Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

IOTC-2026- WPDCS22-29

Estimating the Required Catch Sample Weight for Small-scale Purse Seiners in Thailand's Andaman Sea

Pavarot Noranarttragoon and Sakol Pheaphabrattana

Discussions (for information and open discussion):

The paper is to inform meeting members that Thailand conducted an estimation of the required catch sample weight for small-scale purse seiners in Thailand's Andaman Sea. The result showed that analysis based on total catch weight per fishing trip from small-scale purse seiners indicated that, at a 95% confidence level and a relative margin of error of 20% (e = 0.20), the required catch sample weight was 21.94 kg/trip (95% CI: 18.13–26.12 kg/trip). The mean catch sample weight collected in 2025 exceeded the estimated minimum sampling requirement for a 20% margin of error.

Feedback (to collect input and suggestions)

[The paper is to request review and comments on…, as set out in Section X]

Conclusion (to record a concluded position or summary)

[The paper is to seek confirmation that…, as set out in Section X]

Recommendation (to ask the meeting to endorse a recommendation)

[The paper is to seek endorsement on…, as set out in Section X]

Decisions (to request formal approval of actions)

[The paper is to seek approval on…, as set out in Section X]

IOTC-2026- WPDCS22-29

Estimating the Required Catch Sample Weight for Small-Scale Purse Seiners in Thailand's Andaman Sea

Pavarot Noranarttragoon[1*] and Sakol Pheaphabrattana[2]

[1] Marine Fisheries Research and Development Division, Department of Fisheries, Thailand

[2] Fisheries Resource Assessment Group, Department of Fisheries, Thailand

*Corresponding author: pavarotn@gmail.com

Abstract

Thailand's Department of Fisheries conducts monthly sampling of small-scale purse seiners along the Andaman Sea coast using accidental sampling. Catch samples are collected from sampled vessels for species identification and fish length measurements. This study aimed to determine the catch sample weight required from each vessel using statistical methods. In 2025, 638 fishing trips were sampled out of a total of 22,254 trips. Total catch weight ranged from 100 to 30,000 kg/trip, averaging 3,294.69 ± 3,088.31 kg/trip. Catch sample weight ranged from 3.46 to 318.70 kg/trip, with a mean of 25.59 ± 23.13 kg per trip. The five dominant species were bigeye scad (*Selar crumenophthalmus*), Japanese scad (*Decapterus maruadsi*), Indian mackerel (*Rastrelliger kanagurta*), shortfin scad (*Decapterus macrosoma*), and goldstripe sardinella (*Sardinella gibbosa*), accounting for 9.74%, 8.05%, 7.44%, 7.11%, and 6.82% of the total catch, respectively. Neritic tunas collectively accounted for 14.50% of the total catch, while skipjack tuna (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*) accounted for 2.12% and 1.79%, respectively. Analysis based on total catch weight per fishing trip indicated that, at a 95% confidence level and a relative margin of error of 20% (e = 0.20), the required catch sample weight was 21.94 kg/trip (95% CI: 18.13 – 26.12 kg/trip). The mean catch sample weight collected in 2025 exceeded the estimated minimum sampling requirement for a 20% margin of error.

Keywords: catch sample weight, catch per unit effort, species composition, pelagic fish, neritic tuna

1. Introduction

Small-scale purse seine fisheries in Thailand's Andaman Sea are multispecies fisheries primarily targeting small pelagic fishes, particularly mackerels, scads, and sardines. Fishing operations involve both free-swimming schools and schools associated with anchored fish aggregating devices (FADs). Tuna and tuna-like species are also caught and account for a relatively small proportion of the overall catch compared with the principal small pelagic groups. These include neritic tunas, such as bullet tuna (*Auxis rochei*), frigate tuna (*A. thazard*), kawakawa (*Euthynnus affinis*), and longtail tuna (*Thunnus tonggol*), as well as seerfishes and occasional tropical tunas and billfishes. Previous studies in the Andaman Sea reported that neritic tunas and seerfishes accounted for 12.87% and 0.38% of purse seine catches in 2024, respectively (Pheaphabrattana et al., 2025). Although these species are not the primary targets of the fishery,

reliable information on their catches and size composition is important for national fisheries management and the scientific work of the Indian Ocean Tuna Commission (IOTC).

Thailand's Department of Fisheries (DOF) maintains regular data collection programs to monitor purse seine fisheries and provides information for fisheries statistics and stock assessment. Two complementary approaches are implemented along the Andaman Sea coast. The first is a monthly sampling survey conducted by researchers from the Marine Fisheries Research and Development Centers. Fishing vessels are selected at landing sites, and catch samples are collected from the sampled trips for species identification, estimation of species composition, and fish length measurements. Information on fishing activities and catches is also obtained through interviews and associated fishing records. Species composition data from these surveys have supported the disaggregation of mixed commercial catch categories into individual neritic tuna and seerfish species, thereby improving the species resolution of Thailand's catch reporting (Noranarttragoon et al., 2023).

The second approach involves port-based data collectors, introduced in 2025 to supplement the monthly surveys, with particular emphasis on length measurements of tuna and tuna-like species. Whereas the monthly surveys collect information on both catch composition and fish sizes during scheduled sampling visits, port-based collectors provide more frequent opportunities to measure fish at designated landing sites. These approaches therefore serve complementary purposes: the monthly surveys provide information on the multispecies catch, while port-based sampling increases the availability of species-specific length data (Pheaphabrattana and Noranarttragoon, 2025).

The usefulness of catch sampling depends on whether the sampling design and the quantity of fish examined are appropriate for the intended purpose. In multispecies fisheries, differences in catch quantity, species composition, and individual fish size can affect the information obtained from a given sample weight. This is particularly relevant for species occurring in relatively low proportions, which may be poorly represented in small catch samples. Fisheries sampling programs must also balance information needs against available staff, processing time, and operational constraints at landing sites. Consequently, sampling intensity should be evaluated in relation to the objectives of data collection, variability in the fishery, and the desired level of precision (Sparre, 2000).

The catch sample weights collected through Thailand's monthly purse seine surveys vary considerably among fishing trips. A statistical evaluation of these sample weights is therefore needed to provide an evidence-based basis for reviewing current sampling practices. Using data collected from small-scale purse seiners in Thailand's Andaman Sea during 2025, this study examines the total catch and catch sample weights recorded per fishing trip and estimates the required catch sample weight under a specified confidence level and relative margin of error. The estimated requirement is then compared with the sample weights collected through the monthly surveys. The findings are intended to inform improvements in catch sampling protocols and the allocation of sampling effort, while supporting the continued collection of species composition and biological data from this multispecies fishery.

2. Method

2.1 Vessel sampling

Purse seiners were sampled at fishing ports along the Andaman Sea coast of Thailand from January to December 2025 (Figure 1). Sampling was conducted monthly, for 4–5 days per month, using accidental sampling. Each sampled fishing trip was treated as a sampling unit. The total catch weight per trip was obtained through interviews with captains or fishing masters and from fishing logbook records.

A sample of the catch was collected from each sampled trip for species identification. Species were identified following Carpenter and Niem (1999a, 1999b, 2001a, 2001b). Fish were sorted by species, and the weight of each species in the sample was recorded in grams (g). The total catch sample weight per trip was calculated by summing the weights of all species in the sample and converted to kilograms (kg) for subsequent analysis. A total of 638 fishing trips were sampled during the study period.

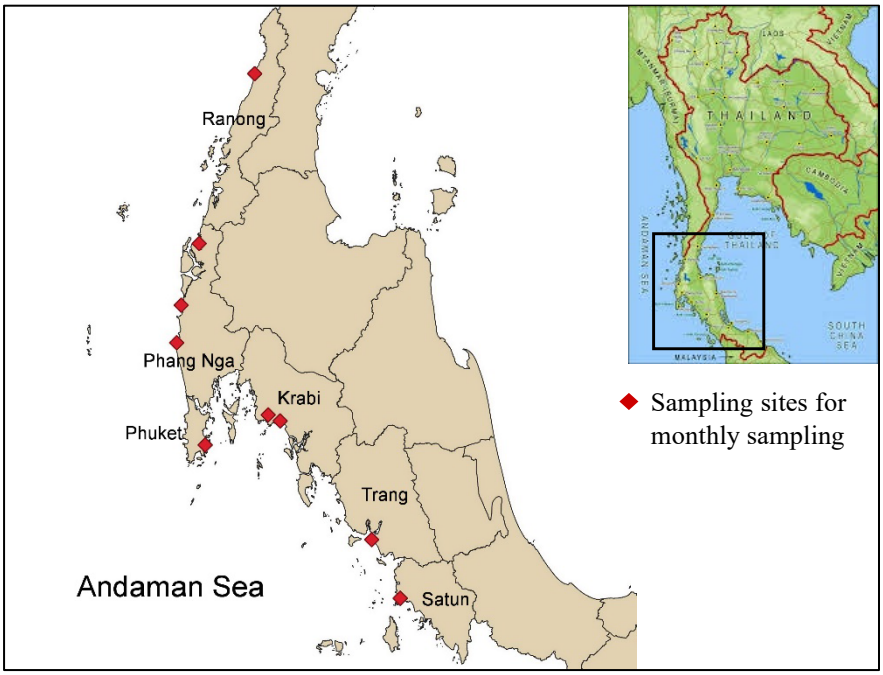

Figure 1 Sampling sites of purse seiners along the Andaman Sea Coast of Thailand in 2025

2.2 Data analysis

2.2.1 Average total catch weight and average catch sample weight

The average total catch weight per fishing trip was calculated using the total catch weights obtained through interviews with captains or fishing masters and cross-checked against fishing logbook records. The average catch sample weight per fishing trip was calculated using the weight of fish collected by DOF staff from each sampled trip for species identification. Both averages were calculated across all sampled fishing trips as follows:

$$\bar{C} = \frac{\sum_{i=1}^{n} C_i}{n}$$

$$\bar{S} = \frac{\sum_{i=1}^{n} S_i}{n}$$

$$SD_C = \sqrt{\frac{\sum_{i=1}^{n}(C_i - \bar{C})^2}{n-1}}$$

$$SD_S = \sqrt{\frac{\sum_{i=1}^{n}(S_i - \bar{S})^2}{n-1}}$$

where $\bar{C}$ is the average total catch weight per sampled fishing trip (kg/trip); $\bar{S}$ is the average catch sample weight per sampled fishing trip (kg/trip); C_i is the total catch weight of sampled fishing trip i (kg); S_i is the catch sample weight collected from sampled fishing trip i (kg); SD_C and SD_S are the sample standard deviations of total catch weight and catch sample weight, respectively; and *n* is the total number of sampled fishing trips (n = 638).

2.2.2 Catch per unit effort (CPUE)

The catch per unit effort (CPUE) was analyzed as follows.

$$CPUE = \frac{\sum_{i=1}^{n} C_i}{\sum_{i=1}^{n} E_i}$$

where C_i is the total catch weigh of sampled fishing trip i (kg); E_i is the number of fishing days of sampled fishing trip i; and *n* is the total number of sampled fishing trips.

2.2.3 Species composition

The species composition (%) was analyzed as follows.

$$P_j = \frac{\sum_{i=1}^{n} C_{ij}}{\sum_{i=1}^{n} C_i} \times 100$$

where P_j is the percentage composition by weight of species j; C_{ij} is the catch weight of species j from sampled fishing trip (i) (kg); C_i is the total catch weight from sampled fishing trip (i) (kg); and *n* is the total number of sampled fishing trips.

2.2.4 Required catch sample weight

The required catch sample weight was calculated following Sharon (1999). First, the coefficient of variation of total catch weight was calculated as:

$$CV_C = \frac{SD_C}{\bar{C}}$$

where CV_c is the coefficient of variation of total catch weight, expressed as a ratio; SD_c is the sample standard deviation of total catch weight; and $\bar{C}$ is the average total catch weight per sampled fishing trip (kg/trip).

The preliminary sample weight was calculated for five specified margin of error, *e* = 0.05, 0.10, 0.15, 0.20, and 0.25, corresponding to 5%, 10%, 15%, 20%, and 25% respectively as follows:

$$n_0\,(e) = \left(\frac{CV_c}{e}\right)^2$$

The preliminary estimate was then adjusted for the finite sample weight as follows:

$$n(e) = \frac{n_0(e)}{1 + \frac{n_0(e)}{N}}$$

where $n_0(e)$ is the preliminary sample weight estimate at a given value of *e*; *n(e)* is the corresponding estimate after adjustment for the finite sample weight; and *N* is the total number of fishing trips in 2025 (N = 22,254).

To examine the effect of uncertainty in the estimated CV on the calculated sample weight, the standard error of the CV was approximated as:

$$SE(CV_C) = \frac{CV_C}{\sqrt{2n}} \times \sqrt{1 + 2{CV_C}^2}$$

where $SE(CV_C)$ is the approximate standard error of the estimated CV, and *n* is the number of sampled fishing trips (n = 638).

Approximate lower and upper 95% confidence limits for the CV were calculated as:

$$CV_{C,L} = CV_C - z_{1-\alpha/2}\,SE(CV_C)$$

$$CV_{C,U} = CV_C + z_{1-\alpha/2}\,SE(CV_C)$$

where $CV_{C,L}$ and $CV_{C,U}$ are the approximate lower and upper confidence limits, respectively; α is the significance level, set at 0.05; and $z_{1-\alpha/2}$ is the standard normal critical value, approximately 1.96 for a two-sided 95% confidence interval.

For each value of *e*, lower and upper preliminary sample weight estimates were calculated from the corresponding confidence limits for the CV:

$$n_{0,L}(e) = \left(\frac{CV_{C,L}}{e}\right)^2$$

$$n_{0,U}(e) = \left(\frac{CV_{C,U}}{e}\right)^2$$

These estimates were subsequently adjusted for the finite sample weight:

$$n_L(e) = \frac{n_{0,L}(e)}{1 + \frac{n_{0,L}(e)}{N}}$$

$$n_U(e) = \frac{n_{0,U}(e)}{1 + \frac{n_{0,U}(e)}{N}}$$

where $n_{0,L}(e)$ and $n_{0,U}(e)$ are the lower and upper preliminary sample weight estimates, respectively, and $n_L(e)$ and $n_U(e)$ are the corresponding estimates after adjustment for the finite sample weight.

3. Results

3.1 Total catch and catch sample weight

In 2025, 638 fishing trips were sampled, representing 2.87% of the 22,254 small-scale purse seine fishing trips recorded through the Port-in Port-out (PIPO) reporting system under the Department of Fisheries reporting requirements.

Total catch weight varied considerably among sampled fishing trips, ranging from 100 to 30,000 kg/trip, with a mean of 3,294.69 ± 3,088.31 kg/trip (mean ± SD). The median was 2,500 kg/trip, and the 25th and 75th percentiles were 1,500 and 4,075 kg/trip, respectively. The mean exceeded the median, indicating a right-skewed distribution, with some trips recording substantially larger catches. The coefficient of variation was 93.74%, indicating considerable variation in catch weight among trips.

Catch sample weight also varied widely, ranging from 3.46 to 318.70 kg/trip, with a mean of 25.59 ± 23.13 kg/trip. The median sample weight was 20.36 kg/trip, with the central 50% of observations ranging from 15.44 to 27.41 kg/trip. Sample weights of 10 to less than 30 kg/trip were collected from 479 trips, accounting for 75.08% of all sampled trips. Only nine trips (1.41%) had sample weights of 100 kg or more. The coefficient of variation of catch sample weight was 90.38%, showing substantial variation in the quantity of fish collected for examination.

The combined catch sample weight was 16,323.60 kg, equivalent to 0.78% of the combined total catch weight of the sampled trips. At the individual-trip level, the percentage of the catch sampled ranged from 0.08% to 17.58%, with a median of 0.86%. These results indicate that both the absolute sample weight and the proportion of the catch examined differed considerably among sampled fishing trips.

3.2 Catch per unit effort and species composition

The overall catch per unit effort (CPUE) of small-scale purse seiners operating in Thailand's Andaman Sea in 2025 was 2,135.41 kg/day (Table 1). The catch consisted of multiple species and was dominated by small pelagic fishes, particularly scads, mackerels, and sardines. The species belonging to these groups listed separately in Table 1 collectively accounted for 60.42% of the total catch, with a combined CPUE of 1,290.32 kg/day. Bigeye scad (*Selar crumenophthalmus*) contributed the largest proportion, accounting for 9.74% of the total catch, followed by Japanese scad (*Decapterus maruadsi*, 8.05%), Indian mackerel (*Rastrelliger kanagurta*, 7.44%), shortfin scad (*Decapterus*

macrosoma, 7.11%), and goldstripe sardinella (*Sardinella gibbosa*, 6.82%). Their respective CPUEs were 207.93, 171.99, 158.79, 151.74, and 145.73 kg/day.

Table 1 Catch per unit effort (CPUE) and species composition from small-scale purse seine in the Andaman Sea of Thailand in 2025

Common name	Scientific name	CPUE (kg/day)	Composition (%)
Bigeye scad	*Selar crumenophthalmus*	207.93	9.74
Japanese scad	*Decapterus maruadsi*	171.99	8.05
Indian mackerel	*Rastrelliger kanagurta*	158.79	7.44
Shortfin scad	*Decapterus macrosoma*	151.74	7.11
Goldstripe sardinella	*Sardinella gibbosa*	145.73	6.82
Longtail tuna	*Thunnus tonggol*	138.72	6.50
Torpedo scad	*Megalaspis cordyla*	127.90	5.99
Island mackerel	*Rastrelliger faughni*	99.96	4.68
Kawakawa	*Euthynnus affinis*	95.39	4.47
Oxeye scad	*Selar boops*	52.10	2.44
Rainbow sardine	*Dussumieria acuta*	50.05	2.34
Skipjack tuna	*Katsuwonus pelamis*	45.25	2.12
Bullet tuna	*Auxis rochei*	40.40	1.89
Yellowfin tuna	*Thunnus albacares*	38.24	1.79
Spotted sardinella	*Amblygaster sirm*	38.01	1.78
Frigate tuna	*Auxis thazard*	35.15	1.65
Short mackerel	*Rastrelliger brachysoma*	34.27	1.61
Bigeye trevally	*Caranx sexfasciatus*	27.85	1.30
Yellowtail scad	*Atule mate*	24.00	1.12
Other species	-	451.94	21.16
Total		**2,135.41**	**100.00**

Neritic tunas represented a smaller composition of the catch than the combined mackerel, scad, and sardine groups. The combined CPUE of the four neritic tuna species was 309.66 kg/day. Longtail tuna (*Thunnus tonggol*) was the most abundant neritic tuna, contributing 6.50% of the total catch, with a CPUE of 138.72 kg/day. Kawakawa (*Euthynnus affinis*) accounted for 4.47%, followed by bullet tuna (*Auxis rochei*, 1.89%) and frigate tuna (*A. thazard*, 1.65%), with CPUEs of 95.39, 40.40, and 35.15 kg/day, respectively. Together, these four species accounted for approximately 14.5% of the total catch.

Tropical tunas contributed relatively small proportions. Skipjack tuna (*Katsuwonus pelamis*) accounted for 2.12% of the total catch, with a CPUE of 45.25 kg/day, while yellowfin tuna (*Thunnus albacares*) accounted for 1.79%,

with a CPUE of 38.24 kg/day. Their combined contribution was 3.91%, with a CPUE of 83.49 kg/day. These results show that the sampled purse seine catch was dominated by small pelagic fishes, while neritic and tropical tunas constituted smaller compositions.

3.3 Required catch sample weight

The estimated catch sample weight required increased as the specified relative margin of error decreased (Table 2). At a 95% confidence level and a relative margin of error of 20% (e = 0.20), the required sample weight was 21.94 kg/trip, with lower and upper confidence limits of 18.13 and 26.12 kg/trip, respectively. Reducing the margin of error to 15% increased the required sample weight to 38.98 kg/trip (95% CI: 32.22–46.40 kg/trip), while a margin of error of 10% required 87.52 kg/trip (95% CI: 72.35–104.12 kg/trip). At a margin of error of 5%, the requirement increased substantially to 345.99 kg/trip (95% CI: 286.62–410.73 kg/trip). Conversely, allowing a margin of error of 25% reduced the required sample weight to 14.05 kg/trip (95% CI: 11.61–16.73 kg/trip).

The mean catch sample weight collected in 2025 was 25.59 kg/trip, exceeding the estimated requirement at a 20% margin of error by 3.65 kg/trip, or approximately 16.6%. However, this mean was below the requirements estimated for margins of error of 15% or less. The results therefore indicate that the average sampling effort in 2025 was consistent with the estimated requirement for a 20% margin of error.

Table 2 Estimated catch sample weights required at different relative margins of error for small- scale purse seiners in Thailand's Andaman Sea, based on sampling data collected in 2025

Margin of error (e)	Estimated required sample weight (kg/trip)	Lower 95% confidence limit (kg/trip)	Upper 95% confidence limit (kg/trip)
0.05	345.99	286.62	410.73
0.10	87.52	72.35	104.12
0.15	38.98	32.22	46.40
0.20	21.94	18.13	26.12
0.25	14.05	11.61	16.73

4. Discussion

The results highlight a trade-off between statistical precision and the operational demands of catch sampling in a multispecies purse seine fishery. Although a relative margin of error of 20% may appear relatively large, reducing this margin would require a substantial increase in the quantity of fish examined. Compared with the requirement at a 20% margin of error, the sample weights required at margins of error of 15%, 10%, and 5% were approximately 1.8, 4.0, and 15.8 times greater, respectively. The choice of precision should therefore consider both the intended use of the data and the resources available for routine monitoring.

Increasing sample weight would generally require additional handling, species identification, sorting, weighing, and recording. In catches containing numerous small-bodied species, the additional processing time could be

considerable. Under fixed staffing and sampling schedules, collecting larger samples from individual trips could reduce the number of fishing trips that researchers are able to sample. Consequently, improvements in within-trip sampling precision could be accompanied by reduced coverage across trips, landing sites, or sampling dates. These operational effects were not measured in this study, but they are relevant considerations when translating the estimated requirements into field protocols.

The mean sample weight collected in 2025 exceeded the estimated requirement at a 20% margin of error, suggesting that this level could provide a practical starting point for reviewing routine sampling procedures. Nevertheless, an adequate annual mean does not establish that every sampled trip met the requirement. Sample weights varied widely among trips, and occasional large samples can raise the overall mean. Reviewing the proportion of individual trips meeting the selected sampling target would therefore provide a more informative assessment of consistency in field implementation.

Sampling objectives also require consideration. A sample weight suitable for examining overall catch composition may provide relatively few observations of species occurring at low proportions, including some tuna and tuna-like species. Likewise, meeting an overall sample-weight target does not necessarily ensure sufficient length measurements for each species. The monthly catch sampling program and supplementary port-based length sampling can therefore serve complementary purposes, with additional sampling directed towards species for which biological observations remain limited.

Future refinement of the program could combine the estimated sample-weight requirements with records of processing time, staff effort, and the number of trips sampled per visit. Such information would help identify a sampling target that balances precision with operational feasibility. Larger samples could be considered where catch diversity or specific data needs justify the additional effort, while maintaining coverage across fishing trips, locations, and seasons.

References

Carpenter, K. E. and V. H. Niem (Eds.). 1999a. FAO Species Identification Guide for Fishery Purposes. The living marine resources of the Western Central Pacific. Vol. 3. Batoid fishes, chiamaeras and bony fishes part 1 (Elopidae to Linophrynidae). FAO, Rome. p. 1397–2068.

Carpenter, K. E. and V. H. Niem (Eds.). 1999b. FAO Species Identification Guide for Fishery Purposes. The living marine resources of the Western Central Pacific. Vol 4. Bony fishes part 2 (Mugilidae to Carangidae). FAO, Rome. p. 2069–2790.

Carpenter, K. E. and V. H. Niem (Eds.). 2001a. FAO Species Identification Guide for Fishery Purposes. The living marine resources of the Western Central Pacific. Vol 5. Bony fishes part 3 (Menidae to Pomacentridae). FAO, Rome. p. 2791–3380.

Carpenter, K. E. and V. H. Niem (Eds.). 2001b. FAO Species Identification Guide for Fishery Purposes. The living marine resources of the Western Central Pacific. Vol. 6. Bony fishes part 4 (Labridae to Latimeriidae), estuarine crocodiles, sea turtles, sea snakes and marine mammals. FAO, Rome. p. 3381–4218.

Noranarttragoon, P., P. Hiranmongkolrat and S. Pheaphabrattana. 2023. Reconstructed Species Composition of Neritic Tuna and Seerfish Caught by Purse Seiners in the Andaman Sea of Thailand. IOTC-2023-WPDCS19-22.

Pheaphabrattana, S., P. Noranarttragoon and K. Maeroh. 2025. Neritic Tuna and Seerfish Fisheries from Small-scale Purse Seiners in the Andaman Sea of Thailand. IOTC-2025-WPNT15-11.

Pheaphabrattana, S. and P. Noranarttragoon. 2025. Comparison of Length Frequency Data from a Monthly Sampling Survey and a Port-based Data Collector in the Andaman Sea of Thailand. IOTC-2025-WPDCS21-12.

Sparre, P. J. 2000. Manual on Sample-based Data Collection for Fisheries Assessment: Examples from Viet Nam. FAO Fisheries Technical Paper No. 398. Rome, FAO. 171 pp.

Lohr, S. L. 1999. Sampling: Design and Analysis. Duxbury Press, Pacific Grove, CA. 494 pp.

Acknowledgement

The authors would like to thank the data collection teams at the Ranong, Phuket, and Satun Marine Fisheries Research and Development Center, under the Marine Fisheries Research and Development Division, Department of Fisheries, for providing the monthly port sampling data collected from purse seiners.