

INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

17th MEETING

La Jolla, California, USA

8-12 June 2026

DOCUMENT SAC-17-02

STOCK STATUS INDICATORS (SSIs) FOR TROPICAL TUNAS IN THE EASTERN PACIFIC OCEAN

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Summary

Stock status indicators (SSIs; time series of data used as supplements to, or in the absence of, stock assessments), based on both purse-seine and longline data, are presented for the three tropical tuna species (yellowfin - YFT, bigeye - BET, and skipjack - SKJ). Some SSIs based on the floating-object fishery suggest that the fishing mortality of all three species has increased, mainly due to the increase in the number of floating-object sets. The general increasing trend in the number of sets in the floating-object fishery is reflected in increased catches for yellowfin and skipjack, reduced catch-per-set for bigeye, and reduced average length initially for all three species in the floating-object fishery. However, the number of floating object sets appears to have leveled off starting in 2017, although the number of sets in recent years may be suppressed due to the high abundance of skipjack and yellowfin tuna. High catches of yellowfin and skipjack in 2024 and 2025 in the floating object and unassociated fisheries are likely due to high recruitment related to the strong 2023 El Niño. High yellowfin CPUE in the purse seine fishery on dolphins and the longline fishery in 2024 and 2025 is likely due to a previous strong recruitment. Recent low levels of catch of bigeye in the floating object fishery are likely a result of the introduction of the individual vessel threshold (IVT) measure in 2022 that reduced fishing mortality of juvenile bigeye. This is supported by the increase in bigeye CPUE in the longline fishery in 2024 and 2025.

1. BACKGROUND

One of the management objectives for tropical tunas in the eastern Pacific Ocean (EPO) established in the Antigua Convention is to maintain populations at levels of abundance that can produce the maximum sustainable yield (MSY). Management objectives based on MSY or related reference points (*e.g.*, fishing mortality that produces MSY (F_{MSY}); spawner-per-recruit proxies) are in use for many species and stocks worldwide. However, these objectives require estimating both reference points and quantities to which they can be compared. Various model-based reference points require different amounts and types of

information, from biological information (*e.g.*, natural mortality, growth, stock-recruitment relationship) and fisheries characteristics (*e.g.*, age-specific selectivity) to estimates of absolute biomass and exploitation rates, which in turn generally require a formal stock assessment. For many species and stocks, the information required to conduct such an assessment is not available, the assessments are unreliable or cannot be conducted at the frequency that management may require, and thus, alternative approaches are needed.

One alternative is to compute stock status indicators (SSIs), which are simply time series of raw or lightly-processed data for a stock that may reflect trends in abundance or exploitation of that stock. SSIs include quantities such as fishing effort, catch, catch per unit effort (CPUE), and the size of fish in the catch. SSIs cannot be used directly for management approaches that depend on model-based quantities (*e.g.*, MSY, F_{MSY}), but they can be used for historical comparisons and to identify trends and can provide information that may be useful for managing a stock. They can also be used in management strategies that do not rely on model-based harvest control rules, such as strategies that use empirical (data-based) harvest control rules for which performance can be formally evaluated using management strategy evaluation.

SSIs were initially developed for EPO skipjack because traditional stock assessments of that species were initially considered unreliable (*e.g.*, Maunder and Deriso 2007). More recently, they have also been used as a complementary component of the IATTC staff's management advice for yellowfin and bigeye tuna in the EPO, particularly in years when full stock assessments have not been conducted.

In 2024 and 2025, the staff completed bigeye ([SAC-15-02](#)), yellowfin ([SAC-16-03](#)), and skipjack ([SAC-15-04](#); [SAC-16-04](#)) benchmark assessments, which are now conducted in a model ensemble risk-based framework. The bigeye assessment was updated with additional years of data in 2026 ([SAC-17-03](#)). However, two sets of SSIs, one based on data from the purse-seine fishery and the other on data from the longline fishery, will continue to be reported as supplemental information to monitor the stocks during the management cycle between assessments, and to provide management advice as needed. The same SSIs are computed annually for all three species and compiled in this report to facilitate comparisons among them.

The **purse-seine-based SSIs** reported by set type (NOA: unassociated; DEL: dolphin-associated; OBJ: floating-object associated) whenever possible are the following: **number of sets by set type** (Figure 1), **closure-adjusted capacity** (Figure 1), **catch by set type** (Figure 2), **catch-per-set by set type** (Figure 3), and **average length of the fish in the retained catch by set type** (Figure 4). For yellowfin, additional SSIs were developed based on spatiotemporal modeling of **catch-per-day-fished (CPDF)** and **average fish length** for the fishery associated with dolphins (Figure 5). The current SSIs start in 2000 because the IATTC port-sampling program began the species composition sampling in that year, and it is after the major offshore expansion of the floating-object fishery which started in the early- to mid-1990s. All SSIs are scaled (relative indicators) so that their average equals 1 during the 2000-2025 period (the horizontal solid line in each plot). The 10% and 90% percentiles (the two horizontal dashed lines in each plot) are used as reference levels.

Several indicators that use data from the **longline fishery** have also been developed. These include **catch and effort** (Figure 6), **CPUE** (catch-per-hook), and **average length** of fish estimated from spatiotemporal models (Figure 7). To be consistent with the purse-seine SSIs, the longline SSIs start in 2000 and have been scaled so that their average equals 1 during the 2000-2025 period. Reference levels are also based on the 10% and 90% percentiles.

Exceeding a reference level can have multiple interpretations, and these will depend on the SSI being considered and whether the upper or the lower reference level has been exceeded. To interpret trends in SSIs, it may be helpful to consider multiple SSIs simultaneously.

Further information about bigeye, yellowfin, and skipjack can be found in Documents [SAC-15-02](#) and SAC-17-03, [SAC-16-03](#), and [SAC-16-04](#), respectively, and information on the absolute catch and number of sets by set type can be found in [SAC-17-01](#). The tables and R code we used to generate all figures in this report are available online at <https://github.com/HaikunXu/Indicators/blob/main/2026>.

2. RESULTS AND DISCUSSION

Care needs to be taken when interpreting the information content of indicators about increased fishing mortality. In general, increased effort implies increased fishing mortality, but changes in fishing strategy could cause fishing mortality to remain stable or even decrease when effort is increased. Similarly, increased fishing mortality typically reduces the population size and will be reflected in reduced CPUE. However, changes in fishing strategy could influence the relationship between CPUE and abundance. In addition, abundance may fluctuate due to environmental conditions, particularly given its impact on recruitment, which is more influential on fisheries that catch mainly juveniles like the OBJ fishery. Catch may increase due to the fishing mortality increasing faster than the stock is declining, possibly because the stock-recruitment relationship is weak and fisheries catch mainly juveniles, or decrease due to the fishing mortality increasing slower than the stock is declining. The mean size in the catch could decrease due to increased fishing mortality, but it could also decrease due to increasing recruitments (i.e., more small fish entering the fishery) or increase due to low recruitments. As indicated above, the age range of fish caught by a fishery also needs to be taken into consideration when interpreting the indicators.

Fishing effort provides the most direct indicator of fishing mortality. Historically, starting in the 1990s, longline fishing effort has declined, whereas purse-seine effort has increased. Since 2000, the number of floating-object sets has increased rapidly, leveling off in 2017 and remaining around the 90% reference level, except for a decline in 2020 associated with the COVID-19 pandemic (Figure 1). Over the same period, unassociated sets declined, while dolphin-associated sets remained relatively stable. Closure-adjusted purse-seine fishing capacity showed no clear trend over most of the period but increased in 2015 to a higher level. In 2025, closure-adjusted fishing capacity was at the 90% reference level.

The increased number of sets in the floating-object fishery is expected to increase fishing mortality on all three tuna stocks, particularly skipjack and bigeye tuna. However, detecting this increase in fishing mortality in recent years is complicated by the introduction of the Individual Vessel Threshold (IVT) measure for bigeye tuna in 2022, which was designed to reduce fishing mortality on juvenile bigeye, and by the strong 2023 El Niño event in the Pacific Ocean, which increased recruitment for all three species. Therefore, careful interpretation of the indicators is needed beginning in 2022.

Prior to 2022, some floating-object fishery SSIs suggest that the stocks for all three species have potentially been subject to increased fishing mortality, mainly due to the increase in the number of sets in the floating-object fishery as described above (see [FAD-05 INF-D](#) for details on the relationship between the number of floating-objects sets and the fishing mortality for juvenile bigeye), although it has leveled off since 2017. The number of sets may be suppressed in recent years due to the high abundance of skipjack and yellowfin tuna. Overall, there have been increasing trends in catch for skipjack and yellowfin on floating-object sets since 2000 (Figure 2). In contrast, the catch-per-set for yellowfin and skipjack in floating-object sets has not shown an obvious trend since the mid 2000s (Figure 3). Since skipjack dominates the catch of the OBJ fishery and using sets as an effort measure does not include search time, catch-per-set may not be a good indicator of abundance for skipjack, while it may be for yellowfin. The catch of bigeye in the floating object fishery has remained stable (Figure 2), but the catch-per-set has declined steadily (Figure 3). The catch in weight of bigeye in unassociated sets has declined over time, but the catch in numbers has not. This is consistent with a reduction in the average length (Figure 4). The average length for the three tropical tunas on floating-object sets showed similar temporal trends: decreased between 2000 and 2015 and remained relatively stable thereafter.

On the other hand, trends in some of the other SSIs do not necessarily support the interpretation that increased fishing mortality is occurring due to the increase in the number of floating-object sets. Positive trends were observed in the catch-per-set for skipjack and yellowfin in unassociated and dolphin-associated sets, respectively (Figure 3). However, these may also be reflective of increased fishing efficiency due to improved technology. Both the dolphin-associated purse-seine (Figure 5) and longline (Figure 7) indices of abundance for yellowfin have been increasing since about 2015. The longline index of abundance for bigeye has not shown a noticeable long-term trend since 2005 (Figure 7). It is worth noting that the longline indices of abundance for bigeye and yellowfin are from a spatiotemporal model that incorporates catch and effort data from both Japan and Korea (Figure 7). The rationale for selecting these joint longline indices of abundance for both species is detailed in [SAC-16 INF-U](#). The joint longline index for yellowfin is generally consistent with the Japanese index, whereas the joint index for bigeye shows marked differences from the Japanese index (Figure 7). [SAC-16 INF-U](#) focuses on developing a joint longline index of abundance for use in the benchmark assessment of yellowfin tuna, so the joint index of abundance for bigeye developed for this document is considered preliminary and requires further investigation.

Skipjack catch in weight increased substantially in 2024–2025 and moderately in 2023 in the floating-object fishery, and increased substantially in 2024 in the unassociated fishery. This pattern is consistent with the strong recruitment associated with the 2023 El Niño and the age at which skipjack enter the purse-seine fishery. This increase is also reflected in catch-per-set in weight (Figure 3). Average length increased in 2025, and in 2024 for the floating-object fishery, as individuals from the large cohort grew in size. Catch in numbers was highest one year earlier, in 2023, in the floating-object fishery; however, because these fish were smaller, catch in weight was lower than in 2024. Catch of yellowfin in the floating-object and unassociated fisheries increased one year later, in 2025 (Figure 2a), either due to the older age at which yellowfin enter these fisheries or to a lagged response to the large recruitment event following the strong El Niño. Catch of bigeye tuna did not increase, but this may be due to the introduction of the IVT measure.

Both the dolphin-associated purse-seine (Figure 5) and longline (Figure 7) indices of abundance for large yellowfin show substantial increases in 2024 and 2025. These increases are consistent with the strong cohort seen in the floating object fishery in 2022, particularly the catch in numbers. The longline index of abundance for bigeye also shows an increase in 2024 and 2025 (Figure 7). The Korean index increased in 2024, while the Japanese index increased in 2025. These increases could reflect reduced fishing mortality on juveniles following the introduction of the IVT measure in 2022, strong recruitment associated with the 2023 El Niño, or a combination of both. Because bigeye are generally not caught in the longline fishery below 100 cm (about 2 years of age) and are not fully selected until 150 cm (about 4 years of age), it is plausible the increase is primarily due to the IVT.

Of all three tropical tuna species, the SSIs are particularly concerning for bigeye. Bigeye is caught mainly in the floating-object fishery for which the catch per set (Figure 3) has shown a consistent decline over time. The catch for bigeye in the floating-object fishery has been somewhat stable, except in 2021–2025 when catches reached low historical levels (Figure 2a). These indicate that, for bigeye, fishing mortality has been increasing and the abundance has been decreasing. During 2021–2025, both the catch in weight (Figure 2a) and catch-per-set (Figure 3) for bigeye in floating-object sets were at the lowest levels since 2000, which may partly be a result of the introduction of the individual vessel threshold (IVT) measure to provide incentives to reduce bigeye catches under Resolution [C-21-04](#). An evaluation of the impact of the IVT measure confirmed that it likely had a positive effect on reducing bigeye catches in 2022–2024 ([SAC-15 INF-K](#), [SAC-16 INF-S](#)). The increase in the longline CPUE corroborates the impact of the IVT measure reducing the fishing mortality on juveniles allow more individuals to enter the longline fishery.

Identifying the causes of different trends in the SSIs for a stock is difficult, even when SSIs are considered in

aggregate. The inconsistencies among SSIs for yellowfin may be due to an interaction between potential stock structure and differences in the spatial distribution of effort in the different set types and gears (see IATTC-95-05 [Fig. B-4](#)). In addition, catch-per-set may not be a reliable indicator of relative abundance, particularly for the target species (*i.e.*, skipjack in the floating-object fishery and yellowfin in the dolphin-associated fishery).

ACKNOWLEDGEMENTS

The authors gratefully acknowledge Japan and Korea for providing operational longline CPUE data through the final quarter of 2025, and Japanese scientist Takaaki Hasegawa for providing technical support that facilitated the timely production of the longline index of abundance.

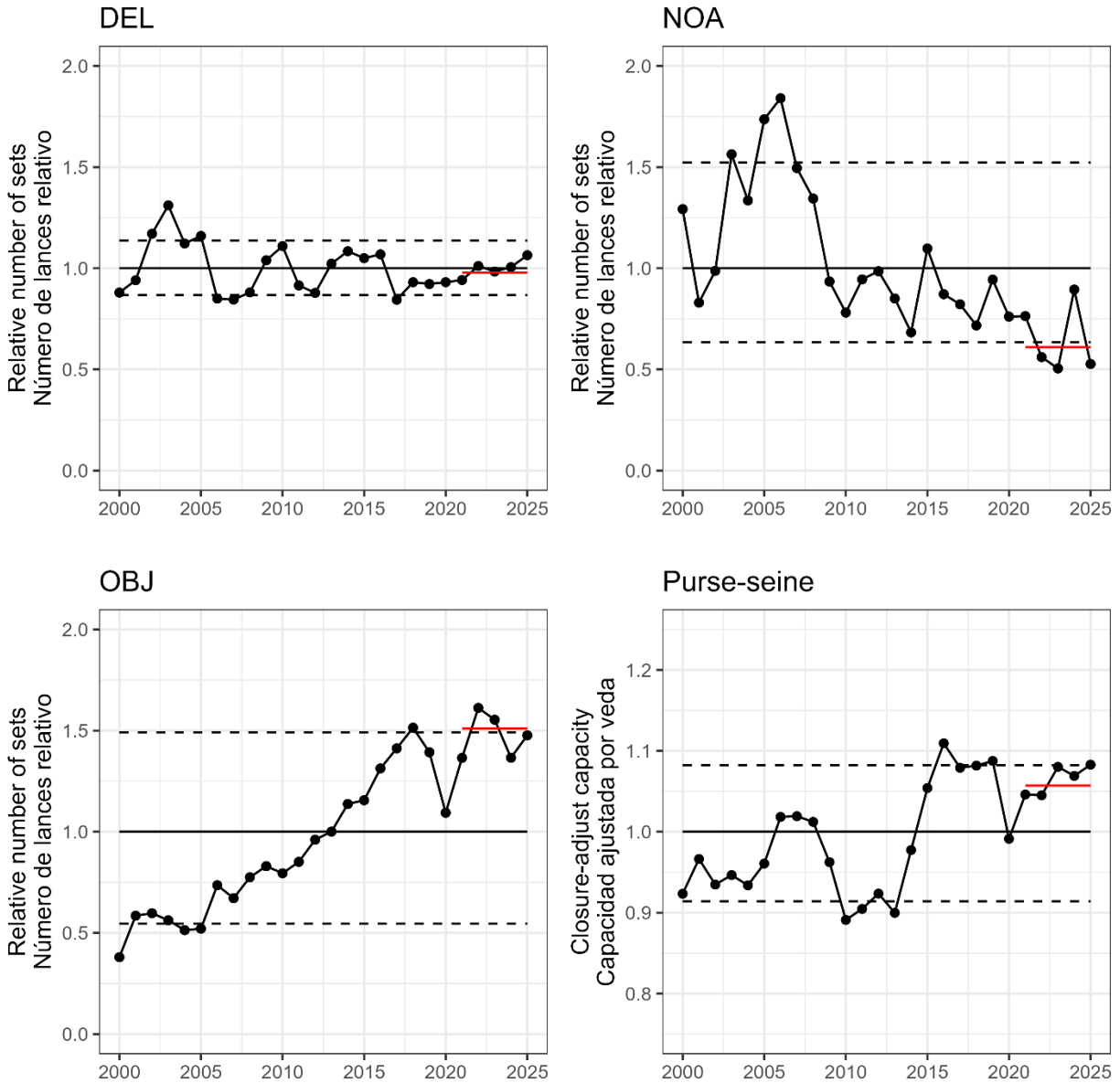


FIGURE 1. Indicators based on purse-seine fishing effort, 2000-2025. The red horizontal lines mark the benchmark reference levels (average conditions in 2021-2023).

FIGURA 1. Indicadores basados en el esfuerzo de pesca de cerco, 2000-2025. Las líneas horizontales rojas marcan los niveles de referencia (condiciones promedio en 2021-2023).

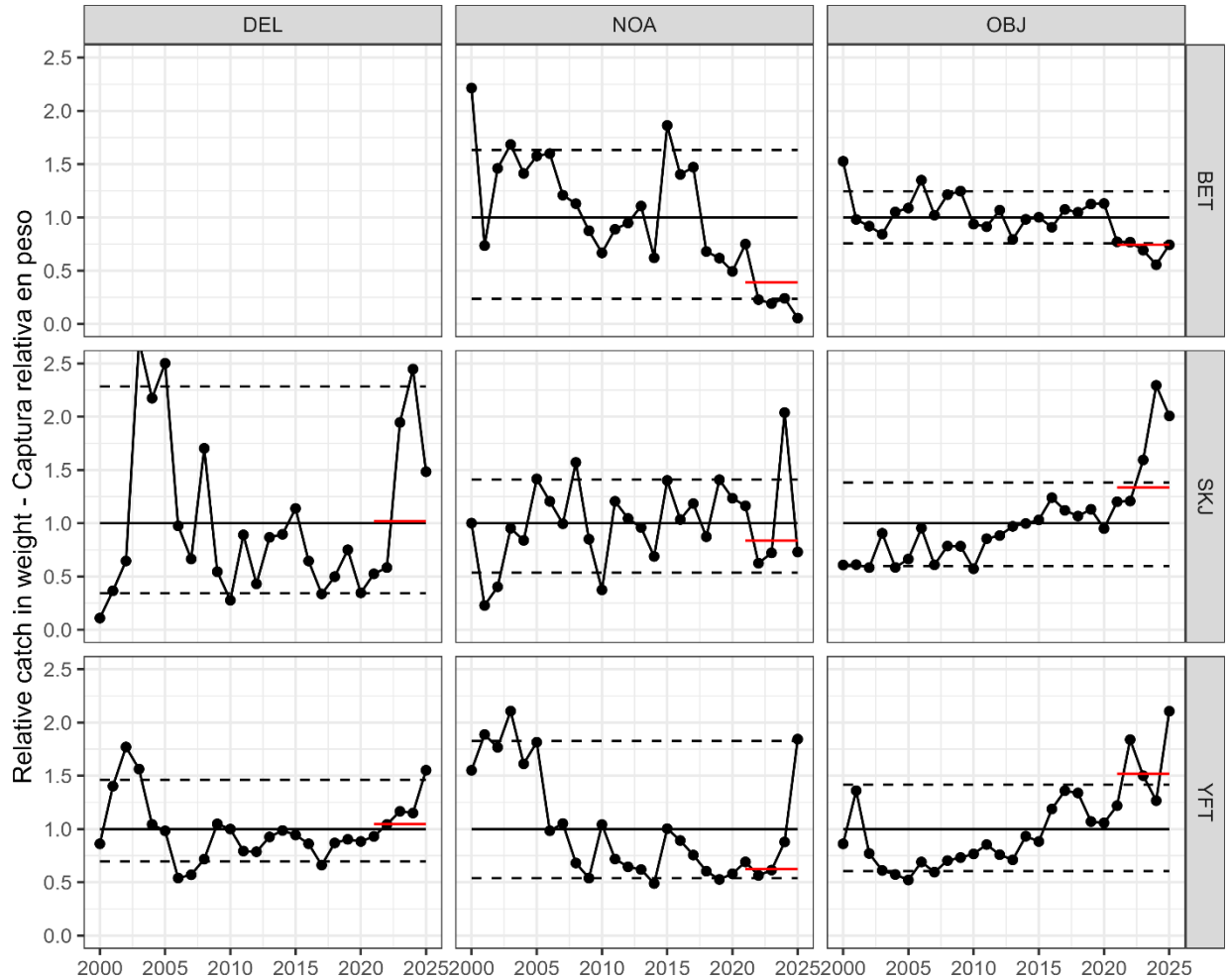


FIGURE 2a. Indicators based on purse-seine catch in weight, 2000-2025. The OBJ catches during 2020 and 2021 (COVID-19 years) are biased-adjusted according to SAC-14-INF-D. The red horizontal lines mark the benchmark reference levels (average conditions in 2021-2023).

FIGURA 2a. Indicadores basados en la captura cerquera en peso, 2000-2025. La captura por lance OBJ durante 2020 y 2021 (años de COVID-19) es ajustada por sesgo acorde a SAC-14-INF-D. Las líneas horizontales rojas marcan los niveles de *statu quo* (condiciones promedio en 2017-2019). Las líneas horizontales rojas marcan los niveles de referencia (condiciones promedio en 2021-2023).

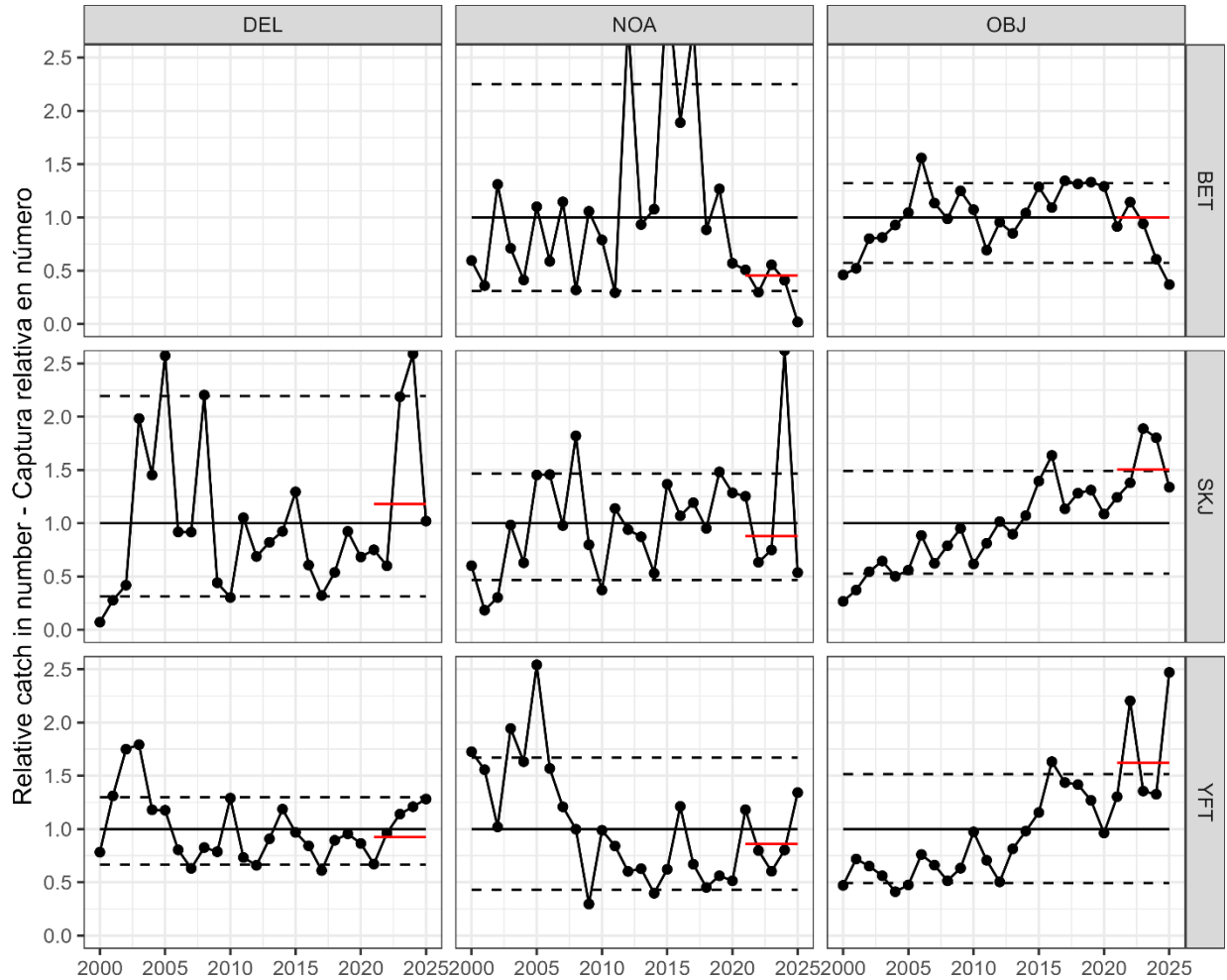


FIGURE 2b. Indicators based on purse-seine catch in number, 2000-2025. The OBJ catches during 2020 and 2021 (COVID-19 years) are biased-adjusted according to SAC-14-INF-D. Here we assume that the impact of COVID-19 on the port sampling did not influence the size composition of the catch. The red horizontal lines mark the benchmark reference levels (average conditions in 2021-2023).

FIGURA 2b. Indicadores basados en la captura cerquera en número, 2000-2025. La captura por lance OBJ durante 2020 y 2021 (años de COVID-19) es ajustada por sesgo acorde a SAC-14-INF-D. Aquí se supone que el impacto del COVID-19 en el muestreo en puerto no influyó en la composición por talla de la captura. Las líneas horizontales rojas marcan los niveles de referencia (condiciones promedio en 2021-2023).

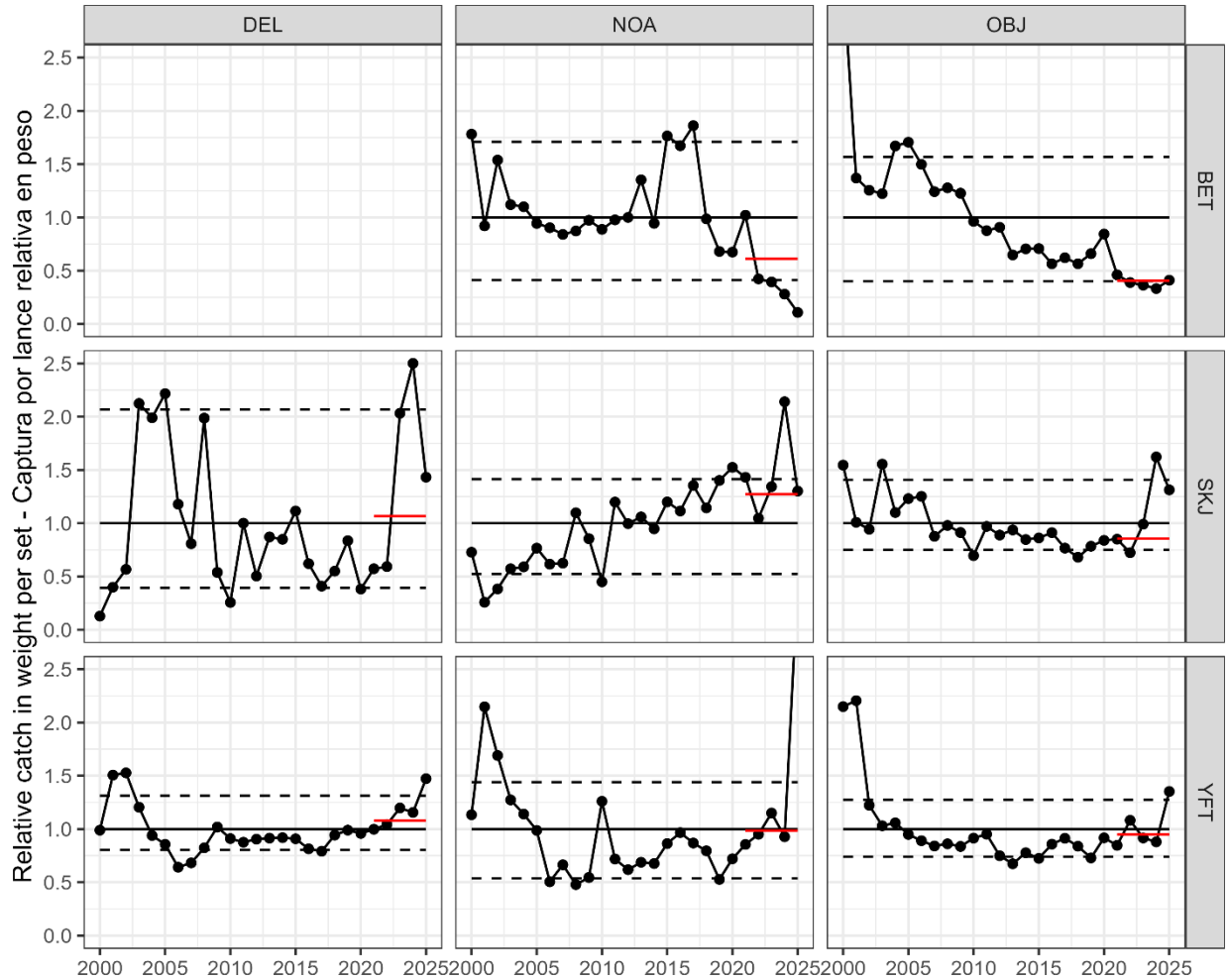


FIGURE 3. Indicators based on purse-seine catch-per-set, 2000-2025. The OBJ catch per set during 2020 and 2021 (COVID-19 years) are biased-adjusted according to SAC-14-INF-D. The red horizontal lines mark the benchmark reference levels (average conditions in 2021-2023).

FIGURA 3. Indicadores basados en captura por lance cerquero, 2000-2025. La captura por lance OBJ durante 2020 y 2021 (años de COVID-19) es ajustada por sesgo acorde a SAC-14-INF-D. Las líneas horizontales rojas marcan los niveles de referencia (condiciones promedio en 2021-2023).

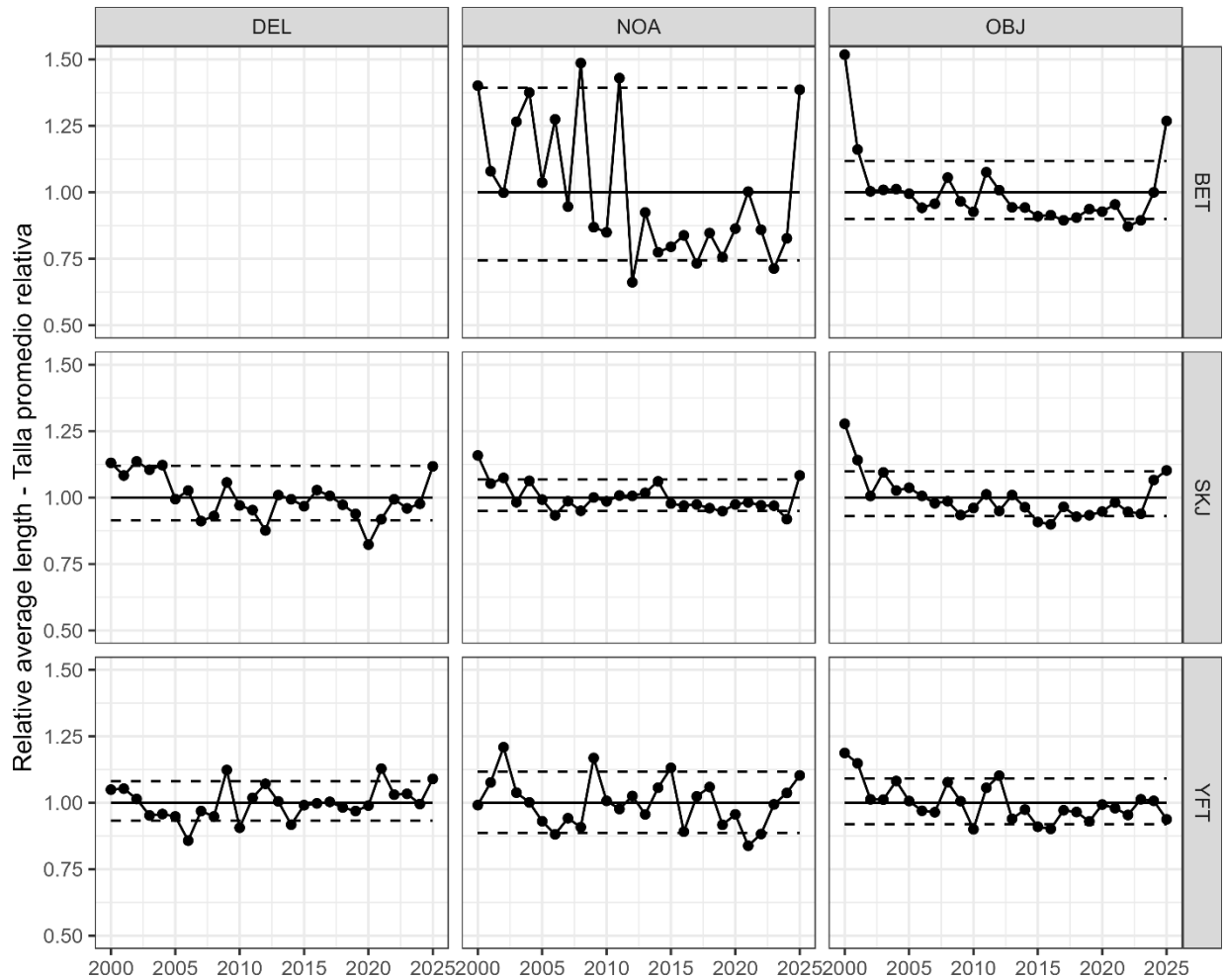


FIGURE 4. Indicators based on the average length of fish in the purse-seine catch, 2000-2025. The y-axis limits differ from the figures for the other indicators to accentuate the changes because average length is less sensitive to fishing mortality.

FIGURA 4. Indicadores basados en la talla promedio de los peces en la captura cerquera, 2000-2025. Los límites del eje “y” difieren de las figuras de los otros indicadores para acentuar los cambios ya que la talla promedio es menos sensible a la mortalidad por pesca.

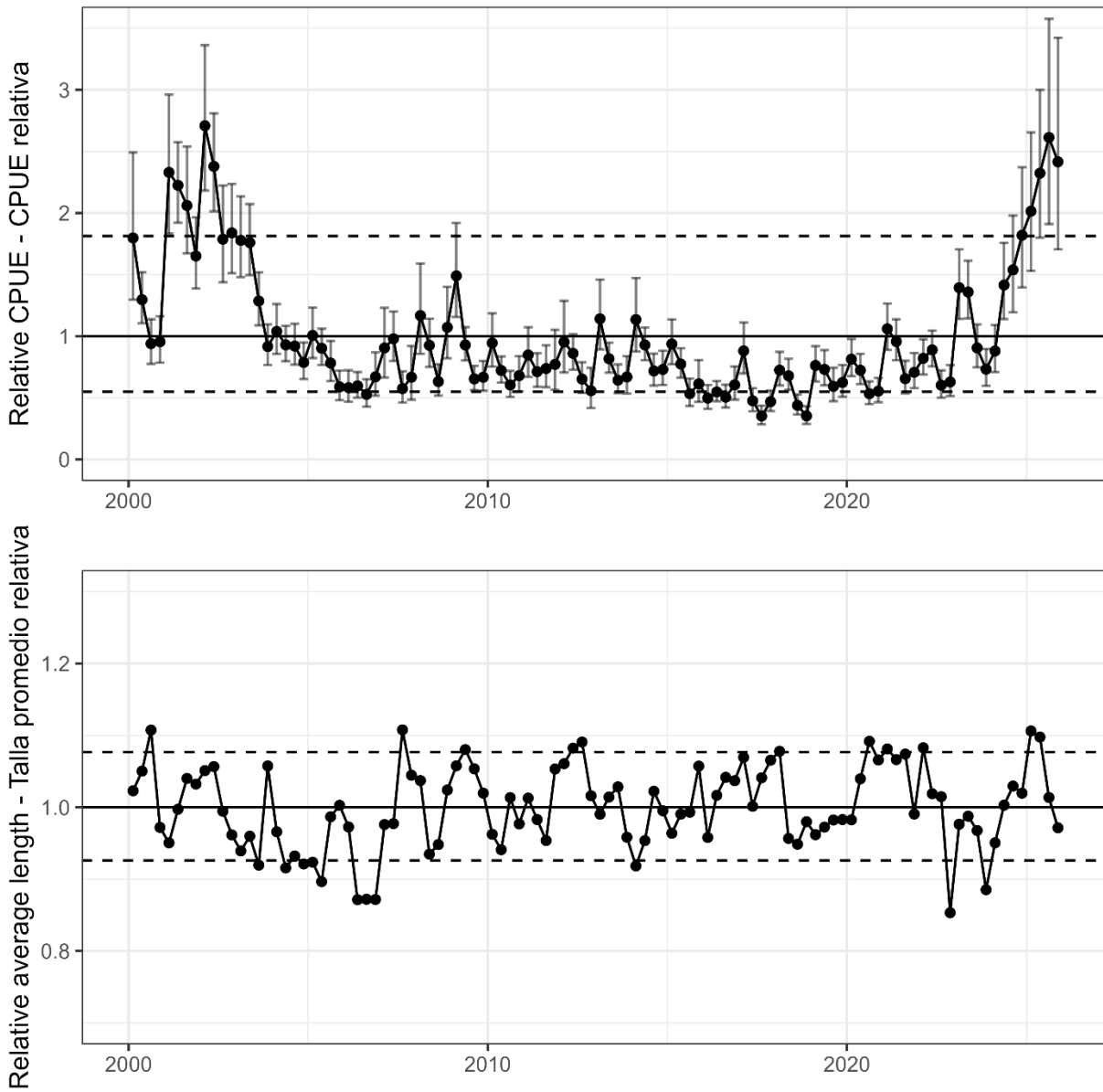


FIGURE 5. Quarterly indicators based on spatio-temporal modeling of catch-per-day-fished and length compositions for the purse-seine fishery on yellowfin associated with dolphins, 2000-2025. The error bars represent the 95% confidence intervals.

FIGURA 5. Indicadores trimestrales basados en el modelado espaciotemporal de la captura por día de pesca y composiciones por talla para la pesquería cerquera de aleta amarilla asociada a delfines, 2000-2025. Las barras de error representan los intervalos de confianza del 95%.

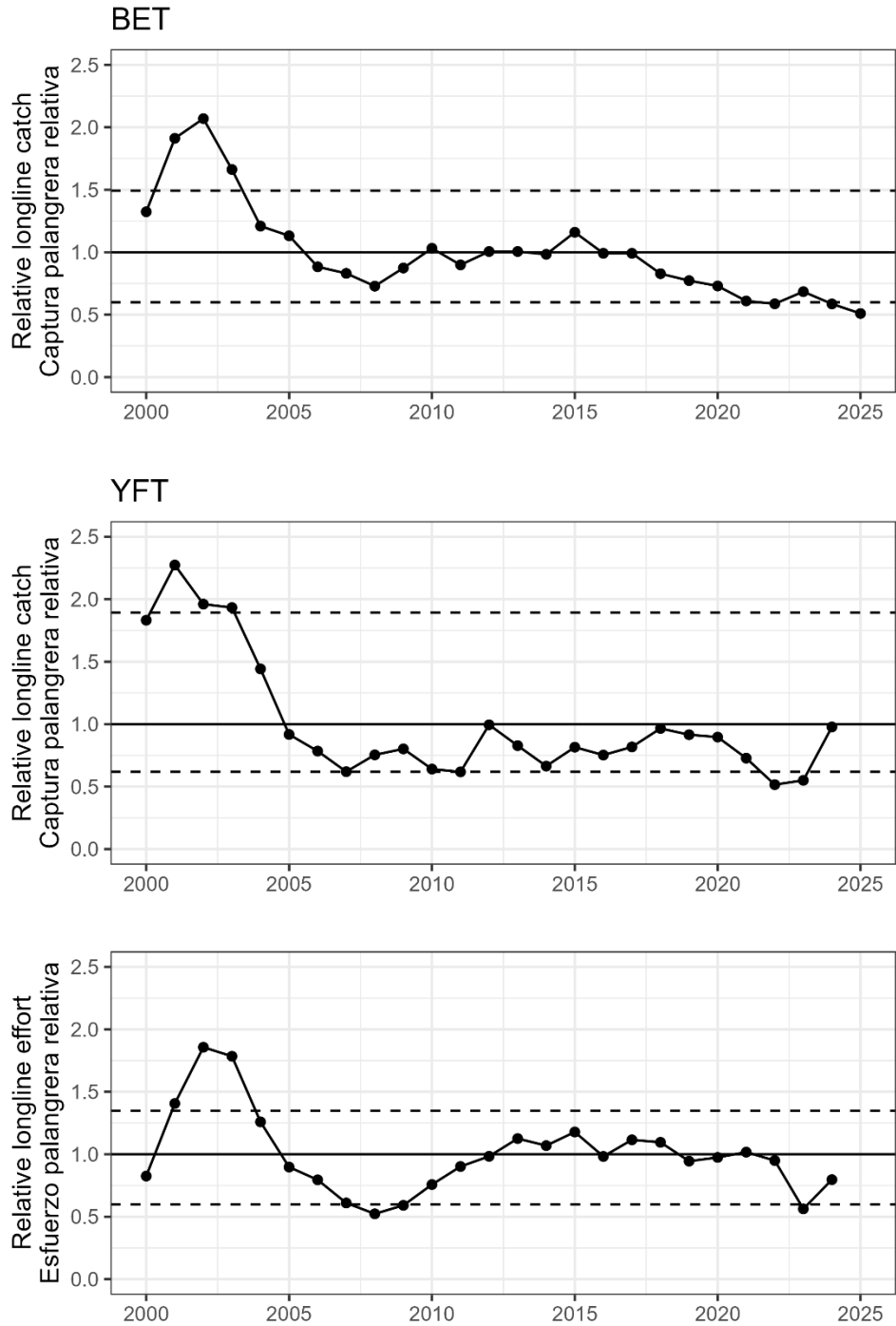


FIGURE 6. Indicators based on longline catch and effort data for all fleets combined, 2000-2025 (catch data for 2025 included only that for bigeye tuna from monthly reports and effort data for 2024 is preliminary).

FIGURA 6. Indicadores basados en datos de captura y esfuerzo de palangre para todas las flotas combinadas, 2000-2025 (los datos de captura para 2025 solo se incluyen para atún patudo, obtenidos de los informes mensuales, y los datos de esfuerzo para 2024 son preliminares).

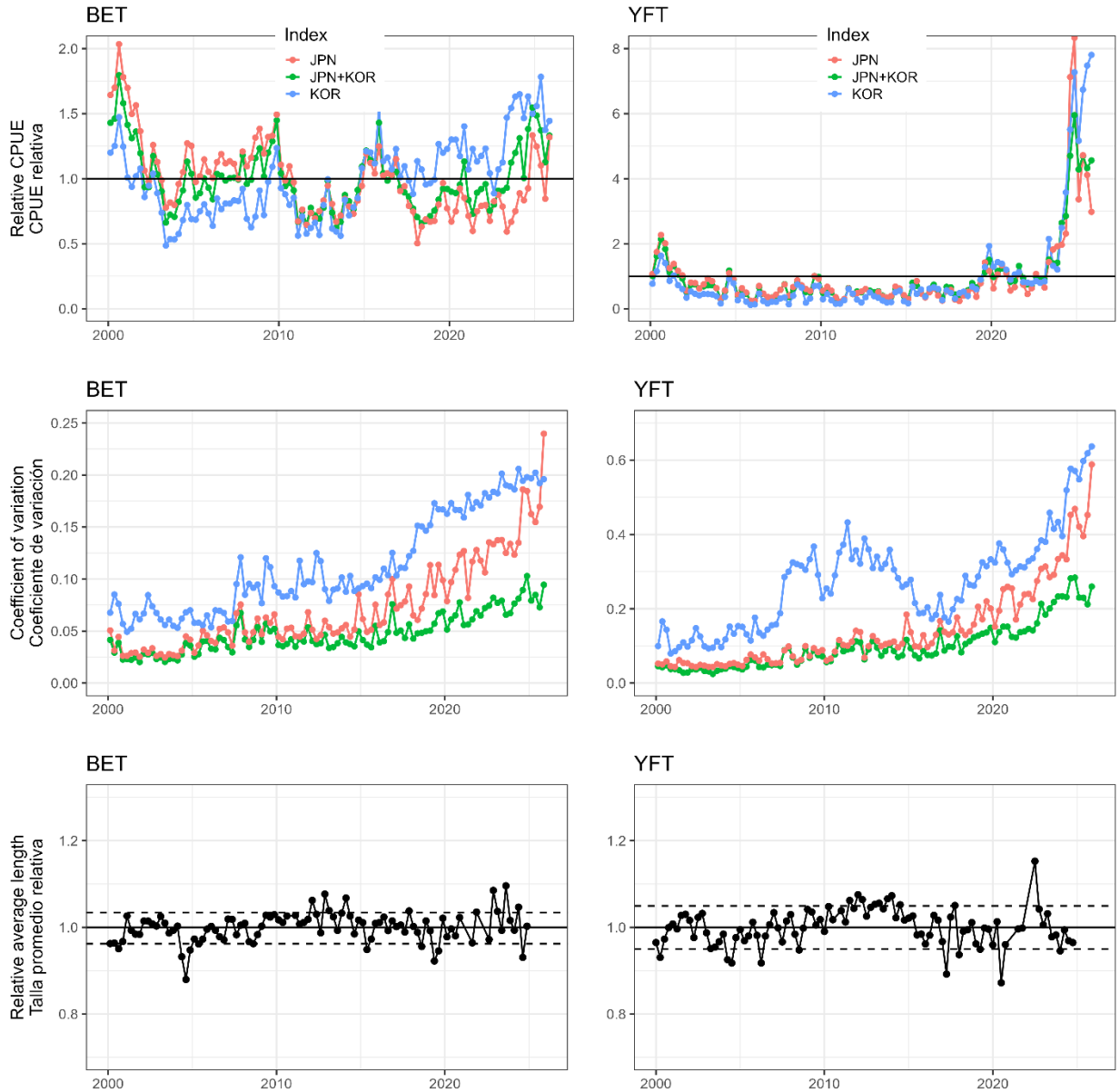


FIGURE 7. Quarterly indicators based on spatio-temporal modeling of Japanese, Korean, or Japanese + Korean longline CPUE data (top row), the associated coefficient of variation (middle row), and Japanese + Korean longline length composition data (bottom row), 2000-2025. The y-axis limits for average length differ from the figures for the other indicators to accentuate the changes because average length is less sensitive to fishing mortality.

FIGURA 7. Indicadores trimestrales basados en el modelado espaciotemporal de datos de CPUE de palangre de Japón, Corea o Japón + Corea (fila superior), el coeficiente de variación asociado (fila central) y los datos de composición por talla de palangre de Japón + Corea (fila inferior), 2000-2025. Los límites del eje “y” para la talla promedio difieren de las figuras de los otros indicadores para acentuar los cambios ya que la talla promedio es menos sensible a la mortalidad por pesca.