thung Kha-Swee Bay, Chumphon Province

11) Ban Don Bay, Surat Thani Province

12) Pattani Bay, Pattani Province, and

13) Ao Ted, Nakhon Si Thammarat Province

Dolphins and Whales, currently, there are 27 species of whales and dolphins found in Thailand. Divided into groups of dolphins and whales that live near the shore (Residence/Nearshore) and populations offshore have long-distance migrations. (Migratory/Offshore) There are 5 species of dolphins and whales that have been studied in terms of status, population estimation, and distribution in the nearshore populations: Bottlenose dolphins (Indo-Pacific Bottlenose dolphin, Tursiops aduncus), Finless porpoise (Neophocaena phocaenoides), Humpback dolphin (Indo-Pacific Humpback dolphin, Sousa chinensis), Irrawaddy dolphin (Orcaella brevirostris), and Bryde's whale (Balaenoptera edeni). The other 22 species of dolphins and whales are mostly reported natural sightings. Rarely found from the survey because it is a population living in the remote area with long distance migration. They include the spotted dolphin (Pantropical spotted dolphin, Stenella attenuata), the striped dolphin (Stenella coeruleoalba), the jumping dolphin (Stenella longirostris), the Omura's whale (Balaenoptera omurai), the blue whale (Balaenoptera musculus), the Fin whale (Balaenoptera physalus), and the Humpback whale (Megaptera novaeangliae), the Sperm whale (Physeter macrocephalus), the Pygmy sperm whale (Kogia breviceps), the Dwarf sperm whale (Kogia sima), the Ginkgo-toothed beaked whale (Mesoplodon ginkgodens), the Cuvier's beaked whale (Ziphius cavirostris), the Blainville's beaked whale (Mesoplodon densirostris), the Killer whale (Orcinus orca), the Short-finned pilot whale (Globicephala macrorhynchus), the False killer whale (Pseudorca crassidens), the Pygmy killer whale (Feresa attenuata), the Melon-headed whale (Peponocephala electra), the Rough-toothed dolphin (Steno bredanensis), the Fraser's dolphin (Lagenodelphis hosei), the Risso's dolphin (Grampus griseus), and the Long-beaked common dolphin (Delphinus capensis).

Group of Cartilaginous Fish that have been studied in terms of their status and distribution and are commonly seen in 2 major dive sites: whale sharks (Rhincodon typus) and manta rays.

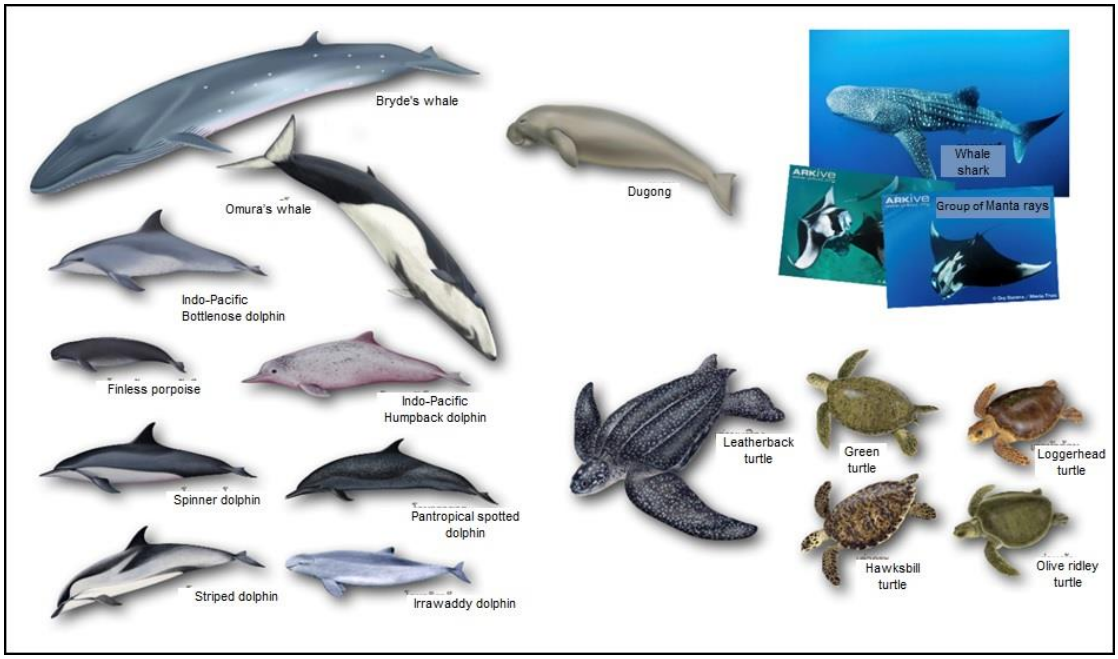


Figure 1.20 Rare marine animal species in Thailand included in the status and distribution data in this report.

Status of Rare Marine Animals

Sea Turtle

Sea turtle egg laying data in 2022 (data as of July 2022), there were 604 sea turtle nesting nests. It consists of 348 nests of green turtles and 256 nests of hawksbill turtles. Grass turtles and leatherback turtles were not found laying eggs. The main nesting sites for sea turtles in the Gulf of Thailand were found at Ko Khram in Chonburi Province and Ko Kra in Nakhon Si Thammarat Province. On the Andaman coast, it is found at the Similan Islands, Phang Nga Province (Figure 1.21). Comparison with past egg laying data of sea turtles from 5-year egg laying data. Since 2017, 373 sea turtle nests have been found (296 green turtle nests, 73 hawksbill turtle nests, 2 grass turtle nests, 2 leatherback turtle nests). In 2018, 413 nests of sea turtles were found (246 nests of green turtles, 167 nests of hawksbill turtles, and no nests of grass turtles and leatherback turtles). In 2019, 434 nests of sea turtles were found (226 nests of green turtles, 203 nests of hawksbill turtles, 2 nests of grass turtles, 3 nests of leatherback turtles). In 2020, 491 nests of sea turtles were found (240 nests of green turtles, 234 nests of hawksbill turtles, 1 nest of grass turtles, 16 nests of leatherback turtles). In 2021, 502 nests of sea turtles were found (199 nests of green turtles, 283 nests of hawksbill turtles, 2 nests of grass turtles, 18 nests of leatherback turtles). From the above data, it was found that green turtles and spotted turtles lay eggs both on mainland beaches and island beaches along the Gulf of Thailand and Andaman Sea coasts. The tendency of the number of egg laying times of hawksbill turtles tends to increase. Green turtles tend to decrease. As for the egg laying areas of leatherback turtles and grass turtles, they are only found on mainland beaches along the

Andaman Sea. The grass turtles lay very few eggs. If found laying eggs, there will be only 1-2 nests per year and there is a tendency to lay eggs down. While leatherback turtles, although there is an increased egg laying trend between 2020 and 2021. In 2022, leatherback turtles did not lay eggs. This may be because the leatherback turtles will return to lay eggs again in 3-5 years (Shanker et al., 2003).

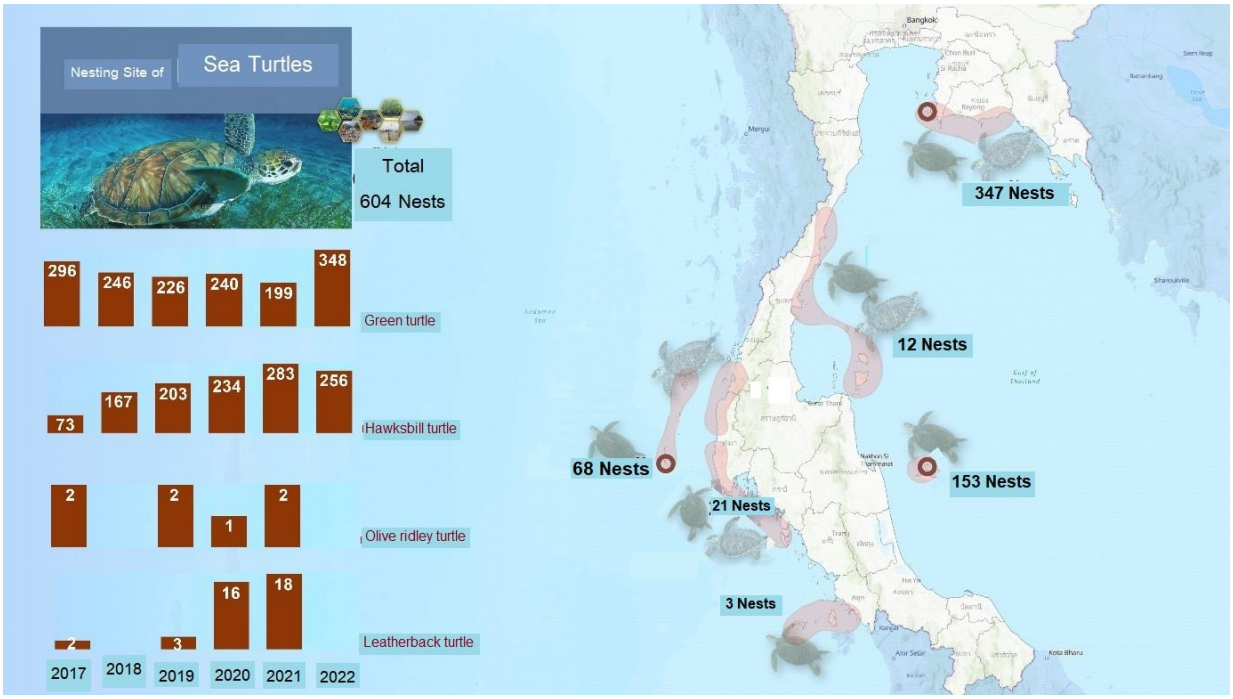


Figure 1.21 Statistics of the number of egg-laying of sea turtles of each species for the past 6 years (left image), number and egg-laying area of green turtles and hawksbill turtles in the fiscal year 2022. The dark spot is the main egg-laying area (right image).

Dugong

Dugongs are spread in the sea grass areas on the west and east coasts of Thailand. Trang province is home to the largest dugong population in Thailand. In fiscal year 2022, the survey found about 273 dugongs, which 31 were found in the Gulf of Thailand and 242 were found in the Andaman Sea (Figure 1.22). Compared with the past data, there were 2 periods of population change trends in dugongs. The first period is between 2007 and 2014, the dugong population tends to decrease. The average number of dugongs found in both the Gulf of Thailand and the Andaman Sea coasts decreased from 240 to 200 in 2014. As for the second period, the dugong population tends to increase. In 2016-2017, there were about 221 dugongs found, increasing to 250 in 2018 and to 261 in 2019. Although in 2020, the dugong population survey has decreased to 255 individuals but in the year 2021, although unable to fly to explore the dugong in Trang Province, which is the largest dugong population in Thailand due to the situation of the outbreak of Coronavirus Disease 2019 (COVID-19). However, when using the population estimation method from past survey data in key areas together with the area of distribution, the estimated population of

dugongs was 261, with about 32 dugongs found on the Gulf of Thailand and 229 dugongs on the Andaman coast.

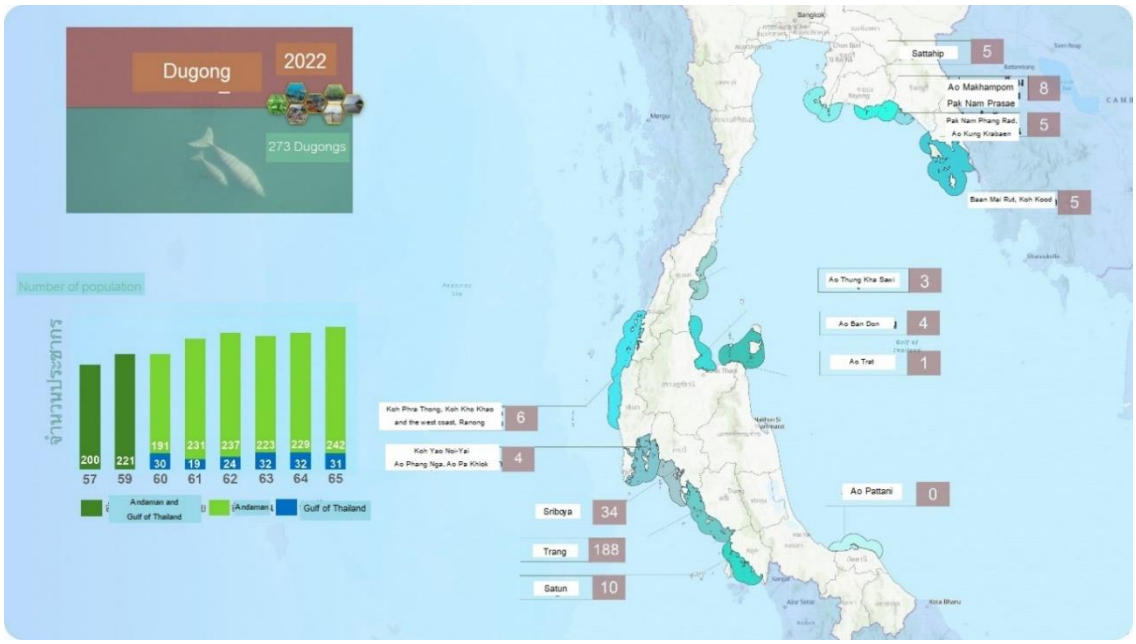


Figure 1.22 Number of dugongs found per year in Thailand, 2014 - 2022 (left picture)

Distribution area and number of dugongs in Thailand, fiscal year 2022 (right picture)

Although the survey found that the dugong population tends to increase more than in the past, there are still strandings or deaths of dugongs every year. In which there are deaths from various causes such as illness, baby dugongs are separated from their mothers or other causes such as being hit by solid objects, Stingray spines, accidents, and fishing gear.

Dolphins and Whales

The status-studied dolphin and whale species with population estimates and distribution are limited to 5 types of nearshore populations: Indo-Pacific Bottlenose dolphin, Finless porpoise, Indo-Pacific Humpback dolphin, Irrawaddy dolphin, and Bryde's whale. In 2022, 2,310 dolphins and whale populations can be assessed in hot spots (Figure 1.23). The most abundant species were finless porpoises, 30.5 percent, followed by Irrawaddy dolphins, 29.4 percent, humpback dolphins, 26.7 percent, bottlenose dolphins, 10.8 percent, and Bryde's whales, 2.6 percent. When compared to the past 5 years, it was found that the finless porpoise and Irrawaddy dolphins were the most abundant species, followed by humpback dolphins, bottlenose dolphins, and Bryde's whales, respectively.

Dolphins and whales in the nearshore population have been observed and reported sightings in both the Gulf of Thailand and the Andaman Sea. But there are hot spots for each type of dolphins and

whales such as the Irrawaddy dolphins in Trat Bay, the upper Gulf of Thailand, including Irrawaddy dolphins in Songkhla Lake, Bottlenose dolphins around Surin-Similan Islands, Phang Nga Province, Mai Thon Island, Phuket Province which in the Gulf of Thailand has been surveyed in some areas in certain seasons. Humpback dolphins in Khanom Bay Nakhon Si Thammarat Province, Don Sak Bay Surat Thani Province, Ta-se Bay Libong Island Trang Province, Sarai Island - Puyu Island, Satun Province. The finless porpoise is a species that has been observed along the coast of the Gulf of Thailand from Trat Province. - Pattani Province on the Andaman side from Phang Nga Province - Satun Province. Bryde's whales are hotspots in the upper Gulf of Thailand and are seen during certain seasons in the central Gulf of Thailand. The dolphin and whale populations of all 5 species are likely to increase between 2017 - 2020. The dolphin and whale population estimates are the most common in 2020 due to the high frequency of surveys due to budgetary factors. And decreased in 2021 due to the situation of the Coronavirus 2019 (COVID-19) epidemic, in which field surveys could not be carried out fully. Offshore/Migratory populations of dolphins and whales are reported in nature which is not found in natural surveys or rarely seen. Data on status or population will be based on data on that dolphin and whale species at the regional population or Global population.

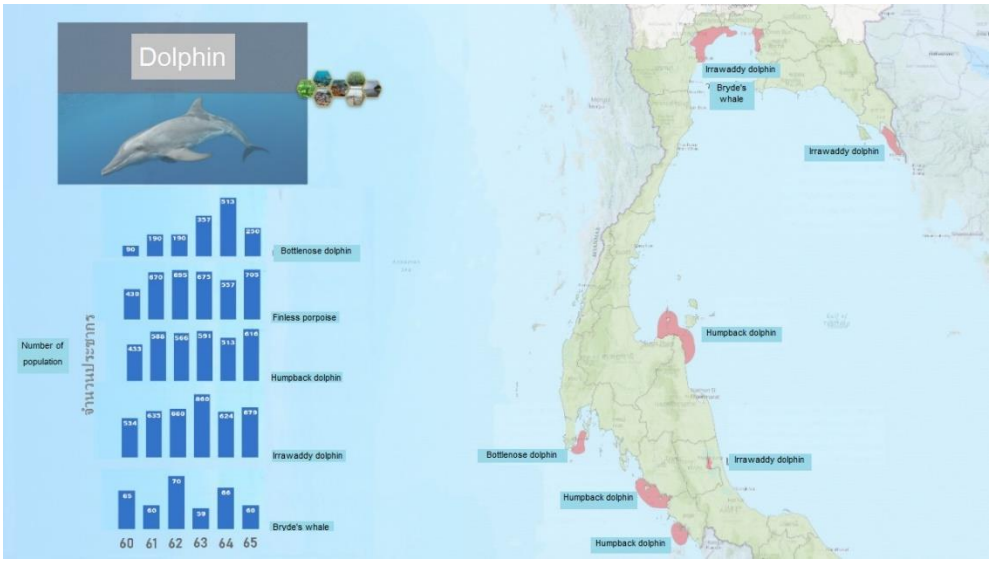


Figure 1.23 Number of nearshore dolphins and whales, fiscal year 2017 - 2022 (left picture)

Hotspots (pink area) of dolphins and whales near shore (right photo)

For the survey of Bryde's whales, which are the main population in the Gulf of Thailand. Especially the upper Gulf of Thailand; Samut Prakan Province, Bangkok, Samut Sakhon Province, Samut Songkhram Province, and Phetchaburi Province. In addition, some seasons spread to the central Gulf of Thailand, Chumphon Province, Surat Thani Province. In fiscal year 2022, 56 unique identities can be identified. The population of Bryde's whales in the Gulf of Thailand tends to increase (Figure 1.24). From the data from 2010 - 2022, it was found that the birth rate was about 10.09% (5 units/year) and has a mortality rate of

about 5.08% (3 units/year). In the Andaman Sea, Bryde's whales are found in Phang Nga and Phuket provinces.

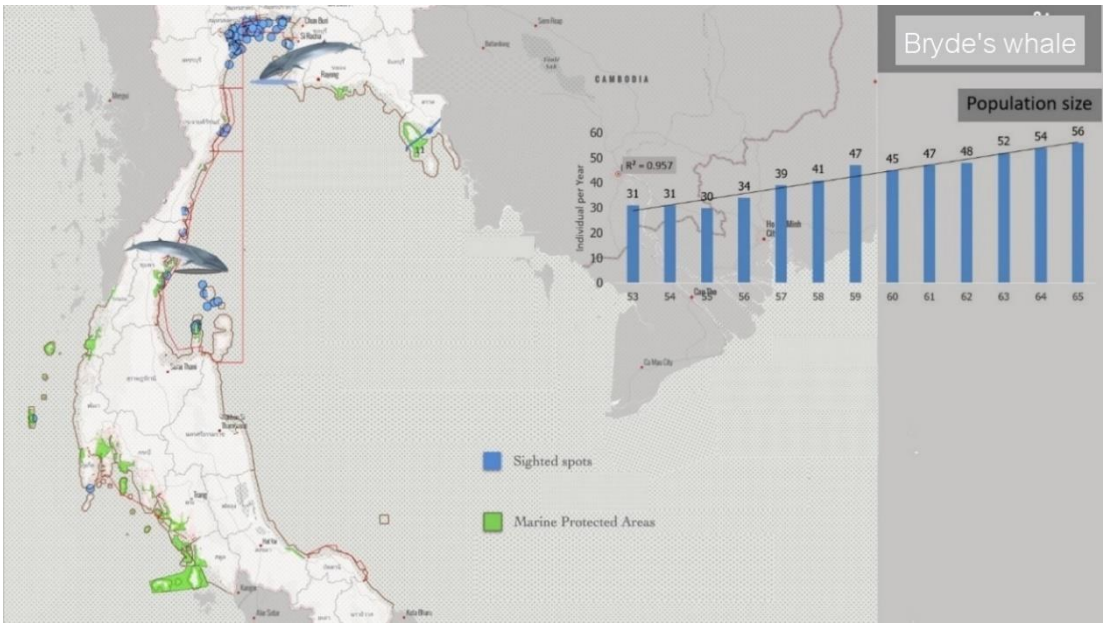


Figure 1.24 Number of identifiable Bryde's whales, fiscal year 2010 - 2022 (right picture)

Distribution area of Bryde's whale (left image)

Cartilaginous Fish

There are 2 species of cartilaginous fish that have been studied in terms of status, identification and distribution: Whale sharks and Manta rays. Whale sharks are commonly seen in Thailand's major dive sites. Whale shark surveys require a network of divers to inform the news as well as gather information from social media to identify whale sharks.

In 2022 (data as of July 2022), there were 40 whale sharks (Figure 1.25), 21 in the Gulf of Thailand and 19 in the Andaman Sea. The areas where whale sharks are most found in the Andaman Sea are at Hin Eight Mile Dive Site in Satun Province, followed by Rise Riu Rocks in Phang Nga Province and Koh Haa in Krabi Province. As for the coastline in the Gulf of Thailand, the province where whale sharks are found most often is Surat Thani Province around Hin Bai scuba diving spot, followed by Chumphon Rock Division and Ko Ngam Noi in Chumphon Province respectively. In the past data shows that whale sharks can be found throughout the year along the Gulf of Thailand and the Andaman Sea. It is found on the coast and 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). As for the Andaman Sea, whale sharks can be found along the coast and islands from the upper Andaman (Ranong, Phang Nga, Phuket), Lower Andaman (Krabi Province, Trang Province, Satun Province).

The changing trend of the whale sharks' population is divided into 2 periods, between 2016 - 2019. There is a tendency for the population to increase from 41 to 141 and in the second period, the population of whale sharks tends to decrease. In 2020 – 2022, whale shark populations were found at 89, 21 and 40 respectively. This is because whale shark population estimates are based primarily on sighting collections and online media from dive tourism networks. During the second period (2020 – 2022) was during the outbreak of the Coronavirus 2019 (COVID-19), the number of tourists decreased and therefore received less information about whale sharks. According to recurrence data, between 2016 and 2022, an average of 5 ± 2.9 recurrences of whale sharks were found per year.

Manta Ray, it is found on the Andaman coast more than the Gulf of Thailand. Although getting a proper photograph of the manta ray's abdomen to identify its identity is quite difficult, it can be done. In 2021, 18 manta rays found in the Andaman Sea were identified and in 2022 (data as of July 2022), 10 manta rays were identified. It is found along the entire Andaman Sea coast where manta rays are found most frequently around Bon Island, Phang Nga Province. (Figure 1.25)

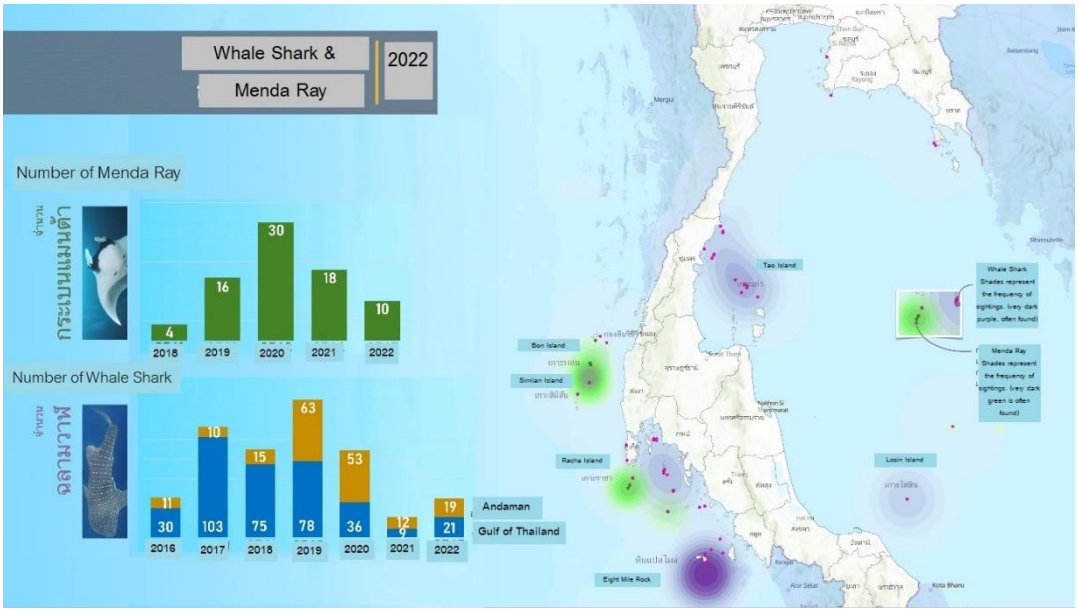


Figure 1.25 Number of identifiable whale sharks and manta rays in Thailand, 2016 – 2022 (left picture).

Distribution of whale sharks and manta rays in 2022 (right photo)

Rare Marine Animals Beached

Beached Statistics of rare marine animals in the fiscal year 2022 (data as of September 2022) were found 659 times, of which 438 sea turtles (67%), 192 dolphins and whales (30%), and 18 dugongs (3%) (Figure 1.26). In addition, 9 whale sharks and 2 manta rays were found beached when comparing beached statistics of rare marine animals in 3 main groups, such as sea turtles, dugongs, dolphins and whales. During the past 10 fiscal years, there were a total of 5,900 beached animals, an average of 590 ± 220 animals per year. From the fiscal year 2013 - 2020, there is a tendency for beaching to increase continuously. Found the rarest marine animal beached in the fiscal year 2020 (905 times) and decreased in the fiscal year 2021-2022. However, in the future, it is expected that each year there may be a tendency for rare marine animals to be beached on the ground due to the deterioration of environmental quality including natural risk factors and human exploitation activities at sea. In addition, advances in communication have resulted in faster and more convenient beaching information and increased awareness of the coastal community.

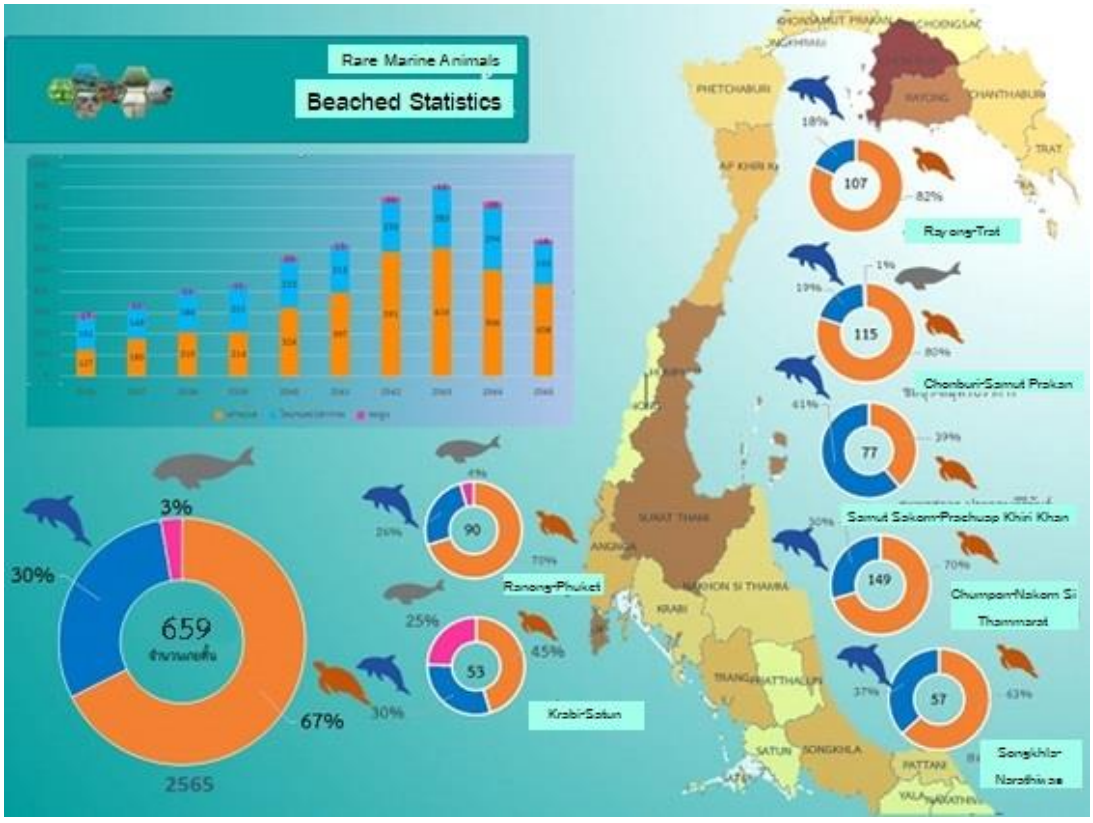


Figure 1.26 Figure 1.26 Beaching of rare marine animals such as sea turtles, dugongs, dolphins and whales retrospectively from the fiscal year 2013-2022 (top left picture).

Proportion of beached rare marine animals by group, fiscal year 2022 (bottom left picture)

Proportion of beached rare marine animals by area of responsibility of Marine and Coastal Resources Research Center in fiscal year 2022 (right picture)

Cause of beached

Most of the rare marine animals found stranded in fiscal year 2022 have already died when the beaching was notified. Dugongs accounted for 89% of fatal or carcass beaching, while dolphins and whales accounted for 93% of fatal or carcass beaching. The proportion of sea turtles beached dead, or carcass was 54% and live beached was 46%. (Figure 1.27) For cartilaginous fish, most of them are live beaching by whale shark had 89% live beaching and manta rays had 100% live beached.

Beaching of Dugongs

In fiscal year 2022 (data as of September 2022), there were 18 dugong beaching, of which 16 were died (89%) and 2 were live (11%) which can be successfully rescued and released back to nature. There were 7 dugongs beached (39%) for unknown reasons due to rotten carcasses and 11 identifiable dugongs beached. (61%) The cause of the beached from the number that can be identified, it was found that 8 dugongs were beached aground because of sickness (73%), one was caused by fishing gear (9%), and one dugong was found to be sick with eating marine debris (9%), and one was accidental at sea (9%). The beaching rate due to sickness tends to increase from 2021, and when considering the beaching statistics of dugongs during the 10 fiscal years, a total of 165 dugongs are beached representing an average of 17 ± 6 dugongs per year, with the beached in the fiscal year 2022 a decrease compared to the fiscal year 2021.

Beaching of dolphins and whales

In fiscal year 2022 (data as of September 2022), 192 dolphins and whales were beached, 178 dead or carcasses stranded (93%) and 14 live (7%) by 7 were successfully rescued and released back to nature (50%) and 7 died during treatment (50%). The majority of dolphin and whale beaching are unknown due to rotting carcasses in 124 (65%) and 68 (35%) have identifiable causes. Most of them were caused by sickness, 23 (34%) were suspected to be caused by fishing gear, 12 (18%) were severely knocked, 9 (13%) were caused by 6 fishing gear (9%), and a total of 18 (26%) were caused by other causes such as lost balls, misdirection, marine debris, etc. The cause of beached up due to illness tends to decrease, while the cause from marine debris tends to increase from the fiscal year 2021. Dolphin and whale beaching statistics during the 10 fiscal years found a total of 2,138 dolphins and whales beached, equivalent to an average of 214±49 individuals per year with an increasing trend from 2013 to 2021 and decreasing in 2022.

Beaching of sea turtles

In fiscal year 2022 (data as of September 2022), there were 438 beached sea turtles with 237 (54%) beached dead or carcass, and 201 were beached alive (46%). Most sea turtle beaching was unknown due to rotting carcasses of 182 (42%). Of the 256 (58%) beached animals identified as the cause, 85 (33%) were caused by marine debris, 81 (32%) were beached aground and 37 (14%) were caused by fishing gear. Fishing gear that most often affects sea turtles is nets, hooks and traps. It was also caused by other causes such as vessel accidents, sickness with marine debris, and 53 (21%) lost direction. The beaching statistics of sea turtles during the 10 fiscal years found a total of 3,597 sea turtles stranded, representing an average of 360

± 175 individuals per year with a tendency to increase continuously between 2013 - 2020 and begin to decrease in 2021 and 2022.

Beaching of cartilaginous fish

In fiscal year 2022 (data as of September 2022), there were 9 whale shark beaching, 1 dead (11%) and 8 live (89%). All 8 were successfully rescued and released back into nature. The reason for most whale shark beaching is fishing gear (8 whale sharks) and one rotten carcass is unknown. Fishing gears that often affect whale sharks are surroundings nets. As for manta rays, 2 beached manta rays were found, both were alive, both were able to be rescued and successfully released back into nature. The cause of the beached is caused by marine debris in the form of a rope tied around the body.

Rescuing Rare Marine Animals Beached

The Department of Marine and Coastal Resources emphasizes the rescue of stranded rare marine animals by establishing a rare marine animal rescue center with veterinary personnel, marine academics and medical equipment at 7 locations covering all coastal areas of Thailand. Working with rare marine animals also works with marine and coastal networks, which have completed the basic rare marine animal rescue course, numbering more than 1,000 in the network. According to statistics on saving rare marine animals in the past 5 years, namely the fiscal year 2018 - 2022, it was found that a group of sea turtles that were beached alive and were rescued from nursing homes in the sanatorium under the Department of Marine and Coastal Resources had an average survival rate of 90%. Dolphins and whales had an average survival rate of 50 percent and dugongs had an average survival rate of 55%.

For fiscal year 2022 (data as of September 2022), 201 live beached sea turtles were found which has a survival rate of 80% from rescue and medical treatment. The dolphin and whale have 14 beached lives, with a survival rate of 50% in rescue and medical treatment. The 2 dugongs were found beached alive, and both were saved (100%) (Figure 1.27). The 8 live beached whale sharks and 2 live beached manta rays were all rescued and released (100%).

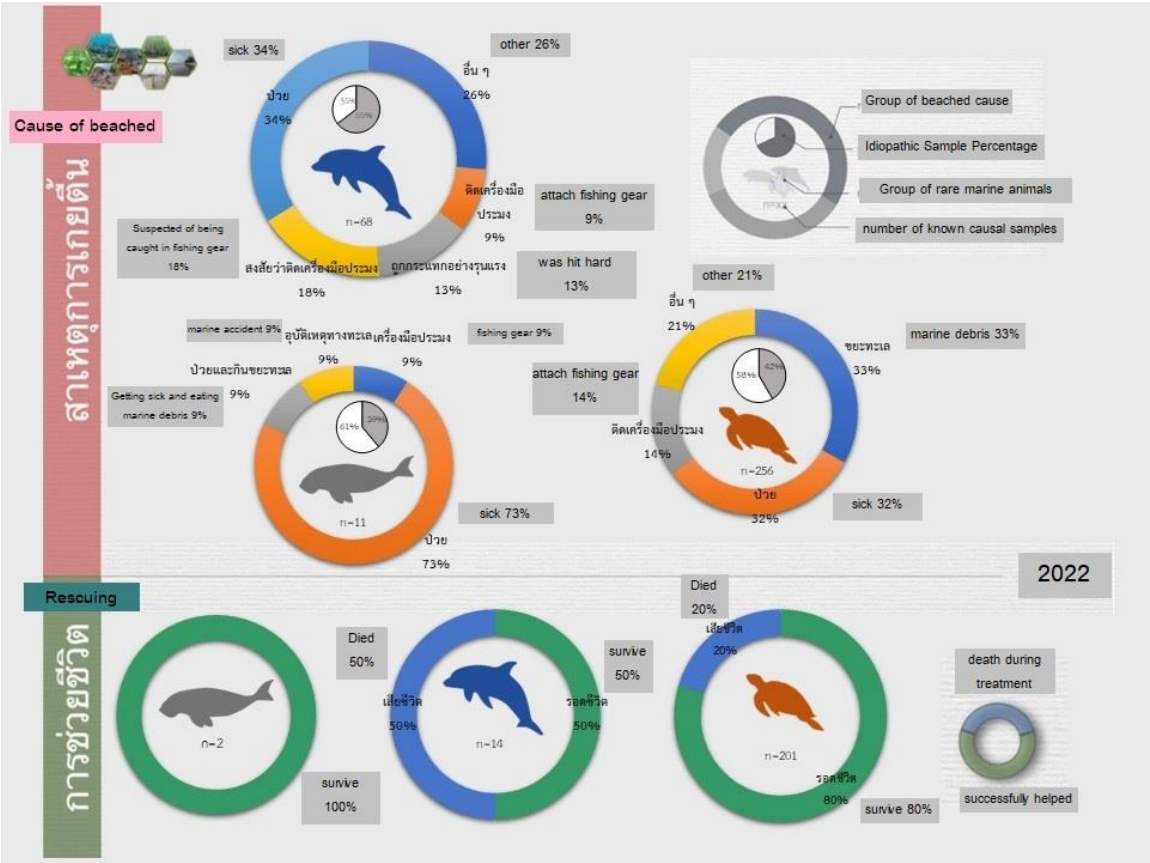


Figure 1.27 Causes of rare marine animal beaching in the fiscal year 2022 (top picture) and the results of saving rare marine animals in the fiscal year 2022 (bottom picture).

2. Mangrove Forest, Beach Forest and Swamp Forest Resources

1. Mangrove Forest Resources

The mangrove forests under the responsibility of the Department of Marine and Coastal Resources in the areas of 24 coastal provinces (from high-resolution satellite image translation in 2020) are 1.73 million rai of preserved mangrove forests. It was found most in the lower Andaman coast area, about 712,561.22 rai, followed by the upper Andaman coast and the eastern region, 460,180.47 rai and 222,461 rai.

The 10-year trend data (from 2013 - 2022)

Mangrove forest area data analysis was performed for the first time in 1961 when satellite images were interpreted only for concession forest areas. Subsequently, data of Thailand's mangrove forests were analyzed by translating satellite images in 1975, 1979, 1986, 1989, 1991, 1993, 1996, 2000, 2004, 2009, 2014, 2017, 2018 and 2020. The 10-year trend of mangrove forests is based on the mangrove forest areas in Thailand that have been translated aerial photographs in 2014, 2017 - 2018 and 2020. The mangrove forests in Thailand are distributed in the coastal areas of the eastern, central and southern regions, totaling

24 provinces, namely Trat, Chanthaburi, Rayong, Chonburi, Chachoengsao, Samut Prakan, Bangkok, Samut Sakhon, Samut Songkhram, Phetchaburi, Prachuap Khiri Khan, Chumphon, Surat Thani, Nakhon Si Thammarat, Phatthalung, Songkhla, Pattani, Ranong, Phang Nga, Phuket, Krabi, Trang, and Satun. The provinces with the most mangrove forest areas are Phang Nga, Satun and Krabi respectively. Which at present, (Referring to the year 2020) there was an increase in the mangrove forest area from 2014 to 202,435.26 rai (Figure 1.28 and Table 1.5). The reason why the area of mangrove forest increases every year is because the state has measures to prevent forest encroachment. The process of reclaiming the forest from the invaders to bring the area back to replant. Including a campaign to support the cultivation of awareness of forest resource conservation, participation of all sectors in planting mangrove forest restoration, planting trees on important days therefore increasing the area of the mangrove forest.

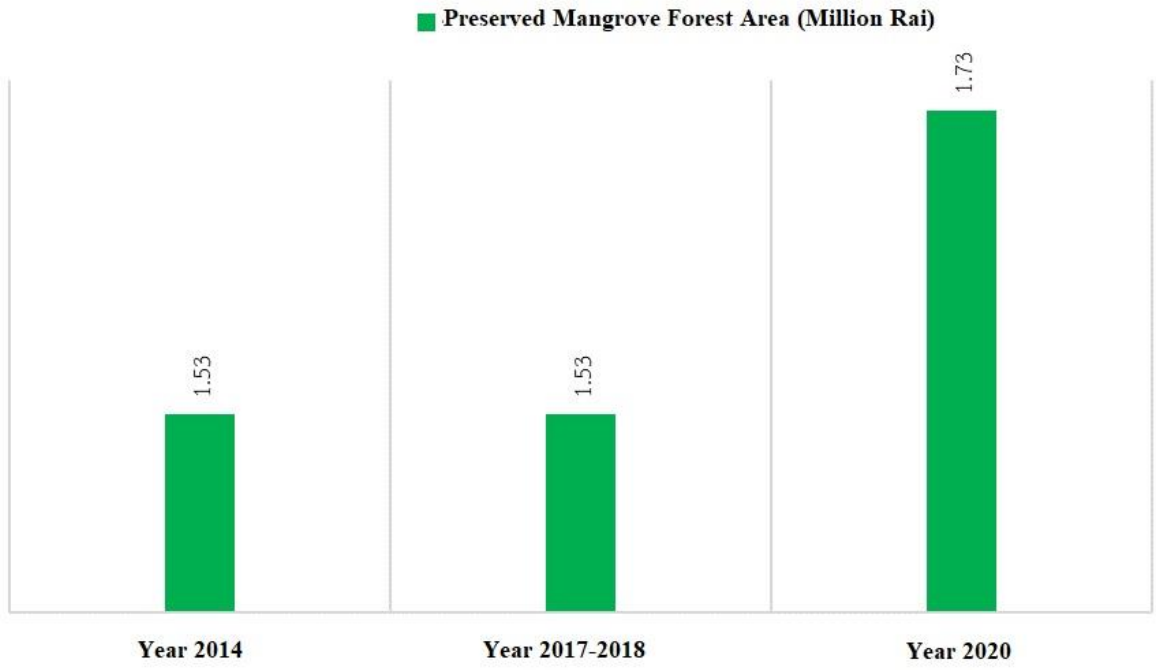


Figure 1.28 Changes in mangrove forests in Thailand between 2014 and 2020

Table 1.5 Changes in mangrove forest areas in Thailand between 1961-2020 (unit: rai)

No	Province	1961	1975	1979	1986	1989	1991	1993	1996	2000	2004	2009	2014	2017-2018	2020
1	Samut Prakan	-	3,750.00	6,500.00	644.00	-	-	1,950.00	1,857.50	7,216.02	9,163.91	12,524.17	10,643.31	13,563.52	21,087.08
2	Bangkok	-	-	-	-	-	-	1,250.00	1,236.25	3,249.09	2,537.28	3,351.79	2,526.50	2,943.08	4,741.24
3	Samut Sakhon	-	115,625.00	90,100.00	887.00	-	-	11,369.00	10,601.75	19,252.75	14,908.92	25,257.22	20,385.69	19,547.57	27,068.94
4	Samut Songkhram	-	51,250.00	47,800.00	306.00	-	-	5,775.00	7,156.25	15,956.57	14,112.42	14,272.75	18,246.56	16,427.19	28,038.33
5	Phetburi	13,750.00	55,000.00	48,700.00	3,606.00	3,056.00	2,100.00	12,925.00	12,936.25	19,165.59	6,550.71	18,568.75	14,839.53	12,857.34	19,486.75
6	Prachuap Khiri Khan	6,875.00	2,500.00	2,100.00	906.00	669.00	437.50	250.00	268.75	3,121.88	2,705.92	1,708.58	1,506.89	3,120.66	7,734.56
7	Trat	80,625.00	66,250.00	61,500.00	55,112.00	53,987.00	48,437.50	47,925.00	47,086.50	59,482.23	57,503.64	61,974.19	59,727.02	61,086.43	67,823.16
8	Chanthaburi	96,250.00	163,125.00	150,400.00	90,668.00	54,350.00	16,643.75	25,450.00	24,332.25	78,580.35	73,711.93	75,428.91	82,594.79	80,461.29	101,704.97
9	Rayong	10,625.00	34,375.00	28,800.00	15,122.00	10,987.00	962.50	4,250.00	4,103.00	11,764.01	8,709.45	11,283.57	10,190.83	11,134.93	13,632.44
10	Chonburi	-	23,750.00	20,700.00	9,362.00	6,550.00	937.50	575.00	575.00	4,547.87	4,510.31	5,554.41	4,551.71	4,452.82	6,656.34
11	Chachoengsao	-	18,750.00	14,500.00	4,625.00	3,556.00	2,293.50	3,348.00	3,015.75	10,917.55	7,812.01	7,309.34	7,585.35	10,694.73	11,557.73
12	Chumphon	50,625.00	46,250.00	43,300.00	22,662.00	14,156.00	11,362.50	20,584.00	19,698.75	45,291.80	40,535.39	32,240.11	37,001.35	35,786.66	46,264.15
13	Surat Thani	160,000.00	23,125.00	36,300.00	26,774.00	23,544.00	13,775.00	19,775.00	19,586.25	58,127.04	32,510.28	46,574.20	47,829.71	40,922.73	60,814.69
14	Nakhon Si Thammarat	382,500.00	96,875.00	80,200.00	55,224.00	53,256.00	50,156.25	49,975.00	52,601.00	59,875.64	66,098.51	73,549.60	80,922.46	64,864.75	109,374.77
15	Phatthalung	8,750.00	11,875.00	10,200.00	656.00	525.00	375.00	800.00	881.25	1,354.38	2,041.03	399.98	445.72	8,874.39	1,908.93
16	Songkhla	8,125.00	36,875.00	32,400.00	6,031.00	4,300.00	1,431.25	3,425.00	3,896.50	21,805.11	6,395.08	7,991.95	17,178.75	17,270.39	14,624.71
17	Pattani	35,000.00	6,875.00	8,700.00	11,425.00	10,994.00	10,275.00	8,095.00	6,906.75	26,439.87	23,228.84	21,993.68	17,405.86	20,509.71	20,939.54
18	Narathiwas	-	-	-	-	-	-	-	-	-	113.06	184.49	74.91	1,508.18	820.08
19	Ranong	191,250.00	151,250.00	141,200.00	135,087.00	132,388.00	121,687.50	120,675.00	120,229.00	170,334.80	158,342.90	154,448.34	161,919.41	162,587.60	171,736.57
20	Phang nga	358,750.00	319,375.00	304,475.00	227,625.00	222,663.00	209,437.50	191,976.00	190,265.25	262,736.48	271,627.74	275,316.68	274,401.14	271,719.16	288,443.90
21	Phuket	28,125.00	19,375.00	17,800.00	12,094.00	11,163.00	9,712.50	9,675.00	9,448.00	11,724.86	10,593.06	12,327.42	13,446.40	12,950.97	15,785.40
22	Krabi	335,625.00	206,250.00	198,500.00	189,450.00	185,269.00	199,468.75	178,292.00	176,709.25	219,338.38	224,217.06	218,185.74	213,646.09	221,486.16	230,790.77
23	Trang	243,750.00	212,500.00	205,400.00	164,225.00	156,500.00	192,806.25	152,050.00	150,596.75	223,676.91	204,642.34	220,975.76	211,625.11	216,427.49	226,408.77
24	Satun	288,750.00	289,375.00	246,100.00	195,243.00	180,581.00	194,081.25	183,877.00	183,402.00	245,821.59	215,602.75	223,638.95	225,889.65	226,987.58	239,576.28
All Total		**2,299,375.00**	**1,954,375.00**	**1,795,675.00**	**1,227,734.00**	**1,128,494.00**	**1,086,381.00**	**1,054,266.00**	**1,047,390.00**	**1,579,780.77**	**1,458,174.54**	**1,525,060.56**	**1,534,584.74**	**1,538,185.33**	**1,737,019.90**

- 1961, concession forest area
- 1975, translated from Landsat 1 satellite images, scale 1:250,000, performed by the National Research Council of Thailand.
- 1979, translated from Landsat 2 satellite image translation, scale 1:250,000, conducted by the Royal Forest Department in collaboration with the National Research Council of Thailand.
- 1986, translated from Landsat 3 satellite images, scale 1:250,000, operated by the Royal Forest Department.
- 1989, translated from Landsat 5 satellite images and SPOT satellites operated by the Royal Forest Department.
- 1991, translated from Landsat 4 and 5 satellite image translation, scale 1:250,000 performed by the National Research Council of Thailand.
- 1996 and 2000, translated from Landsat 5 satellite images, scale 1: 50,000, operated by the Royal Forest Department.
- 2004 and 2009, translated from Landsat 5 satellite images, scale 1: 50,000, performed by the Department of Marine and Coastal Resources.
- 2014, translated from Landsat 8 satellite images, scale 1: 50,000, performed by the Department of Marine and Coastal Resources.
- 2017-2018, translated from satellite images Sentinel-2 and Landsat 8, scale 1: 50,000, performed by the Royal Forest Department in collaboration with the Forest Research Center, Faculty of Forestry, Kasetsart University.
- 2020, translated from Theos satellite image, scale 1: 10,000, performed by the Department of Marine and Coastal Resources. in collaboration with the Geo-Informatics and Space Technology Development Agency (Public Organization)

Classification of utilization in mangrove forest areas.

Utilization classification data in mangrove forest areas, 24 coastal provinces in the year 2020 that have been analyzed jointly between the Department of Marine and Coastal Resources and the Geo-Informatics and Space Technology Development Agency (GISTDA) by categorizing utilization patterns into 13 types. It was found that the total area of mangrove forest was 3,041,733.25 rai. Divided into preserved mangrove forests with an area of 1,737,019.90 rai, beach forests, swamp forests, forests on hills, and lowland ecosystems with an area of 217,962.39 rai, Swamp area/Smooth beach, sandy beach, area 84,729.06 rai, river, canal, mining and sea, area 179,024.60 rai. The remainder has been transformed into various forms of utilization, including aquaculture area, salt field area, agriculture, city/building and the wharf, total area 822,997.30 rai, details (Figure 1.29 and Table 1.6)

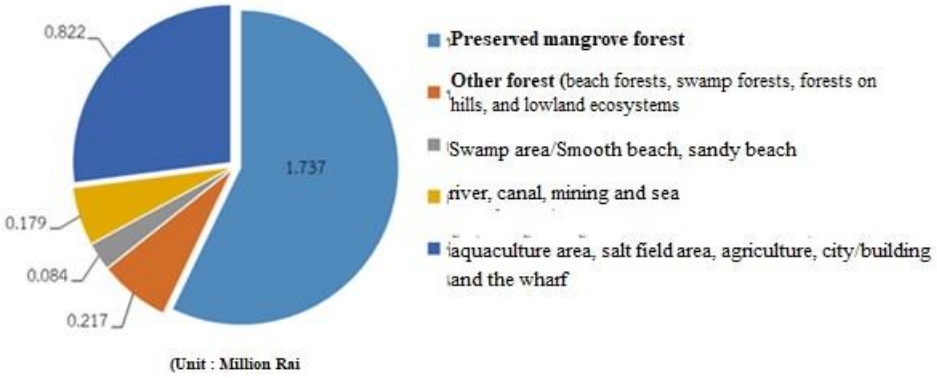


Figure 1.29 Classification of mangrove utilization zones in 2020

When following the changes in mangrove utilization comparing between 2014 and 2020, it was found that the mangrove forest area increased by about 202,436 rai or equivalent to the annual average growth rate of 28,919 rai. The swamp forest has an area of approximately 16,217 rai. Beach forest has an increased area of 23,461 rai. For swamp area/smooth beach, there is an additional area of approximately 36,258 rai. Areas that have been transformed into aquaculture areas, salt fields, agriculture, cities/buildings and wharf areas, it was found that there was a decrease in the area of about 215,467 rai. For utilization patterns that increased from 2014, including cities/buildings and wharf areas.

Table 1.6 Data on utilization classification in mangrove areas, 2020

Zone	Province	Table 1.6 Data on utilization classification in mangrove areas, 2020 (Rai)													
		Preserved Mangrove Forest	Beach Forest	Swamp Forest	Aquaculture areas	Salt Fields Area	Agriculture Area	Cities/ Buildings	Wharf	Swamp Area/ Smooth Beach	Sandy Beach	River, Canal, Mining and Sea	Forest on hills	Lowland Ecosystems	Total
East Coast Area	Trat	67,823.16	642.23	3,501.06	16,636.26	0	11,298.03	2,157.20	48.29	311.62	10.37	3,728.44	20.67	4,963.78	111,141.11
	Chantaburi	101,704.97	53.51	1,078.28	71,479.54	351.56	11,961.91	3,980.68	4.59	30.92	4.63	10,967.25	149.26	13,452.53	215,219.63
	Rayong	13,632.44	413.08	522.86	12,316.86	0	2,702.13	788.92	1.9	85.7	21.07	1,624.96	157.99	2,184.27	34,452.18
	Chonburi	6,656.14	164.62	0	4,213.23	707.17	40.13	10,716.50	0	6,362.01	0	869.21	0	4,281.77	34,010.78
	Chachoengsa	11,557.73	0	0	5,783.20	3,561.66	382.62	6,876.33	82.33	1,464.90	0	989.41	0	3,020.19	33,718.37
	Samut Prakan	21,087.08	0	0	48,469.04	0	20.45	6,162.25	124.27	3,061.03	0	3,552.00	0	605.35	83,081.47
The Upper Gulf of Thailand Coast	Bangkok	4,741.24	0	0	20,242.54	0	80.01	6,426.71	0	509.71	0	1,131.02	0	1,241.89	34,373.12
	Samut Sakhon	27,068.94	0	0	50,409.11	43,523.75	5,049.39	31,193.32	1.66	3,122.39	0	3,990.84	0	9,137.78	173,497.18
	Samut Songkhram	28,038.33	0	0	37,586.37	9,398.61	583.21	4,352.93	0.22	0	0	1,621.84	0	3,818.80	85,400.31
	Phetchaburi	19,486.75	700	0	27,429.55	21,216.90	6,430.66	3,847.55	6.11	0	101.97	3,838.14	0	5,637.87	88,695.50
	Prachuap Khiri Khan	7,734.56	1,357.84	0	3,385.07	0	830.61	549.01	0	0	43.79	678.97	360.71	2,942.47	17,883.03
	Chumphon	46,264.15	682.18	39.44	12,349.89	0	26,486.78	1,872.92	11.58	0	37.21	2,379.86	773.16	2,962.48	93,859.65
The Lower Gulf of Thailand Coast	Surat Thani	60,814.69	2,704.84	907.58	17,609.53	0	8,810.89	1,432.06	76.61	10,010.65	57.76	3,637.59	22.9	5,893.39	111,978.49
	Nakhon Si Thammarat	109,374.77	628.20	0	35,871.92	0	7,566.36	2,466.11	6.92	3,409.33	336.31	3,267.34	336.48	2,372.04	165,635.78
	Phatthalung	1,908.93	0	4,428.04	973.57	0	6,693.93	204.98	0	0	0	380.98	0	3,505.02	18,095.45
	Songkhla	14,624.71	2,615.78	12,814.98	5,625.14	0	6,814.29	6,305.41	0	0	42.66	2,479.80	7.94	17,893.36	69,224.07
	Pattani	20,939.54	1,395.35	4,482.61	3,328.57	0	3,285.75	3,542.14	0	0	288.11	2,725.14	0	5,461.76	45,448.97
	Narathiwat	820.08	535.01	8,650.15	0	0	0	0	0	0	0	0	0	0	10,005.24
The Lower Andaman Coast	Satun	239,576.28	191.07	124.74	11,896.05	0	37,357.07	4,019.53	54.75	7,637.22	188.88	32,079.82	3,760.69	2,858.38	339,744.48
	Trang	226,408.77	3,692.43	0	9,724.85	0	26,070.29	999.84	189.7	1,878.81	1,643.26	34,947.81	1,038.19	2,288.75	308,882.70
	Krabi	230,790.77	4,406.97	0	9,459.60	0	25,056.38	2,599.46	12.95	9,699.01	281.28	33,555.55	5,208.47	7,922.86	328,993.30
	Phuket	15,785.40	1,680.37	189.87	2,162.65	0	882.2	2,720.02	140.08	542.13	9.79	1,260.20	501.39	911.67	26,785.77
The Upper Andaman Coast	Phangnga	288,443.90	23,483.52	399.95	4,975.90	0	19,141.57	2,285.44	43.27	11,389.23	438.47	21,668.11	3,257.56	8,596.52	384,123.44
	Ranong	171,736.57	1,802.30	0	4,150.05	0	10,597.25	3,698.25	14.46	21,255.37	453.47	7,650.32	1,967.47	4,157.72	227,483.23
Total		1,737,019.90	47,149.30	37,139.56	416,078.49	78,759.65	218,141.91	109,197.56	819.69	80,770.03	3,959.03	179,024.60	17,562.88	116,110.65	3,041,733.25

3.1 Marine resources

3.1.1 Coral reefs

Coral reefs are rich resources and ecosystems that are important in being a habitat for many species from larvae to adults. It is a source of food and income for the community. Including the importance in terms of the relationship between the ecosystem and the way of life of coastal communities. The importance of the national economy, such as fishing, tourism industry. However, these areas are likely to be affected by human activities quite a lot, both from coastal and steep developments such as construction with open soil, dredging coastal areas for roads, buildings, accommodation, etc. The impact of tourism activities, which is one of the activities that has expanded rapidly. Impacts from fishing activities, illegal fishing, such as poaching nets, trawling, using poisonous drugs or illegal fishing in coral reefs as well as the problem of waste from the remains of fishing nets that come from repairing and cutting down the nets in the middle of the sea, impact of traffic and maritime transport such as entry and exit of ships through coral reefs, digging of waterways for navigation. Including the effects caused by climate change such as natural changes in global temperature and caused by human action. From the compilation of the causes of coral reef degradation in 2022, it was found that the major problems affecting the coral reefs in each province (Table 3.1) ranked in order of frequency found as problems can be divided as follows:

• **Marine debris** from coastal communities and fishing debris such as gillnets and fly lines, which may cover and become trapped in coral gaps and inhibit coral growth. Especially the garbage nets caused by repairing the nets and dumping the remaining seine into the sea and being swept into the coral reef area or from illegal fishing along or near the coral reefs. It was found to be a problem in 91 areas from 15 provinces such as Ao Thammachat Coral Reef Area (Koh Chang), Koh Mai Si Lek, Koh Wai, Koh Kood, Koh Mak and Koh Rang, in Trat Province, Koh Lao Beach, Koh Kwang, Laem Sadet, Koh Saba in Chanthaburi Province, Koh Man, Phala Beach, Koh Man Nai, Koh Samet, Koh Kee Pla and Koh Saket in Rayong Province, Koh Man Wichai, Koh Samae San, Koh Lan, Koh Si Chang, Koh Kham Yai, Koh Kham Noi and Koh Krok in Chonburi Province, Koh Ram Ram, Koh Talu, Koh Sing, Koh Sang, Koh Leam, Koh Ping and Koh Phang in Prachuap Khiri Khan Province, Koh Ngam, and Koh Hin Triangle in Chumphon Province, Koh Tae Nok and Natien Island in Surat Thani Province, Koh Kra in Nakhon Si Thammarat Province, Koh Nu and Koh Maeo in Songkhla Province, Koh Losin, Koh Lopee and Lopee Rocks in Pattani Province, Brawae Rock and piles of stones in Narathiwat Province, Koh Phayam in Ranong province, the King Cruiser pile of rocks and Khai Islands in Phang Nga Province, Naka Yai Island, Koh Tapao Noi, Koh Taphao Yai, Tang Khem Bay, Koh Aew, Koh Mai Thon, Koh Racha Noi, Koh Racha Yai, Patong Bay, Bang Tao Bay and Nai Yang in Phuket province, Koh Ka, Koh Lanta Yai, Koh Pida Nai, Koh Phi Phi Le and

Koh Hong in Krabi Province, Koh Muk in Trang Province, Hin Eight Mile, Tarutao, Koh Takiang and Koh Bird's Nest in Satun Province, etc.

• **Fishing** near or in the coral reef which causes damage to coral reefs including the problem of fishing gear such as nets that cover corals. It was found to be a problem in 64 areas from 13 provinces, such as Ao Thammachart Coral Reef Area (Koh Chang), Koh Mai Si Lek, Koh Wai, Koh Kood, Koh Mak and Koh Rang in Trat Province, Phala Beach and Koh Samed in Rayong Province, Koh Samae San and Koh Sichang in Chonburi Province, Local fishing and commercial fishing such as seine surrounded by rocks, spinning boats around Koh Ram, Koh Talu, Koh Sing, Koh Sang, Koh Ping and Koh Phang in Prachuap Khiri Khan Province. Around Koh Taen Nok, Northern Samui, Hin Bai and Koh Matlang in Surat Thani Province, Koh Kra in Nakhon Si Thammarat Province, around Losin Island, Lopi Island and Lopi Rock Division in Pattani Province. The area of Brawae Rock and piles of stones in Narathiwat Province, Koh Phayam in Ranong province, Koh Khai Island in Phang Nga province, Ban Laem Khad, Naka Yai Island, Rang Yai Island, Tapao Noi Island Tapao Yai Island, Tang Khem Bay, Lone Island, Hey Island, Aew Island, Racha Yai Island, Racha Noi Island and Bon Island in Phuket Province, around Koh Ka, Koh Lanta Yai in Krabi Province, Waen Island in Trang Province and Tarutao Island in Satun Province, etc.

• **Anchoring** in coral reefs from tourism activities, local fisheries and commercial fisheries, the anchor dropped on the coral caused the coral to break and the anchor cable, both chain and rope. When rubbing against the coral by the force of the wind, the wind will sweep and rub the coral to break along the line that the line passes through. It was found to be a problem in 26 areas from 9 provinces, namely, Koh Mai Si Lek, Koh Kood, Koh Kradat, Koh Mak, Koh Wai and Koh Phee in Trat Province, Koh Kwang in Chanthaburi Province, around Koh Mun Nai, Koh Samet, Koh Kee Pla and Koh Man in Rayong Province, Koh Samae San in Chonburi Province, Koh Kra in Nakhon Si Thammarat Province, Koh Nu, Koh Maeo and Koh Kham in Songkhla Province, Koh Phayam in Ranong Province, Koh Khai Island in Phang Nga Province, Koh Racha Yai, Koh Racha Noi and Coral Island in Phuket Province, Phida Nai Island and Phi Phi Island in Krabi Province.

• **Waves, winds, and monsoons** are natural issues that cause coral fractures especially during the monsoon season. It was found to be a problem in 26 areas from 9 provinces, namely Ao Thammachat (Koh Chang), Koh Mai Si Lek, Koh Wai, Koh Kood, Koh Mak and Koh Rang in Trat Province, Phala Beach, Koh Man Nai, and Koh Samet, Koi fish in Rayong Province, around Samae San Island and Sichang Island in Chonburi Province, Koh Kra in Nakhon Si Thammarat Province. Around Koh Nu, Koh Maeo in Songkhla Province, around Koh Phayam in Ranong Province, King Cruiser pile of rocks and Khai Islands in Phang Nga Province, around Koh Hong in Krabi Province.

• **Coral reef diving activities**, both diving using a breathing apparatus that is carried with the diver (SCUBA diving) and snorkeling, which is an activity that can be found in areas where diving is important. Resulting in stepping on, touching or hitting the coral with the fins. It was found to be a problem in 22 areas from 7 provinces, namely Ao Thammachat Coral Reef (Koh Chang) in Trat Province, Kwang Island and Laem Sadej in Chanthaburi Province, around Samae San Island and Si Chang Island in Chonburi Province, Koh Taen in Surat Thani Province, Koh Kham in Songkhla Province, Coral Island, Maiton Island, Racha Noi Island, Racha Yai Island, Bon Island, Pling Island, Waew Island, Patong Bay, Kamala Bay, Bang Tao Bay, Khao Sai Kru and Nai Yang in Phuket Province, around Koh Pida Nai, Koh Phi Phi Leh and Koh Hong in Krabi Province.

• **Stepping on corals during low tide** from tourists and walking to find aquatic animals by local fishermen. It was found to be a problem in 20 areas from 6 provinces, including Koh Talu, Koh Sing and Koh Sang in Prachuap Khiri Khan Province, Koh Ran Ped and Ko Ran Kai in Chumphon Province, around Hin Ngam Beach, Sao Phao Sub-district, Sichon District in Nakhon Si Thammarat Province, Koh Kham in Songkhla Province, Koh Phayam in Ranong Province, Koh Taphao Noi area Taphao Yai Island, Tang Khem Bay, Cape Panwa, Ban Khao Khad, Koh Lon, Koh Hey, Koh Aew, Koh Racha Noi and Koh Racha Yai in Phuket, Phi Phi Island and Hong Island in Krabi Province.

• **Sediment that flows into the sea** from the expansion of coastal communities, coastal activities, dredging, and the growth of tourism activities. It was found to be a problem in 16 areas from 6 provinces, including Laem Sadej Coral Reef in Chanthaburi Province, Plaa Beach, Man Nai Island, Samet Island, Ko Kee Pla and Man Islands in Rayong Province, Samae San Island and Si Chang Island in Chonburi Province. The area of Koh Sadao, Koh Khun Nok, Koh Sai, Koh Leam, Koh Ping and Koh Kola in Prachuap Khiri Khan Province, Koh Phayam in Ranong province, Koh Siray in Phuket province.

• **Sailing/Maritime transport** which causes sediments to disperse on the seafloor and be washed to deposit on the coral. It was found to be a problem in 12 areas from 5 provinces including fisheries or marine transportation causes damage to corals at Pile Rock in Rayong Province, tourist vessels pass by or near the coral reefs in the area of Koh Samae San, Koh Lan and Koh Si Chang, Chonburi Province, vessel fishing near coral reefs in the area of Koh Kra islands and coral reefs in front of Hin Ngam Beach, Sao Phao Sub-district, Sichon District, Nakhon Si Thammarat Province, the entry-exit of ships around the mouth of Songkhla Lake in Songkhla Province, affects coral reefs around Koh Nu, Koh Maeo and Rawai Bay areas in Phuket Province.

• **Dredging of channels** and the construction of ports near the coral reefs have resulted in seafloor changes. This causes wave diffraction to change from the original and obstructs the natural sediment

movement. Including sediments resulting from erosion may be carried by currents and waves to deposit on coral reefs and eventually cause coral death. It was found to be a problem in 4 areas from 4 provinces, namely the area of Chanthaburi Province, Ko Kee Pla in Rayong province, Samae San - Sattahip in Chonburi province, and Koh Nu, Koh Maeo, which were affected by sediment from dredging channels in Songkhla Lake.

• **Coral Bleaching**, from prolonged exposure to the sun during low tide or fresh water that flows into the sea, etc. It was found to be a problem in 6 areas from 3 provinces: Phala Beach Coral Reef Area and Man Nai Island in Rayong Province, Nu Island, Maeo Island and Koh Kham Island in Songkhla Province and Hong Island in Krabi Province.

• **Wastewater/Effluent,** from coastal development and coastal communities. It was found to be a problem in 5 areas from 2 provinces, namely, Koh Samae San, Koh Lan and Koh Sichang in Chonburi Province, Ban Laem Khad Coral Reef Area and Koh Siray in Phuket Province.

• **Fish feeding** which alters the natural balance system and can directly or indirectly cause problems for marine life. Found that it is still an issue in the area of Koh Phayam, Ranong Province.

• **Oil from oil spills**, it was found to be a problem in the areas of Koh Man Nai, Koh Samet, Koh Kee Pla and Koh Man, Rayong Province.

• **Sea farm** in the form of a livestock farm (Sea ranching) that brings aquatic animals such as Cockles are released into water bodies which may cause changes in seawater quality and affect nearby coral reefs. It was found to be a problem in the area of Koh Saket, Rayong Province.

• **Using the space of government agencies without knowledge and understanding.** As a result, coral reefs in the area and nearby areas are damaged, including the area of Samae San – Sattahip in Chonburi Province.

Summary of causes of degradation and impacts on marine and coastal resources and coastal erosion

Compiling causes of degradation and impacts on marine and coastal resources and coastal erosion in 2022 found that it was caused by 2 important parts: natural causes and causes caused by human exploitation activities. By natural causes such as waves, wind and monsoon, tides, currents, and climate change which affects the status of coral reefs, seagrasses, rare marine animals Mangrove Forest and beach forest and coastal erosion. While the main causes of human exploitation activities are including garbage from coastal communities, travel and garbage from fishing that is dumped directly into the sea or garbage that comes with

effluent/wastewater that flows into the sea through rivers and canals. This causes an impact on marine and coastal resources such as coral reefs, sea grasses, mangrove forests and rare marine animals. Problems from fishing, such as fishing with illegal/destructive gear, Effluent discharge into the sea from coastal communities, Conversion to coastal aquaculture areas, Conversion to coastal community and tourism areas, the area is used as an industrial and agricultural factory, Sailing/Maritime transport, sediment flowing into the sea and exploitation that destroys ecosystems such as cutting trees and catching some aquatic animals in the mangrove forests, etc. As well as problems arising from the royal decree setting the land and building tax rates, B.E. 2564. As a result, the mangrove forests in the licensed area were cut down and turned into agricultural land to avoid tax. These not only cause problems and impact on marine and coastal resources. But it also causes impacts on important coastal ecosystems and affects the abundance of marine life, biodiversity, food chains. Including the loss of coastal aquatic animal nursery areas and may affect the security of seafood, as well as impacts on the economy, society and the quality of life of the community and the country.

Threat (สิ่งคุกคาม/สาเหตุของปัญหา)	Coral reef	Sea grass	Rare Marine Animals	Coastal Water Quality	Marine Litter	Mangrove forest Beach forest and swamp	Coastal Erosion
T1 Natural causes	11	10	15			11	21
T2 Sunscreen							
T3 Disease							
T4 Tourists step on coral reefs.	6						
T5 Tourists feed coral reef fish	1						
T6 Inexperienced diver น้ำ (Scuba diving)	7						
T7 Anchor Vessel (tourists and fishing vessels)	9	1					
T8 Sediment flowing into the sea	6	13	2	5			
T9 Fisheries: Destructive, Illegal and Overproduction Tools	13	9	21		14		
T10 Throw rubbish into the sea (including net and fishing gear)	15	6	19		16	15	
T11 Sea Farm Concession	1						
T12 Chemical spills and accidents Hazardous materials and oil	1		2	6		1	
T13 Effluent discharge into the sea (community, cruise vessel)	2	8	8	15	8	8	
T14 Floods and drainage into the sea				1			1
T15 Sailing and Maritime transport	5	4	6	2	4		1
T16 Port (fishery, tourism, goods)		3		3	4	3	3
T17 Digging a marine channel (resource accumulation/loss of sediment)	4	4		2		7	2
T18 Transformed into a coastal community and tourism area.						12	4
T19 Uses coastal aquaculture areas.				4		8	6
T20 Uses the area as an industrial factory.				7		5	1
T21 Using agricultural land (palm plantations, rice fields, rubber)				8		4	1
T22 Uses salt farming area.						0	
T23 Cut the road in the mangrove forest and close to the beach						0	1
T24 Intrusive Construction at Sea							10
T25 Overburden and sea sand							4
T26 Groundwater use in coastal areas (lands subside)							
T27 Loss of sediment from dam construction							
T28 Water hyacinth carcass						0	
T29 Mining seagrass for sale		2					
T30 Ecologically destructive use (logging, fishing, etc.)						15	
T31 Use of government agencies without knowledge and understanding	1						
T32 Inbreeding with close blood			2				
T33 Lack of local cooperation			1				
T34 Closing and opening the floodgates				2			
T35 Wave retardant bamboo/Coastal aquaculture bamboo					2		
T36 Mangrove land tax						2	

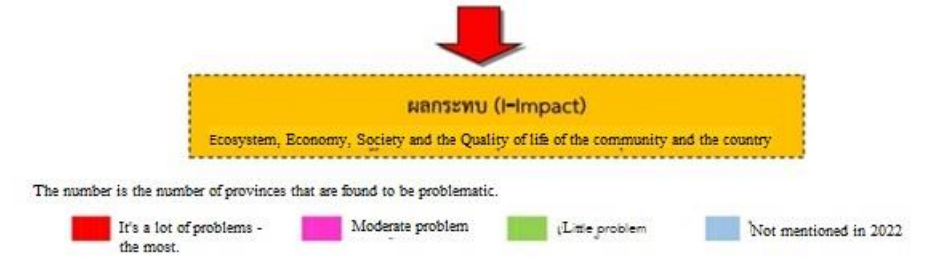


Figure 3.1 Causes of the deterioration of marine and coastal resources and coastal erosion in 2022

Surat Thani

Surat Thani Province has a total area of 12,891.469 square kilometers. The coastline is 157.17 kilometers long and has 108 large and small islands. The important marine and coastal resources are coral reefs, seagrass beds, Rare marine animals, mangrove forests, beach forests and swamp forests.

1 . important ecosystem status

1.1 Marine and coastal resources

1) Coral reefs: According to the data in 2022, there is a distribution area of coral reefs of 35,982 rai, surveyed and assessed areas of 31,071 rai or 86 % of the total coral reef area. The status of coral reefs was largely unchanged except Koh Tao, Laem Thian, Koh Phangan, Hat Yao Bay, Koh Samui, Laem Natien, Hin Ang Wang in the south and Koh Madsum in the south with a tendency to deteriorate. The areas with better coral reefs are Koh Tao (Ao Chalok Ban Kao, Sairee Beach), Koh Katen (east and west), Rab Island in the north, Thai Plao Island, Hin Dup Island, Wua Kantang Island and Sam Sao Island (west, east, north) and Koh Wua Ta Lap (Ao Kha), where the main cause of degradation is sediment from coastal development, fishing waste and sediments from the Tapi River

2) Seagrass source: Surat Thani Province has a potential area as seagrass source of Surat Thani Province, 16,480 rai. Data in 2022 found that seagrass has a total area of 11,854 rai, a decrease of 764 rai compared to the 2021 data , which had a total area of 12,618 rai. Overall, there is a steady trend in Ban Don Bay, Koh Samui, Koh Phangan, Koh Nok Taphao and Koh Tao, and a seasonally declining trend in Nang Kam Bay.

3) Rare marine animals found in Surat Thani Province are hawksbill turtles, humpback dolphins, Irrawaddy dolphins, porpoises, Bryde's whales, black killer whales, and whale sharks. There are 69 animals, consisting of 28 dolphins and whales (18 decrease from 2021) , 41 sea turtles (5 increase from 2021)

1.2 Situation of Mangrove Forest, Beach Forest, and Swamp Forest

From land use classification data in mangrove forest areas Surat Thani Province , year 2020 , with a total area of 111,978.49 Rai consists of 60,814.69 rai is preserved mangrove forest areas.

Beach forest amount 2,704.84 Rai, swamp forest 907.58 rai and other areas such as aquaculture areas, agricultural area, city and building Pier, mud lane/mud beach, Sandy Beach, River, the forest on the hill and the ecological system at ground floor , totaling 47,551.38 rai.

1.3 Marine Environmental Situation

1) Sea water quality in 2022, it was found that there was a deteriorating trend compared to 2021 , water quality was divided into very good (decreased) until not found. In 2022 , good (increased) from 31 % to 40 % , fair (increased) from 53 % to 55% and the threshold has deteriorated (increased) from 2 % to 5 %.

2) Oil Spills: In 2022, no oil spills and bitumen lumps were found.

3) Sea water changing color: during 2017 - 2021 happened 2 times in total. The phytoplankton that causes the sea water color changing phenomenon is *Trichodesmium . erythraeum* and in 2022, there was no sea water changing color phenomenon.

4) Toxic Jellyfish: from surveys since 2010 – 2022 found a total of 7 poisonous jellyfish species: 1) box jellyfish of the family Carukiidae, 2 species are Carukiidae , undescribable and *Morbakka* sp. A spreading in January, March and during June - October 2) Chirodropidae 1 species Chironex *indrasaksajiae* Found spread in January and during July- December 3) Chiropsalmidae 1 species is *Chiropsoides buitendijki,* the spread was observed during January-March, July, August, and November. 4) Scyphozoa fire jellyfish. Family Pelagiidae 2 species: *Chrysaora* cf. *chinensis* and *Pelagia* sp. were found spreading in June 5) Bottlehead jellyfish of the group Hydrozoa of the family Physalidae, 1 species is *Physalia.* sp. was found invasive in February. As of 2022 , there have been no injuries or deaths from jellyfish poisoning.

5) Marine Debris: In 2022, debris was found in communities located next to rivers and canals that flow into the sea including waste from tourism and fishing causing marine debris to remain in mangrove forests, coastal communities and beaches. Especially during the monsoon season, a lot of marine debris is washed up on the beach.

2. The situation of important marine and coastal resources in the area

From the community level discussion meeting And the meeting of the Provincial Marine and Coastal Resources Committee had additional opinions on the marine and coastal resources situation separated by issues as follows:

2.1) Marine resources

- **coral resources**

– Coral reef fisheries result in discarding of fishing gear on the coral reefs in the area of Madlang Island - Natien Island, Koh Samui District and Koh Hin Bai - Koh Tae Nok - Koh Tae Nai, Koh Phangan District

– Tourist boats are disorganized and anchored in coral reefs. Boats taking tourists cause sediment to spread and the problem of mooring buoys that began to deteriorate and disappear.

– The popularity of consuming Lup mushrooms or sea fascia has led to a decrease in quantity in the area of Koh Samui District .

– The phenomenon of the lowest water level in 3 years in the area of Freedom Beach , Koh Tao Subdistrict resulting in coral damage.

– Coral reefs around the Angthong islands It is influenced by the sediment from the estuary and the effluent that flows into the Tapee River and the fishing boats that pass by, resulting in continuous sediment stirring.

- **Sea Grass Resources**

– Waste water / effluent problems from communities around Koh Samui

– Sediment from channel dredging / construction / coastal development Koh Samui and Koh Phangan area

– Fishing near the seagrass beds, including boat traffic in the seagrass beds during low tide , such as Koh Matlang. Koh Samui District and around Phum Riang Bay, Chaiya District.

– Changes in seasonal conditions around Koh Matlang, Koh Samui District and Bandon Bay area.

- **rare sea creatures**

– The impact of fishing gear and marine debris has resulted in the beaching of rare marine animals. Especially among sea turtles, there may be a bandage around the body and paddle blade causing injury, disability or death of the animal.

– Dolphin population in Don Sak District. There is a risk of inappropriate dolphin tourism. and ship accidents

2.2) Marine environment

- **marine debris**

– The problem of marine waste from coastal communities that dump waste directly into rivers and canals, including waste from tourism . and fishing causing marine debris to remain in mangrove forests, coastal communities and beaches. Especially during the monsoon season, a lot of marine debris is washed up on the beach.

– Garbage dumping was found in chum areas located next to rivers and canals that flow into the sea. Around Village No. 5, Bang Chana Sub-district, Mueang District and Village No. 6, Kadae Sub-district, Kanchanadit District

– Found littering in the community area near the beach of Ban Hua Thanon, Koh Samui District .

2.3) Mangrove Forest Resources

– population increase expansion of community resources Causing the need for land to expand into the mangrove forest area. Mangrove forest resources are encroached for agricultural use and aquaculture. Most of them are shrimp farming, which are scattered around the seashore. There is destruction of mangrove forests for widespread of shrimp farming. Shrimp species that are commonly raised are black tiger prawns, White leg shrimp.

– The growth in tourism uses the land to build a resort, construction of the pier, building a pier in the mangrove forest will have more expansion projects in the future in coastal provinces such as the pier to Koh Samui, Pier to Koh Phangan.

– Utilization of mangrove trees to use according to the way of the community, burning charcoal, stilts for construction of resorts, restaurants, piers .

– The boundary of the mangrove forest in the area is unclear. People do not know the boundaries of the forest. People trespass and cut trees around Ban Nang Kam Beach, Village No. 10 , Don Sak Sub-district, Don Sak District.

– Although the dredging of channels is not done directly in the mangrove forest area, but in the area of the waterway or the waterway that passes through the mangrove forest when digging a trench, the dredger will spray the muddy soil or sand excavated from the bottom water into the mangrove forest area.

2.4) other

– Conflicts in the use of fishery resources and coastal resources in the area of Bandon Bay coastal resource management and fishery resources in Ban Don Bay area with management that is not in the same direction.

3. Important of marine and coastal resources issues in the area Between the year 2021 - 2022

1) Baby mussels are born naturally around Ban Don Bay. Since Tha Chana District, Chaiya District, Tha Chang District, Phun Phin District, Mueang District, Kanchanadit District, Don Sak District, information from the NAT network in the area informs that smuggling boats are used in the area of Don Hoi and the mollusks that were found were white clams, clams in Tha Chana-Chaiya districts, and cockles in Tha Chang District - Don Sak District

2) The problem of occupying sea areas for cockle farming in Ban Don Bay in Ban Pod Sub-district, Don Sak District has resulted in conflicts between local people and foreign fishermen.

3) Electrical system development project for various island areas. The Provincial Electricity Authority has a project to expand electricity using submarine cables 7.1 kilometers from Ao Thong Krut to the east side of Koh Taen Koh Samui District.

4) invasion of coastal areas. In the case of a complaint, a private company occupies land along the coastline, Village No. 8, Don Sak Subdistrict, Don Sak District.

5) A dugong washed up at Nang Loi Beach, Village No. 8, Tha Chana Sub-district, Tha Chana District, Surat Thani Province. Male, length 2.73 m, weight 415 kg. The cause of death was due to sickness and human activity.

6) From the volcanic eruption near the island of Sumatra Indonesia found a lot of small volcanic rocks floating on the beach, Koh Samui, Koh Phangan, Koh Tao.

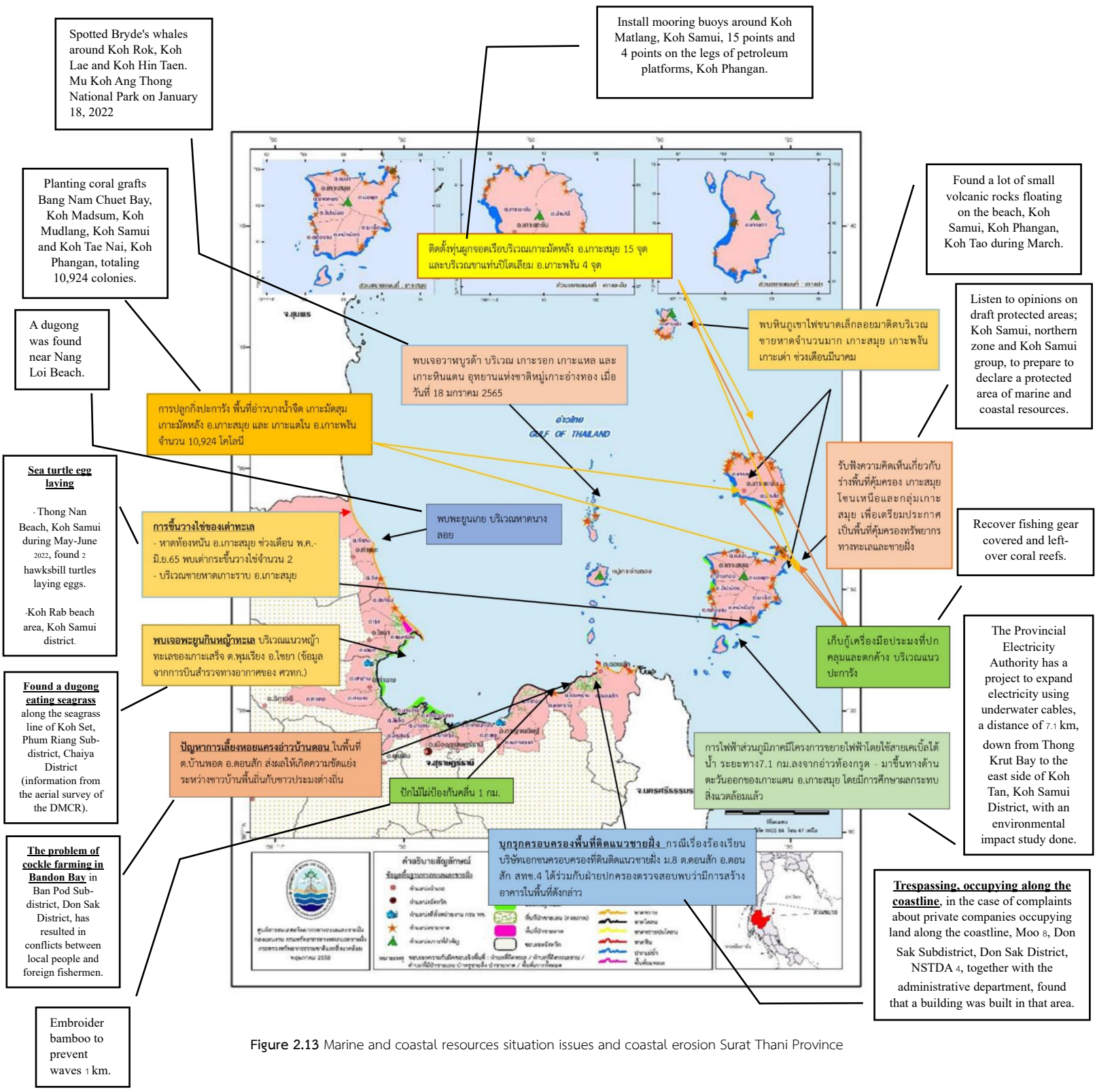


Figure 2.13 Marine and coastal resources situation issues and coastal erosion Surat Thani Province