PART II

Issues and Challenges in Sustainable Development of Fisheries and Aquaculture of the Southeast Asian Region

1. Marine Fishery Resources

1.1 Status, Issues, and Concerns

1.1.1 Tuna and Tuna-like Species

Tunas and tuna-like species are categorized into three groups, *i.e.* neritic tunas, oceanic tunas, and tuna-like species. Neritic tunas are likely found in the seas of Southeast Asia particularly in the Andaman Sea (AS) and South China Sea (SCS), while oceanic tunas migrate over a thousand kilometers. **Figure 39** shows the production of tuna and tuna-like species of Southeast Asia, from Fishing Area 57 (Indian Ocean, Eastern) and Fishing Area 71 (Pacific, Western Central) during 2008–2019. Based on the information provided by the ASEAN Member States (AMSs), neritic tunas include frigate tuna (*Auxis thazard*), bullet tuna (*Auxis rochei*), kawakawa (*Euthynnus affinis*), longtail tuna (*Thunnus tonggol*); oceanic tunas include skipjack tuna (*Katsuwonus pelamis*), southern bluefin tuna (*Thunnus maccoyii*), yellowfin tuna (*Thunnus albacares*), albacore tuna (*Thunnus alalunga*), and bigeye tuna (*Thunnus obesus*); and tuna-like species include narrow-barred Spanish mackerel (*Scomberomorus commerson*), Indo-Pacific king mackerel (*Scomberomorus guttatus*), seerfishes *nei* (*Scomberomorus* spp.), and tuna-like fishes *nei* (Scombroidei). For Fishing Area 57, the average production during the twelve-year period from 2008 to 2019, was about 0.41 million metric tonnes (mt) per year with the lowest at 0.32 mt in 2017 and highest at 0.54 mt in 2010. For Fishing Area 71, the average production was about 1.64 mt per year with the lowest at 1.28 mt in 2010 and highest at 2.05 mt in 2019. Overall, the production of Fishing Area 71 was almost four times higher than that of Fishing Area 57.

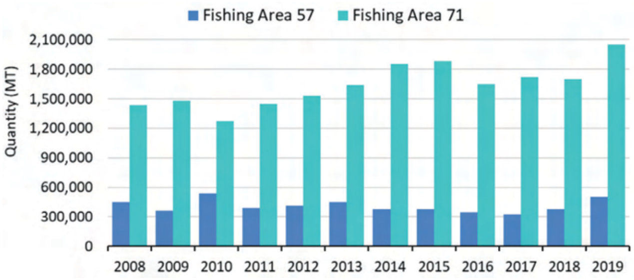


Figure 39. Production of tunas and tuna-like species of Southeast Asia between 2008 and 2019 from Fishing Area 57 and Fishing Area 71 by quantity (mt)

Source: *SEAFDEC, 2022*

RPOA-Neritic Tunas

For the AMSs, neritic tunas are vital fisheries commodities providing food for domestic consumption, generating job opportunities, and bringing about high economic revenues for many countries through their export endeavors since neritic tunas offer high prices for the fish processing industries. However, being concerned that the insufficiency of data and information as well as the unclear stock status of neritic tunas in the Southeast Asian region could possibly lead to the overexploitation of the resources, SEAFDEC/MFRDMD in collaboration with SEAFDEC Secretariat and SEAFDEC/TD organized series of consultations with the AMSs to examine the issues related to the stock status of neritic tunas in Southeast Asia. This led to the development of the Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas) by the AMSs in collaboration with SEAFDEC, and subsequent endorsement of the RPOA-Neritic Tunas during the Forty-seventh Meeting of the SEAFDEC Council in 2015 and the 23rd Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGFi). The main features of the RPOA-Neritic Tunas are shown in **Box 1**.

Box 1. Main features of the RPOA-Neritic Tunas

Objectives	Issues	Action plan
Determining available data and information, improving data collection, and developing the key indicator	Insufficient data and information	Improve data collection and analysis for neritic tunas
Improving sustainable fisheries management	Inadequate understanding of management and conservation measures	Enhance understanding of management and conservation measures of neritic tunas
Improving compliance to rules and regulations and access to markets	Illegal, unreported and unregulated (IUU) fishing	Combat IUU fishing occurring in the Southeast Asian region
Enhancing regional cooperation	Insufficient information on status and trends of neritic tunas at sub-regional level	Assessment of the status and trends of neritic tunas at sub-regional level

One of the key actions of the RPOA-Neritic Tunas requires the need to enhance regional cooperation for the development of sub-regional Action Plans for neritic tuna fisheries, as well as to support the assessment of the stock status and trends of neritic tuna at the regional level. As also called for in the RPOA-Neritic Tunas, the Scientific Working Group on Neritic Tuna Assessment (SWG-Neritic Tuna) was established which convenes their meetings annually or biannually to continue discussions on the stock status of neritic tunas in the Southeast Asian region.

Stock Assessment of Neritic Tunas

The second series of stock assessments of neritic tunas was conducted by SEAFDEC in cooperation with the Member Countries in February 2020, focusing on kawakawa (*Euthynnus affinis*) and longtail tuna (*Thunnus tonggol*), with the conjecture that these species inhabited Fishing Area 57 and Fishing Area 71. The results of the second assessment were compared to the previous assessment in 2016 which was conducted using A Stock-Production Model Incorporating Covariates (ASPIC), Kobe Plot I-II, and risk assessment (MFRDMD, 2021).

- *Kawakawa*

Indian Ocean

In the Indian Ocean, the stock status of kawakawa had changed from green zone (safe) in 2014 to red zone (unsafe) in 2018, as shown in **Figure 40**. Although kawakawa stock was in a safe condition in 2014, it was recommended that fishing pressure and catch should not exceed the 2014 level, since the 2014 Kobe plot already exhibited 53 % of uncertainties (red, orange, and yellow zones) with only 47 % in the green zone. Meanwhile, the Kobe plot in 2018 revealed a high probability that the stock status of kawakawa is 76 % in the red zone, indicating that serious overfished and overexploitation situations had occurred. Therefore, as shown in **Figure 41**, the current catch of 62,000 mt should be reduced by 60 % (25,000 mt) to avoid the 50 % risks that the total biomass (TB) and fishing mortality (F) would violate their MSY levels.

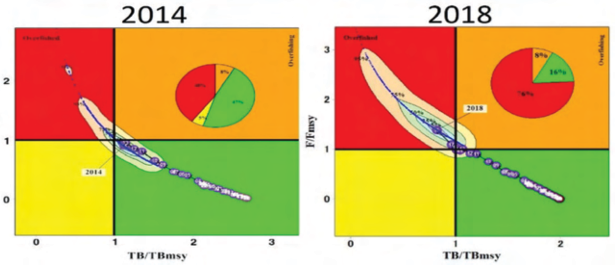
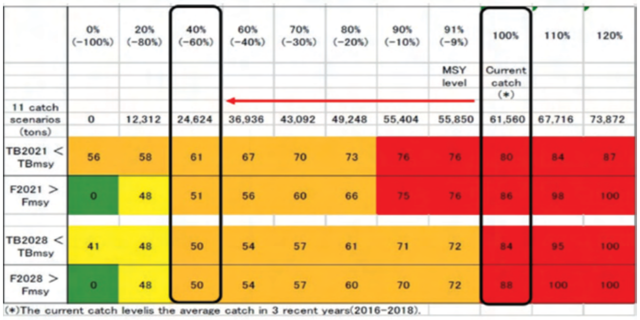


Figure 40. Status of kawakawa in the Indian Ocean in 2014 and 2018 based on Kobe Plot



	0% (−100%)	20% (−80%)	40% (−60%)	60% (−40%)	70% (−30%)	80% (−20%)	90% (−10%)	91% (−9%)	100%	110%	120%
								MSY level	Current catch (*)		
11 catch scenarios (tons)	0	12,312	24,624	36,936	43,092	49,248	55,404	55,850	61,560	67,716	73,872
TB2021 < TBmsy	56	58	61	67	70	73	76	76	80	84	87
F2021 > Fmsy	0	48	51	56	60	66	75	76	86	98	100
TB2028 < TBmsy	41	48	50	54	57	61	71	72	84	95	100
F2028 > Fmsy	0	48	50	54	57	60	70	72	88	100	100

(*)The current catch levelis the average catch in 3 recent years(2016–2018).

Figure 41. Risk assessment of kawakawa in the Indian Ocean

Pacific Ocean

As shown in **Figure 42**, the stock status of kawakawa in the Pacific Ocean remains in a safe situation, as it is in the green zone. The 2013 Kobe plot showed that there was no probability for uncertainties to fall under the unsafe zone (red, orange, and yellow zones). Thus, it was then recommended that the current catch and fishing pressure (F-fishing mortality levels) should be maintained under their MSY levels, *i.e.* at 185,000 mt and 0.43, respectively. Moreover, since the 2018 Kobe plot also revealed that the stock status of kawakawa in the Pacific Ocean side is still in the green zone (safe) with a probability of 84 %, this indicates that kawakawa is not exploited. However, it is still necessary that the current catch of 205,000 mt should be reduced by 20 % (164,000 mt) to avoid a 50 % risk of the TB and F violating their MSY levels as indicated in **Figure 43**. Specifically, even if the stock status is in the green zone or the 2018 current catch is higher than the MSY level, the catch should still be reduced in order that the stock status remains in a safe condition.

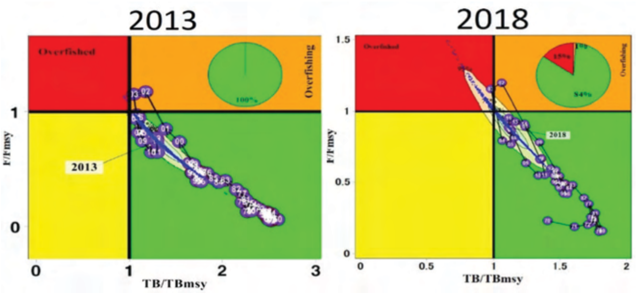
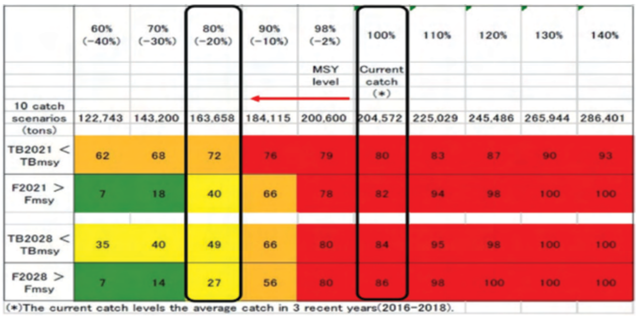


Figure 42. Status of kawakawa in the Pacific Ocean in 2013 and 2018 based on Kobe Plot



	60% (−40%)	70% (−30%)	80% (−20%)	90% (−10%)	98% (−2%)	100%	110%	120%	130%	140%
					MSY level	Current catch (*)				
10 catch scenarios (tons)	122,743	143,200	163,658	184,115	200,600	204,572	225,029	245,486	265,944	286,401
TB2021 < TBmsy	62	68	72	76	79	80	83	87	90	93
F2021 > Fmsy	7	18	40	66	78	82	94	98	100	100
TB2028 < TBmsy	35	40	49	66	80	84	95	98	100	100
F2028 > Fmsy	7	14	27	56	80	86	98	100	100	100

(*)The current catch levels the average catch in 3 recent years(2016–2018).

Figure 43. Risk assessment of kawakawa in the Pacific Ocean

- *Longtail tuna*

Indian Ocean

For longtail tuna in the Indian Ocean, the stock status seemed to have recovered from being in the red zone in 2014 to be in the green zone in 2018 as shown in **Figure 44**. In 2014, its Kobe plot showed very high uncertainties of being in the red, orange, and yellow zones with 78 % probability, indicating that the stock was already overfished, yet fishing activities continued. Thus, it was recommended to reduce the catch and fishing mortality (F) to their MSY levels at 37,000 mt and 0.51, respectively. However, the 2018 Kobe plot revealed that the stock status of longtail tuna in the Indian Ocean is already in the green zone (safe) with 63 % probability. It is therefore suggested that the current catch in 2018 at 124,000 mt could be increased to the MSY level of 167,000 mt, considering that the probability of the total biomass and fishing mortality violating their MSY levels is less than 50 % (**Figure 45**).

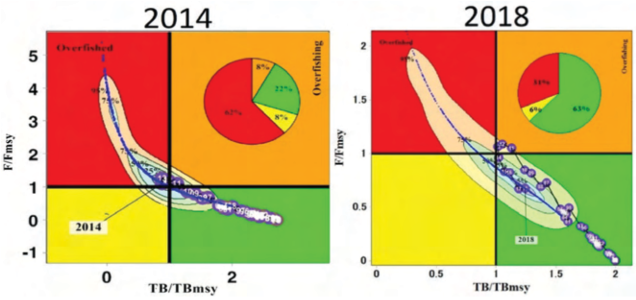
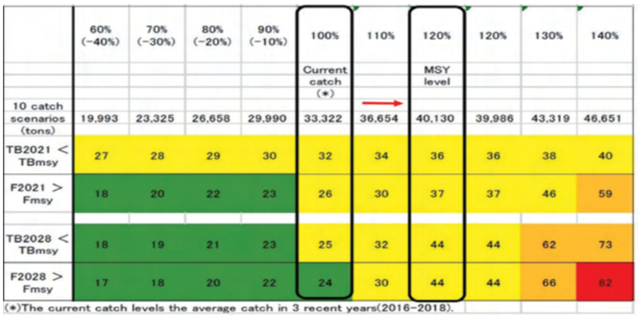


Figure 44. Status of longtail tuna in the Indian Ocean in 2014 and 2018 based on Kobe Plot



	60% (−40%)	70% (−30%)	80% (−20%)	90% (−10%)	100%	110%	120%	120%	130%	140%
					Current catch (*)		MSY level			
10 catch scenarios (tons)	19,993	23,325	26,658	29,990	33,322	36,654	40,130	39,986	43,319	46,651
TB2021 < TBmsy	27	28	29	30	32	34	36	36	38	40
F2021 > Fmsy	18	20	22	23	26	30	37	37	46	59
TB2028 < TBmsy	18	19	21	23	25	32	44	44	62	73
F2028 > Fmsy	17	18	20	22	24	30	44	44	66	82

(*)The current catch levels the average catch in 3 recent years(2016–2018).

Figure 45. Risk assessment of longtail tuna in the Indian Ocean

Pacific Ocean

In the Pacific Ocean, the stock status of longtail tuna in 2013 was in the green zone (safe) as shown in **Figure 46**, indicating zero probability of uncertainties to be in red, orange, and yellow zones. It was then suggested to increase the catch and fishing pressure but should be less than their MSY and Fmsy levels, that is at 200,000 mt and 1.07, respectively. Since the 2018 Kobe plot also showed that the stock status of longtail tuna remained healthy with a 100 % probability of being in the green zone (safe), it is therefore suggested that the current catch at 124,000 mt could be increased to the MSY level of 167,000 mt, because the probability of total biomass and fishing mortality violating their MSY levels is less than 50 % as shown in **Figure 47**.

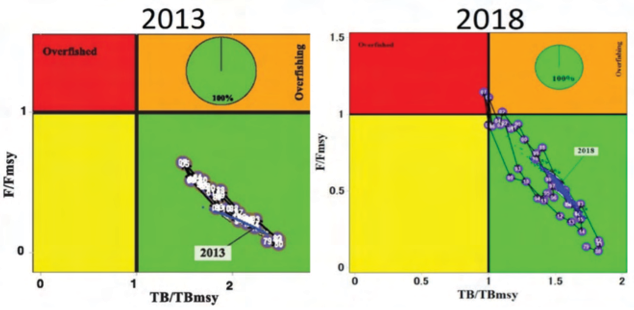
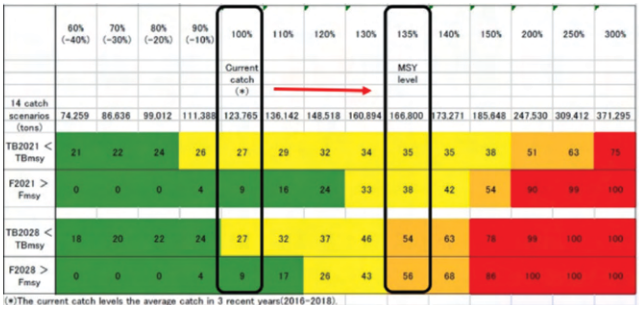


Figure 46. Status of longtail in the Pacific Ocean in 2013 and 2018 based on Kobe Plot



	60% (−40%)	70% (−30%)	80% (−20%)	90% (−10%)	100%	110%	120%	130%	135%	140%	150%	200%	250%	300%
					Current catch (*)				MSY level					
14 catch scenarios (tons)	74,259	86,636	99,012	111,388	123,765	136,142	148,518	160,894	166,800	173,271	185,648	247,530	309,412	371,295
TB2021 < TBmsy	21	22	24	26	27	29	32	34	35	35	38	51	63	75
F2021 > Fmsy	0	0	0	4	9	16	24	33	38	42	54	90	99	100
TB2028 < TBmsy	18	20	22	24	27	32	37	46	54	63	78	99	100	100
F2028 > Fmsy	0	0	0	4	9	17	26	43	56	68	86	100	100	100

(*)The current catch levels the average catch in 3 recent years(2016–2018).

Figure 47. Risk Assessment of longtail tuna in the Pacific Ocean 2018

Stock Assessment of Tuna-like Species

In 2018, the SEAFDEC Secretariat in collaboration with SEAFDEC/TD organized the "Practical Workshop on Stock Assessments of Indo-Pacific King Mackerel and Narrow-barred Spanish Mackerel in the Southeast Asian Waters" at SEAFDEC/TD in Samut Prakan, Thailand, which was attended by representatives from the AMSs. The training course aimed to enhance the knowledge of the participants on the stock and risk assessments of the Indo-Pacific king mackerel (*Scomberomorus guttatus*) and narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the waters of Southeast Asia (SEAFDEC, 2019).

- *Narrow-barred Spanish mackerel*

Indian Ocean

Results of the assessments showed that the stock status of the narrow-barred Spanish mackerel in the Indian Ocean is in the green zone but very close to the MSY (TB and F) while the probability of getting into the red zone is 71 % (**Figure 48**). Thus, the stock is still not safe even if the stock status of 2016 is in the green zone. Based on the results of the risk assessments (**Figure 49**), the current catch level should be reduced by 20 % (43,300 mt), so the probabilities of violating the MSY (TB and F) would be less than 50 % in 10 years (2026).

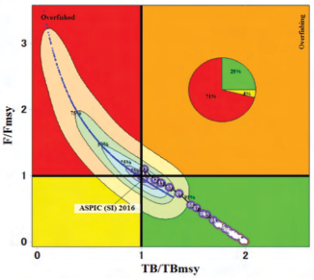


Figure 48. Status of narrow-barred Spanish mackerel in the Indian Ocean in 2016 based on Kobe Plot

	0%	20%	40%	60%	70%	80%	90%	100% Current Catch (*)	102% MSY level	110%	120%	130%
10 catch scenarios (tons)	0	10,818	21,636	32,454	37,863	43,272	48,681	54,090	55,170	59,499	64.908	70,317
TB2019< TBmsy	33	38	42	27	50	54	57	61	62	67	71	76
F2019 > FMSY	0	27	29	35	39	43	51	60	63	74	91	100
TB2026 < Tbmsy	13	27	29	33	36	41	46	59	63	80	95	100
F2026 > FMSY	0	27	29	33	36	40	46	59	64	84	100	100

(*) The current catch levels the average catch in 3 recent year (2014-2016)

Figure 49. Risk assessment of narrow-barred Spanish mackerel in the Indian Ocean

Pacific Ocean

The resultant Kobe plot (**Figure 50**) indicates that the stock status in 2016 was in the red zone (serious situation), and based on the risk assessments, the current catch should be reduced by at least 80 % (32,800 mt) to secure the MSY levels for both TB and F at the probability of 50 % or more in 3–10 years. However, even with the 80 % reduction, the probability of violating the MSY (TB and F) would still be more than 50 %. As the 80 % reduction is too much and too critical for the fishing and processing industries, the SEAFDEC-organized workshop suggested that step-wise reductions could be adopted, *i.e.* for example, by 40 % reduction (98,300 mt) as the first step for a few years, afterward, reduction levels would be adjusted depending on results of the next stock and risk assessments (**Figure 51**).

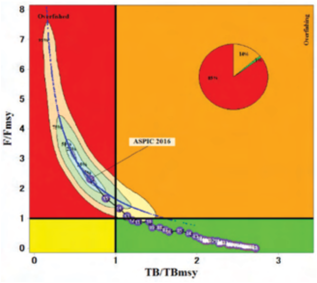
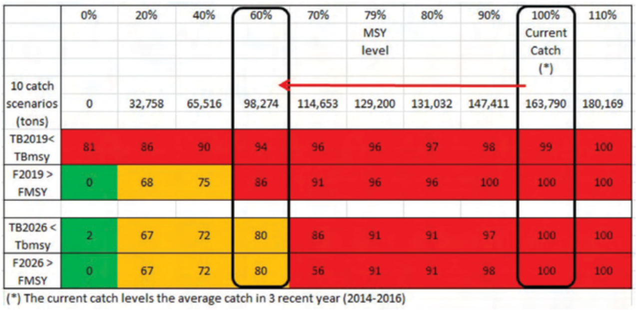


Figure 50. Status of narrow-barred Spanish mackerel in the Pacific Ocean in 2016 based on Kobe Plot



	0%	20%	40%	60%	70%	79% MSY level	80%	90%	100% Current Catch (*)	110%
10 catch scenarios (tons)	0	32,758	65,516	98,274	114,653	129,200	131,032	147,411	163,790	180,169
TB2019< TBmsy	81	86	90	94	96	96	97	98	99	100
F2019 > FMSY	0	68	75	86	91	96	96	100	100	100
TB2026 < Tbmsy	2	67	72	80	86	91	91	97	100	100
F2026 > FMSY	0	67	72	80	56	91	91	98	100	100

(*) The current catch levels the average catch in 3 recent year (2014-2016)

Figure 51. Risk assessment of narrow-barred Spanish mackerel in the Pacific Ocean

- *Indo-Pacific king mackerel*

Indian Ocean

The stock status of the Indo-Pacific king mackerel in the Indian Ocean (**Figure 52**) is in the green zone and is in a very healthy situation as the TB and F in 2016 are far away from their MSY levels and the probability of uncertainties in the green zone is 97 %. Moreover, as shown in **Figure 53**, it is suggested that the current catch level could be increased by 15 % to the MSY level (21,500 mt), for even with the increase to MSY levels, the probabilities violating the MSY (TB and F) would be less than 50 % in 10 years (2026).

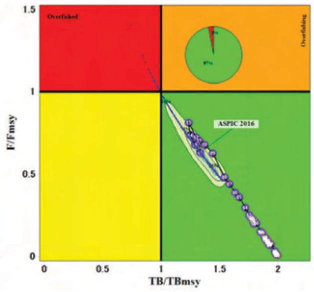
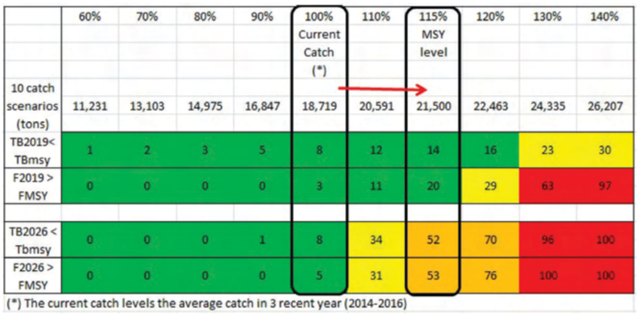


Figure 52. Status of Indo-Pacific king mackerel in the Indian Ocean in 2016 based on Kobe Plot



	60%	70%	80%	90%	100% Current Catch (*)	110%	115% MSY level	120%	130%	140%
10 catch scenarios (tons)	11,231	13,103	14,975	16,847	18,719	20,591	21,500	22,463	24,335	26,207
TB2019< TBmsy	1	2	3	5	8	12	14	16	23	30
F2019 > FMSY	0	0	0	0	3	11	20	29	63	97
TB2026 < Tbmsy	0	0	0	1	8	34	52	70	96	100
F2026 > FMSY	0	0	0	0	5	31	53	76	100	100

(*) The current catch levels the average catch in 3 recent year (2014-2016)

Figure 53. Risk assessment of Indo-Pacific king mackerel in the Indian Ocean

Pacific Ocean

As shown in **Figure 54**, the stock status of Indo-Pacific king mackerel in the Pacific Ocean indicates that the stock status in 2016 is in the green zone (TB/TBmsy = 1.45 and F/Fmsy = 0.63). This suggests that the stock status is in a very safe situation as TB and F in 2016 are far away from their MSY levels. Based on the risk assessment (**Figure 55**), it is suggested that the current catch level could be increased by 31 % to the MSY level (15,100 mt). Even with increases

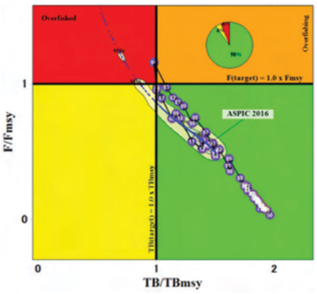
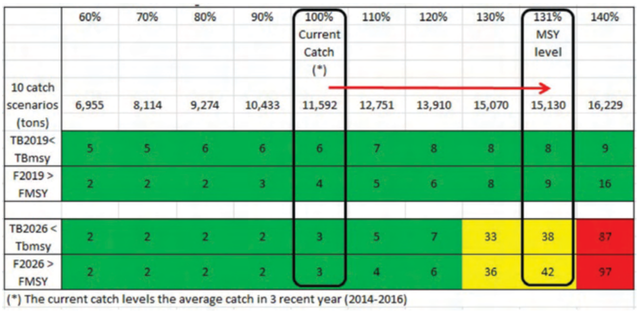


Figure 54. Status of Indo-Pacific king mackerel in the Pacific Ocean in 2016 based on Kobe Plot



	60%	70%	80%	90%	100% Current Catch (*)	110%	120%	130%	131% MSY level	140%
10 catch scenarios (tons)	6,955	8,114	9,274	10,433	11,592	12,751	13,910	15,070	15,130	16,229
TB2019< TBmsy	5	5	6	6	6	7	8	8	8	9
F2019 > FMSY	2	2	2	3	4	5	6	8	9	16
TB2026 < Tbmsy	2	2	2	2	3	5	7	33	38	87
F2026 > FMSY	2	2	2	2	3	4	6	36	42	97

(*) The current catch levels the average catch in 3 recent year (2014-2016)

Figure 55. Risk assessment of Indo-Pacific king mackerel in the Pacific Ocean

in the MSY levels, the probability of violating the MSY (TB and F) would be less than 40 % in 10 years (2026).

Life History of Tunas

In 2020, a study of the life history of kawakawa (*Euthynnus affinis*) was conducted using the hard part analysis method by estimating the annual ring or age using the otolith. In estimating the fish age, the otolith's growth is related to the fish size and generally follows an allometric increase in dimensions. The results of using the otolith in determining the age of *E. affinis* indicated that the age of kawakawa having 240–640 mm fork length could be 1–7 years old.

Genetic Population Study

From 2016 to 2018, SEAFDEC/MFRDMD with funding support from the SEAFDEC-Sweden Project carried out the "Population Study of *Thunnus tonggol* (Bleeker, 1851) in the Southeast Asian Region," using full-length sequences of the mitochondrial displacement loop (D-loop) and cytochrome b (*Cyt b*). A total of 548 samples from 12 sites in the Southeast Asian region (**Figure 56**) was collected from May 2017 to July 2018. The pairwise FST comparison analysis among the sampling sites showed no significant difference for D-loop, but for *Cyt b*, Banda Aceh and Pemangkat in Indonesia showed significant differences from the other sites. The phylogenetic reconstruction defines the haplotypes into genetically homogenous gene trees among all sampling sites based on the homogeneous, single-clade gene trees and complex reticulation of the median-joining network.

Furthermore, the high contribution of within-localities variation through AMOVA firmly proposed that *T. tonggol* in the Southeast Asian region are genetically identical with ambiguous genetic structure, which is likely due to high genetic connectivity. Although the haplotype diversity is high, there is low nucleotide diversity among *T. tonggol* populations in the studied populations, suggesting population expansion of *T. tonggol* in the region due to the lack of geographical structure inferred by both markers.

Using the same samples, the other study in 2019 "Genotyping of microsatellite markers to study the genetic structure of the longtail tuna, *T. tonggol* in the Southeast Asian region," which was funded by the Department of Fisheries Malaysia, had supported the previous study of SEAFDEC/MFRDMD which found that *T. tonggol* in the region is a single stock. Besides, other studies have also reported that in their studied locations, there exists a single stock structure for the same species (Kunal *et al*., 2014; Willette *et al*., 2016; Kasim *et al*., 2020).

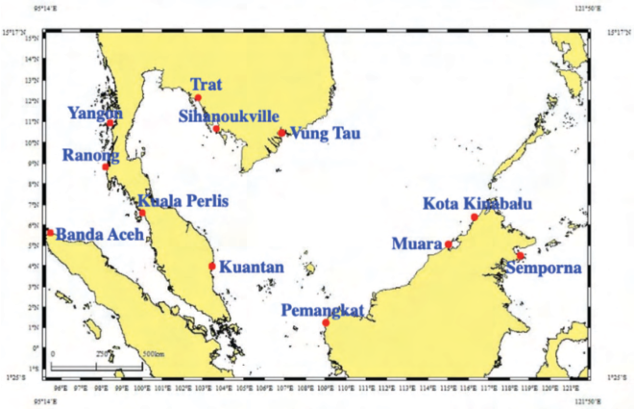


Figure 56. Sampling locations for the genetic study on *Thunnus tonggol* in the Southeast Asian region

Issues and Challenges

The optimum catch level (suggested total allowable catch (TAC)) for the neritic tuna species had been developed based on the results of the stock and risk assessments. However, this TAC is a reference for the SEAFDEC Member Countries, especially those that exploit the tuna resources on a large scale. Moreover, since SEAFDEC cannot provide legally binding TAC recommendations because this is beyond its scope for not being an RFMO, it could only provide recommendations, which the concerned countries and relevant agencies and organizations could consider and take a good look for the sustainability of the tuna resources in the Southeast Asian region.

It should also be noted that the optimum catch levels are not different by species, *i.e.* catch of kawakawa in the Indian Ocean (unhealthy stock) and kawakawa in the Pacific Ocean (safe but close to red zone) needs to be reduced from the current levels. In contrast, longtail tuna catch in the Pacific

Ocean and Indian Ocean could be increased. Even so, if the catch of longtail tuna (healthy stock) is increased as suggested, the stock status of kawakawa could be worse because kawakawa and longtail tuna are being exploited by multi-gears and multi-species fisheries in the same ecosystems. Thus, the increase or reduction of catch would be difficult to attain because the gears used in the fisheries could catch the other species with healthy and unhealthy stock status. Therefore, catch reduction strategies should be developed based on the species composition, stock status, fishing seasons, fishing ground, commercial values, and seasonal closures. Each Member Country should consider developing their respective strategies based on their unique situation and factors.

Way Forward

Currently, the activities carried out by the SWG-Neritic Tuna are under the JTF VI Phase 2 Project "Fisheries Management Strategies for Pelagic Fish Resources in the Southeast Asian Region" implemented by SEAFDEC/MFRDMD. The ongoing project activities include assessment of the stock status of neritic tunas, clarification of the stock structure by molecular methods (genetic study), and life history (otolith) study for neritic tunas in the region. Moreover, the following are the future endeavors of SEAFDEC in collaboration with the AMSs.

- Strengthen the cooperation and coordination with IOTC and WCPFC to avoid duplication of works
- Explore the possibility of organizing training courses on stock assessments of neritic tunas and economically important small pelagic species
- Enhance the knowledge on environmental factors that affect the abundance of neritic tunas and small pelagic species
- Continue the activities under the RPOA-Neritic Tunas focusing on longtail tuna and kawakawa, including the genetic study

1.1.2 Scads

Scads are small pelagic fishes under the family Carangidae, that often have a yellow stripe running from head to the caudal peduncle. Mainly feeding on copepods, scads also consume the larvae of pteropods, ostracods, and gastropods (Pastoral *et al*., 2000). Scads normally inhabit the warm coastal waters usually down to 20 m and are distributed around the Andaman Sea, South China Sea, East China Sea, Gulf of Tonkin, Gulf of Thailand, Strait of Malacca, and Java Sea. In the South China Sea, scads are distributed over the continental shelf but concentrated towards the coastal zone (Albert *et al*., 2003). These species are known as migrating species; thus, it is considered that the stocks are shared, especially from the Gulf of Thailand to Sunda Shelf, Straits of Malacca, Eastern South China Sea, and the Gulf of Tonkin (SEAFDEC, 2017b). Wahidah *et al*. (2013) reported that the population of Japanese scads (*Decapterus maruadsi*) in the South China Sea is partially shared with moderate genetic variation, while Noorul *et al*. (2020) found a genetic homogeneity within the Sundaland region's population (Andaman Sea and South China Sea), including the populations found in Rosario, Philippines, and Ranong, Thailand (Andaman Sea) but with different stock structures to that of the Northern Viet Nam populations (Nghe An and Cat Ba).

Although their value is less than the other pelagic species, scads are among the commercially important marine species (Abu-Talib *et al*., 2013; Ahmadi, 2020). In the region, scads are mainly caught using purse seine, especially in the Gulf of Thailand (SEAFDEC, 2014). The types of purse seine are either with the use of luring light in Thailand or fish aggregating devices (FADs) in the Philippines and East Coast of Peninsular Malaysia. Other fishing gears used include trawl net, drift net, ring net, scoop net, and hook and line. In the Southeast Asian region, the production of scads including the Indian scad (*Decapterus russelli*), scads *nei* (*Decapterus* spp.), bigeye scad (*Selar crumenophthalmus*), yellowstripe scad (*Selaroides leptolepis*), hardtail scad (*Megalaspis cordyla*), jacks, crevalles *nei* (*Caranx* spp.), and Carangids *nei* (Carangidae) in the Fishing Area 71 was more than three times higher than in Fishing Area 57 (**Figure 57**). Between 2008 and 2019, the average production was around 0.31 mt per year in Fishing Area 57 and 1.14 mt per year in Fishing Area 71.

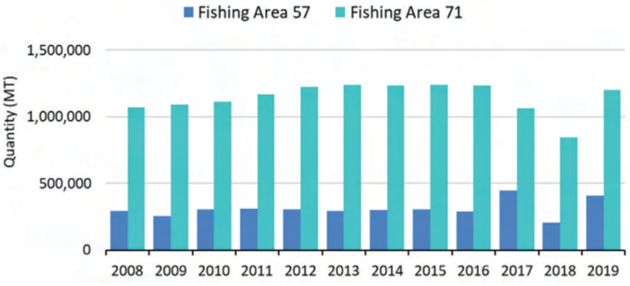


Figure 57. Production of scads of Southeast Asia between 2008 and 2019 from Fishing Area 57 and Fishing Area 71, by quantity (mt)

Source: *SEAFDEC, 2022*

Exploitation rate

The exploitation rate (E) value of more than 0.50 demonstrates that the fishery resource in such an area is exploited more than the optimum level (Gulland, 1983). In the South China Sea, the highest E value was recorded for *D. macrosoma* (0.86) and *D. maruadsi* (0.86) in the waters of Brunei Darussalam. In the Andaman Sea, the highest E value was recorded for *D. maruadsi* at 0.71 in the Andaman Sea coast of Thailand (**Table 57**).

Issues and Challenges

- Insufficient historical time series data and lack of regular collection of data and information
- The validity and reliability of some data submitted