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Characterisation of the fisheries catching Oceanic whitetip sharks *(Carcharhinus longimanus)* in the Western and Central Pacific Ocean

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Characterisation of the fisheries catching oceanic whitetip sharks (*Carcharhinus longimanus*) in the Western and Central Pacific Ocean

Report prepared for WCPFC SC20

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EXECUTIVE SUMMARY

The next stock assessment for oceanic whitetip shark (*Carcharhinus longimanus*) is scheduled for 2025. The work for the assessment will be undertaken over two years. This paper, as well as Hill-Moana et al. (2024), represent the background work for the SC20s consideration and information for feedback into the SC21 assessment.

Oceanic whitetip sharks are caught as bycatch in longline fisheries targeting tuna, billfish and blue sharks between 35^{o}N and 40^{o}S, and as bycatch in the tropical purse seine fisheries of the WCPO. No target fisheries exist for oceanic whitetip sharks and since 1st January 2013 their retention has been prohibited within the WCPO. While there was a lag in its implementation, by 2015 almost all oceanic whitetip sharks have been discarded or cut-free from longline sets, and more than half of those are released alive and healthy. In the purse seine fishery oceanic whitetip shark's retention rates have declined over time, and by 2015 all are released. However, release condition lacks detail and this data collection could be improved.

This paper describes the longline gear designs that catch oceanic whitetip sharks; presents information on fate and condition, as well as length data; discusses the impact of vessel flag; presents the spatio-temporal distribution of the catch; and provides recommendations for the 2025 stock assessment.

The following recommendations are proposed for the Scientific Committee to consider:

1. CPUE and length analysis used for the 2025 stock assessment should include vessel flag and gear characteristics as variables when undertaking standardisations.
2. Noting that very little detailed information exists on the life status of oceanic whitetip sharks released from the catch on purse seine vessels, it is recommended that observers on purse seine vessels be encouraged to prioritise the collection of detailed life status data at both capture and release.
3. Release survival work should be undertaken, and while this work is currently in the SC work plan, the start date is currently unscheduled.
4. It is recommended that the 2025 stock assessment explicitly provide commentary on the recent trends in fishing mortality since the inception of CMM2019-04 and its stock specific predecessor CMM2011-04.

1. INTRODUCTION

Oceanic whitetip sharks (*Carcharhinus longimanus*) are wide ranging across the Pacific Ocean. They are caught as bycatch in tropical and sub-tropical longline fisheries targeting tuna, billfish and blue sharks throughout the Western and Central Pacific Ocean (WCPO). Oceanic whitetip sharks are also caught in the purse seine fisheries of the WCPO. Unlike blue shark, where some target fisheries exist in the South Pacific Ocean, no target fisheries exist for oceanic whitetip sharks (Williams and Ruaia 2021). While oceanic whitetip sharks were caught as bycatch and were retained in large numbers historically, since 1st January 2013 oceanic whitetip sharks within the WCPFC have been required to be released (WCPFC 2011).

Historically, bycatch went unreported or were poorly reported on vessel logsheets, particularly for sharks that were finned and discarded (Brouwer and Harley 2015, Brouwer and Hamer 2020). Observer data exist for most longline fisheries in the WCPO. However, for many fleets the observer programmes are relatively new and observer effort is not representative of the fishing effort distribution (Williams et al. 2020). Most WCPO shark fisheries data are characterised by poor historic logsheet reporting and, while recent reporting has improved, mandatory release policies have further complicated the information available from catch data. As a result, historic catch for sharks is ambiguous, and catch histories often need to be reconstructed rather than relying on reported or observed catch (Peatman et al. 2018, Neubauer et al. 2021, Large et al. 2022, Neubauer et al. 2023).

Successful stock assessments have been undertaken for oceanic whitetip sharks in the WCPO (Tremblay-Boyer et al. 2019 and Neubauer et al. 2019). Brouwer and Hamer (2020) also note that past management interventions may complicate the CPUE standardisation, along with:

1. the impact of regulatory changes on fishery dependent data;
2. generally low observer coverage in longline fleets particularly in the high seas; and,
3. for most fleets after CMM2011-04 (oceanic whitetip shark CMM) came into force, most oceanic whitetip sharks have been released and not all are reported on logsheets nor seen by observers.

This work underpins the catch reconstruction that is developed in Hill-Moana et al., (2024) and is aimed at assisting the SC20 make decisions around the data availability and interpretation of trends in the data that will be fed into the 2025 stock assessment.

2. METHODS

Data from Members, Cooperating Non-Members and Participating Territories (CCMs) of the WCPFC held by the Pacific Community (SPC) were extracted from various databases at SPC. Longline and purse seine logsheet, as well as observer data and annual catch estimates were requested, including:

- Longline
  - WCPFC public domain yearbook catch and effort data aggregated by year and flag.
  - 5x5° aggregated best effort estimates by day, flag, latitude and longitude, catch and effort.
  - Operational (logsheet[1]) catch and effort data from 1970-2022, by day, flag, Exclusive Economic Zone (EEZ), latitude and longitude, set type, catch and effort.
  - Observer data[1], including all set, gear, catch, fate and condition information.
  - Length data including length (cm) measurement units for all fish measured.
- Purse-seine
  - WCPFC public domain yearbook catch and effort data aggregated by year and flag.
  - 1x1° aggregated best effort estimates by day, flag, latitude and longitude, set type, catch and effort.
  - Operational (logsheet[1]) catch and effort data, by day, flag, EEZ, latitude and longitude, set type, catch and effort.
  - Observer data[1] including all set, gear, catch fate and condition information.
  - Length data including length (cm) measurement units for all fish measured.

All data were collated and analyses were performed in R (R Core Team 2020). Longline catch and effort, as well as observer data, were plotted spatially. Range checks were performed on the latitude and longitudes to ensure all data were from the WCPO, and outliers were removed. Catch and effort data were collated by grid cell (1x1^o or 5x5^o), year and month. Nominal annual and monthly Catch per Unit of Effort (CPUE) was used to derive the catch per 100 hooks for longline, and catch per set for purse seine, on both the logsheet as well as observer data. No standardised CPUE information is presented here, those analyses are presented in Hill-Moana et al. (2024).

The total oceanic whitetip shark catch by flag and ocean area (EEZ, as well as high seas areas) were calculated from the unraised logsheet data, and summaries of the catch by ocean area are derived from the raised aggregated datasets provided. Observers are instructed to observe every hook to the extent possible, and when breaks occur these are recorded. On longline vessels each fish is identified, measured, sexed, allocated a fate code, and condition code on capture and release (if the fish is observed being

[1]Note: Not all logsheet and observer data are available for stock assessments of elasmobranchs. As a result, the SPC could not release logsheet or observer data from some WCPFC CCMs in some years for the oceanic whitetip shark stock assessment and related analyses.

released/discarded). The time of capture is recorded, as is the hook number, along with other relevant information. In addition, the set, haul and gear information are recorded separately. The catch and set data sets were merged, and this dataset was then used for all analyses of observer data.

Oceanic whitetip shark fate and condition information were extracted from the longline merged dataset. For each fish observed, observers record the fate of the fish and allocate the fate to one of 26 codes (Table 1). The fish condition is recorded at capture and release (if the fish is released) and allocated to one of six codes (Table 2). Fate codes were grouped into four broad groups (Escaped, Discarded, Cut-free and Retained; noting that the finned state was included as retained). These data were then collated by year and vessel flag.

Fish are allocated to a hook number within a basket, where the first hook aboard after a float is recorded as hook one. Subsequent hooks are then numbered sequentially to the next float. Hooks on a shark line, that is, those attached directly to the float, are allocated number 99. The hooks between floats is recorded for each set. This allows the mid-point to be known, and all hooks beyond the mid-point were re-numbered from the mid-point back to one. For example, a basket with 10 hooks between floats would have hooks numbered 1-5 and 5-1. The shark line hook was allocated a number 0 as they are the shallowest hooks. Therefore, the shallowest hooks have the lowest number, and the deepest hooks the largest. These allocated hook numbers can then be used as a proxy for relative capture depth.

The observers record the float line length (m), branch line length (m), branch line distance (m) and the use of lightsticks. The branch line distance is the length of mainline between two branch lines. The observer instructions note that "Distance between branch lines may be hand measured or calculated by the observer using the formula: Line Setting Speed x Branch line Set Interval, or if not available, ask fishing master etc. for the distance between branch lines." Prior to 2016, the number of lightsticks used was the total number used in the set. This changed in 2016 to recording the hook number between floats that lightsticks were recorded on. In reality the take-up of new forms is slow, due to the length of the trips, and this change probably only impacts data after 2018.

Most observer programmes record oceanic whitetip shark length as upper jaw to fork in tail (UF). A small proportion of observers record other length metrics, such as total length (TL), fork length (FL) or pre-caudal length (PC).

3. RESULTS

The longline fishing effort in the WCPO extends from over 40^{o}N to over 40^{o}S, but effort is not evenly distributed through the area. Fishing effort is highest in the tropics and subtropics but with less effort along the equator (Figure 1). Reported oceanic whitetip shark catch from logsheet reporting, is highest from the Equator to 25^{o}S and with hotspots of high reported catch in Australia, Fiji, American Samoa and French Polynesia (Figure 1).

Reported oceanic whitetip shark catch generally increased from the 2015, while observers have been reporting oceanic whitetip sharks since the mid-1990s (Figure 2). Observer reported catch increased after 1997 and has fluctuated without trend since that time. For most CCMs, catch of oceanic whitetip sharks was not well reported prior to 2005, and

was highest in the 2010s. For many CCMs, catch reporting declined to almost zero after 2012, with the exception of Australia and the Marshall Islands (Figure 3). These trends were also evident in the spatial distribution of the reported catch: in the 1990s most catch was reported around Australia; in the 2000s high catch densities were reported around Hawaii, Kiribati and the Cook Islands as well as Australia through to the Solomon Islands; whereas, in the 2010s the catch is broadly reported across the tropical and sub-tropical Western Pacific (Figure 4).

3.1 Fate and condition

Prior to 2015 most oceanic whitetip sharks were retained (Figure 5). In 2015 there was a fairly abrupt change to the recorded fate of oceanic whitetip sharks and almost all have been discarded or cut-free. These trends were consistent between vessel flag and observer program (Figure 6 and Figure 7), but with some variation. Prior to 2015, most CCMs retained oceanic whitetip sharks, changing to discarding and cutting them free between 2000 and 2015. French Polynesia began discarding oceanic whitetip sharks around 2010, as did New Caledonia. A number of flags, such and New Zealand and Kiribati, have not recorded any oceanic whitetip sharks since 2015.

In the longline fishery a high proportion (~75%) of oceanic whitetip sharks arrived at vessels alive and healthy for most flagged vessels (Figure 8). At release however, most fish were discarded dead from most vessels. On some vessels oceanic whitetip sharks have been released alive and healthy, e.g., those flagged to French Polynesia, where around 75% of the oceanic whitetip sharks since 2005 have been released alive and healthy, and improvements are also evident on Fiji and Chinese Taipei vessels (Figure 9). Overall, in the most recent 9 years, a high proportion of the oceanic whitetip sharks were released, and while the condition at capture has changed little, improvements in the condition at release are evident (Figure 10).

For purse seine fishing vessels, from 1995 to 2015 oceanic whitetip shark retention rates declined steadily. Since 2015, almost all have been released (Figure 11). The condition at capture and release data were not well collected prior to 2015. The more recent data show that only about half of the oceanic whitetip sharks were alive at capture, with most of the remainder recorded as dead or unknown (Figure 11). At release, about half of the released fish were alive, but with the condition recorded as unknown.

3.2 Hook depth

Within each basket, hooks were numbered from 1 (closest to the float) to the middle of the basket (highest number) and then back to 1, with hook number 0 referring to fish caught on shark lines (lines attached to the float). These data show that oceanic whitetip sharks are caught on the shallow hooks (Figure 12). Assessing these data in five-year time bins show that the use of shark lines has declined, and were seldom used since 2015 (Figure 13). The catch at size does not change dramatically with depth, where the shallow and deep hooks have similar size frequencies (Figure 14).

Grouping the hooks into shallow (hooks 0-6) and deep (hooks 7+) again show that there is little difference in fish size on the shallow and deep hooks (Figure 15). Both deep and shallow hooks have a peak at 130 cm UF.

3.3 Length data

Oceanic whitetip shark length data have been collected by fishery observers since 1995. Most oceanic whitetip sharks were measured to a single length measurement type (UF). The length data were relatively evenly split between males and females and there are no obvious differences in the size of males and females. The data show that length measurements were collected sporadically (Figure 16). Overall the length data were normally distributed with a peak at around 150 cm UF. Through time, the length frequency data were relatively stable; the median length declined slightly through the 2000s with a slight increase after 2020, but these recent data are sparse. Catch by flag information showed that some flags such as the Vanuatu and the Solomon Islands caught slightly smaller oceanic whitetip sharks compared to other fleets (Figure 17). There are distinctive trends in oceanic whitetip shark size spatially (by latitude), but not by time (year quarter) (Figure 18 and Figure 19). Generally speaking, throughout the year, smaller fish (both male and female) are more abundant in the north of the WCPO, with larger fish south of 15^{o}S. The size trends across the WCPO from East to West fluctuate with no specific trend that is easily discernible. Trends in changes in the distribution with maturity are also less obvious (Figure 20).

3.4 Catch ratios

Figure 21 presents the species proportions by depth. These data indicate that a higher proportion of the catch in shallow sets is made up of swordfish and sharks, and with the sharks predominantly blue sharks but also a small number of oceanic whitetip sharks. The data also indicate that the proportion of blue sharks in deep sets has declined since 2010, and the catch of oceanic whitetip sharks is too sparse to discern any trends. The oceanic whitetip shark catch proportions in the shallow sets are also too sparse to be informative.

While blue sharks make up the majority of the shark catch (Figure 22 A & B), excluding blue sharks from the data reveal increases in observed oceanic whitetip shark catch from 2015 worresponding with a change in reporting: where sharks coded to the generic shark code (SHK) are greatly reduced and species specific reporting has increased (Figure 22 C & D). The catch proportions by flag indicate that the oceanic whitetip shark catch was too infrequent to provide definitive trends (Figure 23).

3.5 Gear attributes

Overall, the longline gear that with positive catch of oceanic whitetip sharks in the WCPO consisted of lines with 2000-3000 hooks; 200 baskets; 20-29 hooks between floats; float lines of around 30m long; branchlines of 20m long; with 40m between branchlines; 500 lightsticks per line; and various bait types (Figure 24). For the sets that caught oceanic whitetip sharks, sets with few hooks between floats accounted for about half of the sets prior to 2000, but with higher numbers of hooks between floats thereafter (Figure 25). The number of hooks set has increased from 2000, but the number of baskets set has declined (Figure 25). Bait use was relatively varied: between 1995 and 2000 squid was most common along with mackerel and other fish bait; and from 2000 onwards, other bait types were most frequently used (Figure 25).

The observed hooks between floats for sets catching oceanic whitetip sharks by flag

showed that Australian vessels had fewer hooks between floats, while China, Korea and Chinese Taipei vessels increased their hooks between floats from 2000. The Unites States vessels have used relatively similar hooks between floats throughout the time period (Figure 26). The number of hooks set varies between flags and through time (Figure 27). Generally speaking, the Australian and Papua New Guinea vessels set fewer hooks, whereas China, Fiji, Korea, Chinese Taipei and the United States have increased the number of hooks set over time. French Polynesia has had relatively consistent number of hooks at around 1500-3000 hooks set. The number of baskets set is relatively similar between flags, with most setting 100-300 baskets, but the Unites States vessels have increased theirs through time (Figure 28). Many WCPFC CCMs used squid, mackerel, or general fish bait in the late 1990s, but most have used other bait types since 2000 (Figure 29).

The temporal trends in sets catching oceanic whitetip sharks show branchline length decreasing through time but increasing somewhat since 2015. Branchline distance has also decreased slightly, and floatline length has fluctuated without trend. Lightstick use is difficult to interpret, but seems to increase in prevalence in the last 5 years (Figure 30). By flag, branchline length is relatively higher in the more recent years for Chinese and Japanese vessels, few other fleets show any strong temporal trends (Figure 31). Branch line distance shows a reduction between lines for Fiji, New Caledonia and Chinese Taipei (Figure 32). Floatline length varies by flag and by year with no definitive trends, the only consistent flag is the United States vessels who consistently used floatline lengths of 20-29m (Figure 33). The lightstick data are poorly documented, with only Chinese Taipei showing any temporal trends with an increase in lightstick reporting in 2019-2023 (Figure 34). Overall, a small number of vessels had 100% light stick use (i.e. one lightsick for every hook set), but most have zero lightstick use (Figure 35).

Prior to 2013, about half of the vessels fishing in the WCPO reported using Japanese hooks, with most of the remaining hooks being circle hooks. A small proportion of vessels used J-hooks or other hook types, but since 2013 most ($\sim$80%) vessels were observed using circle hooks, with the remainder using J-hooks (Figure 36). However, for sets catching oceanic whitetip sharks, most catch is made on Japanese and circle-hooks (Figure 37). Hook type is thought to impact the survivability of sharks, but overall, the difference between oceanic whitetip sharks landed in good condition (A1) compared to those that were dead (D) show no trends for hook type (Figure 38).

3.6 Observer program data

The observed number of sets varied by observer program, and sets containing oceanic whitetip sharks form a small part of this dataset (Figure 39). For many observer programs, the data were recent (post-2010) and sparse, or patchy. However, some, such as French Polynesia, have a relatively long history of observer data. The observed sets reported by the French Polynesia observer program have slowly increased through time, and have been relatively high and consistent since 2010. However, sets containing oceanic whitetip sharks are few. The French Polynesia and Solomon Islands reported a moderate number of sets with oceanic whitetip sharks. The number of observed sets has increased in recent years for China, Fiji, and Tongan observer programs, and all observer programs have sets containing oceanic whitetip sharks.

4. DISCUSSION

Brouwer and Hamer (2023) note that the next stock assessment for oceanic whitetip sharks is scheduled for 2024/2025. This paper, as well as Hill-Moana et al. (2024), represent the background work for the SC20s consideration and information for feedback into the SC21 assessment.

Oceanic whitetip sharks are caught as bycatch in longline fisheries targeting tuna, billfish and blue sharks throughout the Western and Central Pacific Ocean (WCPO) between 35^{o}N to 40^{o}S, and with hotspots of high catch in Australia, Fiji, American Samoa and French Polynesia. They are also caught as bycatch in the tropical purse seine fisheries of the WCPO. Unlike blue shark, where some target fisheries exist in the South Pacific Ocean, no target fisheries exist for oceanic whitetip sharks (Williams and Ruaia 2021). Although oceanic whitetip sharks have not been very well reported in logsheets, they were caught as bycatch and were retained in large numbers in the past.

Since 1st January 2013 oceanic whitetip sharks within the WCPFC have been required to be released (WCPFC 2011). This management intervention seems to have been effective as in the longline fishery reported oceanic whitetip shark catch has declined in the recent years. Prior to 2013, almost all oceanic whitetip sharks were retained. In 2013 and 2014 about half the oceanic whitetip sharks were released or cut-free, and in 2015 there was an abrupt change with almost all being released from 2015 onwards. In 2015, about ∼75% of oceanic whitetip sharks were discarded, and an additional ∼25% were cut-free with almost none being retained. In general, the uptake of releasing sharks has varied by fleet. While most fleets began releasing oceanic whitetip sharks in 2015, there was a lag in the uptake of the release requirements in 2013 and 2014. Some fleets, such as the Cook Islands, New Caledonia and French Polynesia, began releasing sharks earlier, around 2008, prior to the CMM being agreed (2011). This suggests that while some flags pre-empted the CMMs release policy, others had a slower uptake, but all appear to have implemented it by 2015.

Observer program and/or vessel flag effects have been observed in the different characterisations of the gear (Brouwer et al. 2021; Brouwer et al. 2022; Brouwer et al. 2023), where gear characteristics will vary depending on the target species. While specific target is not well documented, gear characteristics are relatively well documented by observers and some are captured on longline logsheets. These gear characteristics will impact the catchability of sharks (Ward et al. 2008, Godin et al. 2012). As a result, vessel flag and target species will likely impact the interactions with oceanic whitetip sharks. Vessels setting gear with the characteristics that make the gear lie shallower in the water will increase the ability of that gear to catch oceanic whitetip sharks. Furthermore, the practice of the vessel and the law in the EEZ within which they are fishing will determine when in the catch history these fish were cut-free, caught and discarded or retained.

While observer programs may be a proxy for flag, observer program and/or vessel flag should be included as variables in CPUE and length analysis standardisation. Brouwer and Hamer (2023) note the spatio-temporal issues associated with observer coverage and suggest that fishery data standardisations should take these into account if possible. Oceanic whitetip shark data are relatively sparse compared to other species such as blue sharks, suggesting that a catch reconstruction will be an essential part of this assessment. Additionally, Neubauer et al. (2019) noted that the non-retention of oceanic whitetip shark also introduced additional uncertainty about the value of indicators such as CPUE

to monitor populations of oceanic whitetip shark. All of these factors will need to be considered when undertaking catch reconstruction and CPUE analyses for the planned 2025 stock assessment of oceanic whitetip sharks.

WCPFC (2019) and its predecessors require that oceanic whitetip sharks be released when captured on all gear. A high proportion of oceanic whitetip sharks are alive and healthy when captured by longline vessels, and about 20% of them are dead when captured in purse seine gear. Observers on purse seine vessels, however, do not record the details of the life status very well, and for sharks that are alive the condition is largely unknown. Some work has been done on the post release survival of oceanic whitetip sharks from longline vessels showing high (~85%) survival rates (Hutchinson et al. 2021). Considering the high proportion of oceanic whitetip sharks cut-free and discarded, as well as the high survival rates and relative improvements in release condition in the most recent years, it is assumed that fishing related mortality of ocranic whitetip sharks from longline gear should have decreased since the inception of the shark CMM (WCPFC 2019) and its stock specific predecessor (WCPFC 2011). The release condition of oceanic whitetip sharks on purse seine vessels is not well documented, and getting more detail on life status and release survival from this fishery would be informative.

Finally, the hypothesis that oceanic whitetip shark fishing related mortality has decreased since 2015 should be tested as part of the 2025 stock assessment, along with commentary on the extent to which any reductions in fishing morality are improving the stocks ability to recover. The assessment should also provide commentary on the effectiveness of release policies required in (WCPFC 2011) and (WCPFC 2019).

5. RECOMMENDATIONS

The following recommendations are proposed for SC20 to consider:

1. CPUE and length analysis used for the 2025 stock assessment should include vessel flag and gear characteristics as variables when undertaking standardisations.
2. Noting that very little detailed information exists on the life status of oceanic whitetip sharks released from the catch on purse seine vessels, it is recommended that observers on purse seine vessels be encouraged to prioritise the collection of detailed life status data at both capture and release.
3. Release survival work should be undertaken, and while this work is currently in the SC work plan, the start date is currently unscheduled.
4. It is recommended that the 2025 stock assessment explicitly provide commentary on the recent trends in fishing mortality since the inception of CMM2019-04 and its stock specific predecessor CMM2011-04.

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TABLES

Table 1: Fate codes used by observers in the WCPFC regional observer programme. Fate codes are used to descibe whether the fish was retained (RET), discarded (DIS), released, (REL), cut free (CUT).

Code	Description	Group
RGG	Retained gilled and gutted (for sale)	RET
RGT	Retained gilled gutted and tailed (for sale)	RET
RWW	Retained whole	RET
RPT	Retained partial (e.g. fillet, loin, trunk)	RET
RFR	Retained both fins and trunk (sharks)	RET
RHG	Retained headed and gutted (billfish)	RET
RSD	Retained but shark damaged	RET
RCC	Retained for crew consumption	RET
RGO	Retained gutted only.	RET
ROR	Retained other reason (specify)	RET
DFR	Discarded trunk fins retained (sharks)	RET
DGD	Discarded gear damage (tuna only)	DIS
DSD	Discarded shark damage	DIS
DWD	Discarded whale damage	DIS
DUS	Discarded uneconomic species	DIS
DDL	Discarded too difficult to land	CUT
DSO	Discarded struck off	CUT
DCF	Discarded cut free	CUT
DDH	Discarded de hooked	CUT
DTS	Discarded too small (target species)	DIS
DPQ	Discarded poor quality	DIS
DOR	Discarded other reason (specify)	DIS
ESC	Escaped	ESC
DPA	Discarded protected species, Alive	DIS
DPD	Discarded protected species, Dead	DIS
DPU	Discarded protected species, Unknown	DIS

Table 2: Condition codes used by observers in the WCPFC regional observer programme. Condition codes are used to describe the animal's health status; and recorded when it is first caught and again if it is discarded / released.

Code	Description
A0	Alive (not categorized)
A1	Alive, healthy
A2	Alive injured, distressed
A3	Alive, but dying
D	Dead
U	Condition unknown

Table 3: Purse seine set association codes used by observers in the WCPFC regional observer programme.

Code	Description
1	Unassociated
2	Feeding on baitfish
3	Drifting log, debris or dead animal
4	Drifting raft, FAD or Payao
5	Anchored raft, FAD or Payao
6	Live whale
7	Live whale shark
8	Other

FIGURES

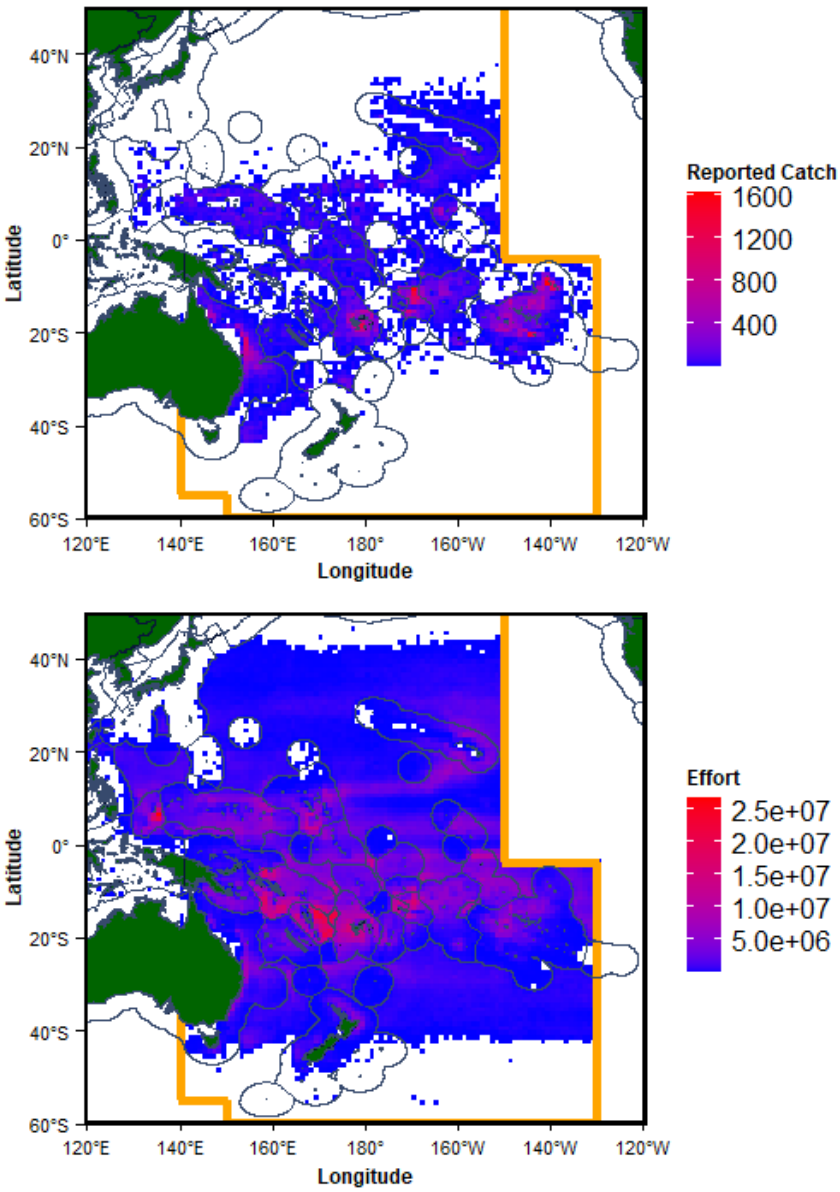

Figure 1: Longline oceanic whitetip shark catch in tonnes (top) fishing effort in hooks set (bottom) as reported on the available logsheets in the WCPFC Convention area 1995 - 2023.

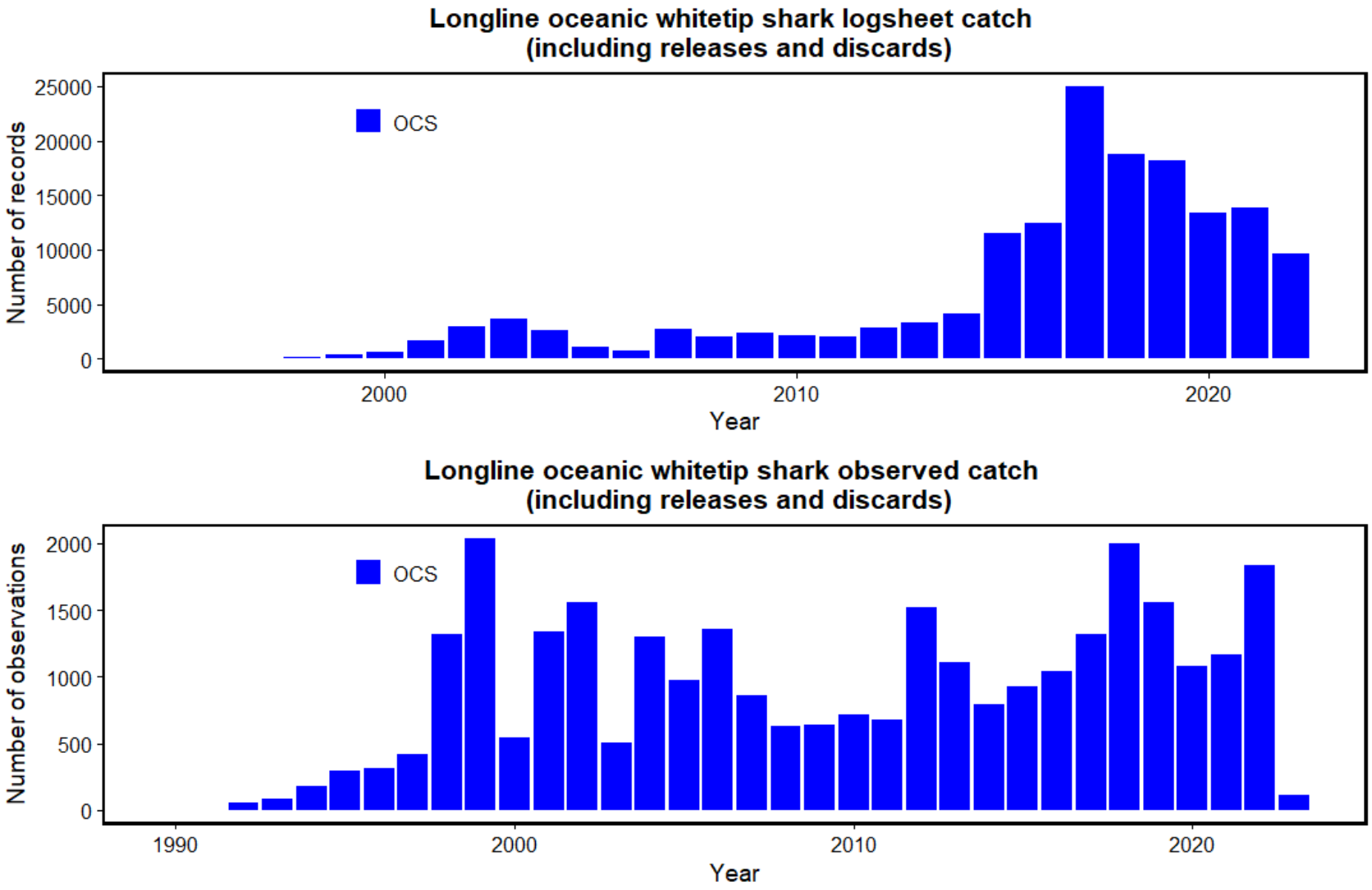

Figure 2: Longline catch reported on logsheets (top) and by observers (bottom).

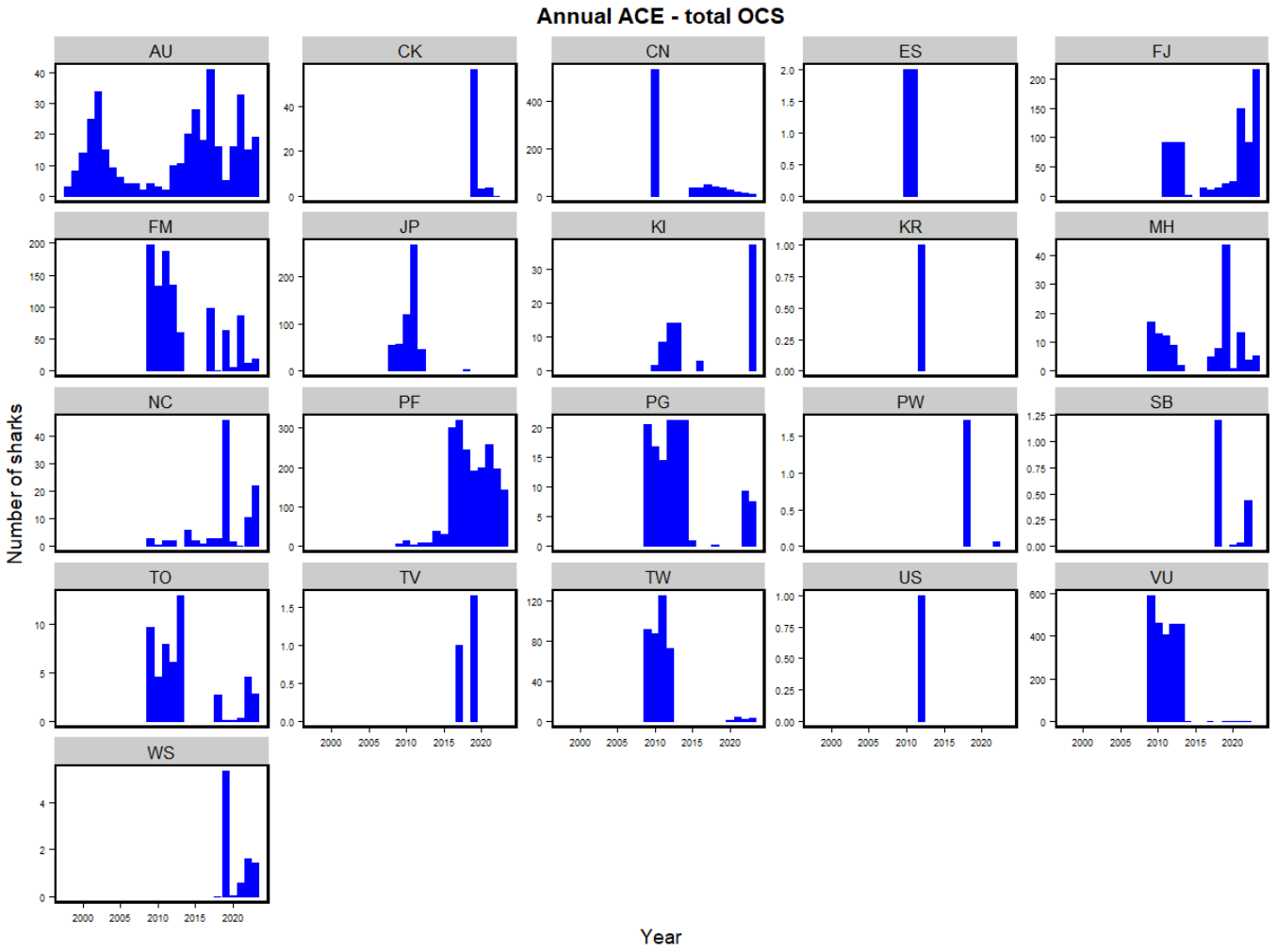

Figure 3: Longline oceanic whitetip shark annual catch estimates reported by flag states in WCPFC the WCPFC Convention area 2000 - 2023.

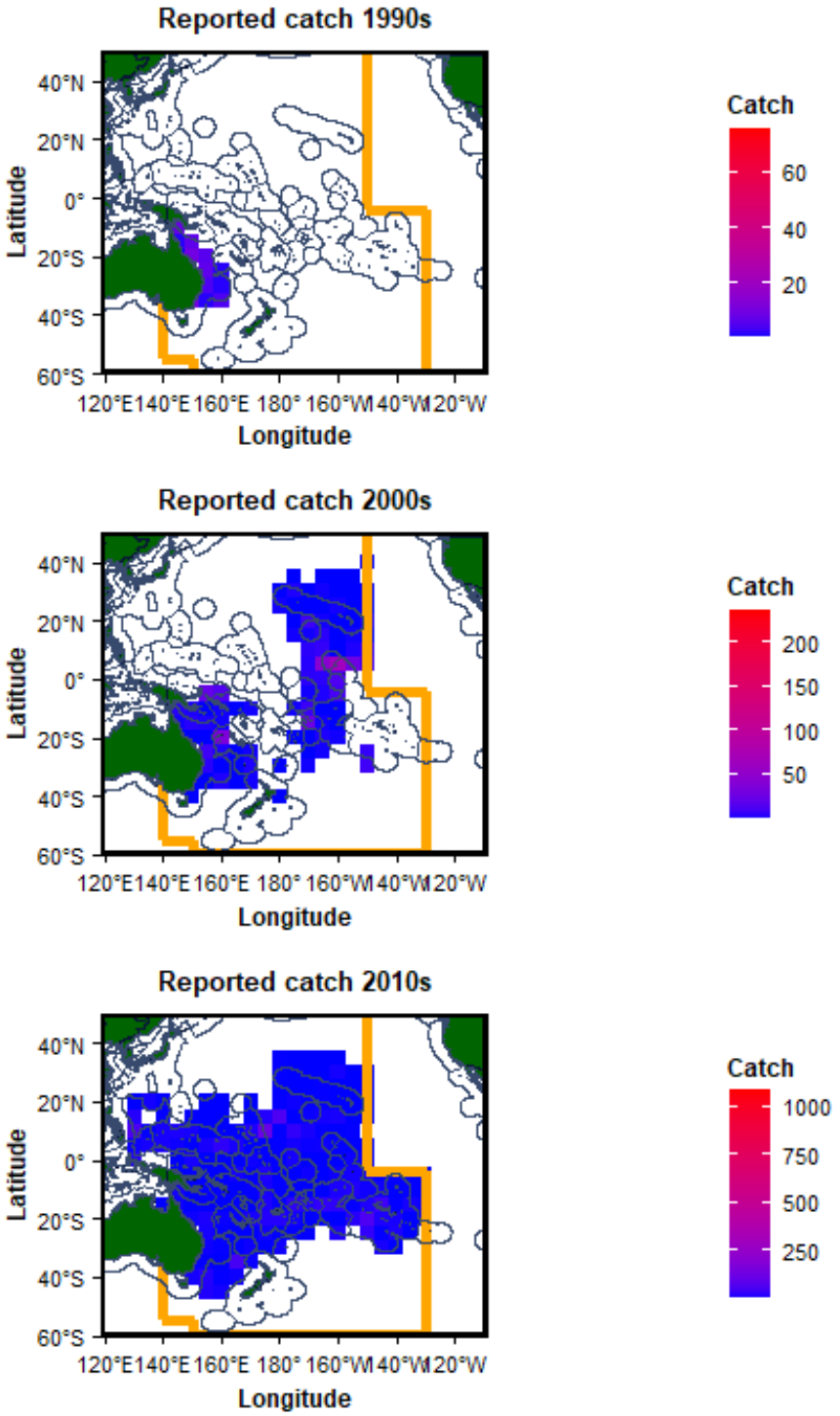

Figure 4: Reported logsheet catch by decade of oceanic whitetip sharks in the WCPFC from 1990-2022 aggregated to 1x1 degree squares across all fleets and months of the year.

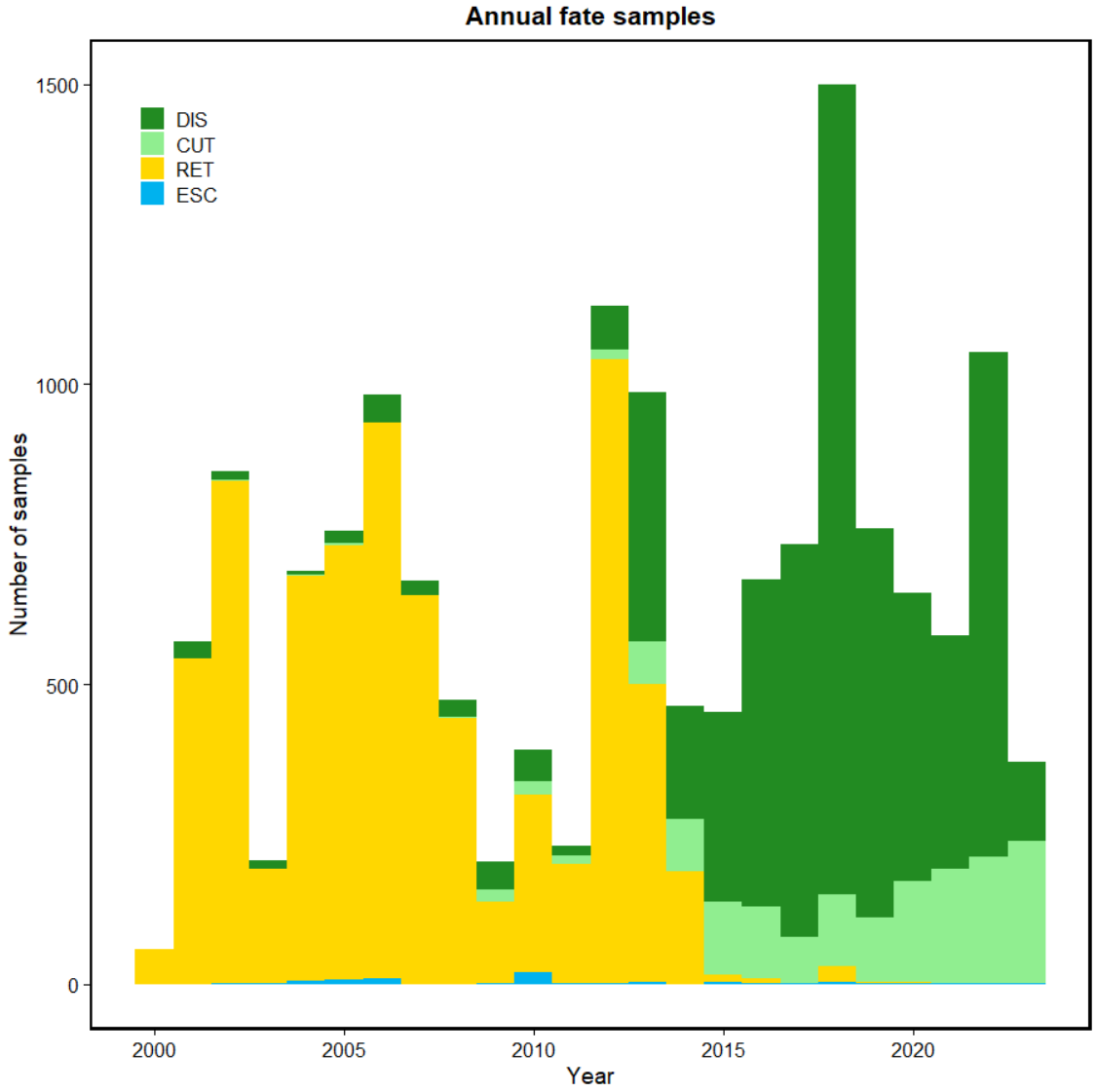

Figure 5: Fate of longline caught oceanic whitetip shark observed by flag 2000 - 2023. ESC = Escaped, RET = Retained, DIS = Discarded, CUT = Cut free.

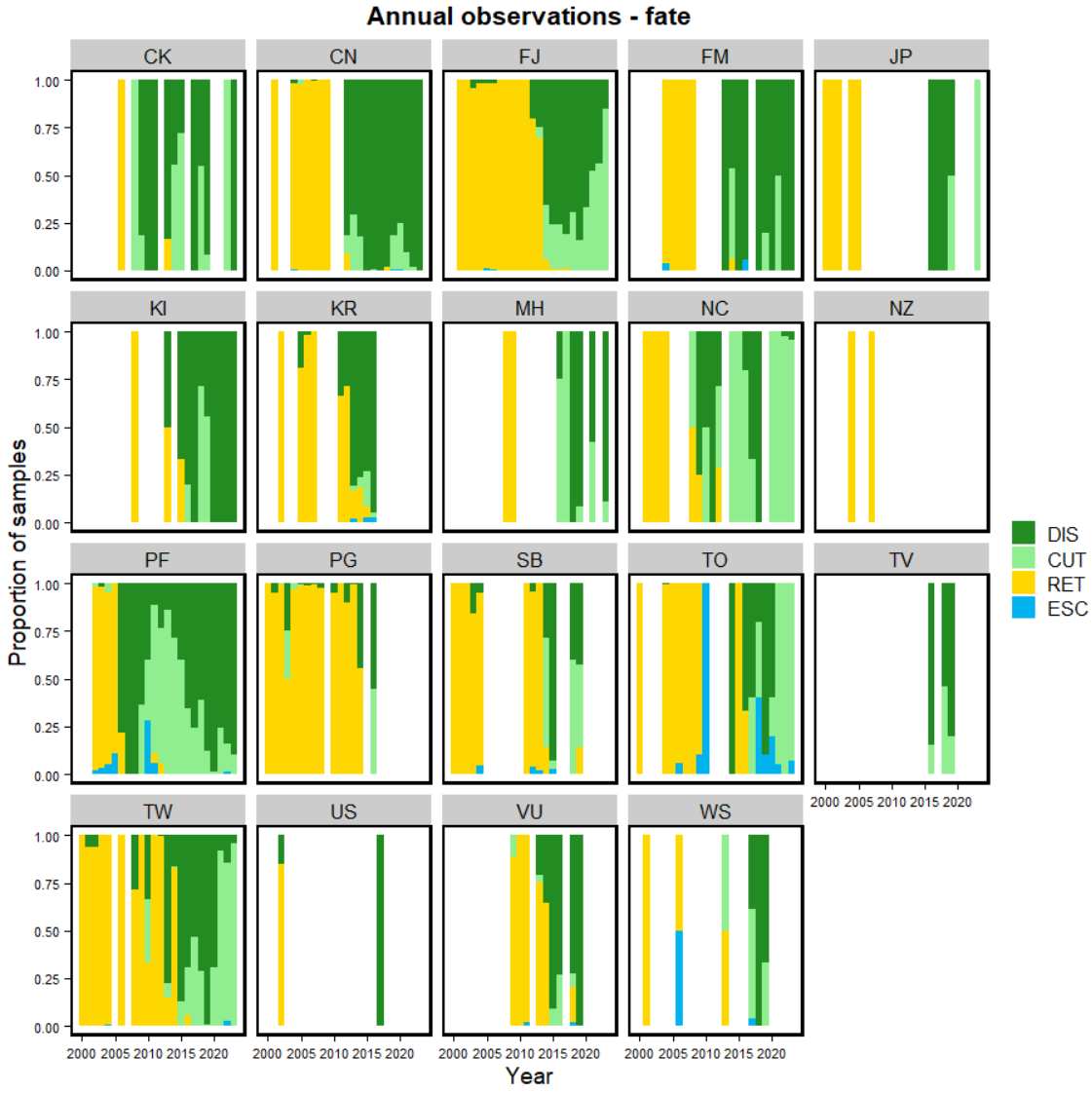

Figure 6: Fate proportions by flag of longline caught oceanic whitetip shark observed by flag 2000 - 2023. ESC = Escaped, RET = Retained, DIS = Discarded, CUT = Cut free.

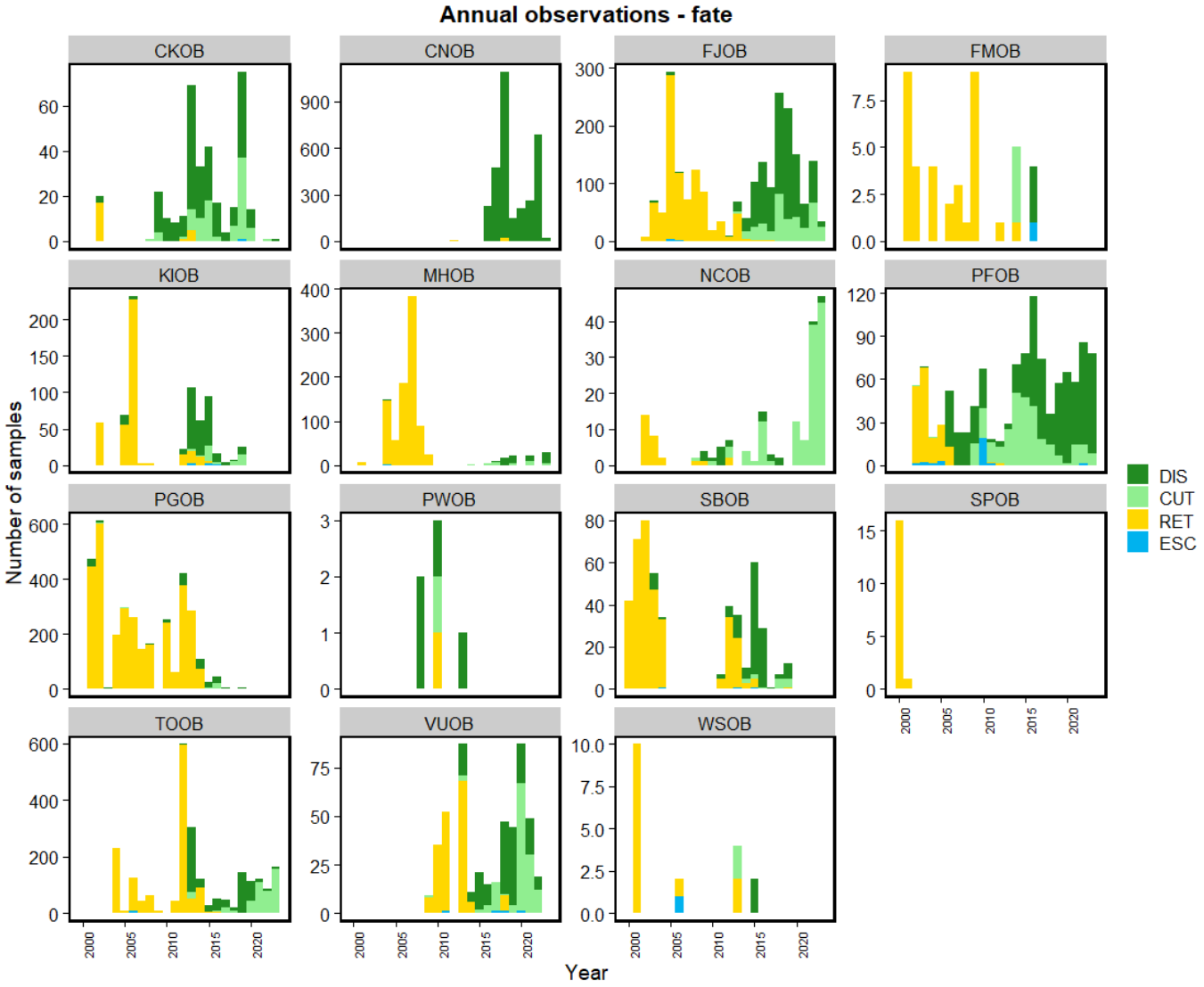

Figure 7: Fate totals by observer program of longline caught oceanic whitetip shark observed by flag 2000 - 2023. ESC = Escaped, RET = Retained, DIS = Discarded, CUT = Cut free.

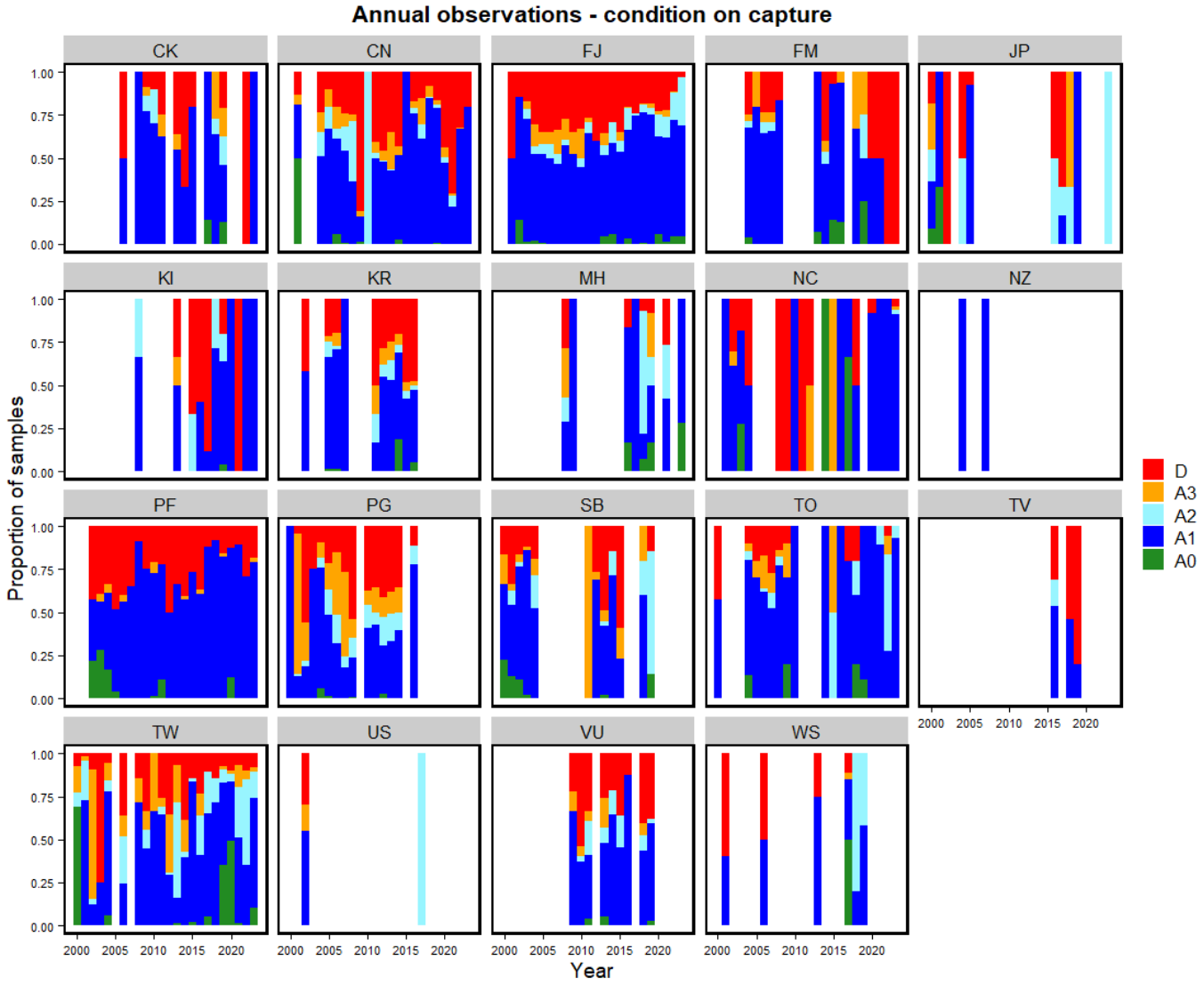

Figure 8: Condition at capture of longline caught oceanic whitetip shark observed by flag in the WCPFC between 2000 - 2023. D = Dead, A0 - A3 are various life states as defined in Table 2.

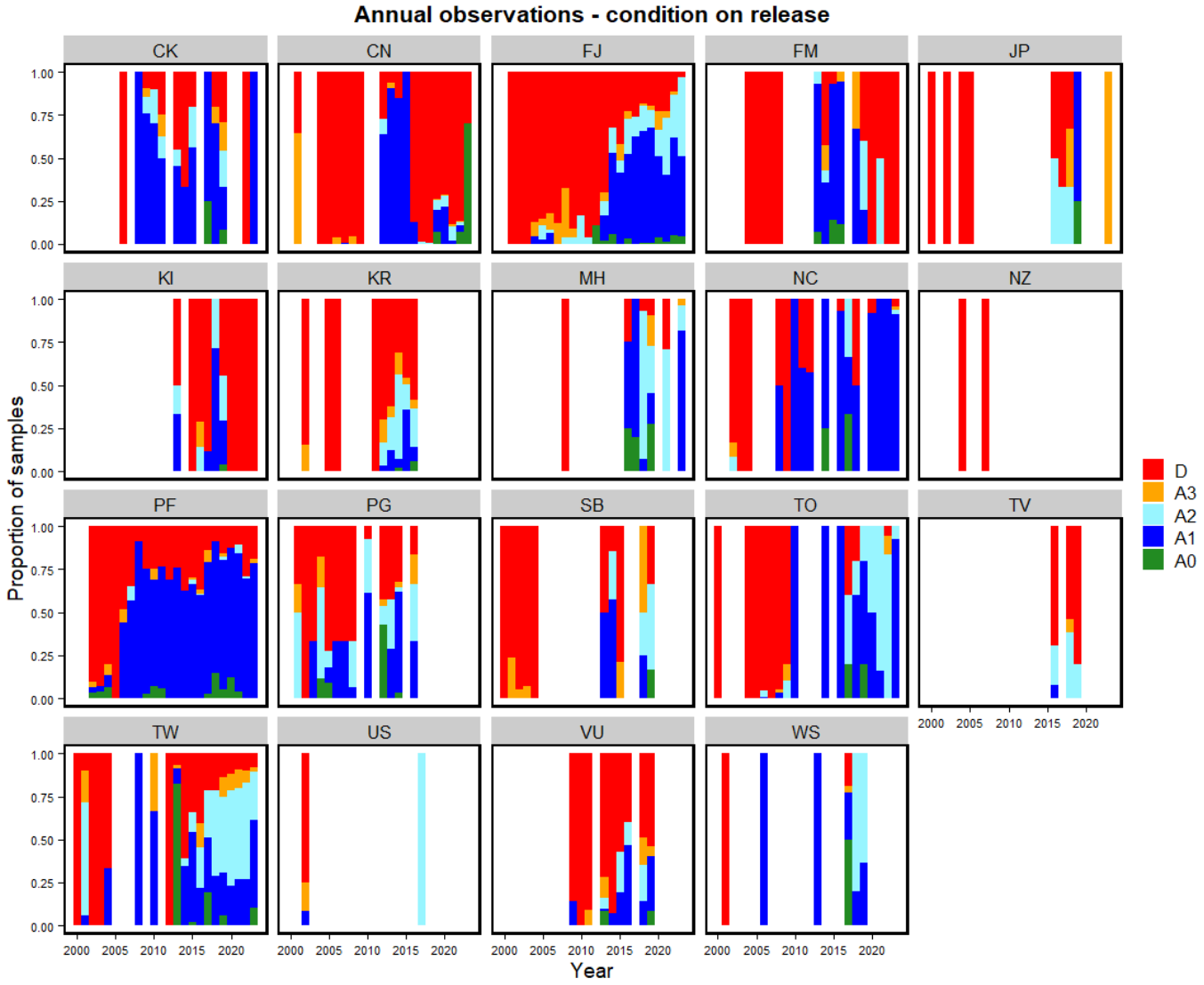

Figure 9: Condition at release of longline caught oceanic whitetip shark observed by flag in the WCPFC between 2000 - 2023. D = Dead, A0 - A3 are various life states as defined in Table 2.

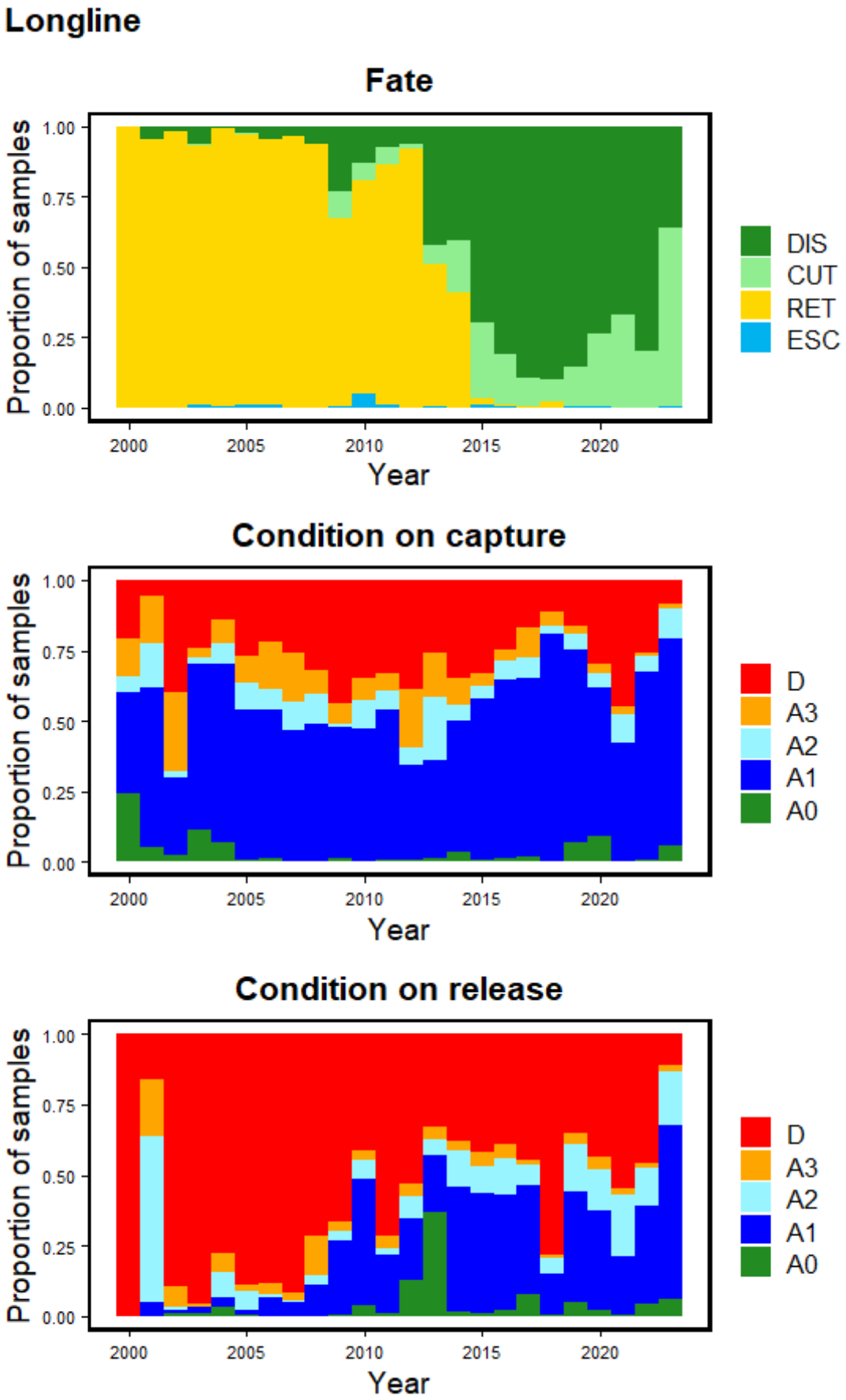

Figure 10: Fate of fish (top), condition at capture (middle) and release (bottom) of all longline caught oceanic whitetip shark observed in the WCPFC between 2000-2021. ESC = Escaped, RET = Retained, DIS = Discarded, CUT = Cut free, D = Dead, A0-A3 are various life states as defined in Table 2.

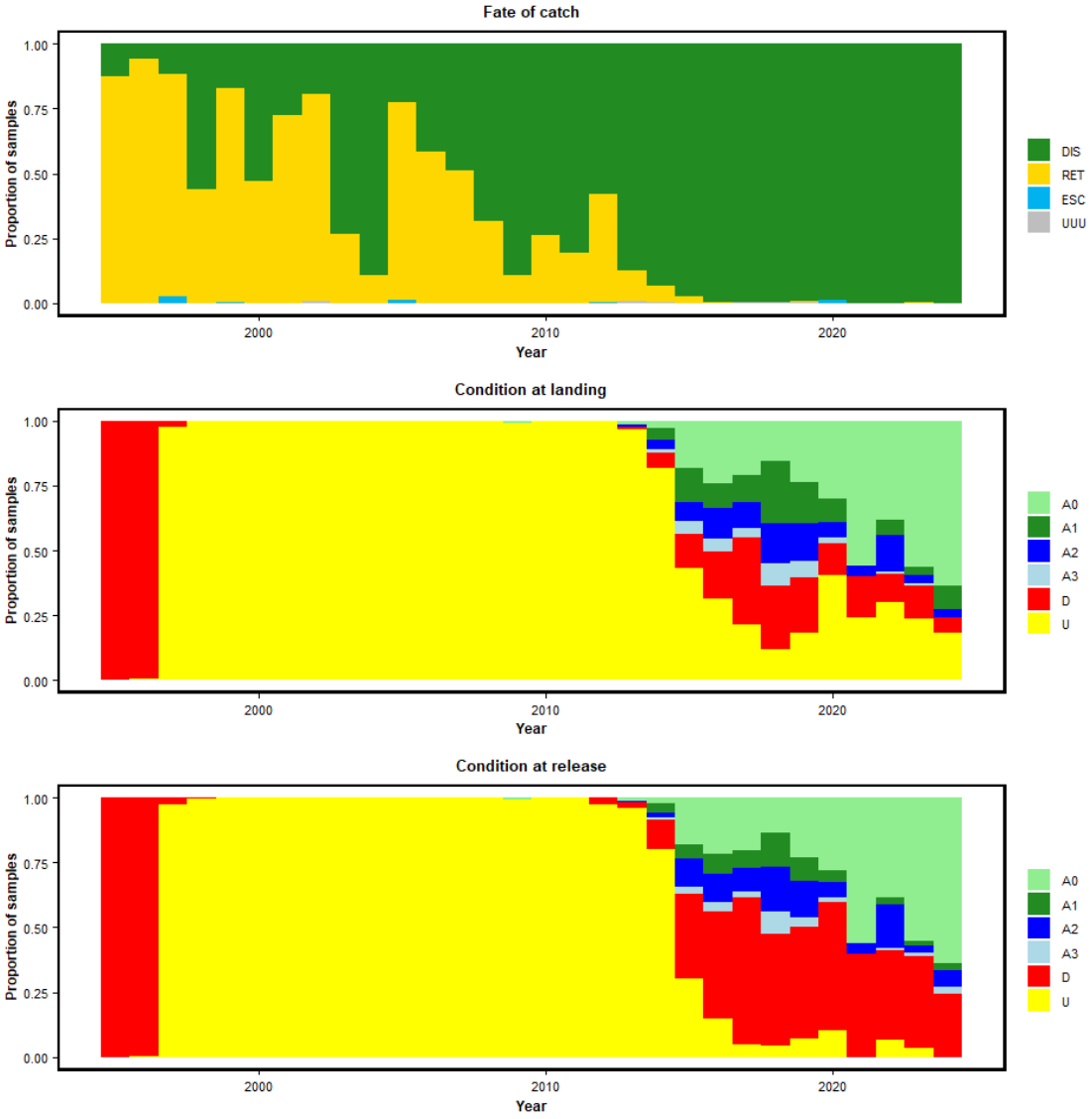

Figure 11: Fate of fish (top), condition at capture (middle) and condition at release (bottom) of all purse seine caught oceanic whitetip shark observed in the WCPFC between 1998-2023. ESC = Escaped, RET = Retained, DIS = Discarded, UUU = unknown, D = Dead, A0-A3 are various life states as defined in Table 2 and U = unknown.

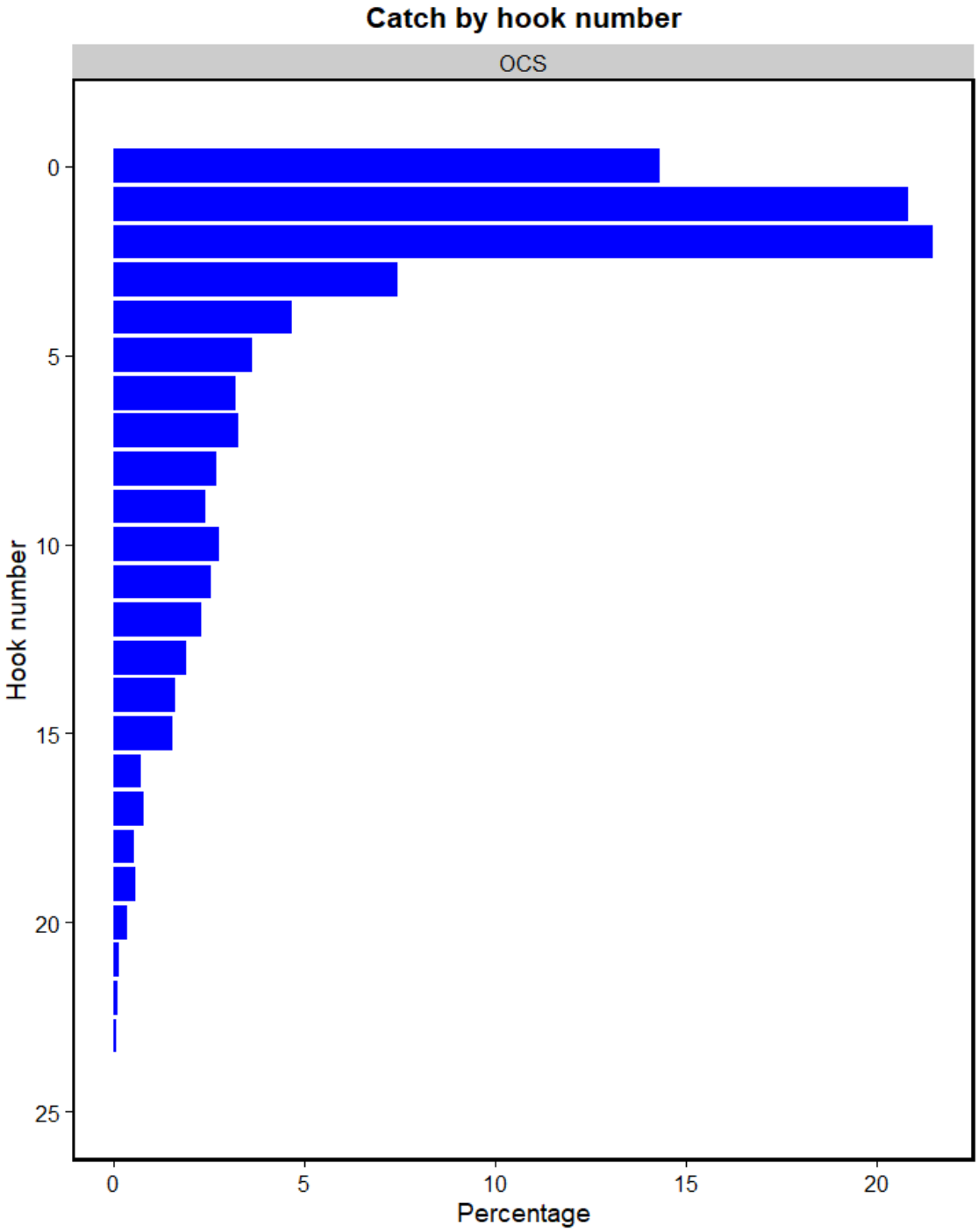

Figure 12: Catch of oceanic whitetip shark by hook number relative to the closest float observed in the WCPFC between 2000 - 2023. Hooks were numbered from 1 to the middle of the basket and then back to 1 hook number 0 refers to fish caught on shark lines that are attached to the float.

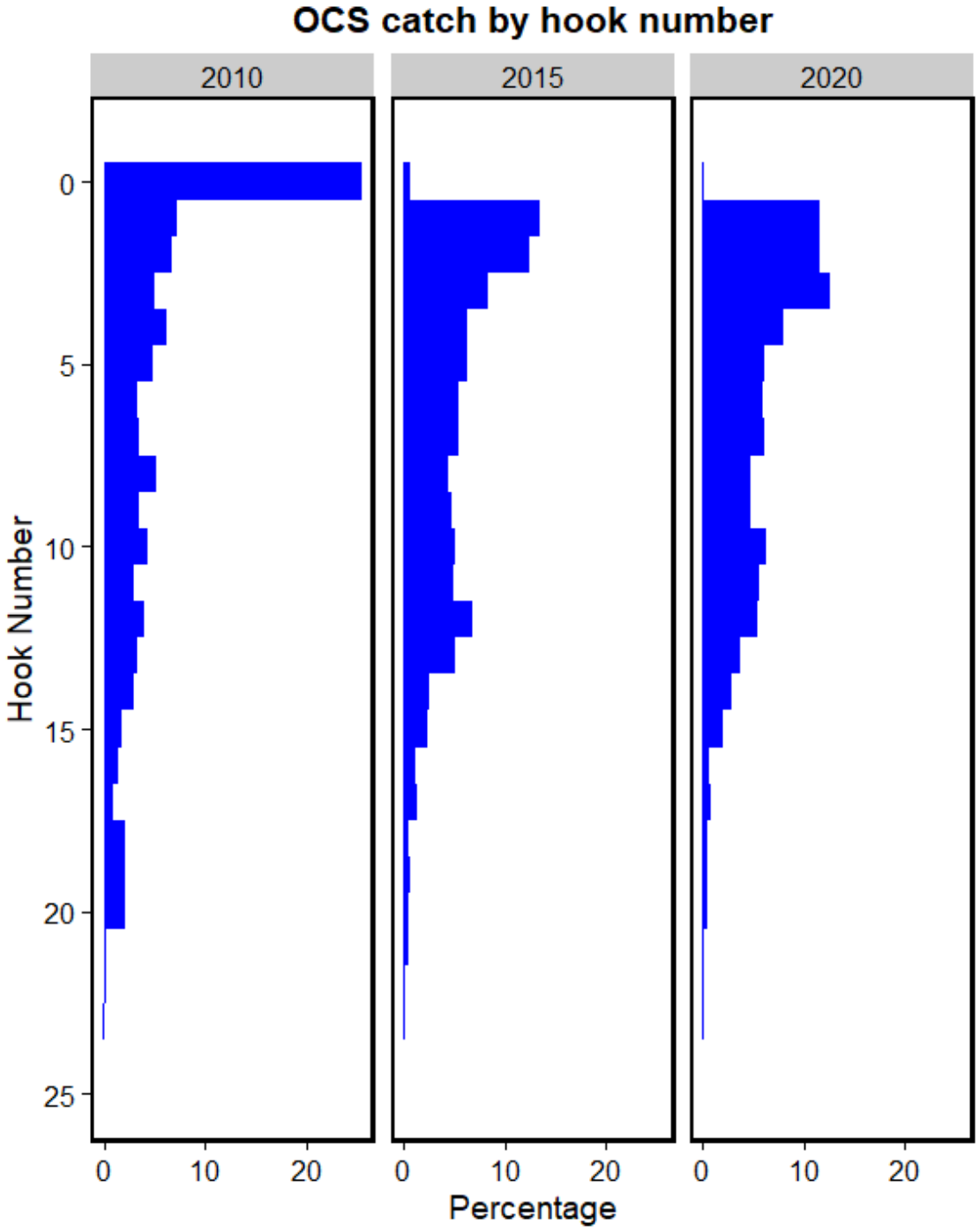

Figure 13: Catch of oceanic whitetip shark by hook number relative to the closest float observed in the WCPFC between 2000 - 2023 separated by decade. Hooks were numbered from 1 to the middle of the basket and then back to 1 hook number 0 refers to fish caught on shark lines that are attached to the float.

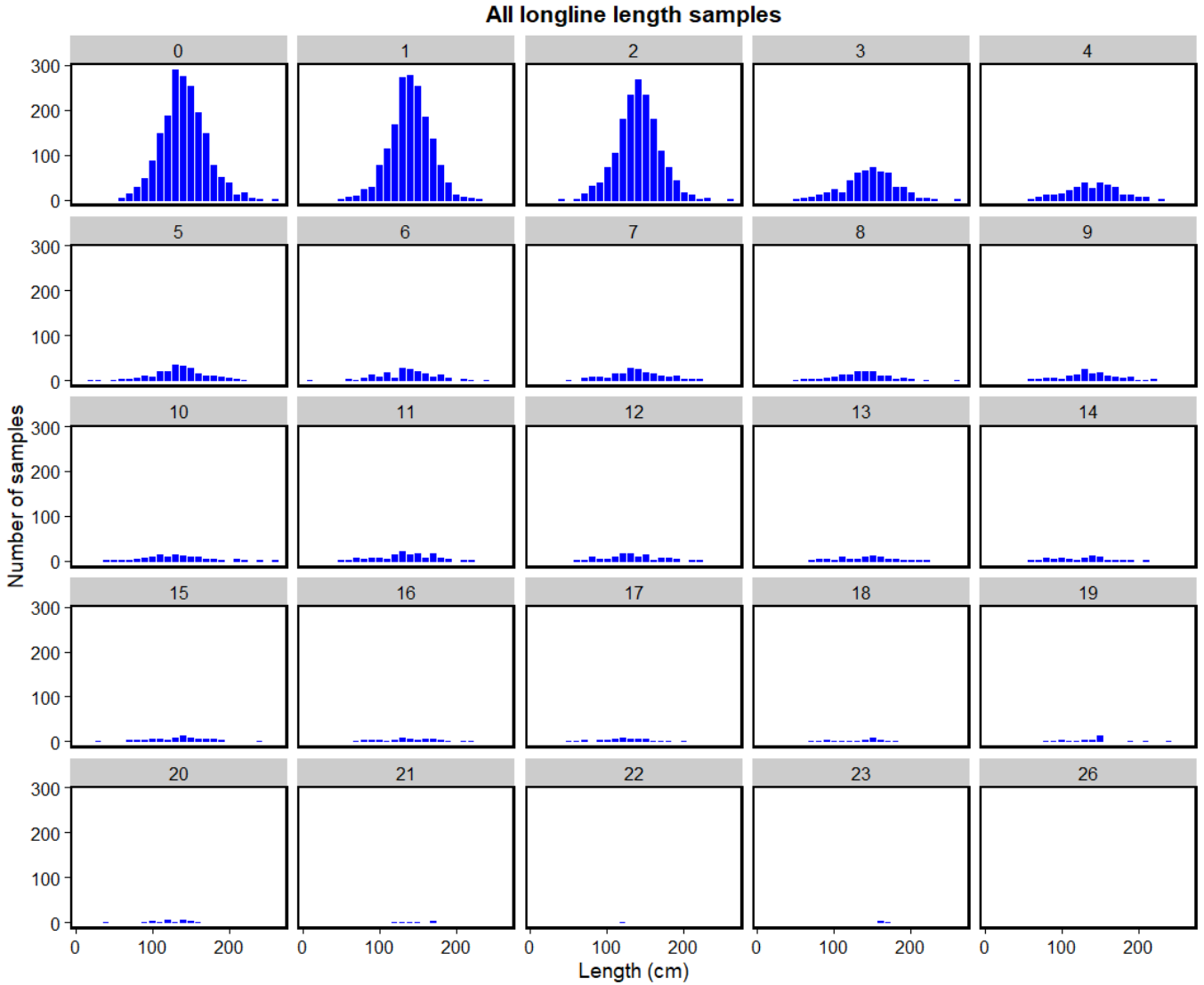

Figure 14: Length frequency distributions, for fish measures to UF only, of oceanic whitetip sharks observed in the WCPFC between 2000 - 2023 caught by hook number.

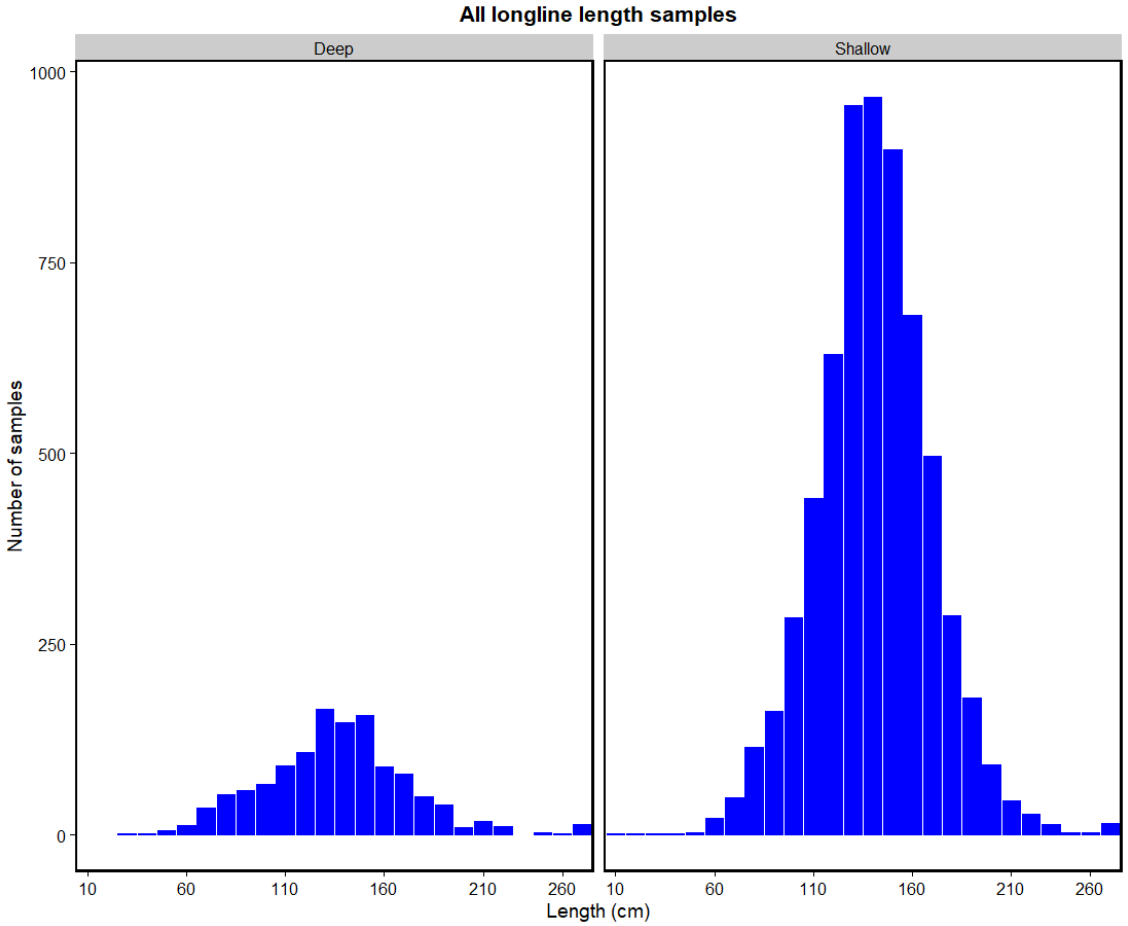

Figure 15: Length frequency distributions, for fish measures to UF only, of oceanic whitetip sharks observed in the WCPFC between 2000-2023 caught by depth group where shallow hooks are hook numbers 6 or less and deep are hook numbers 7 and higher.

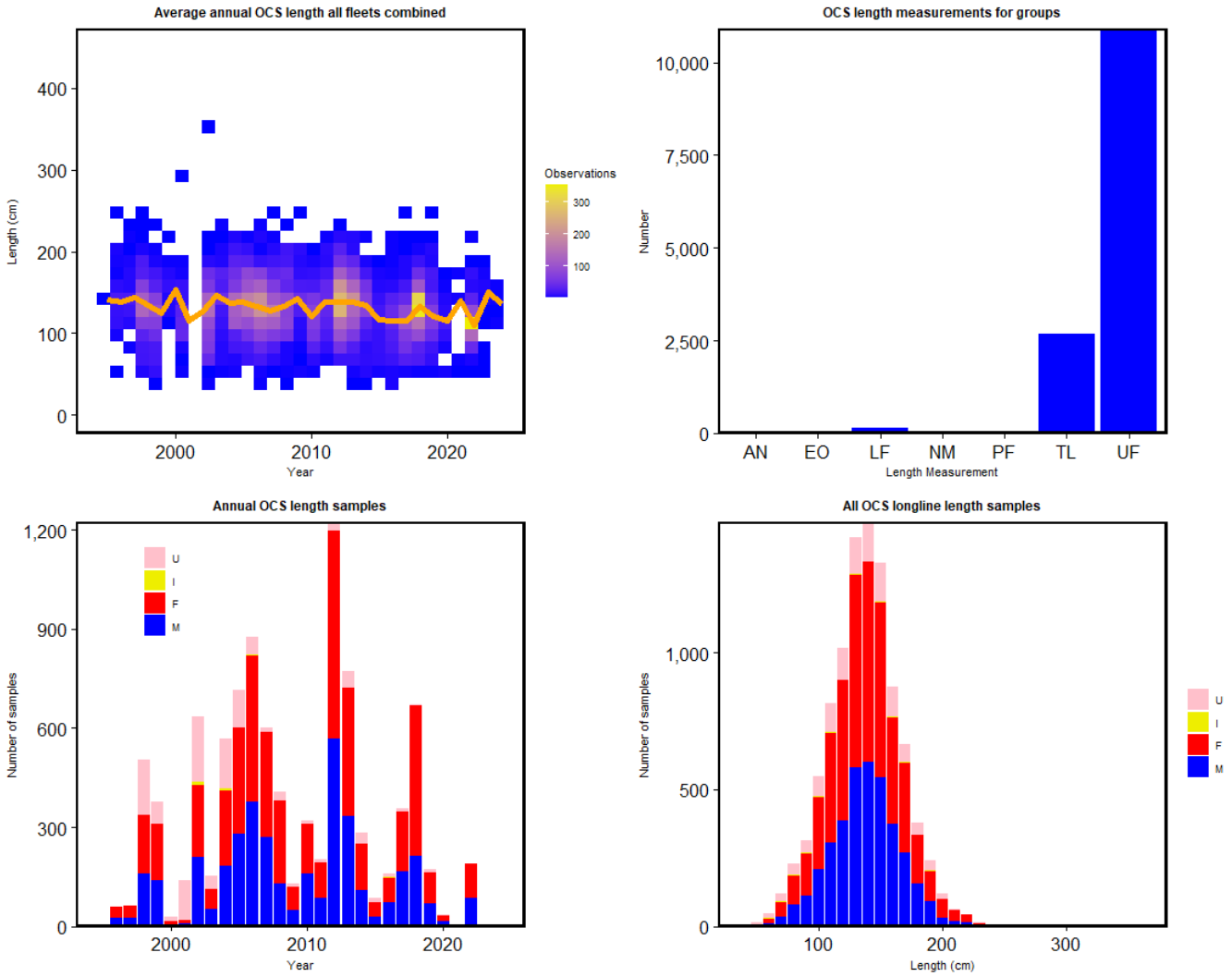

Figure 16: Length data availability of oceanic whitetip sharks observed in the WCPFC between 1990-2023, showing the average annual length (top left), the units of length measurements (top right), the number of samples collected by sex (bottom left) and the overall length frequency (bottom right). UL = Upper-jaw fork length; TL = Total Length; PC = Pre-caudal length; U = Sex unknown; I = Immature; F = Female; and M = Male.

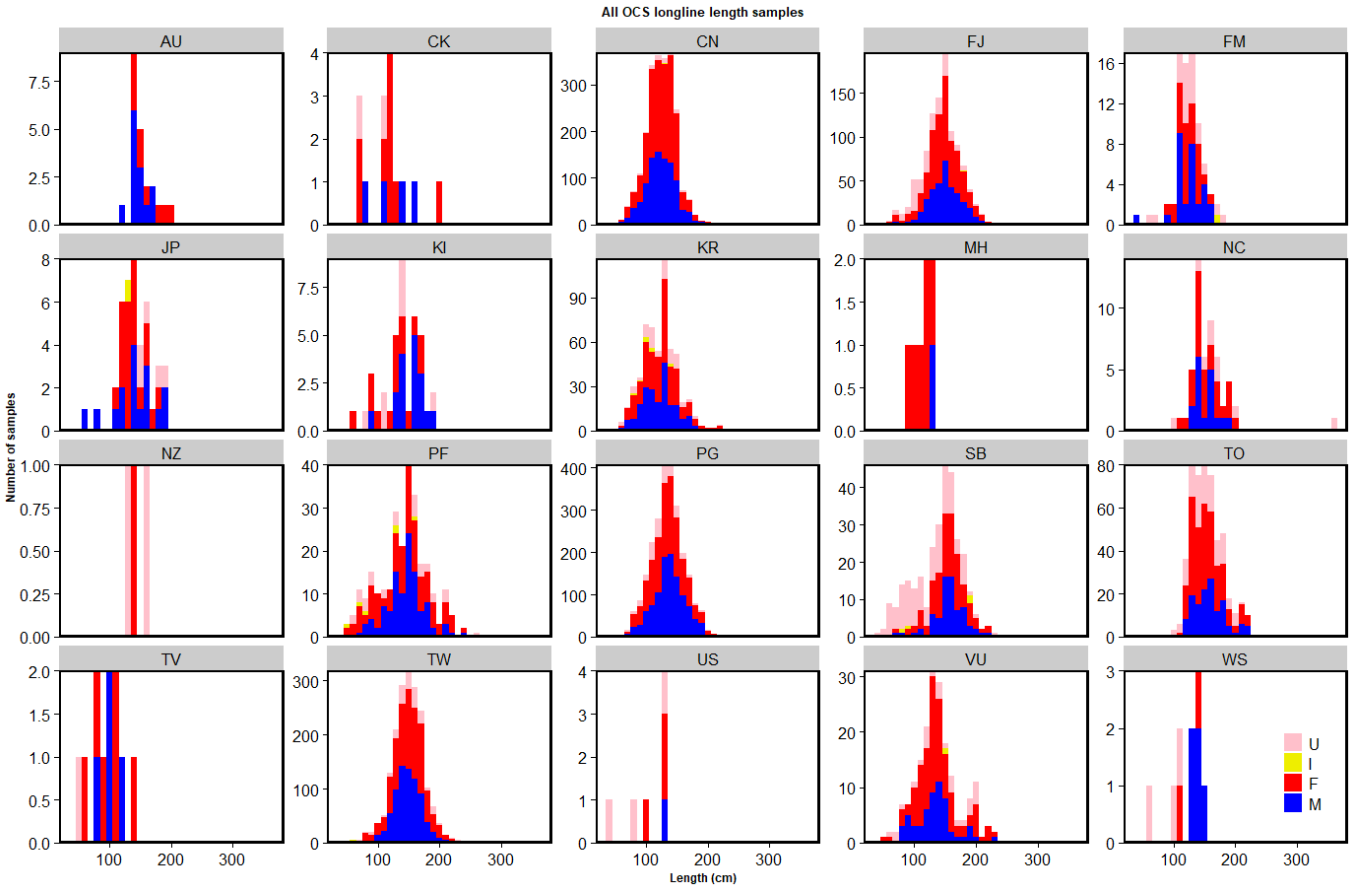

Figure 17: Length frequency distributions, of oceanic whitetip sharks observed in the WCPFC between 1990 - 2023 by flag. U = Sex unknown, I = Immature, F = Female and M = Male. Note: the y - axis scales are not the same between plots.

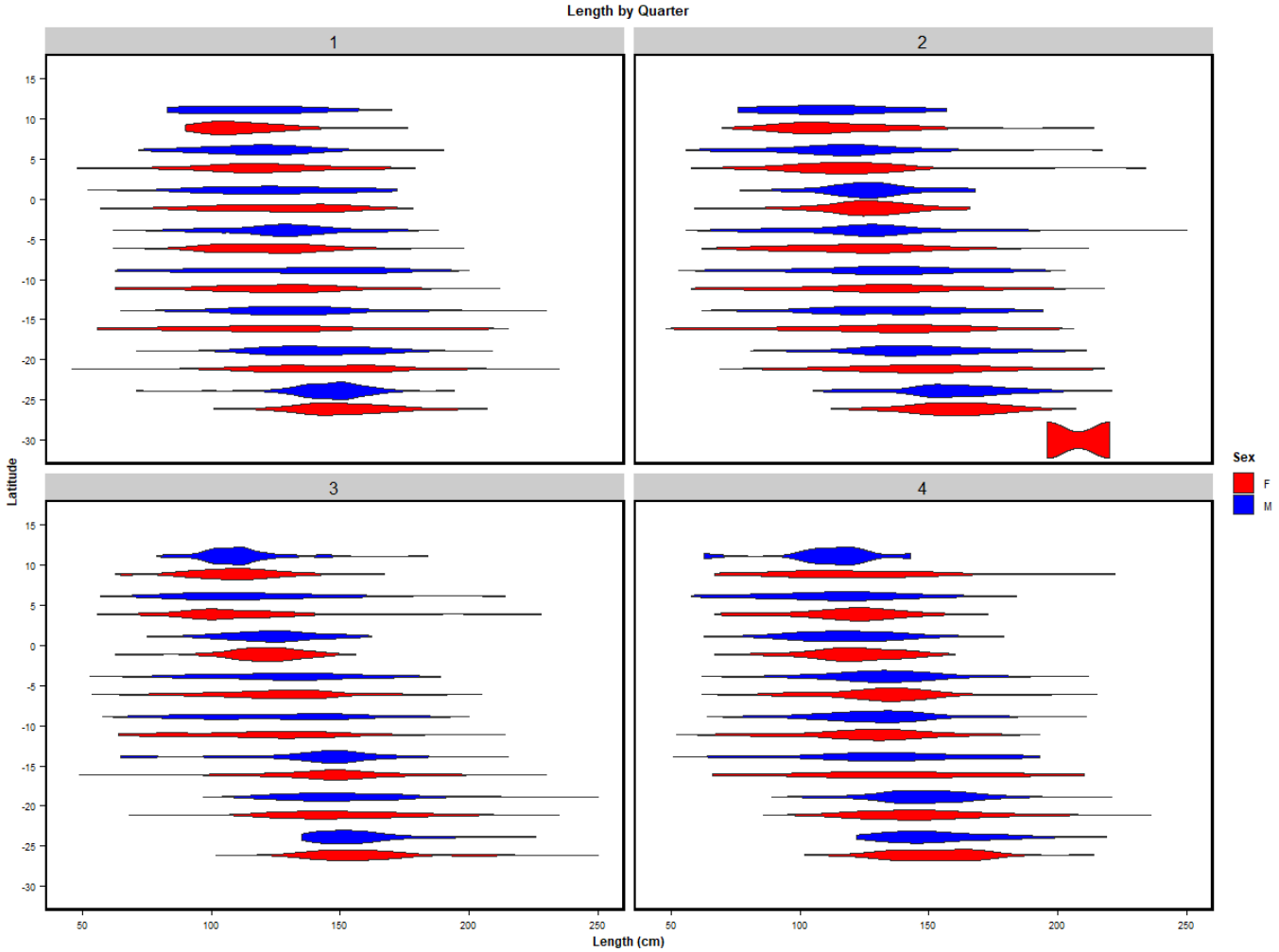

Figure 18: Length distribution by latitude, year quarter and sex, of oceanic whitetip sharks observed in the WCPFC between 2000 - 2023.

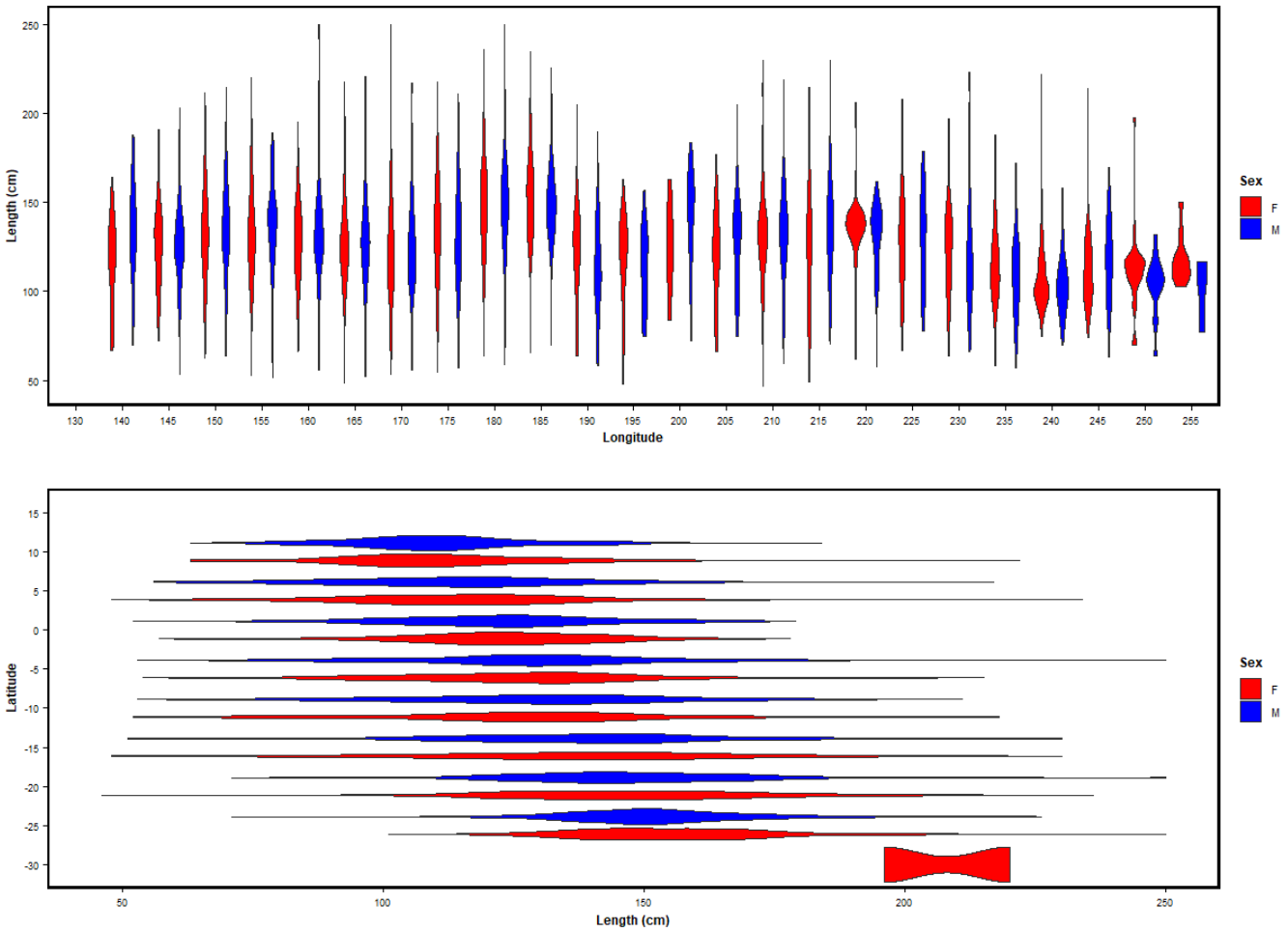

Figure 19: Length distribution by latitude, longitude and sex, of oceanic whitetip sharks observed in the WCPFC between 2000 - 2023.

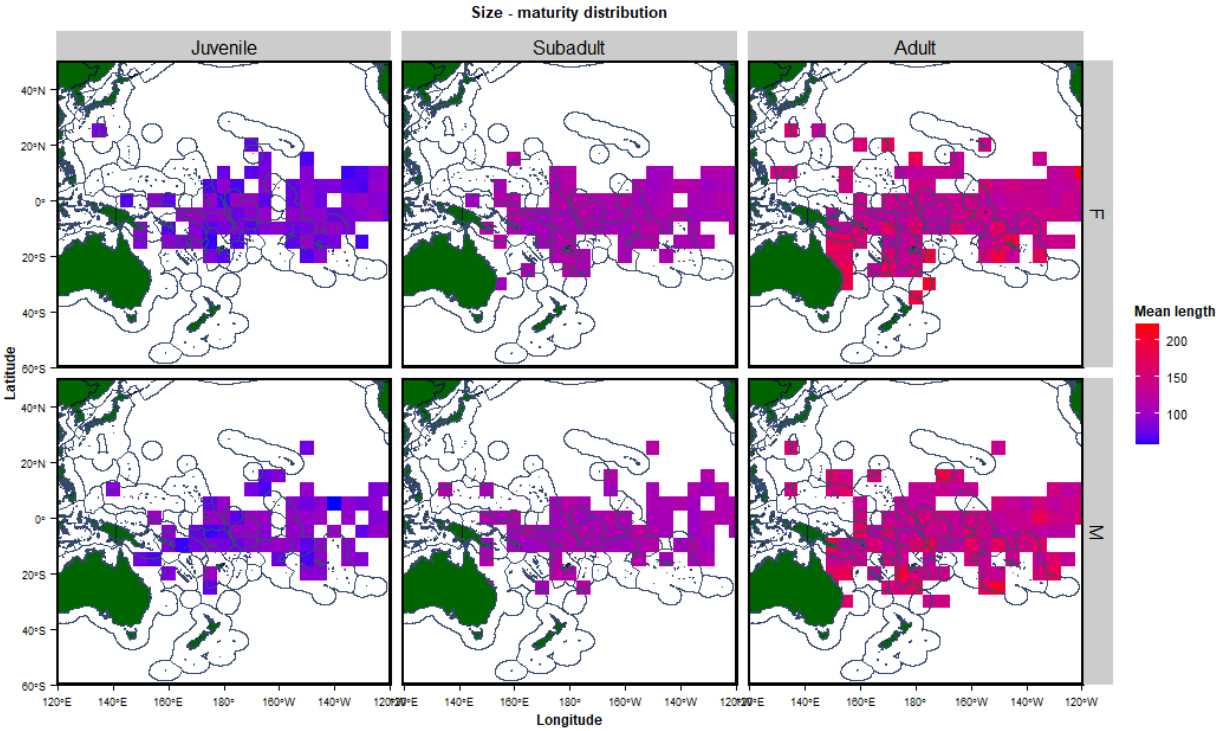

Figure 20: Length distribution by maturity, of oceanic whitetip sharks observed in the WCPFC between 2000 - 2023. Density = the total number of samples (male and female combined) by latitude group.

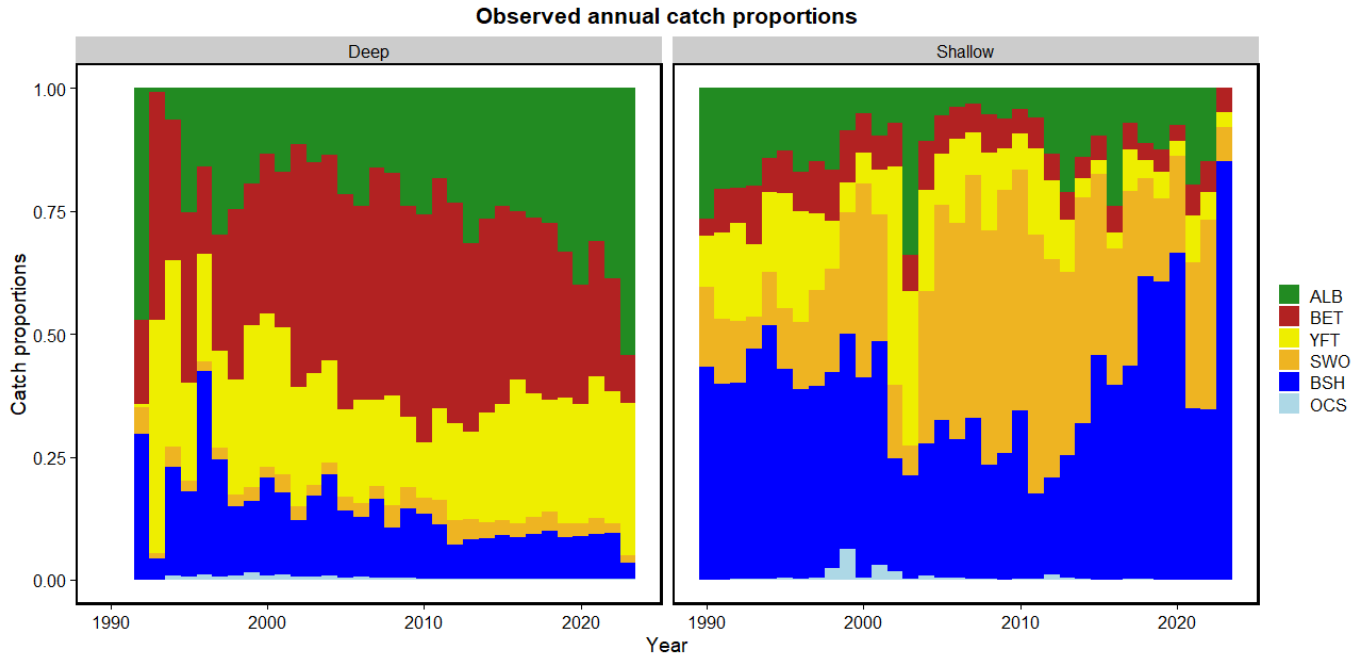

Figure 21: Species proportions of tuna swordfish and oceanic whitetip sharks observed in the WCPFC between 2000 - 2023 and separated into deep (left) and shallow (right) sets.

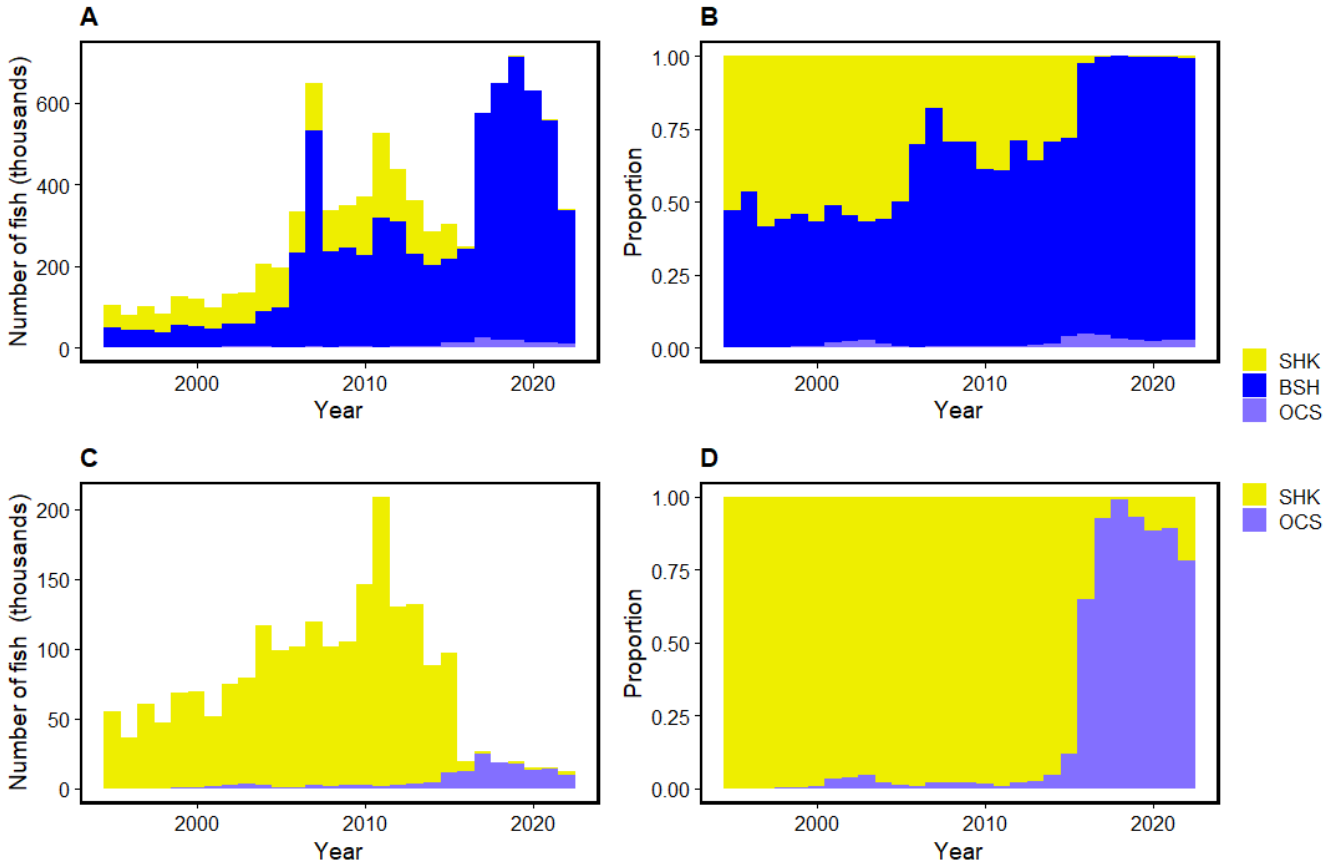

Figure 22: Species proportions of sharks observed in the WCPFC between 1990-2023, separated into: all sharks (A), and proportion of all sharks (B); with blue sharks exluded, the number of oceanic whitetip sharks (C), and the proportion of oceanic whitetip sharks (D). SHK = generic shark code; BSH = blue shark; OCS = oceanic whitetip shark.

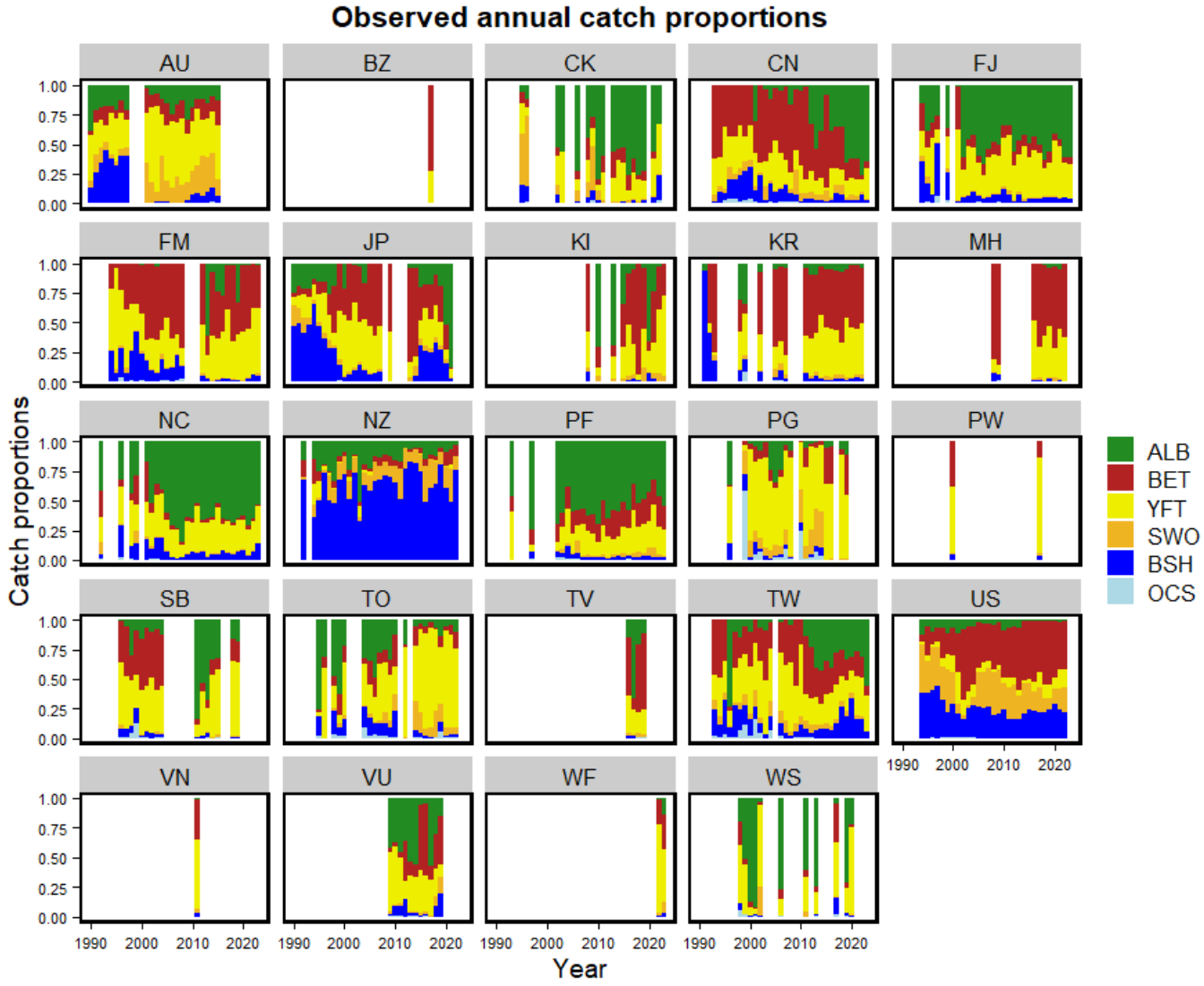

Figure 23: Species proportions of tuna, swordfish and oceanic whitetip sharks observed in the WCPFC between 2000 - 2023 and separated by flag.

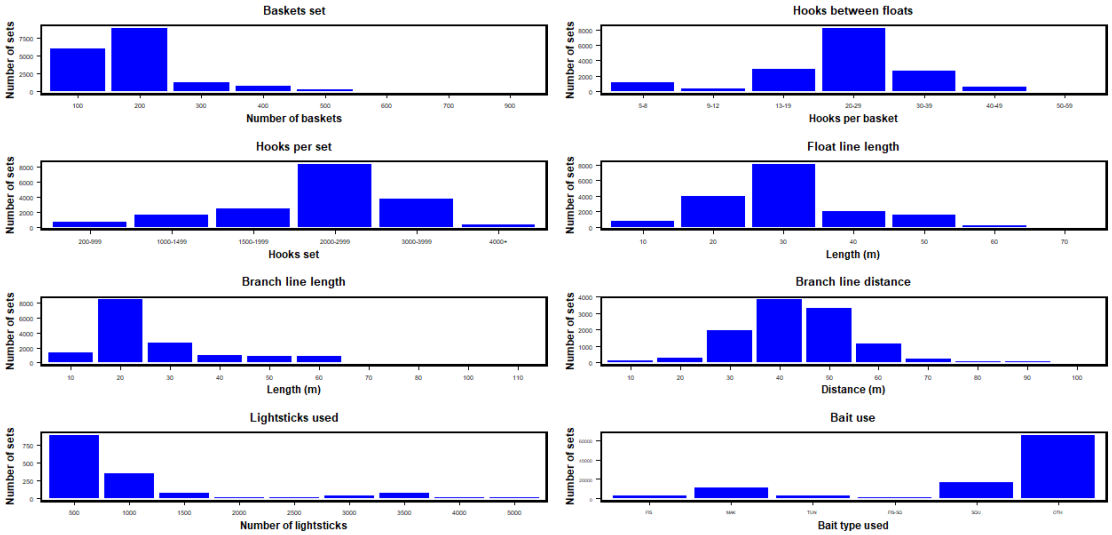

Figure 24: The observed baskets set, hook between floats,hooks set, float line length, branch line length, branch line distance, number of lightsticks used and reported bait use in sets catching oceanic whitetip sharks made in the WCPFC between 1990 - 2023 from all fleets.

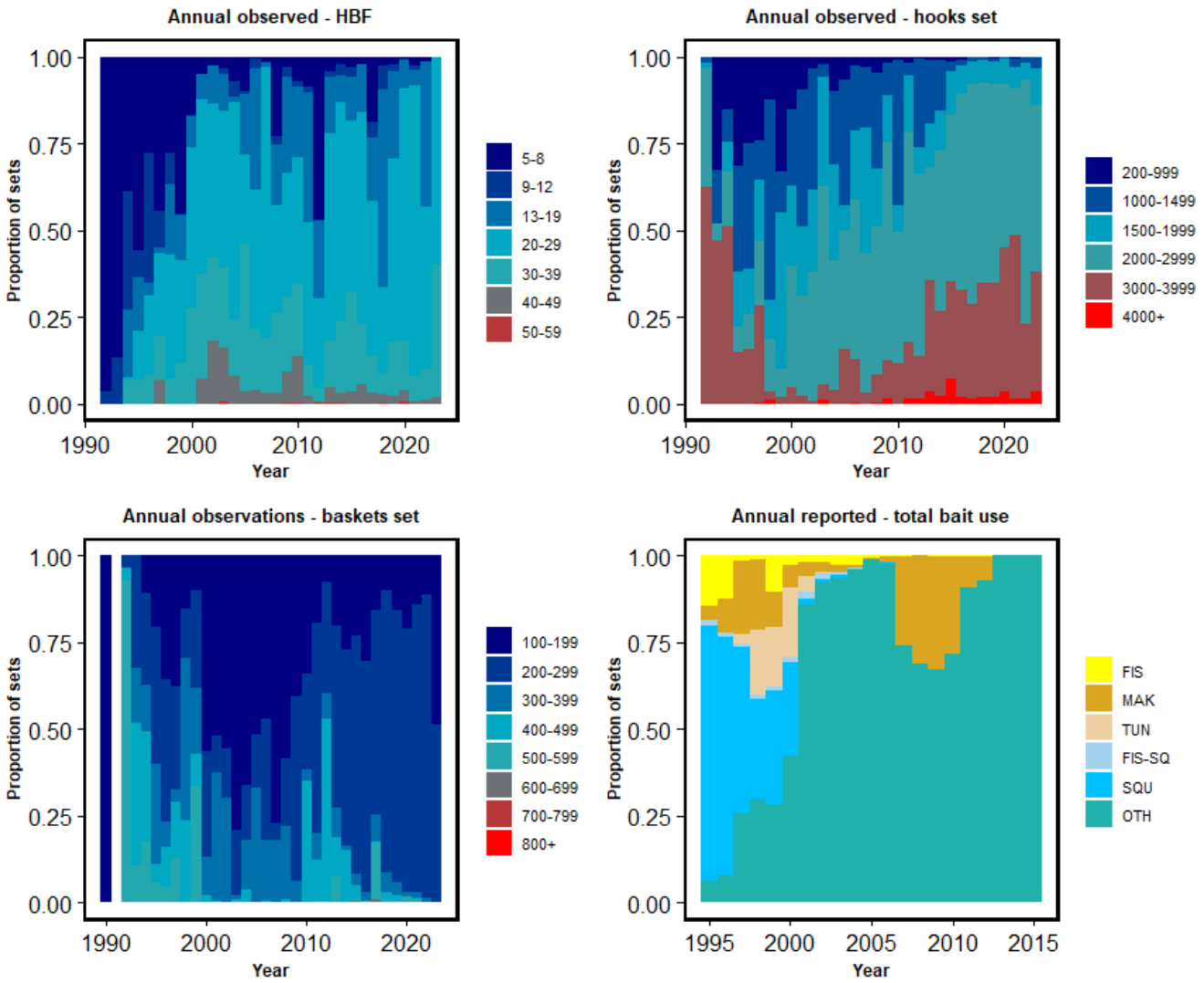

Figure 25: Observed hook between floats (HBF), hooks set, baskets set and reported bait use in sets catching oceanic whitetip sharks made in the WCPFC between 1990 - 2023 from all fleets.

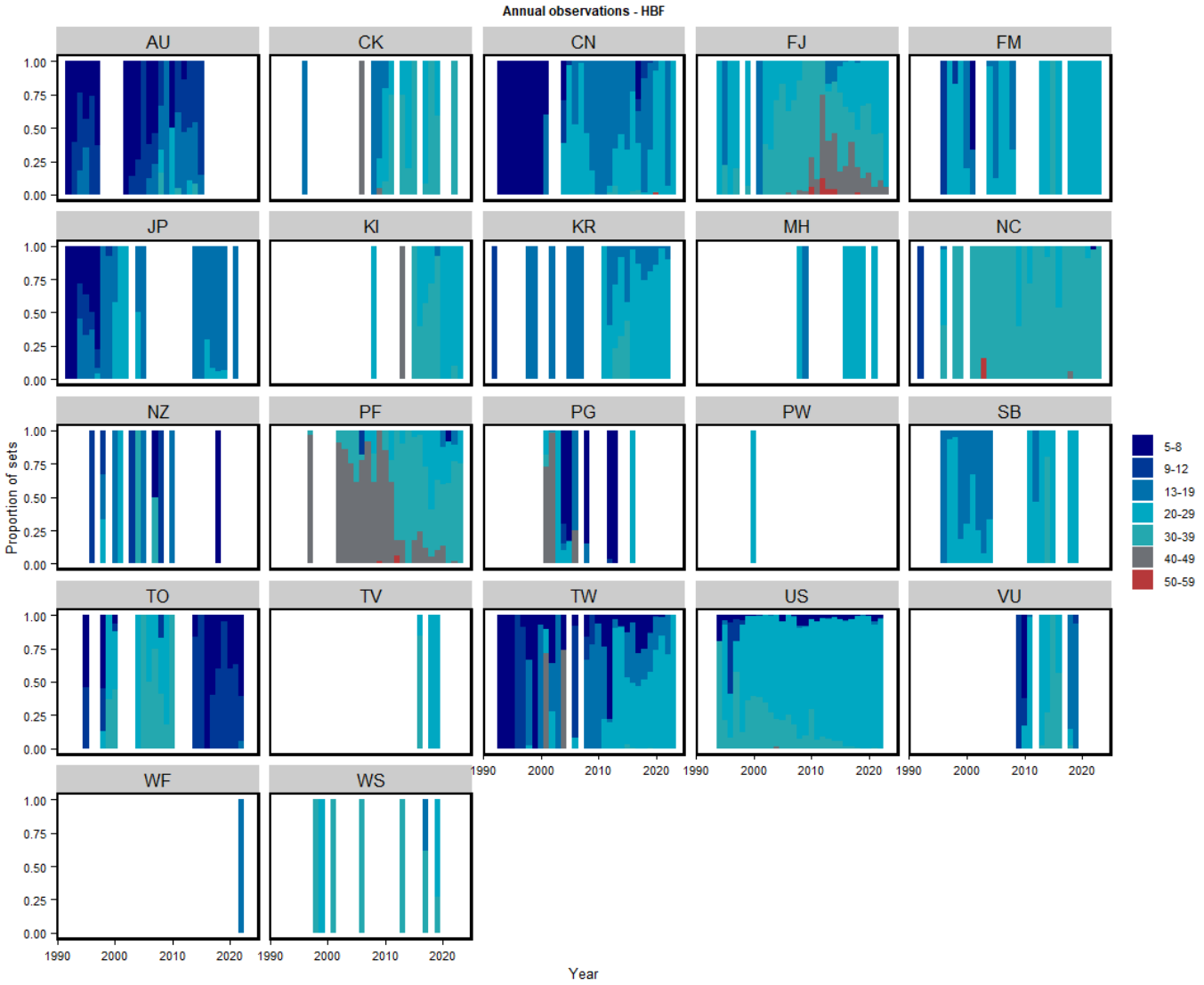

Figure 26: Observed hook between floats (HBF) in sets catching oceanic whitetip sharks, by flag in the WCPFC between 1990 - 2023.

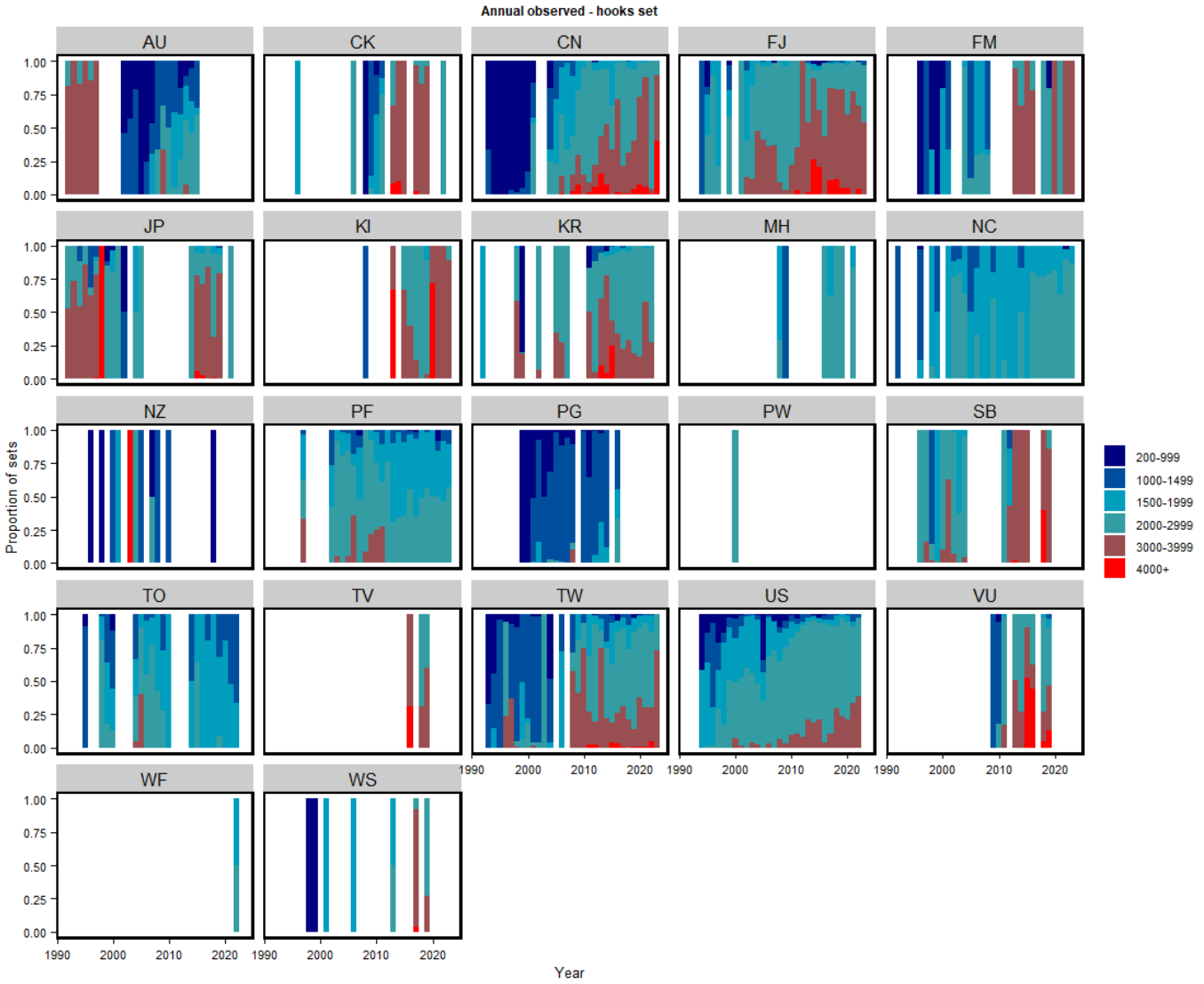

Figure 27: Observed hooks set on longline sets catching oceanic whitetip sharks, by flag in the WCPFC between 1990 - 2023.

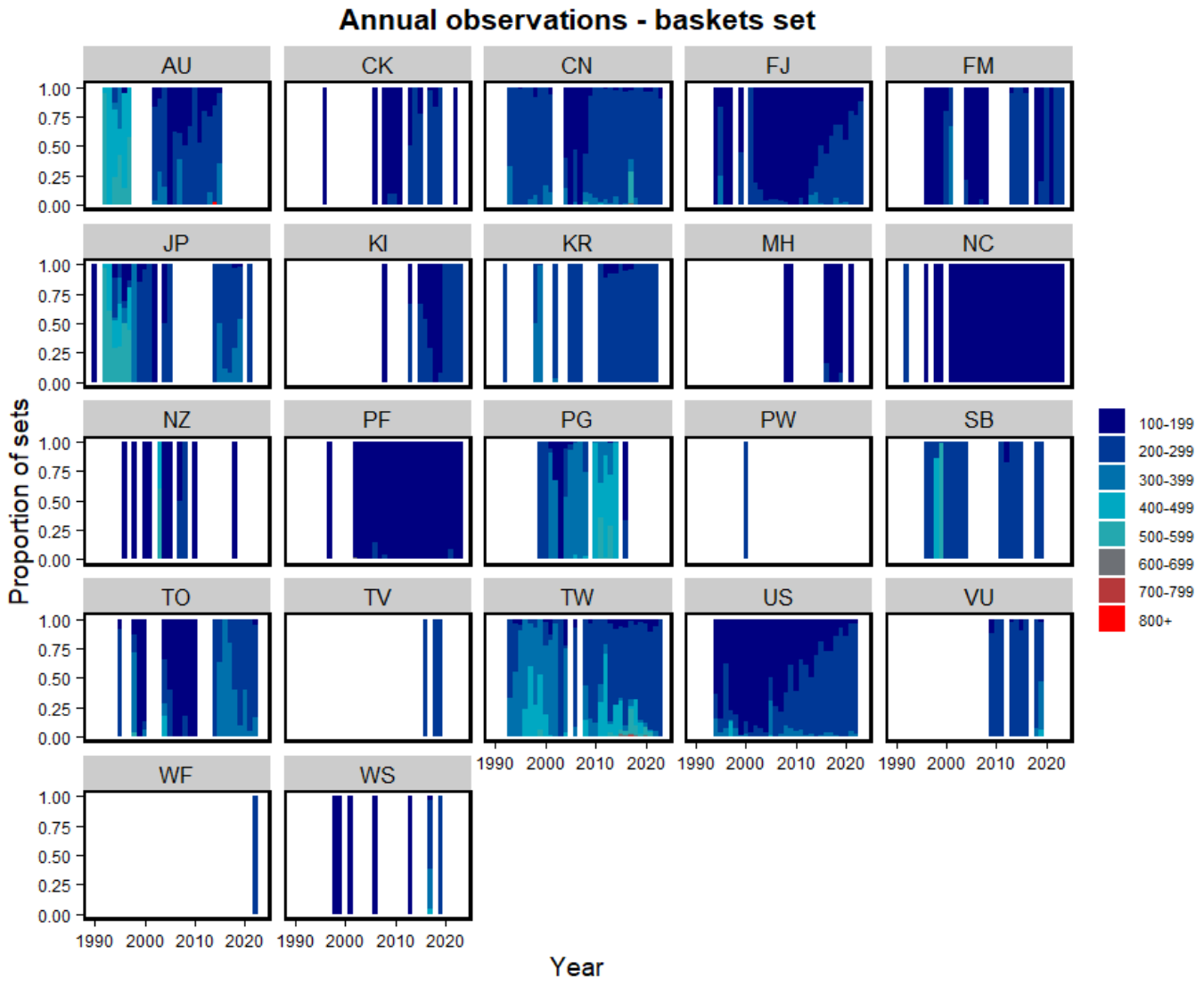

Figure 28: Observed baskets set on longline sets catching oceanic whitetip sharks, by flag in the WCPFC between 1990 - 2023.

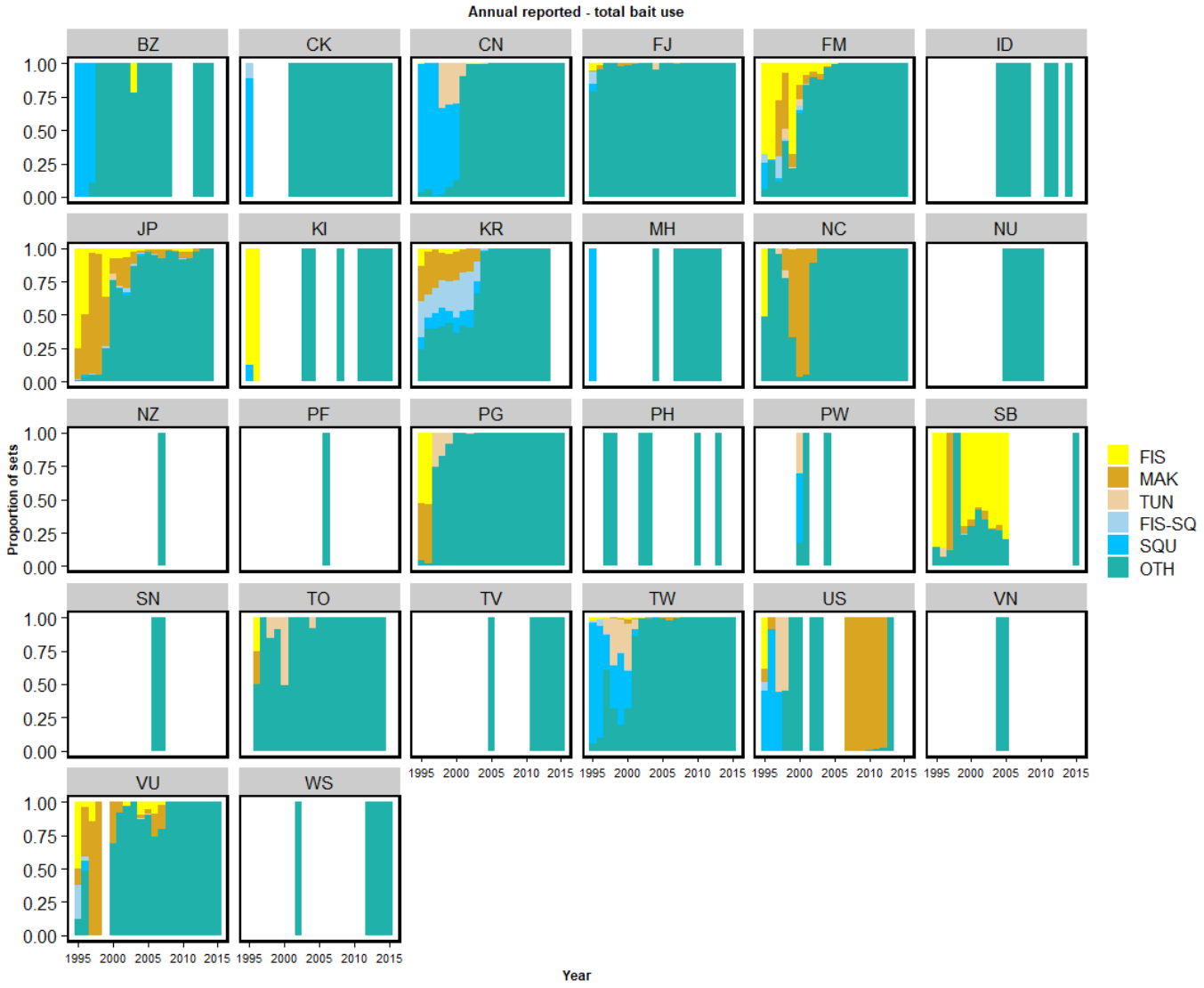

Figure 29: Reported bait use set on longline sets catching oceanic whitetip sharks, by flag in the WCPFC between 1990 - 2015. Note these data are truncated as bait data are currently collected differently and are no longer comparable after 2015.

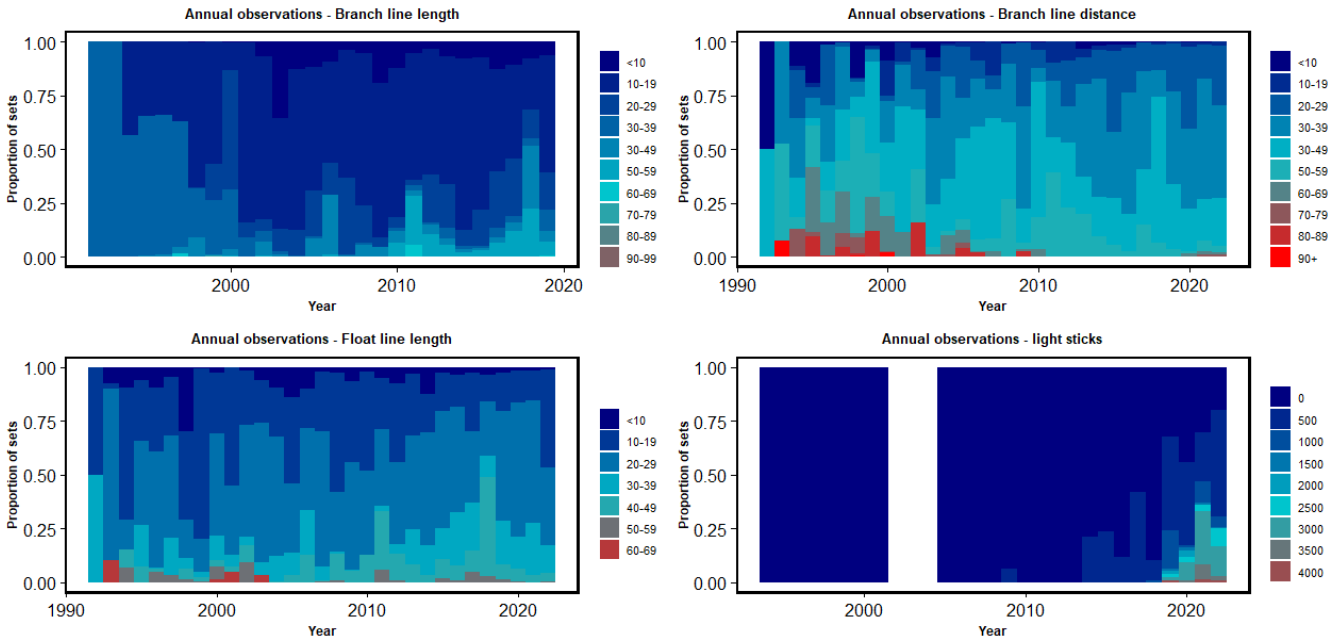

Figure 30: Observed branchline length, branchline distance, float line length and lightstick use on longline sets catching oceanic whitetip sharks, in the WCPFC between 1990 - 2023.

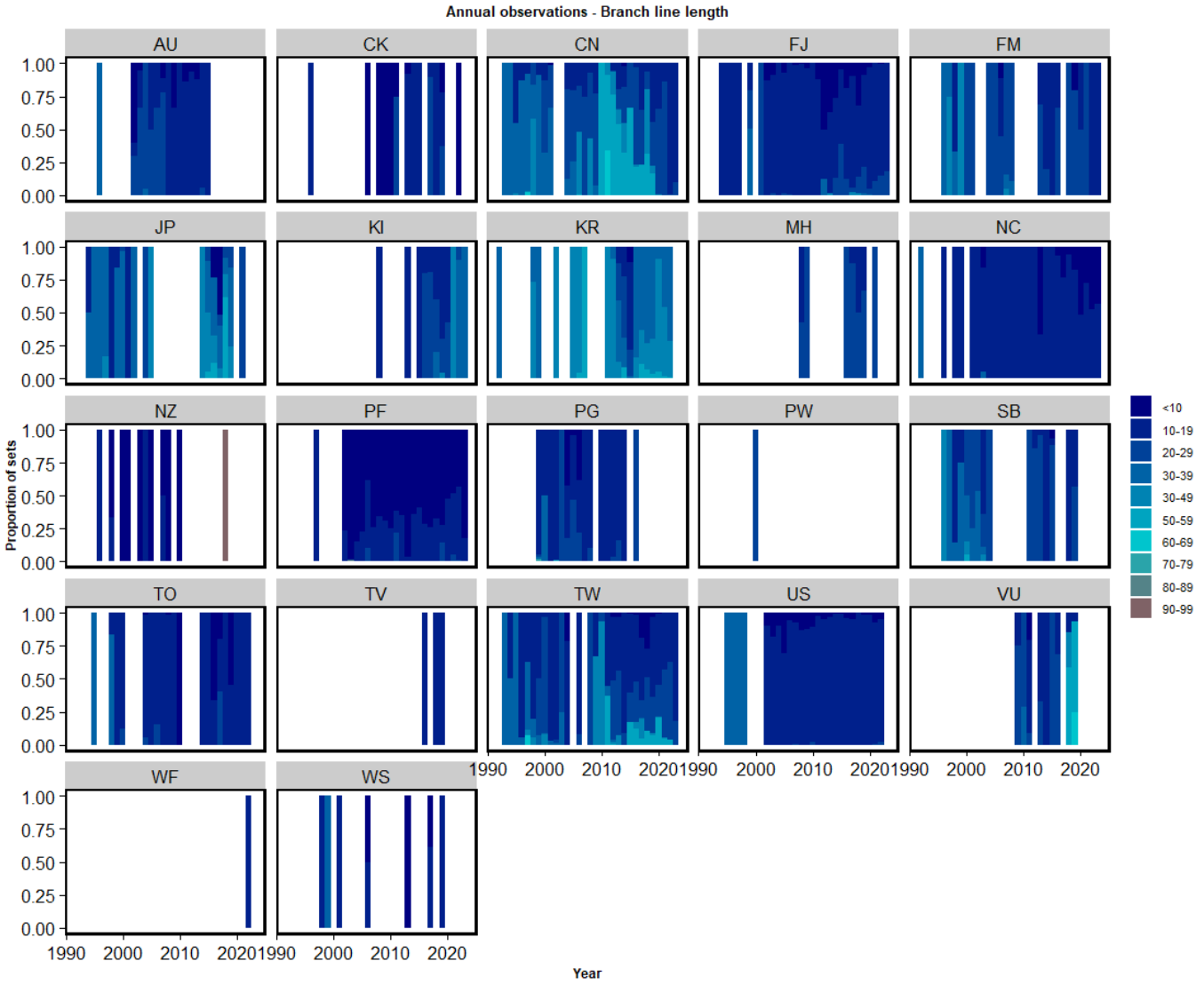

Figure 31: Observed branchline length, used on longline sets catching oceanic whitetip sharks, by flag in the WCPFC between 1990 - 2023.

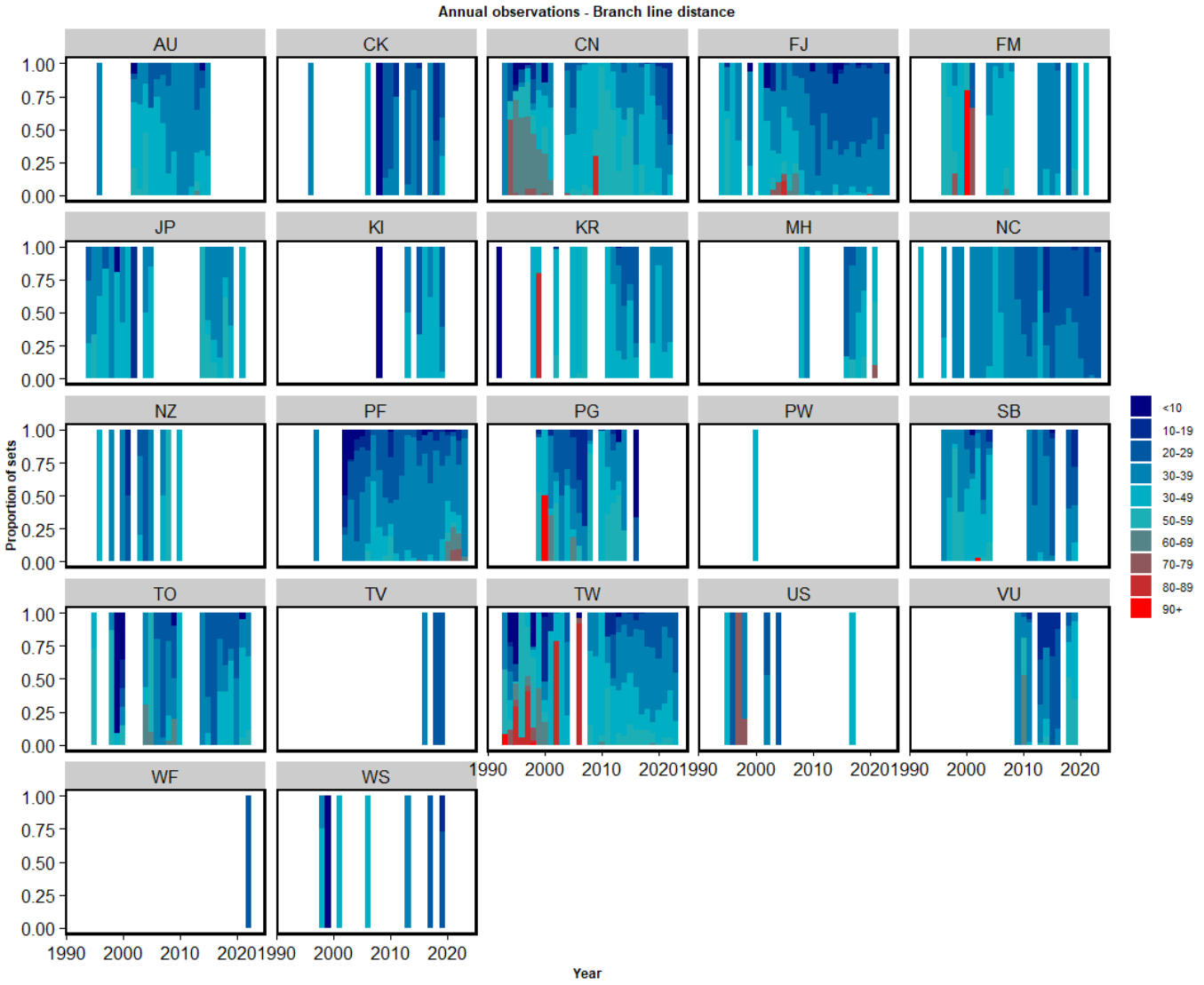

Figure 32: Observed branchline distance, used on longline sets catching oceanic whitetip sharks, by flag in the WCPFC between 1990 - 2023.

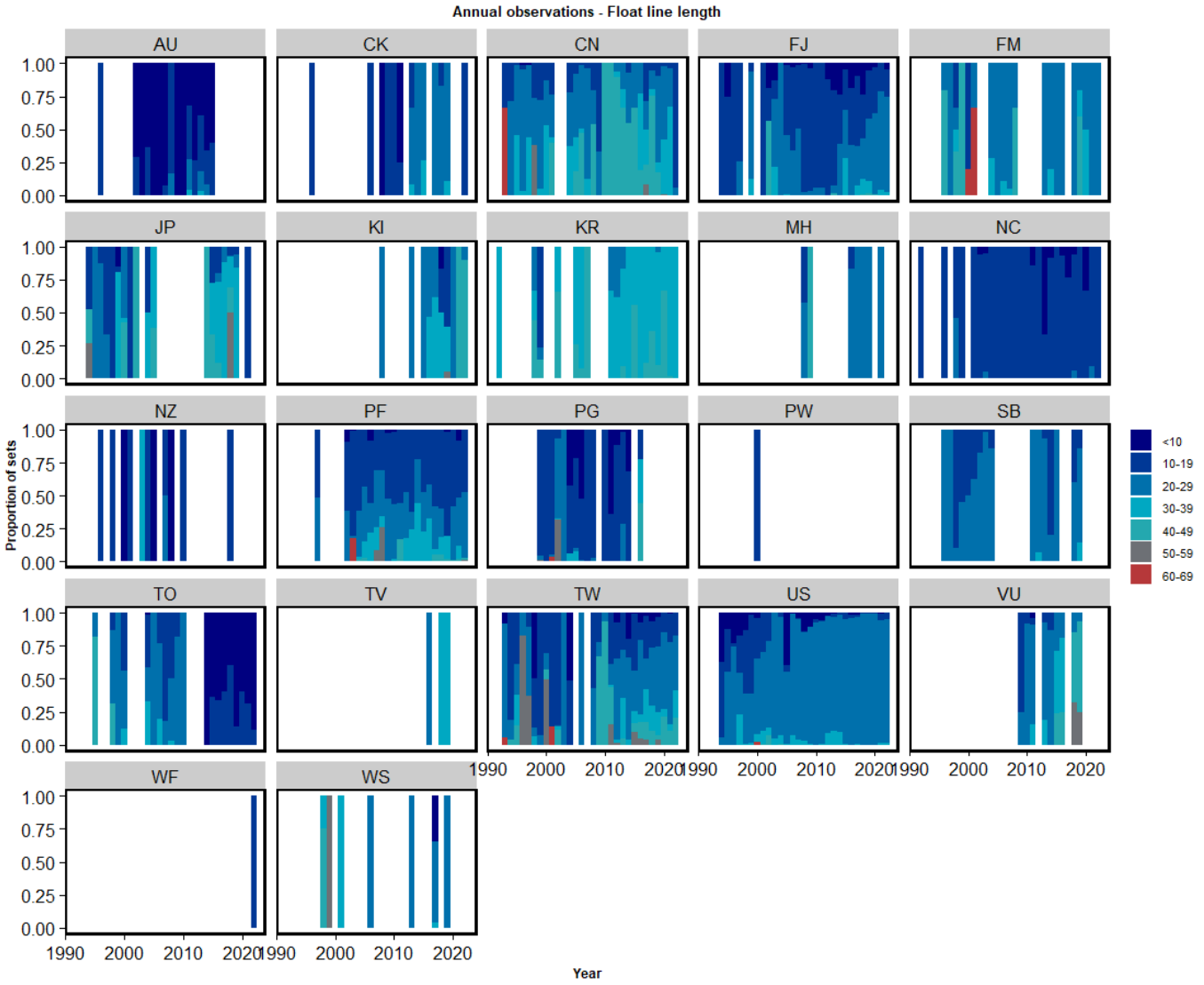

Figure 33: Observed float line length, used on longline sets catching oceanic whitetip sharks, by flag in the WCPFC between 1990 - 2023.

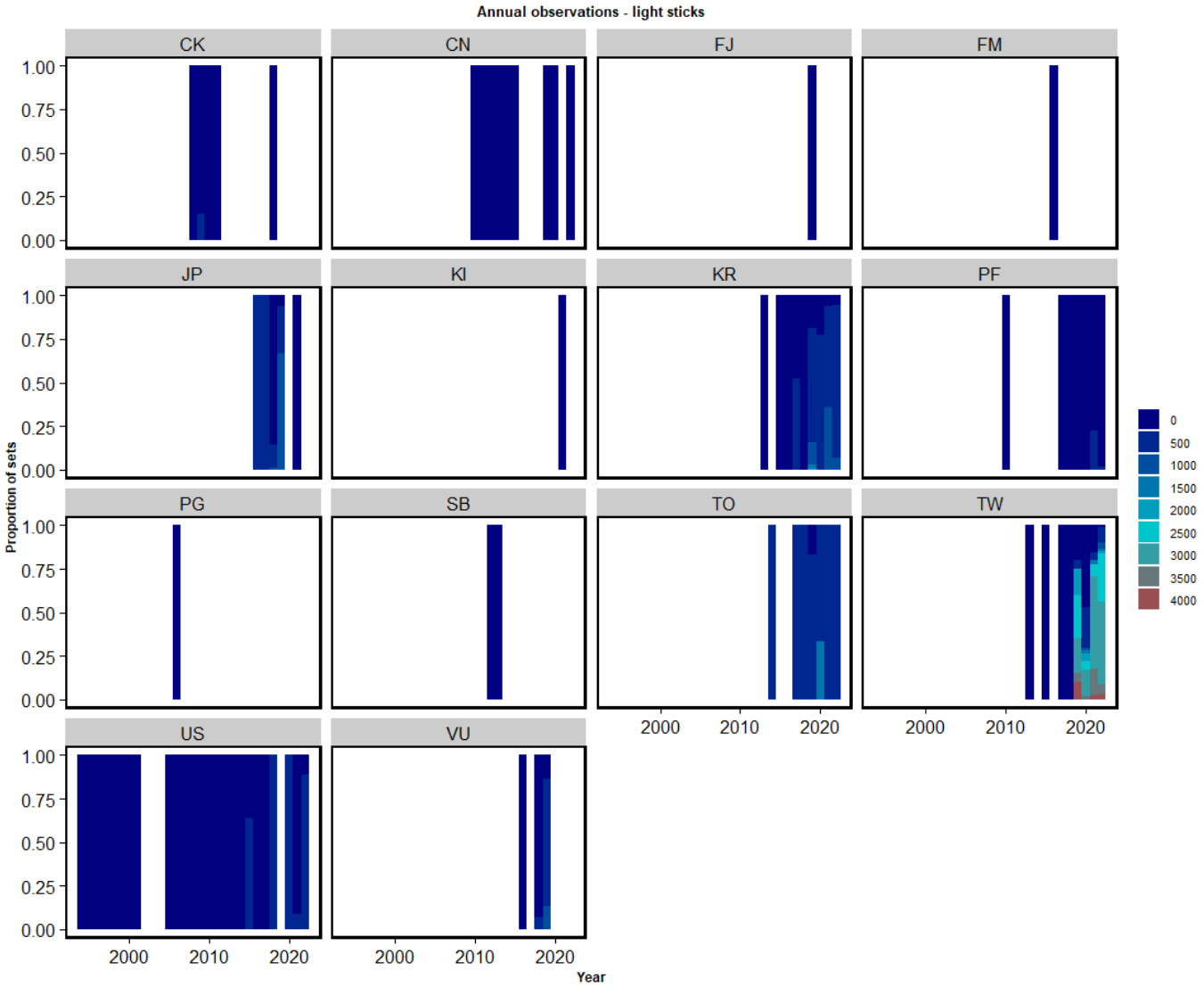

Figure 34: Observed lightstick use on longline sets catching oceanic whitetip sharks, by flag in the WCPFC between 1990 - 2023.

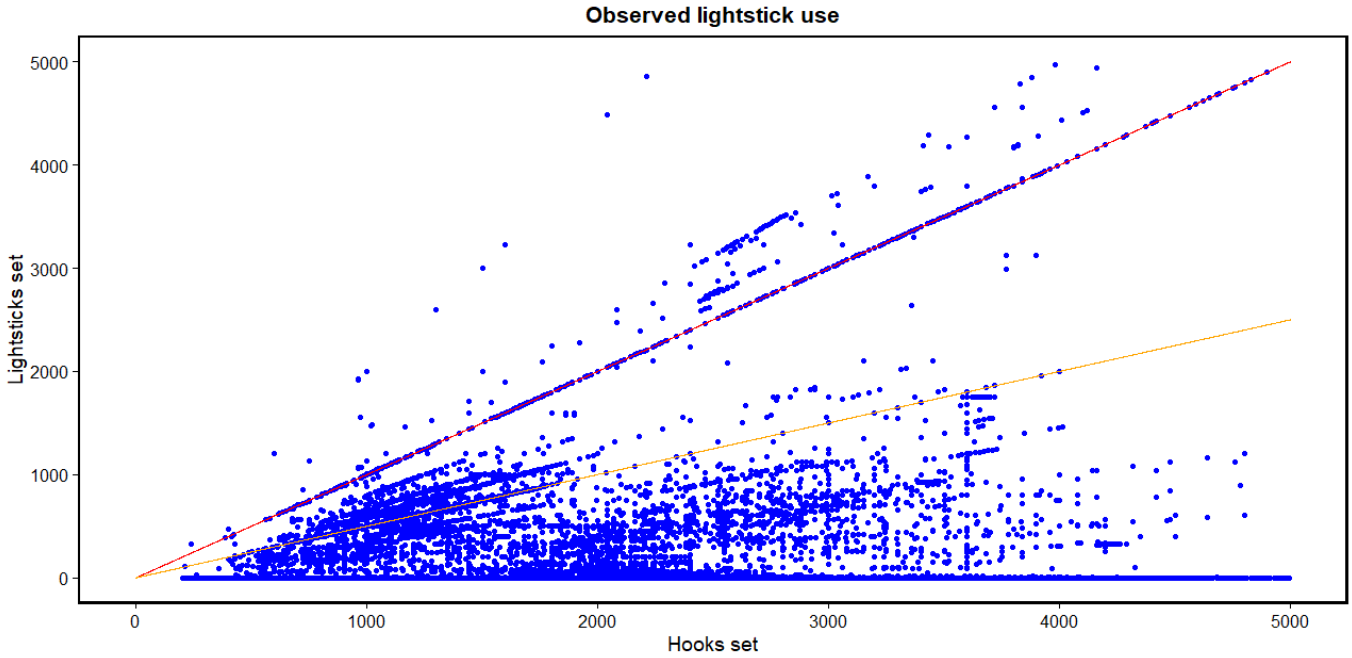

Figure 35: Comparison of the number of lightsticks to the number of hooks set in sets catching oceanic whitetip sharks. The red line represents the 1:1 ratio. The orange line represents the 1:0.5 ratio.

Figure 36: The use of hook types for all fleets combined in the WCPFC between 2008 - 2023.

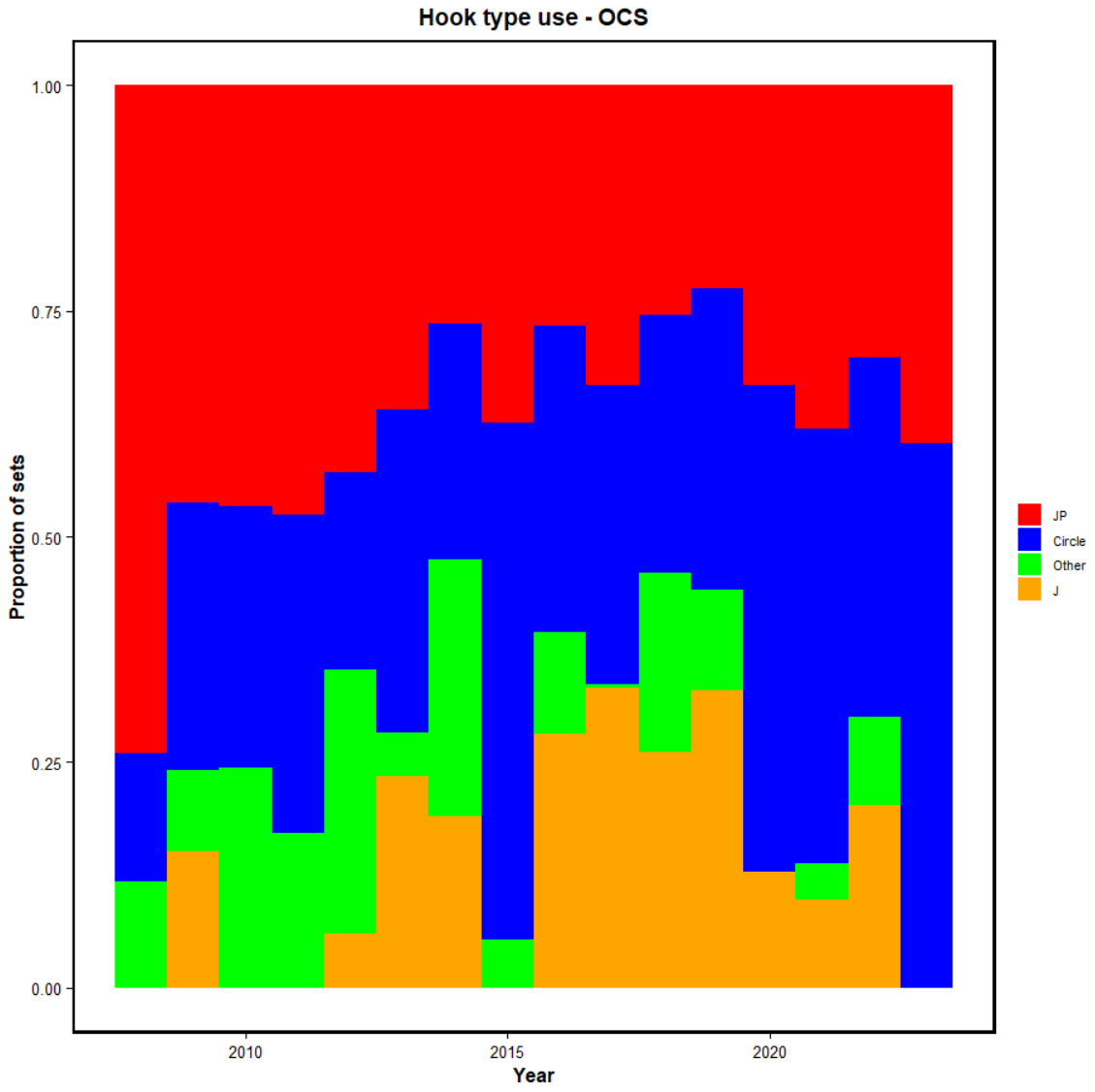

Figure 37: The use of hook types for all fleets combined for sets catching oceanic whitetip sharks in the WCPFC between 2008 - 2023.

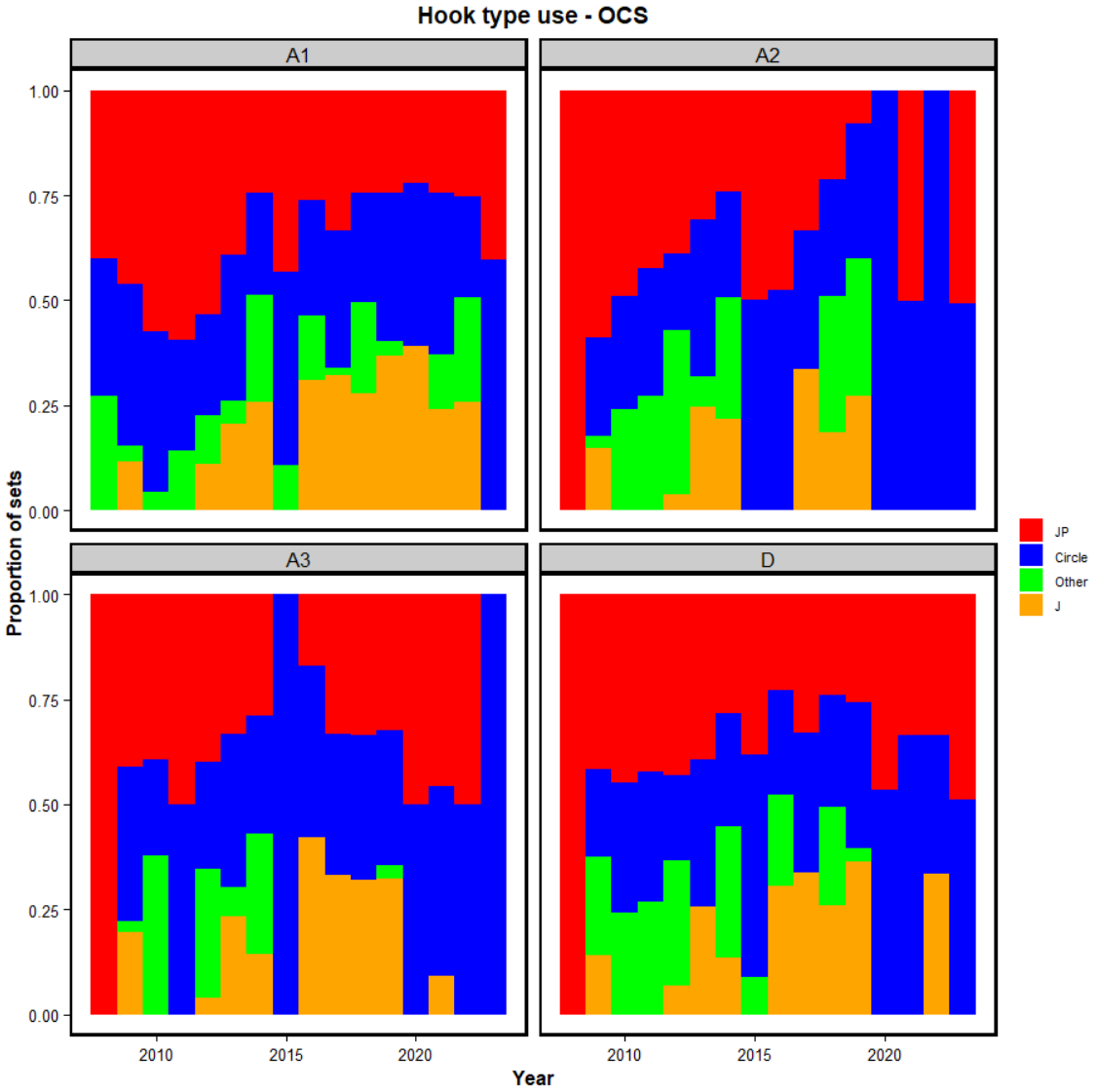

Figure 38: Oceanic whitetip shark condition at capture by year and hook type. Condition codes are shown in Table 2. Hook type definitions are as follows: JP = Japanese hooks; Circle = circle hook; J = J-hook.

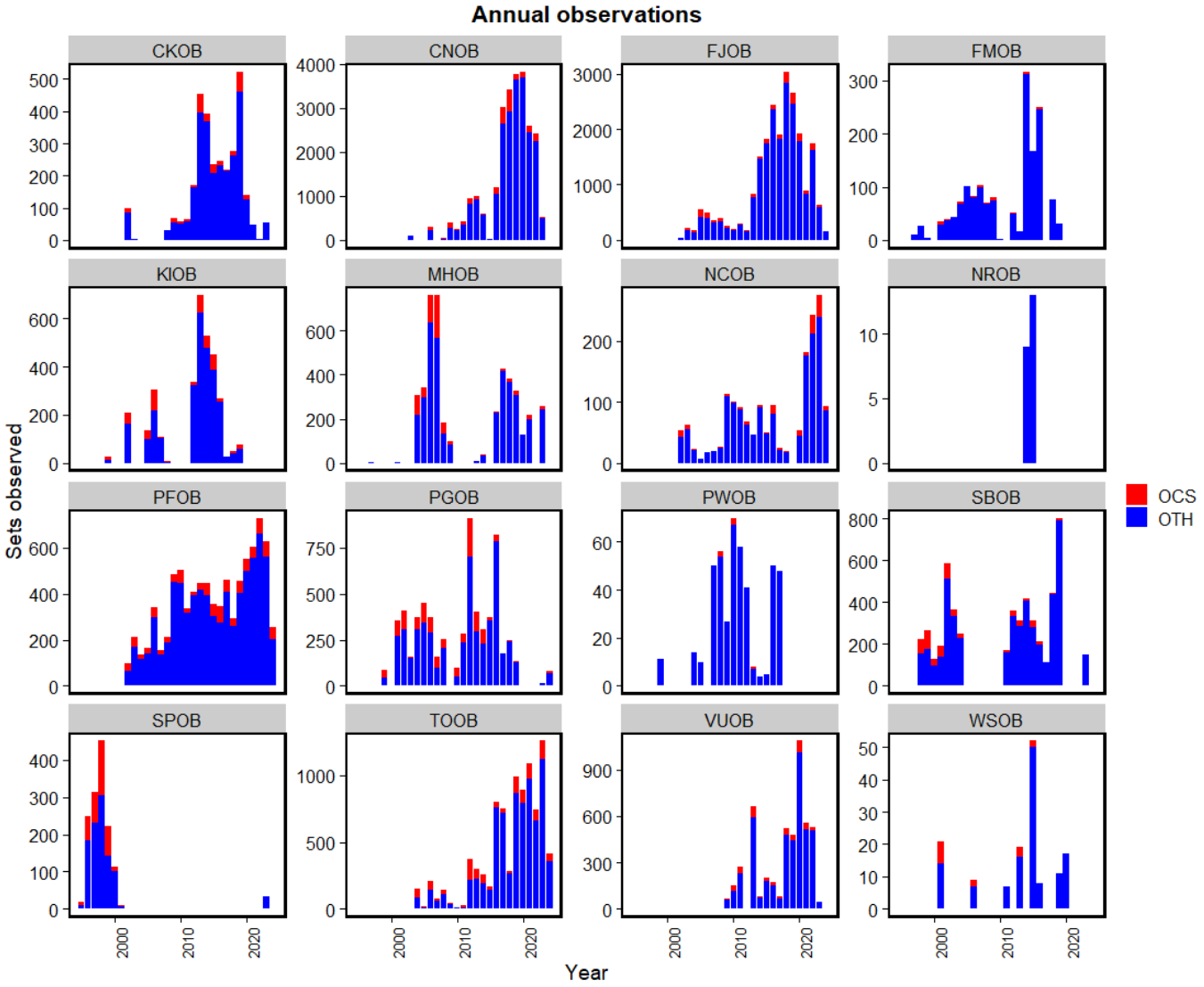

Figure 39: Sets observed by observer program and year showing all sets without oceanic whitetip sharks (OTH) and sets where oceanic whitetip sharks were observed (OCS).