SHARKWG

ISC/25/ANNEX/07

ANNEX 07

25th Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
Busan, Republic of Korea
17-20 June 2025

REPORT OF THE SHARK WORKING GROUP WORKSHOP[1]

June 2025

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ANNEX 07

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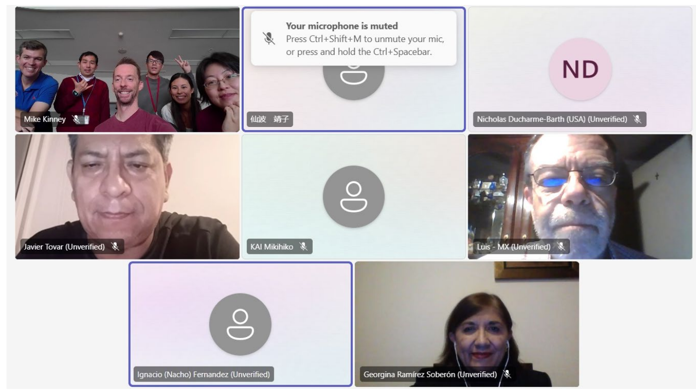
International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC)

27 – 30 January and 3 February 2025
Yokohama, Japan



1. OPENING AND INTRODUCTION

The Shark Working Group (SHARKWG or WG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) held a 5-day hybrid meeting from 27 – 30 January and 3 February 2025. The primary goal of the workshop was to conduct an indicator analysis of the North Pacific blue shark and to recommend whether a benchmark assessment should occur prior to the scheduled benchmark stock assessment in 2027.

1.1. Welcoming Remarks

Michael Kinney, SHARKWG Chair, opened the meeting at 9:00 on 27 January 2025 (Japan time). Participants included members from Chinese Taipei (TWN), Japan (JPN), Mexico (MEX), the United States of America (USA), the Inter-American Tropical Tuna Commission (IATTC), and The International Commission for the Conservation of Atlantic Tunas (ICCAT) (Attachment 1). The SHARKWG Chair welcomed all participants and expressed his wish for a productive meeting.

2. ADOPTION OF AGENDA AND ASSIGNMENT OF RAPPORTEURS

The WG adopted the meeting agenda before the meeting (Attachment 3). The WG chair also assigned the rapporteurs M. Oshima, M. Kai, Y. Semba, N. Ducharme-Barth, W.P. Tsai, D. Ovando and J.I. Fernández Méndez.

3. NUMBERING WORKING PAPERS AND DISTRIBUTION POTENTIAL

Seven working papers and four presentations were submitted (Attachment 2). The WG agreed to post all working papers on the ISC website and make them publicly available following the close of the meeting.

4. REPORT OF THE SHARKWG CHAIR

The WG Chair summarized the outcomes of the last ISC Plenary (ISC 24) and the preceding half day meeting of the SHARKWG, held in June 2024. The main objective for the WG at both meetings was the presentation of the most recent North Pacific shortfin mako (*Isurus oxyrinchus*) assessment. The shortfin mako assessment was well received by the Plenary, and was adopted as the best available scientific information to be used to support stock status and conservation recommendations.

The Plenary again tasked the WG with producing an indicator analysis, this time for North Pacific blue sharks (*Prionace glauca*), with the goal of tracking a few key fisheries indicators (catch per unit effort (CPUE) from each member nation) to determine if any major changes to the stock had occurred which would warrant concerns about the time span between benchmark assessments. Once again, the results of this analysis are to be reported at the ISC 25 Plenary. The WG also elected a new chair and vice-chair at these meetings.

5. REVIEW OF UPDATED BLUE SHARK CPUE DATA

The WG heard presentations on and discussed 5 working papers on updated CPUE information for North Pacific blue sharks.

Update on standardized catch rates for blue shark (Prionace glauca) in the 2006-2022 Mexican Pacific longline fisheries based upon a shark scientific observer program. José Ignacio Fernández-Méndez*, Georgina Ramírez-Soberón , José Leonardo Castillo-Géniz, Horacio Haro-Ávalos, and Luis Vicente González-Ania (ISC/25/SHARKWG/01)

Abundance indices for blue shark (*Prionace glauca*) in the northwest Mexican Pacific for the period 2006-2022 were estimated using data obtained through a pelagic longline observer program, for two partially overlapping fisheries. Individual longline set catch per unit effort data, collected by scientific observers, were analyzed to assess effects of environmental factors (such as sea surface temperature (SST), mean-SST anomalies), time-area factors (year, quarter, distance to the nearest point on the coast including islands), and fishing strategy (nocturnal vs diurnal fishing sets). Standardized catch rates were estimated by applying generalized linear models (GLMs) to data from two fleets (Ensenada and Mazatlán). Sea surface temperature, mean SST anomalies, distance to the coast, latitude, year, quarter and catch of swordfish in the fishing set were all significant factors included in the model. The results of this analysis show a relatively stable trend in the standardized abundance index in the period considered for the Ensenada fleet (operating mainly above 25° N) and a descending trend in the last years of the time series for the Mazatlán fleet (operating mostly below 25° N). These trends could be explained in terms of the different fishing strategies of the fleets involved.

<u>Discussion</u>

The WG discussed whether the targeting change (from blue shark to swordfish) was seasonal and, if so, whether it would be reasonable to use year-season as a random effect. The authors indicated that this shift was not seasonal. **The WG suggested that, given this, it might be better to separate the CPUE time series into before and after 2014/2015 when the targeting changed.** The WG also asked about the increasing trend in blue shark catches in the Mexican Pacific longline fisheries, and whether that trend could be attributed to a corresponding increase in fishing effort. The author responded that this was not the case, as far as he knows, but it is something they will check, as it may be an issue with the way the Mexican fishing administrative authorities are processing the shark landing data.

The WG expressed some concerns with the Mazatlan fleet, they suggested focusing effort on Ensenada data only, and removing Mazatlan data from the model. As the current meeting is not meant to focus on improving CPUE methodologies but rather to update the group on current CPUE trends for use in an indicator analysis the group paused this discussion. The authors indicated that they look forward to further collaborations to improve Mexico's CPUE indices.

Spatio-temporal model for CPUE standardization: Application of blue shark caught by Japanese offshore and distant water shallow-set longliner in the western North Pacific up to 2023. Mikihiko Kai (ISC/25/SHARKWG/02)

This working paper updates the standardized CPUE of blue shark caught by Japanese offshore and distant-water shallow-set longline fishery in the western North Pacific up to 2023. Since the catch data of sharks caught by commercial tuna longline fishery is usually underreported due to the discard of sharks, the author filtered the logbook data using similar filtering methods applied in 2021. The nominal CPUE of filtered shallow-set data was then standardized using the spatio-temporal generalized linear mixed model (GLMM) to provide the annual changes in the abundance of blue sharks in the northwestern Pacific. The author focused on seasonal and interannual variations of the density in the model to account for spatial and seasonal changes in the fishing location due to the target changes between blue shark and swordfish. The predicted annual changes in the CPUE of blue shark revealed a slight upward trend until 2005, followed by a downward trend after 2005, reaching its lowest level in 2008. After that, it showed an increasing trend again until 2015, but then started to decrease again, and it has been fluctuating in recent years. The abundance indices predicted from the spatio-temporal model, with a large amount of data collected in the most abundant waters in the western North Pacific, are very useful information about the abundance in this region.

Discussion

The WG indicated that recently, many regional fisheries management organizations (RFMOs), such as the Indian Ocean Tuna Commission (IOTC) and International Commission for the Conservation of Atlantic Tunas (ICCAT), have recommended using clustering approaches to identify fishing strategies for target species. This method distinguishes fishing operations targeting specific species by analyzing patterns in species composition and operational characteristics. The WG suggests that the author could consider using cluster analysis in the future to identify fishing strategies. The author mentioned that it is possible to use the cluster analysis in future analyses for identifying fishing method changes. However, it was mentioned that this fleet changes area and target by season. A spatio-temporal model can consider targeting shift without using cluster analysis, but it may still be possible to look into this more in the future.

The WG asked whether, when fishers switch their target between blue shark and swordfish (*Xiphias gladius*), the change is primarily a shift in fishing location, or if it also involves modifications such as changes in gear configuration or variations in the number of hooks per basket. The author indicated that it is just a location shift. It was also mentioned that this shift can occur during the same trip, with fishers moving to a different area and changing their target.

The WG expressed some concern about filtering fishing set data to only include those with a high reporting of sharks and focusing on part of the fishery with a high catch rate of sharks. This approach might miss some signals in population abundance. The author responded that the longline fleet, especially in the past under reported shark discards, which is one of the reasons that such data is removed. The authors also mentioned that if all the data are used for CPUE standardization, a lot of non-effective shark longline effort could be included (e.g., artificially deflating nominal catch rates) which could create issues. The WG mentioned, however, that perhaps observer data could help with this issue. It was responded that Japan has a short time series, but they could check the nominal CPUE from observer data. There is limited observer coverage (~5%), but for the next assessment, Japan could provide a comparison of that data set.

Spatio-temporal model for CPUE standardization: Application to blue shark caught by longline of Japanese research and training vessels in the western and central North Pacific up to 2023. Mikihiko Kai (ISC/25/SHARKWG/03)

This working paper updates the standardized CPUE of blue shark caught by Japanese research and training vessels (JRTVs) longline fishery in the western and central North Pacific up to 2023, using the same methodology applied in 2021. A statistical filtering method was employed to remove unreliable set-by-set data collected by JRTVs after the 2000s. The nominal CPUE of the JRTVs was then standardized using a spatio-temporal generalized linear mixed model (GLMM) to provide annual changes in the abundance indices in the North Pacific. The predicted abundance indices of blue shark revealed a downward trend until 2008, followed by an upward trend thereafter, which is similar to trend observed in 2021. The CPUE trends predicted from the fishery-independent data widely collected in the North Pacific provide very useful information about the abundance in this region.

<u>**Discussion**</u>

The WG had no questions or discussion on this working paper.

Updated standardized CPUE and catch estimation of the blue shark caught by the Taiwanese large scale tuna longline fishery in the North Pacific Ocean. Wen-Pei Tsai*, Kwang-Ming Liu, Kuan-Yu Su (ISC/25/SHARKWG/04)

In the present study, the blue shark catch and effort data from observers' records of the Taiwanese large-scale longline fishing vessels operating in the North Pacific Ocean during the period of 2004-2022 were analyzed. The catch per unit effort (CPUE) of blue shark, as the number of fish caught per 1,000 hooks, was standardized using delta lognormal approach. The standardized CPUE of blue shark showed a stable increasing trend. The results suggested that the blue shark stock in the North Pacific Ocean seems at the level of optimum utilization. The blue shark by-catch was estimated using the area-specific nominal CPUE multiplying the fishing effort and accounting for the coverage rate. Estimated blue shark by-catch in weight ranged from 1 ton in 1973 to 1,200 tons in 2022.

<u>**Discussion**</u>

The WG confirmed that the annual changes in the CPUEs estimated from two different configurations (two different models) showed increasing trends.

The WG questioned the long-term fishing strategy shifts (e.g., spatial shifts) in the Taiwanese data. The presenter responded that it is unclear at this time and would have to go back to Kwang-Ming Liu to check.

The WG questioned whether, north of 25° (Area A), there is more albacore targeting, and south (Area B), more tropical tuna targeting. They asked if the authors had considered running separate analyses for these two areas to avoid potentially combining two different fishing operations. The presenter responded that the hooks between floats are added in the model as an explanatory variable to account for the targeting shifts. Deep sets target tropical tuna, while shallow sets target sharks and billfishes.

The WG questioned whether the size of fish may be different in the two fishing areas, which could be another good reason to split those indices up for the assessment. The presenter responded that larger sizes are caught in Area A (Northern area) and smaller sizes are caught in Area B (Southern area).

The WG questioned why standardized CPUE is being used in the calculation of annual blue shark bycatch in numbers from 2004 to 2022. The presenter responded that it is unclear at this time and will need to check with the lead author.

The WG suggested that interaction in the spatiotemporal model might be worth exploring in the future, including year x station as a random effect. The presenter agreed and welcomed future opportunities to work with WG members to improve estimates of Taiwanese CPUE for blue sharks.

Updated blue shark CPUE from US Hawai'i longline fisheries; 2002-2023. Nicholas Ducharme-Barth (ISC/25/SHARKWG/05)

Standardized catch-per-unit-of-effort (CPUE) of blue shark from the Hawai'i based longline fleet was updated through 2023 using the previous generalized linear modeling (GLM) approach. Standardized CPUE has declined for both the deep-set and shallow-set sectors of the fishery over the last 3 years. However, changes in the deep-set sector of the fishery, notably a switch in leader material and bait type, as well as limitations in the standardization approach used make it difficult to discern whether this decline is representative of the underlying spawning stock.

<u>Discussion</u>

The WG commented that the use of the spatio-temporal model is the right direction for future analysis.

The WG clarified the change in regulations over the most recent three years. The presenter responded that, due to changes in regulations in 2023, the deep-set fleet shifted to monofilament leaders, a shift aimed at protecting oceanic whitetip sharks, which substantially changes the catch rates of blue sharks. At the same time, they also switched bait types from Pacific saury to milkfish due to lower cost. Therefore, it is required to start a new index in the shift period.

The WG noted that the fleet has moved around in space quite a bit, making it unclear at this stage whether the recent decline in the shallow-set is real or a change in space. The WG also saw a decline in the deep-set in recent years, but that is the period of the change in gear and bait.

The WG questioned if the same decline was observed for shortfin mako sharks. The presenter responded that it is unclear as the data for shortfin mako were cut off in 2020 due to these issues. The WG noted that analysis could be done to see if the same drop occurs in the deep-set data.

The WG discussed whether the decline could be due to the bait type; however, it is unclear at this point, suspecting that it has more to do with spatial effects which are not currently accounted for.

The WG asked if it is possible to account for the effect of increased bite-offs from the change from wire leaders in the standardization process. The WG raised an interesting question since it is unclear what zeros mean now, meaning that the shark was there but it is impossible to detect it, but might still have some fishery-based mortality from being hooked or trailing gear. The WG noted that it is unclear whether we'd have the data to be able to detect that.

The WG questioned whether there is new data on the frequency of bite-offs. The WG noted that it wouldn't tell you what species caused it, but it's something at least about the frequency of the bite-offs occurring. Recollection is that that data is not being actively reported. It could potentially be worked on in the future with electronic monitoring.

The WG noted that, for species like sharks, for U.S. vessels, very rarely are they brought on board the vessel; the line is usually cut off or snapped off as it's coming along the boat, so electronic monitoring may be less capable of capturing that unless configured properly.

The WG questioned whether it would be possible to observe different CPUEs between different gear types. The authors responded that yes, this is something that will be done in the future.

6. ENVIRONMENTAL CONSIDERATIONS

Marine-climate interactions with the blue shark (Prionace glauca) catches in the western coast of Baja California Peninsula, Mexico. José Ignacio Fernández-Méndez et al. Presentation 1.

Fishery and size data by sex of 28,110 blue sharks from 2162 long-line sets documented by observers on board 204 fishery trips from the industrial fleet based in Ensenada, Mexico, during 2006–2016, were used to conduct a spatial–temporal analysis of the catch-per-unit-effort (CPUE) and its relationship with climate indices along the west coast of the Baja California Peninsula. Catch length analysis by maturity groups indicated catches were composed mainly by juvenile females (58–199 cm TL) and males (60–179 cm TL). Relationships of seasonal CPUE with sea surface temperature (SST) and Chlorophyll-a (Chl) were analyzed determining aggregations were in areas characterized by oceanographic physical processes. From the exploratory analysis of annual correlations of climate indices with CPUE, the local climate SanDiAs Index explained most variation in CPUE. A generalized additive model (GAM) with 13 predictor variables was applied to gain insight on their relationship with the total CPUE by size and sex groups. The model explained 50.5% of the total blue shark CPUE and 65.5% for juvenile females. The GAM results revealed blue shark CPUE is influenced by five relevant factors: SST, NPGO, year, latitude with distance to coast and quarter interactions, and hooks set. There is a trend to increase or decrease of CPUE when compared with the delay of NEI and SanDiAs indices in more than 1 year. Local and regional climate indices can be successful tools for forecasting blue shark catches in the Northwestern Mexican Pacific.

<u>Discussion</u>

The WG expressed their appreciation for this work and their interest in seeing it continued. It was noted that the aim and results of this study closely match the discussion on climate change and its effect on ISC species. The possibility of including this effect in future projections of North Pacific blue shark was also mentioned.

The WG noted that the IATTC was doing similar work, and there may be room for some overlap. The authors expressed interest in collaborating.

The WG pointed out the issues with identifying which observed effects are related to catchability and which are climate-related, something that will need to be considered in terms of what needs to be accounted for or controlled for in a standardization model. These kinds of issues are difficult to understand but something the WG will need to continue working on.

6.1. ISC Climate Change Vulnerability Assessment Discussion (ISC Plenary request)

The WG developed the climate vulnerability matrix based upon the assumption that adult/sub adult sharks are highly migratory and will move to ideal habitat/food areas, but that young of the year (YOY), which the WG added in place of larvae on the worksheet, would perhaps be less mobile and thus experience greater impacts. The WG chair provided a draft vulnerability matrix that the rest of the WG was asked to review over the course of the meeting. The WG elected to focus on blue sharks for this exercise and apply the results to shortfin mako. The WG reviewed the blue shark matrix at the close of the meeting (Attachment 4).

7. BLUE SHARK INDICATOR ANALYSIS

The WG discussed the merits of the indicator type analysis assigned by the Plenary 24. The overall goal of the analysis is to help identify major changes to blue or shortfin mako shark stocks in the years between assessments that would merit a change to the assessment schedule.

The WG indicated that past analysis where the WG attempted to collect data on length, catch, and CPUE to conduct future projections were not accepted by the Plenary. **The WG determined that the updated data meant for the indicator work was difficult to interpret outside of the context of an assessment model in terms of changes to the stock.**

The WG also indicated that the most recent shortfin mako shark assessment was a two-year process, with the conceptual model coming first followed by the normal work of the assessment (data updates, model construction, etc.). Given this schedule is likely to be similar for blue sharks, the WG questioned their ability to advance the schedule of the next assessment. With the next blue shark assessment scheduled for 2027, a "red flag" from this analysis could only realistically move the next assessment forward by 1 year, to 2026, leaving limited time for improvements.

The WG also mentioned that none of the other billfish or shark assessments done by WCPFC include an indicator type analysis similar to what the SHARKWG is asked for here, despite these assessments being on a similar 5-year (or more) schedule.

Given all this, the WG agreed that continued work on future indicator-like analyses was not a constructive use of the WG's time and that the WG resources should instead be focused on making improvements to the assessments themselves, which the WG noted was the original intention of the change from a 3 to a 5-year assessment schedule.

The WG also agreed to set aside time during the current WG meeting to draft acceptable language for a statement to the Plenary 25 on the WG's current indicator-like analysis based on the newly updated CPUE information provided at this meeting, as well as a statement of the group's intention to refocus its efforts away from such analysis in the future. (Attachment 5).

8. SAMPLING OF CITES-LISTED SPECIES

Presentation of how to sample species listed by CITES. Nathan Taylor. Presentation 2.

The listing of pelagic shark species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has created significant challenges for scientific research and fisheries management. A major issue is the difficulty in obtaining permits for biological sampling, which has led to a near-total halt in sample collection for certain species, such as oceanic whitetip (*Carcharhinus longimanus*), hammerheads (*Sphyrnidae*), threshers (*Alopias)*, and silky sharks (*Carcharhinus falciformis*). The bureaucratic burden of securing multiple permits for vessels operating in international waters further exacerbates these challenges, rendering timely sampling almost impossible.

CITES also requires individual Non-Detriment Findings (NDFs) for each party rather than a single, coordinated assessment for shared stocks, complicating conservation efforts. The International Commission for the Conservation of Atlantic Tunas (ICCAT) and other Regional Fisheries Management Organizations (RFMOs) have proposed streamlining the NDF process to account for migratory dynamics and reduce redundancy. Additionally, ICCAT has suggested granting special CITES sampling permits directly to RFMOs, allowing them to conduct scientific sampling under their Scientific Committees' oversight.

Another pressing concern is CITES' ongoing review of listing criteria for sharks, with discussions in 2023–2024 considering criteria that could result in species being listed under Appendix II at higher population levels. Changes to these criteria would significantly impact ICCAT member parties. Improved communication between CITES and fisheries authorities is essential to ensure that listing decisions do not inadvertently hinder scientific monitoring and sustainable fisheries management.

To address these challenges, it is crucial that RFMOs and fisheries authorities articulate their difficulties with sampling and NDFs to their national CITES representatives. This engagement is necessary to advocate for practical solutions, such as permitting mechanisms administered by RFMOs, and to ensure that conservation measures remain effective without undermining critical scientific research.

<u>Discussion</u>

The WG asked whether a sample taken before the species was listed would still require an import/export permit. The presenter answered that, although he didn’t know the answer to that particular question, it is possible that any sample, whether old or new, would require a CITES permit. However, this should be confirmed either with CITES or the relevant domestic authority.

In response to the question of whether the results of an assessment would be sufficient to support an NDF by Japan, the presenter answered that this should also be confirmed with CITES, as part of the reason for listing the blue shark was the potential for it to be mistaken for other species in the same family.

The WG commented that NDFs developed by RFMOs could represent the future approach. They cited the example of several Central American countries jointly presenting an NDF for silky shark and noted that the assessments of shortfin mako and blue sharks could serve as supporting evidence for an NDF, particularly in Mexico’s case.

In response to the question of whether an assessment that assigns quotas to different countries based on sustainable catch limits could serve as a basis for NDFs, the presenter answered that it is not entirely clear if CITES would analyze these issues in the same way as an RFMO. He referenced CITES' reviews of significant trade, which consider the total import and export of a particular species.

On comments regarding the difficulties of getting permissions for sampling, even for species like blue shark whose stock is not in a bad state, the presenter answered that probably the problem is of a mainly bureaucratic nature, that is that it just takes a long time to get sampling permits rather than the status of the stock.

In response to whether an RFMO could apply for sampling permits, the presenter answered that it has not yet been formally proposed and that the process could take years.

It was noted that collaboration with aquariums or zoos that already have sampling permits could be an alternative for transporting samples and that CITES has an expedited procedure for scientific organizations.

9. BLUE AND MAKO SHARK BIOLOGY

Blue shark reproductive biology. Javier Tovar. Presentation 3.

The blue shark is the most abundant shark in northern and central Mexican Pacific, which is fished as a target and as by-catch species by Mexican industrial and artisanal coastal fisheries. The annual blue shark landings peaked in 2015 with 5,734 t. Despite being the main shark species caught in Mexican waters, only two articles on its reproductive biology have been published in the last 10 years. In order to definitively know the duration of the reproductive cycle and other reproductive parameters, a study was carried out between 2018 and 2023 that included the examination of 726 sharks (362 males and 364 females) that were voluntarily provided by the Ensenada longline fleet, of Baja California.

For each shark, the date of capture and the coordinates of the place where it was caught were obtained. The sharks were photographed, measured, weighed and dissected in laboratory. In males the condition of the claspers as well as their testicles were examined. In females, ovary, oviducal glands, and uteri were measured and weighted, meanwhile in pregnant females, data on number, size, weight, and sex of the embryos per uterus were recorded. The maturity of both males and females was evaluated using the reproductive scale proposed by Fujinami et al. (2017), where the maturity criterion in males was the condition of the claspers and that of the uteruses in females. We examined 726 blue sharks provided by 21 longline vessels with base in Ensenada, B.C. In total 362 males were examined with a size range of 74-219 cm PCL and 364 females (76-200 cm PCL).

From total females examined 23% were juvenile; 22% adolescent; 7% adult, 36% pregnant and 12% postpartum. 55% of total females examined were mature. From total males examined 43.2% were juveniles, 25.8% adolescents and 31% mature. 69% of the total males were immature. Using a GLM (logistic type) were built the mature ogives were constructed independently for females and males. The L50 for female blue sharks was estimate in 148.5 cm LPC (CI 145.2-151.5 cm LPC) and males 155.7 cm LPC (CI 151.6-159.7 cm LPC). From a subsample of 107 females, their oviducal glands were histologically examined to search for sperm, of which 49% did present evidence of it. A total 128 gravid female blue sharks with 2,362 embryos were examined.

All pregnant females with the exception of one showed evidence of captured-induced parturition (either premature birth or abortion). The monthly growth of the embryos suggests an embryonic period of eleven months, and with a peak of births in the period from May to July. The growth pattern of the ovarian follicles was less evident but the largest follicles were recorded in two periods, April-May and October and November. The monthly growth of embryos as well as ovarian follicles suggests that the reproductive cycle of the blue shark in the eastern Mexican Pacific is longer than one year and differs from those observed by Fujinami et al. (2017).

Discussion

The WG asked about the size difference in maturity between the eastern and western Pacific. They were curious if the differences seen in the L50 between these areas were a true biological difference or if they were perhaps due to methodological differences (e.g. if different criteria were used to identify mature individuals between studies). The WG indicated that the difference between the eastern and western regions could potentially impact the assessment. The authors agreed that the main methodological differences in other studies comes from the criteria used to determine maturity stage. However, in this case, the eastern and western studies used the same criteria, so the differences observed are more likely to be real.

The WG asked about the confidence the authors had in the reproductive cycle indicated in this work as the reproductive cycle will likely have the largest effect on the assessment and is very important for any future CKMR work. Based on the size and frequency of sampling in this study the authors indicated that they are confident in the >1 year cycle of reproduction for blue sharks.

The WG asked about the size frequency of fish used in this analysis as differences in sample size frequency between Japan and Taiwan contributed to different maturity estimates for mako sharks in past years. It was responded that in this study there was less concern of such a difference.

The WG was interested in the resting period for blue sharks and asked, in this study for the eastern Pacific, if they found females that were adults but not pregnant. The authors indicated that yes, they did find adult females that were not pregnant, suggesting that a resting period for this species is possible.

The WG asked about the methodology of measuring follicle diameter because the relationship between embryo development and follicle diameter development was notably different from results from the Northwestern Pacific (Fujinami et al. 2017). **The WG recommended the presenter closely compare the measurement methods between these two works to confirm these differences.**

The WG indicated that this study will have a large impact on the next assessment. They asked about the relationship between litter size and maternal PCL, expressing concern that the relationship might be exponential rather than linear. The authors indicated that they had not explored such a relationship and would look into this issue further.

The WG asked if the authors had any opinion on the potential effects of global warming (e.g., SST), as such information would be useful in filling in the climate change matrix. The authors indicated that they did not have an opinion on global warming issues in relation to reproduction.

Inferring Vertical and Horizontal Movements of Shortfin Mako Sharks (Isurus oxyrinchus) in the Northwestern North Pacific Ocean Using Electronic Tags. Shian-Jhong Lin, Wei-Chuan Chiang*, Wen-Pei Tsai, Michael K. Musyl, Yuuki Y. Watanabe, Soma Tokunaga, Yuan-Shing Ho (ISC/25/SHARKWG/06)

The shortfin mako shark is an essential component of the pelagic shark community. It is widely distributed across tropical and temperate waters. However, there is still limited knowledge about the stock structure of this highly migratory shark, as movement data from tagging programs are generally not incorporated into stock assessments. In this study, pop-up satellite archival tags were deployed on three shortfin mako sharks (weighing 170 kg, 40 kg, and 50 kg) and remained attached for 117 to 142 days. One tag was physically recovered, providing detailed data for the entire 117 days of liberty. The deepest recorded dive reached 989 meters, with the lowest temperature encountered at 4.7°C. During daylight hours, the sharks spent most of their time above 400 meters, in waters with temperatures ranging from approximately 10°C to 25°C. At night, their movements were primarily confined to the mixed layer, from the surface down to about 200 meters. Daytime vertical movements often traversed the thermocline, likely driven by physiological constraints or rapid directional changes, which potentially optimize foraging strategies and increase prey capture success. The tagged sharks predominantly remained along the continental shelf of the northern Pacific Ocean and did not exhibit seasonal migrations. These findings provide valuable insights to identify fishery and gear vulnerabilities and inform management.

Discussion

The WG asked if sharks were brought up onto the deck, or if they were tagged over the side. It was responded that small sharks are sometimes brought up onto the deck for tagging, but larger sharks are mostly tagged over the side.

The WG asked if sex information was being recorded. The author indicated that early in the study they had not been recording sex, but they are doing so now.

The WG asked if there was an explanation for why the tagged sharks were not crossing over the Kuroshio current and into more open waters. The authors indicated that they had yet to look at environmental data to address questions like this. It is something that is planned for the future.

The WG indicated that for the largest animals tagged in this study, the typical depth of the animal (~200 meters) is deeper than what the Japanese shallow-set longline fishing effort usually targets for blue sharks. The WG asked what method was used to catch these animals. The authors answered that the typical fishing method was night time sets with 4 hooks per basket, which would make it part of the shallow-set longline fishery.

Checkpoint for the application of close-kin mark recapture for the North Pacific shortfin mako (Isurus oxyrinchus). Yasuko Semba*, Yohei Tsukahara, Rui Ueda, Hirohiko Takeshima, and Suzuki Nobuaki (ISC/25/SHARKWG/07)

The latest stock assessment of North Pacific shortfin mako was conducted in 2024. Although the stock status was estimated using ensemble approach, some amount of uncertainty, e.g., estimation on the population scale, was recognized and hence the application of close-kin mark recapture (CKMR) method for the future stock assessment was proposed, based on the past successful application to tuna species. However, careful considerations on its application in accordance with the biological aspect of target population is quite important to obtain less uncertain and less biased outputs from this approach. In this document, we listed the check point or issue to be discussed in advance of the development of sampling plan. In addition, challenges for the implementation of international collaborative work, specific to this species, and current work by Fisheries Resources Institute of Japan were also briefly introduced. Understanding these situations would be useful to discuss the future work plan.

Discussion

The WG was concerned that the current plan was to develop a feasibility study and then afterwards, report back to the WG with the results. The WG indicated that perhaps a feasibility study with more direct involvement of the WG would be preferable then receiving a report afterwards.

The WG indicated that the US was planning a CKMR feasibility workshop in June 2025 that would be focused on species of interest to the US and drawing on experts to help shape the design of CKMR projects. The US planned to have a section of this feasibility workshop devoted to shortfin mako sharks, and this section of the workshop would be held in a hybrid mode so that SHARKWG members could participate.

The WG discussed how best to go about developing a feasibility study that did not result in duplicated effort. The WG asked what stage the discussed Japanese feasibility study was at, who was leading it, and what its goals were. It was responded that currently the feasibility study is more focused on testing the genetic kinfinding methods that have worked in the past for pacific bluefin tuna (PBF) on a collection of currently held samples of shortfin mako sharks. The WG indicated that this was of interest but that perhaps the US proposed collaborative feasibility workshop would be a good place to present this work to the WG while also focusing on more immediate concerns, such as what samples need to be collected, how many, how to deal with biological uncertainties (i.e., age and growth, reproductive cycle, etc.).

The WG agreed that Japan's current study goals for 2025 are a component of a larger feasibility study. The WG can use the June CKMR workshop to establish the bigger feasibility study work.

The WG indicated its desire to avoid the situation of PBF, where one country is sampling and developing the CKMR approach alone. For shortfin mako sharks, it is unlikely that Japan would be the only country doing the sampling. Therefore, the WG needs to consider how transferable the genetic methodology protocol is for different countries/labs to carry out.

All attending member nations of the WG (Japan, Mexico, Taiwan) indicated their agreement to attend the planned June hybrid CKMR meeting to conduct a feasibility study for North Pacific shortfin mako. The current plan is to try and hold the meeting the week of June 9th 2025.

The WG agreed that ageing will be very problematic, and that not much can be done about it. Focusing CKMR sampling on YOY has been discussed as potentially a way around this, however, such an approach may introduce other challenges, such as the need for several years of sampling.

The WG indicated that the mako situation is very different from PBF because for PBF, Japan and Taiwan can basically collect samples from the whole population. For shortfin mako shark, there are questions about stock structure, age/growth, etc., so you need samples from all over the Pacific. It will be hard to share samples across countries because of CITES restrictions, so results from different labs will need to be comparable, this is a major concern of a CKMR project on shortfin mako and something that will need to be addressed during a feasibility study.

IATTC's approach to CKMR feasibility study: focus on trying to find what are the biggest go/no-go barriers and address them. Phase 1: what's your budget and how many samples do you need to get to answer your questions? Focusing on simulations before any genetic work, based on estimated population size, how many samples would you need to get, how many sharks do you interact with, how much effort would it take? Phase 2: what kinds of parameters, what kinds of data do we need? Where are key uncertainties, especially with ageing? How much ageing error is ok? Based on all that, how much is that likely to cost, is that feasible? After all of that then go into genetic feasibility.

IATTC agreed to share results and the modeling framework of their current shark feasibility study with the WG. So far, results are looking promising, reasonable sample sizes for population size they think they are dealing with.

The WG discussed ideas for who would do the work in U.S. Nicholas Ducharme-Barth would lead sample design and modeling, however a lead for the genetics hasn't been decided because that depends on sample design. The WG indicated that the outcomes of the 9 June 2025 meeting would likely be what the WG presents to the WCPFC/IATTC scientific committee meetings in 2026.

The WG agreed that the June meeting should include genetics experts but that the goals of the workshop would be: objectives of the CKMR project, determining the number of samples needed, the sampling design, and the likely cost of collection and analysis. This will help determine the budget.

The WG indicated that it could also submit project proposals to WCPFC committee and IATTC SAC for funding after the feasibility study if it looks like it will work.

The WG asked if there are any CKMR experts available in Mexico, or any genetic companies to do the genetic studies. Mexico indicated that they were thinking about making a special report to the new director, but at this moment they have very strong budget cuts so it may be difficult to get funding, they will ask about the possibility of participating in the study. Their institute doesn't have the facilities to do the analyses; however, they could make an agreement with a university to do the work. Mexico indicated that the new director is very interested in shark fisheries. Mexico also indicated that typically universities do the genetic studies, and that would depend on the fisheries authorities as well.

One genetic method, GRAS-di protocol (Enoki and Takeuchi 2018, Enoki 2019) is copyrighted by Toyota so other labs need a license. For example, with Atlantic bluefin, one of the member countries created a custom panel that is intended to be share across labs (outside the developer's lab). The WG may consider taking a similar approach to develop their own panel and avoid licensing fees associated with proprietary protocols in the process. The WG noted that part of a project's budget might need to be set aside to buy licenses or develop a new method. It was mentioned that the choice of genetic method depends on the quality of samples, which depends on the status of the shark body when the sample is collected. For example, tuna samples are usually bad quality because they die much earlier than when the sample is collected so the DNA has started breaking down. Before deciding on a genetic method, researchers will need to check the sample quality of DNA.

The WG agreed to define the components of a feasibility study, at a later date, that the ISC SHARKWG will use to meet the request by the WCPFC SC.

10. REVIEW OF STOCK STATUS AND MANAGEMENT ADVICE TEMPLATE FROM SC20

The WG briefly reviewed the Stock Status and Management Advice Template from SC20. The WG was in agreement that this standardized form for presenting Stock Status and Management Advice is preferable to the current approach which varies by WG. The WG noted that not all parts of the template would apply to sharks but that in general the WG could use the template. As the template is not yet fully adopted, and as the WG has no new assessments until 2027, **the WG agreed that for now they would keep the Stock Status and Management Advice for blue and shortfin mako sharks in their current format**. However, either when the template is officially adopted by the ISC, or when the next blue shark assessment occurs (whichever comes first) the WG will revise its Stock Status and Management Advice to use the provided template from SC20.

11. FUTURE SHARKWG MEETINGS

The WG had a long discussion about the schedule and purpose of upcoming meetings of the SHARKWG. The WG agreed on a schedule that carries them through 2026. During this time the WG will focus on developing a CKMR feasibility study for shortfin mako shark, a conceptual model for blue shark, making improvements to blue shark data sources, presenting CKMR information to the SC, and holding a data preparatory meeting for the next blue shark assessment. A more detailed list of proposed meetings is attached to this document (Attachment 6).

12. CIRCULATE WORKSHOP REPORT

The WG Chair made a draft of the workshop report and distributed it to the WG members on 2 February 2025. The WG members reviewed and approved the draft on 3 February 2025.

13. ADOPTION

The WG adjourned the working group meeting on 3 February 2025 at 12:46 JST.

REFERENCES

Enoki, H. 2019. The construction of psedomolecules of a commercial strawberry by DeNovoMAGIC and new genotyping technology, GRAS-Di. In Proceedings of the Plant and Animal Genome Conference XXVII. https://pag.confex.com/pag/xxvii/meetingapp.cgi/Paper/37002.

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Fujinami, Y., Semba, Y., Okamoto, H., Ohshimo, S. and Tanaka, S., 2017. Reproductive biology of the blue shark (Prionace glauca) in the western North Pacific Ocean. Marine and Freshwater Research, 68(11), pp.2018-2027.

ATTACHMENT 1: LIST OF MEETING PARTICIPANTS

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ATTACHMENT 2: LIST OF WORKING PAPER

WP number	Author(s)	Title
WP01	José Ignacio Fernández-Méndez, Georgina Ramírez-Soberón , José Leonardo Castillo-Géniz, Horacio Haro-Ávalos, Luis Vicente González-Ania	Update on standardized catch rates for blue shark (*Prionace glauca*) in the 2006-2022 Mexican Pacific longline fisheries based upon a shark scientific observer program
WP02	Mikihiko Kai	Spatio-temporal model for CPUE standardization: Application of blue shark caught by Japanese offshore and distant water shallow-set longliner in the western North Pacific up to 2023
WP03	Mikihiko Kai	Spatio-temporal model for CPUE standardization: Application to blue shark caught by longline of Japanese research and training vessels in the western and central North Pacific up to 2023
WP04	Wen-Pei Tsai, Kwang-Ming Liu, Kuan-Yu Su	Updated standardized CPUE and catch estimation of the blue shark caught by the Taiwanese large scale tuna longline fishery in the North Pacific Ocean.
WP05	Nicholas D. Ducharme-Barth	Updated blue shark CPUE from US Hawai'i longline fisheries; 2002-2023
WP06	Lin, Shian-Jhong, Wei-Chuan Chiang, Wen-Pei Tsai, Michael K. Musyl, Yuuki Y. Watanabe, Soma Tokunaga, Yuan-Shing Ho	Inferring vertical and horizontal movements of shortfin mako sharks Isurus oxyrinchus in the northwestern North Pacific Ocean from electronic tags
WP07	Yasuko Semba, Yohei Tsukahara, Rui Ueda, Hirohiko Takeshima, and Nobuaki, Suzuki	Checkpoint for the application of close-kin mark recapture for the North Pacific shortfin mako (Isurus oxyrinchus)
Presentation Number		
P01	Ignacio Fernández Méndez	Marine-climate interactions with the blue shark (*Prionace glauca*) catches in the western coast of Baja California Peninsula, Mexico
P02	Nathan Taylor	Presentation of how to sample species listed by CITES
P03	Javier Tovar	Blue shark reproductive biology

ATTACHMENT 3: SHARKWG AGENDA

SHARK WORKING GROUP (SHARKWG)
INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC
Hybrid SharkWG Meeting DRAFT AGENDA
January 27 – 30, and February 3, 2025
Regular Meeting Hours: 9:00AM - 1:00PM (Japan time).

Jan 27th (Monday), 9:00AM - 1:00PM

1. Opening of SHARKWG hybrid meeting
    a. Opening remarks
    b. Working Group member introductions
    c. Meeting logistics (Daily schedule, Open Science Workshop, Kesennuma trip)
2. Distribution of documents and numbering of working papers.
3. Review and approval of agenda
4. Appointment of rapporteurs
5. Report of the SHARKWG Chair
    a. Summary of June 2024 Plenary
    b. Current meeting objectives
6. Review of Updated CPUE data for the interim analysis
    a. **WP1** Mexico (S10) [JoséIgnacio Fernández Méndez]
    b. **WP2,3** Japan (S6, S7) [Mikihiko Kai]
    c. **WP4** Taiwan (S3) [Michael Tsai]
    d. **WP5** USA (S1, S2) [Nicholas Ducharme-Barth]

Jan 28th (Tuesday), 9:00AM - 1:00PM

7. Environmental effects on CPUE
    a. **Information Paper** Effect of environmental variables on Mexico's blue shark CPUE (José Ignacio Fernández Méndez Presentation)
8. ISC Climate Change Vulnerability Assessment Discussion
    a. Discussion of climate-based projections the WG would be interested in investigating.
    b. Discussion of important and tractable areas of climate research that could be undertaken in the future.
9. Blue shark interim analysis [Nicholas Ducharme-Barth]
    a. Brief discussion of past SharkWG indicator analysis (Feb 2021)
    b. Review and discussion of updated CPUE's and any signs of major changes in the stock. Group agreement on statement to ISC Plenary.
    c. Group discussion on the merits of continued interim analysis and statement to Plenary.

Jan 29th (Wednesday), 9:00AM - 1:00PM

10. Biology presentations
    a. Sampling of CITES-listed species [Nathan Taylor]
    b. Blue shark reproduction [Javier Tovar]
    c. **WP6** Mako shark movement [Wei-Chuan Chiang]
    d. **WP7** Plan of genetic study in relation to CKMR of Mako shark [Yasuko Semba]

i. Discussion of Mako shark CKMR feasibility study [Nicholas Ducharme-Barth]

Jan 30th (Thursday), 9:00AM - 11:00PM (Shortened day to accommodate train travel)

11. Review and possible adoption of new Stock Status and Management Advice Template from SC20
12. Future SHARKWG meeting
    a. ISC Plenary (June 17-20, 2025; Korea)
        i. SharkWG half-day pre Plenary (June 2025; Korea)
    b. Indicator analysis NP Mako (2026)
13. Other matters

Jan 31st - Feb 2nd (Friday - Sunday), Kesennuma, No Meeting

Feb 3rd (Monday), 9:00AM - 1:00PM

14. Clearing of meeting report
15. Final discussion of ISC Climate Change Vulnerability Assessment
16. Meeting Adjournment

ATTACHMENT 4: CLIMATE CHANGE MATRIX (BLUE SHARK)

	Score				
High	3				
Medium	2				
Low	1				
Negligible	0				
Larvae	60%				
Subadult	45%				
Adult	45%				
Fishery	67%				
YOY (Larvae)					
	Impact on Survival	Impact on Growth & Development	Impact on Behavior	Impact on Habitat Availability	Impact on Food Availability
Water Temperature	2	3	2	3	3
Ocean Acidification	0	0	0	0	0
Changing Prey Availability	3	3	3	3	3
Changes in Ocean Currents	3	3	2	3	3
Increased Frequency of Extreme Weather Events	0	0	0	0	0
Shifts in Seasonal Timing of Reproduction	3	3	0	3	3
Subadult					
	Impact on Survival	Impact on Growth & Development	Impact on Behavior	Impact on Habitat Availability	Impact on Food Availability
Water Temperature	1	1	3	3	2
Ocean Acidification	0	0	0	0	0
Changing Prey Availability	3	3	3	3	3
Changes in Ocean Currents	0	0	3	3	3

Increased Frequency of Extreme Weather Events	0	0	0	0	0
Adult					
	Impact on Surviva l	Impact on Growth & Development	Impact on Behavio r	Impact on Habitat Availability	Impact on Food Availability
Water Temperature	1	1	3	3	2
Ocean Acidification	0	0	0	0	0
Changing Prey Availability	3	3	3	3	3
Changes in Ocean Currents	0	0	3	3	3
Increased Frequency of Extreme Weather Events	0	0	0	0	0
Fishery					
Fishing Pressure	3				
Targeting Intensity	1.5				
Management Practices	3				
Economic Dependency on Target Species	1.5				
Fleet Capacity and Technology	2				
Bycatch and Habitat Impacts	2				
Adaptability of Fishing Communities	1				
Monitoring and Data Availability	2				
Potential climate based projections					
Reduced recruitment					
Lower survival (juveniles and/or adults)					
Reduced F					

YOY

Climate Change Variable	Impact on Survival	Impact on Growth & Development	Impact on Behavior	Impact on Habitat Availability	Impact on Food Availability
Increasing Water Temperature	Medium - increased water temperature may decrease YOY survival	High - increased temperatures will change growth rates	Medium - YOY may alter their use of behavior if conditions become unsuitable	High - nursery environments could change	High - likely will change food availability
Ocean Acidification	Unknown	Unknown	Unknown	Unknown	Unknown
Changing Prey Availability	High - fewer prey would decrease survival	High - fewer prey would decrease growth rates and increase competition	High - YOY may alter their behavior if resources diminish	High - less prey availability could reduce the amount of suitable nursery environments	High - likely will change food availability
Changes in Ocean Currents	High - changes in currents could alter conditions and food resources of nursery areas.	High - if changes in currents could alter conditions and food resource available to YOY it will change growth rates	Medium - YOY may alter their use of nursery environments if changes in ocean currents lead to nurseries becoming unsuitable	High - could reduce the amount of suitable nursery environments or simply shift the location	High - likely will change food availability
Increased Frequency of Extreme Weather Events (e.g., storms, hurricanes)	Unknown	Unknown	Unknown	Unknown	Unknown

Shifts in Seasonal Timing of Reproduction	High - may shift to less/more optimal periods for survival	High - may shift to periods with fewer resources/different water temperatures which would change growth rates	Unknown	High - if reproductive timing changes then pups could be introduced when nursery habitat it unsuitable so habitat availability may be low	High - likely will change food availability

Sub Adult

Climate Change Variable	Impact on Survival	Impact on Growth & Development	Impact on Behavior	Impact on Habitat Availability	Impact on Food Availability
Increasing Water Temperature	Low - increased temperature may result in increased metabolic rates or result in forced migrations which may impact the energy budget and could lead to starvation.	Low - increased temperature may result in increased metabolic rates or result in forced migrations which may impact the energy budget and could lead to reduced resources available for growth or reproduction.	High - fish would move into areas of preferred temperature	High - preferred temperature strata may be in areas with undesirable qualities (i.e. low oxygen, low prey) as preferred areas become less abundant	Medium - preferred temperature strata may be in areas with undesirable qualities (i.e. low oxygen, low prey)
Ocean Acidification	Negligible	Negligible	Negligible	Negligible	Negligible
Changing Prey Availability	High - with fewer resources everywhere fish would be	High - less food would result in a decreased growth rate	High - fish would move into areas with higher prey availability	High - fish would move into areas with higher prey availability but may not be	High - changes in prey availability would impact food

	more likely to starve			otherwise preferred conditions	availability as there are the same thing.
Changes in Ocean Currents	Negligible - fish can move to follow preferred oceanographic features	Negligible - fish can move to follow preferred oceanographic features	High - fish would move to follow preferred oceanographic features	High - fish would move to follow preferred oceanographic features which may have less desired conditions	High - fish would move to follow preferred conditions which may not have high prey availability
Increased Frequency of Extreme Weather Events (e.g., storms, hurricanes)	Negligible - fish would move	Negligible - fish would move	Negligible - fish would move	Negligible - fish would move	Negligible - fish would move

Adult

Climate Change Variable	Impact on Survival	Impact on Growth & Development	Impact on Behavior	Impact on Habitat Availability	Impact on Food Availability
Increasing Water Temperature	Low - increased temperature may result in increased metabolic rates or result in forced migrations which may impact the energy budget and could lead to starvation.	Low - increased temperature may result in increased metabolic rates or result in forced migrations which may impact the energy budget and could lead to reduced resources available for growth or reproduction.	High - fish would move into areas of preferred temperature	High - preferred temperature strata may be in areas with undesirable qualities (i.e. low oxygen, low prey) as preferred areas become less abundant	Medium - preferred temperature strata may be in areas with undesirable qualities (i.e. low oxygen, low prey)

Ocean Acidification	Negligible	Negligible	Negligible	Negligible	Negligible
Changing Prey Availability	High - with fewer resources everywhere fish would be more likely to starve	High - less food would result in a decreased growth rate	High - fish would move into areas with higher prey availability	High - fish would move into areas with higher prey availability but may not be otherwise preferred conditions	High - changes in prey availability would impact food availability as there are the same thing.
Changes in Ocean Currents	Negligible - fish can move to follow preferred oceanographic features	Negligible - fish can move to follow preferred oceanographic features	High - fish would move to follow preferred oceanographic features	High - fish would move to follow preferred oceanographic features which may have less desired conditions	High - fish would move to follow preferred conditions which may not have high prey availability
Increased Frequency of Extreme Weather Events (e.g., storms, hurricanes)	Negligible - fish would move	Negligible - fish would move	Negligible - fish would move	Negligible - fish would move	Negligible - fish would move

ATTACHMENT 5: INDICATOR ANALYSIS SUMMARY AND STATEMENT

Indicator Analysis

The WG reviewed the updated CPUE indices for NPO blue shark through 2023. Reviewed indices included Mexico's Ensenada and Mazatlán based longline fisheries, Japanese Kinkai-shallow and research training vessel longline fisheries, US Hawai'i based deep-set and shallow-set longline fisheries, and the Taiwanese longline fishery. Following the previous indicator analysis for 2021 NPO shortfin mako shark, the WG calculated a 5-year moving average (right aligned) for each index. The short-term percent change (ST; last moving average year minus 4 to the last moving average year) was also calculated for each fishery.

The WG noted that the trend over the last 5 years showed either stable or increasing trends for Mexico's Ensenada (ST 38%), Japan's JRTV (ST 26%), and Taiwan's (ST 16%) longline fleets; a fluctuating trend for Japan's Kinkai-shallow fleet (ST -13%); and a decreasing trend for Mexico's Mazatlán (ST -49%, likely related to target and fishing area shifts) and US shallow-set longline fleet (ST -26%). Recent change, 2021-2023, for the US deep-set longline was unable to be calculated due to operational changes in the fishery (gear & bait changes). **Based on the review of these indices, the WG determined that there was no indication that the next scheduled benchmark assessment for NPO blue shark needed to be advanced from 2027 to 2026.**

Additionally, the WG recommends that it no longer conduct "indicator analyses" for either blue or mako sharks on the basis that:

- It is difficult to interpret annual trends in nominal or standardized data outside of the context of the stock assessment
- Indices from disparate sources with changing dynamics (fishing area, gear, bait, etc.), and no established criteria to identify when a change in CPUE warrants a change in the assessment schedule, limits the utility of this type of analysis
- No other WCPFC stock assessments conduct "indicator analyses" even though other billfish and shark assessments produced for the WCPFC are conducted on a similar (5+ year) time period
- The ISC SHARKWG is shifting towards a 2-year development cycle (in-line with other WCPFC shark stock assessments) for stock assessments which would conflict with conducting an indicator analysis 2 years ahead of an assessment as there would be no room to move up the assessment if it was warranted.

ATTACHMENT 6: FUTURE MEETINGS

SHARKWG meeting schedule

1. CKMR workshop NP mako shark (week of June 9th 2025; hybrid meeting; Hawaii)
2. ISC Plenary (June 18-23, 2025; Busan, Korea)
   - SHARKWG half-day pre-Plenary (June 2025; hybrid meeting; Busan, Korea)
3. Blue shark conceptual model meeting (Jan-Feb 2026; 2-day online)
4. Blue shark data improvement (improve CPUE; standardize length, catch reconstruction) (Feb/Mar 2026; hybrid meeting; La Jolla)
   - Report out of the mako shark CKMR meeting and the blue shark conceptual model
5. ISC Plenary; Dr. Liu retirement event (June 2026; Taiwan)
6. SC presentation on NP mako CKMR (Aug 2026)
7. Blue shark data prep (Q4 2026; hybrid meeting; Japan)