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Distribution and trends of reported observed seabird bycatch mitigation use in the WCPFC Convention Area

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ABSTRACT

Under the WCPFC *Conservation and Management Measure to mitigate the impact of fishing for highly migratory fish stocks on seabirds* (CMM 2018-03), Members, Participating Territories and Cooperating Non-members (CCMs) are required to report on the use of seabird bycatch mitigation methods in their commercial pelagic longline fisheries in Annual Reports – Part 1.

For the review of WCPFC CMM 2018-03, we sourced data on reported observed bycatch mitigation use from all Annual Reports – Part 1 during 2019-2023 and relative fishing effort per CCM across the Convention Area from WCPFC. Using these two data sources, we calculated the proportion of annually reported seabird bycatch mitigation use per mitigation method per relevant latitudinal band (>30°S, 30°-25°S, 25°-20°S, 20°S-23°N, and >23°N) as a function of the number of actively fishing CCMs. Further, and based on the assumption that reported observed bycatch mitigation use is representative of total fishing effort for that flag-state, we calculated mitigation use by total relative fishing effort.

Results indicate that the most frequently reported bycatch mitigation methods were weighted branch lines, followed by tori lines, and night setting (across all latitudinal bands). Whilst recognising that mitigation use in the relatively low levels of observed effort may not reflect fishery-wide practices, simple extrapolation provides some interesting insights. In the area >30°S (where 2/3 mitigation methods or hook-shielding devices are required), ≥2/3 mitigation methods were used in only 54% of fishing effort. Conversely, in 30°-25°S ≥2/3 mitigation methods were used in 69% of fishing effort, although only 1/3 mitigation methods or hook-shielding devices are required. In 25°S-20°S, some form bycatch mitigation was used in 45% of fishing effort, despite the absence of requirements for this area. Contrastingly, however, in the area 20°S-23°N some form of bycatch mitigation was used in 57% of effort, even though this area is visited less by vulnerable seabirds than the area of 25°S-20°S and equally has no bycatch mitigation requirements. Few trends in reported bycatch mitigation use over time were evident, but non-reporting was increasing over time across most latitudinal bands.

These results are of relevance to the review of WCPFC CMM 2018-03 as well as to future outreach and education efforts to support the implementation of seabird bycatch requirements across the WCPFC Convention Area.

INTRODUCTION

Seabirds are caught as bycatch globally, including in commercial pelagic longline fisheries (hereafter pelagic longline fisheries). To mitigate the resulting impacts on seabird populations, WCPFC Members, Participating Territories and Cooperating Non-members (CCMs) must adhere to the bycatch mitigation requirements outlined in *Conservation and Management Measure to mitigate the impact of fishing for highly migratory fish stocks on seabirds* (CMM 2018-03). CMM 2018-03 also requires the reporting of the observed bycatch mitigation methods that have been applied in Annual Reports – Part 1. CMM 2018-03 is currently under review (see WCPFC-SC19-EB-IP16 for further details) and consequently, analyses to gain insights into reported observed mitigation use to I) understand preferences of mitigation use, II) evaluate the spatial distribution of mitigation use, and III) identify trends over time would be beneficial, as such insights could identify data deficiencies and sections in CMM 2018-03 worth improving. Here, we completed such analyses using data contained in Annual Reports – Part 1 and pelagic longline fishing effort provided by WCPFC.

METHODS

To evaluate the reported observed seabird bycatch mitigation use across the Western and Central Pacific Ocean (WCPO) and inform the review of CMM 2018-03, we collated two key datasets. The first dataset consisted of the reported observed mitigation use, in proportions per mitigation method, or combinations thereof, per relevant latitudinal band (>30°S, 30°-25°S, 25-23°N, and >23°N), as reported in Annual Report - Part 1 for all CCMs for 2019-2023. As reporting of the Northern Hemisphere methods was inconsistent, with some CCMs reporting "Northern Hemisphere options" and others providing more detailed reports, we grouped all Northern Hemisphere options into one "Northern Hemisphere" category. If the use of tori lines, weighted branch lines, or night setting was reported separately from the Northern Hemisphere options, however, these were considered separately.

The second dataset consisted of standardised (i.e., proportions) non-public longline fishing effort for all CCMs per relevant latitudinal band across the WCPFC Convention Area (>30°S, 30°-25°S, 25°-20°S, 20°S-23°N, and >23°N) for 2015-2023. This dataset was provided by SPC upon request following approval from WCPFC (see Supplementary Material 1 for a graphical representation of the provided data). We included 2015-2018 in the request to evaluate if relative fishing effort changed pre- and post-inception of CMM 2018-03 for those CCMs and Territories who are exempt from the requirements in their EEZs under Paragraph 4 in CMM 2018-03. Similarly, we included the additional latitudinal band of 25°-20°S in the request as recent evidence has highlighted the occurrence of a range of vulnerable seabird species in these latitudes (e.g., Darby *et al*. 2024, Fischer *et al*. 2024a). Assessing relative mitigation use in this latitudinal band was thus considered important.

To assess preferences, distribution, and trends over time of reported observed seabird bycatch mitigation use, we then calculated the proportion of reported observed bycatch mitigation use per mitigation method and combination per relevant latitudinal band per year as a function of the number of CCMs actively engaged in longline fishing. For the latitudinal band of 25°-20°S, for which no explicitly reported bycatch mitigation use existed, we assumed that the proportions of mitigation use mirrored those reported in 20°S-23°N.

In addition, we assumed that reported observed bycatch mitigation use is representative of total fishing effort for that CCM and calculated reported observed bycatch mitigation use per

relevant latitudinal band per year as a function of relative fishing effort, as provided by SPC as well. Whilst recognising that mitigation use in the relatively low levels of observed effort (~5%) typical of pelagic longline fisheries in the WCPO may not reflect fishery-wide practices, this simple extrapolation exercise may provide some interesting insights in the absence of better data.

Finally, to re-evaluate the influence of the exemptions of the EEZs of French Polynesia, Cook Islands, Tonga, Fiji, and New Caledonia for the area of 30°-25°S as specified in Paragraph 4 of CMM 2018-03 in the absence of access to log sheet data, we combined information on relative fishing effort provided by SPC, public catch data, also provided by SPC, and information contained in the previous impact assessment (McKechnie 2018). For this assessment, we had to assume that relative public catch data is representative of effort data and that fishing effort is uniformly distributed within the EEZ. While the former is defensible, the latter will likely result in a slight overestimate when compared to a log sheet data analysis (e.g. McKechnie 2018).

RESULTS

Bycatch mitigation use for >30°S, 30°-25°S, 25°-20°S, 20°S-23°N, and >23°N with the WCPFC Convention Area over the course of 2019-2023, as a proportion of active longline fishing CCMs, as well as relative fishing effort can be found in Fig. 1, while mean proportions over the entire time are provided in Table 1. It should be kept in mind that these numbers are based on relatively low levels of observed effort may not reflect fishery-wide practices.

The most preferred, i.e., the most reported observed, bycatch mitigation method across latitudinal bands were weighted branch lines (reportedly protecting 20-71% of fishing effort depending on the latitudinal band), followed by tori lines (13-68%), and night setting (16-33%). In the area north of 23°N, the Northern Hemisphere options were used most regularly, yet the Southern Hemisphere mitigation options were also used regularly. No use of hook-shielding devices was reported. Non-reporting of CCMs was not uncommon, with 28-51% of CCMs (translating to 4-27% of effort) not reporting bycatch mitigation methods, and non-reporting being proportionally more common in the higher latitudes of both Hemispheres.

Table 1. Mean proportions of reported mitigation methods used as a function of relative fishing effort (and as a function of the number of actively longline fishing CCMs) during 2019-2023 in WCPO. Pear-coloured shading reflects increasing proportions of relative fishing effort. As methods can be used in combination, totals exceed 1.

Mitigation method	>30°S	30°-25°S	25°-20°S	20°S-23°N	>23°N
Tori line	0.66	0.68	0.13	0.18	0.29
	(0.51)	(0.27)	(0.17)	(0.09)	(0.31)
Weighted branch lines	0.52	0.71	0.27	0.40	0.20
	(0.43)	(0.26)	(0.28)	(0.16)	(0.33)
Night setting	0.33	0.19	0.16	0.18	0.20
	(0.25)	(0.12)	(0.17)	(0.10)	(0.19)
Hook-shielding devices	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Northern Hemisphere options	0.00	0.00	0.14	0.14	0.35
	(0.00)	(0.00)	(0.08)	(0.11)	(0.22)
None	0.01	0.06	0.51	0.21	0.00
	(0.02)	(0.17)	(0.28)	(0.24)	(0.00)
Not reported	0.25	0.18	0.04	0.22	0.27
	(0.43)	(0.51)	(0.28)	(0.44)	(0.37)

When evaluating mitigation use across methods, further insights became evident. In the area south of 30°S (where at least two out of three Southern Hemisphere mitigation methods, or hook-shielding devices are required), combinations of two or three mitigation methods were used in only 54% of fishing effort (Fig. 1). Conversely, in the area of 30°-25°S (where requirements are less stringent and at least one out of tori lines, weighted branch lines, or hook shielding devices is required), two or three mitigation methods were used in 69% of fishing effort. In the area of 25°S-20°S, some form of bycatch mitigation method was used in 45% of fishing effort, despite the absence of requirements for this area. Contrastingly, some form of bycatch mitigation method was used in 57% of fishing effort in the area 20°S-23°N.

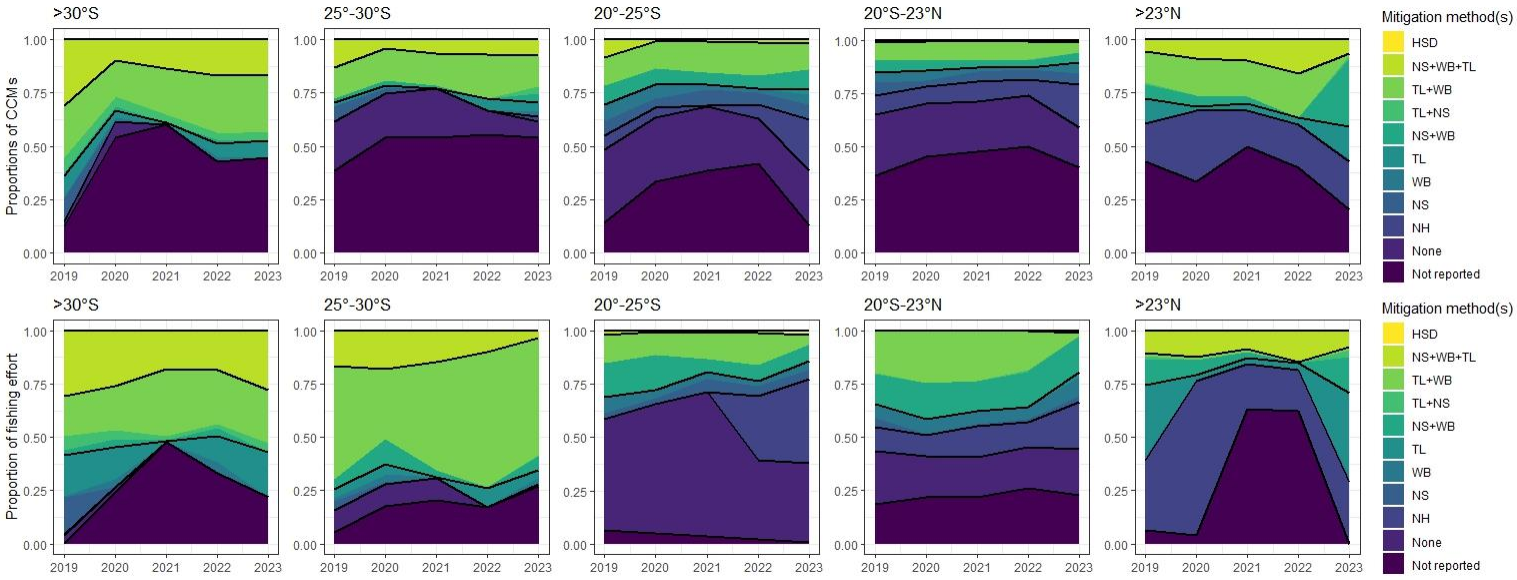

Fig. 1. Proportions of reported mitigation methods used per year per relevant latitudinal band as a function of the number of the number of CCMs that are actively engaged in longline fishing (top row) and as a function of relative fishing effort (bottom row). HSD = hook-shielding devices, NS = night setting, WB = weighted branch lines, TL = tori lines, and NH = Northern Hemisphere options. Black lines delineate major groups of bycatch mitigation methods and combinations thereof (not reported, none, Northern Hemisphere options, one, combination of two, and combination of three Southern Hemisphere options, and hook-shielding devices).

In the Southern Hemisphere, the most observed combination of mitigation methods was tori lines and weighted branch lines (24% south of 30°S and 51% in the area 30°-25°S). Tori lines and night setting (4% south of 30°S and 0% in the area 30°-25°S) and night setting and weighted branch lines (2% south of 30°S and 5% in the area 30°-25°S) were observed much less often. The use of three out of three mitigation methods was not uncommon (24% south of 30°S and 12% in the area 30°-25°S).

Given the relatively short timeframe of the assessment, clear trends in mitigation use were difficult to distinguish. Non-reporting of mitigation use initially appeared to increase over time for most latitudinal bands, but subsequently declined again following 2022. In addition, the use of three out of three mitigation methods appeared to decrease in the area 30°-25°S over time.

The relative fishing effort of the CCMs and territories whose EEZs are exempt of WCPFC CMM 2018-03 requirements for the area of 30°-25°S did not change significantly following the inception of CMM 2018-03 (see Sup. Fig. 1). Jointly, the relative fishing effort within the exempt EEZs of the CCMs and Territories within the area of 30°-25°S equated to a mean of 0.22% for 2019-2023, which mirrors the 2010-2016 mean calculated by McKechnie (2016): 0.25%.

DISCUSSION

The analysis presented here was enabled by the reporting requirements of mitigation use under CMM 2018-03. This requirement is more prominent and detailed in WCPFC than in other tuna RFMOs (e.g., IATTC Resolution C-11-02, ICCAT Recommendation 11-09, or IOTC Resolution 12/06) and consequently enabled advanced insights into the distribution and trends of reported observed use of seabird bycatch mitigation methods throughout the WCPFC Convention Area. However, despite the more stringent reporting requirement, reporting is imperfect and further improvements could be made.

The observed data available on the use of mitigation methods is based on only modest levels of observer coverage, rarely exceeding 10% for any fleet. Whilst it has been demonstrated that estimates of relatively rare events, such as bycatch of a rare seabird species, are highly uncertain at such low levels of observer coverage (e.g. Cryer *et al*. 2018), it is not well understood how representative observer data is on the use of certain operational practices, not intrinsic to fishing, such as use of seabird bycatch mitigation methods. Given that it is not unrealistic to assume that observed fishing activity may be more likely to use such non-intrinsic practices required by regulations than non-observed fishing activity, caution is necessary when seeking to extrapolate to fleet-wide activity. However, insights can clearly still be obtained, and extrapolating observed practices to a fleet-wide assessment provides useful, if uncertain, context for management considerations.

A primary insight from this analysis is the that reported observed bycatch mitigation use does not align with the distribution of seabirds vulnerable to bycatch in pelagic longlines within the WCPFC Convention Area. A large body of evidence (synthesised in Fischer *et al*. 2024a) highlighted the importance of waters south of 25°S and north of 23°N to albatrosses and large petrels. Traditionally, the area south of 30°S was considered the area most important to the Southern Hemisphere species, however recent data have indicated that a wide range of vulnerable species venture to the area of 30°-25°S (Darby *et al*. 2024, Fischer *et al*. 2024a, Richards *et al*. 2024a,b, Rowley *et al*. 2024), and some may even venture further north to the area of 25°S-20°S. However, the reported observed mitigation use mismatched with these insights on seabird distribution. Combinations of two or three mitigation methods were used in only 54% of fishing effort in the area south of 30°S, even when the use of at least two mitigation methods is required under CMM 2018-03. Contrastingly, combinations of two or three mitigation methods were used in 69% of fishing effort in 30°-25°S, even though only one of three mitigation methods are required under CMM 2018-03. Some form bycatch mitigation was used in 45% of fishing effort in 25°S-20°S, despite the absence of requirements for this area. Contrastingly, some form of bycatch mitigation was used in 57% of fishing effort in 20°S-23°N, even though this area is visited less by vulnerable seabirds than the area of 25°-20°S and equally has no bycatch mitigation requirements. Finally, non-reporting was most common in key areas for seabirds: south of 30°S and north of 23°N. Consequently, there is a need for both improvements of the implementation of bycatch mitigation methods in established key areas,

particularly south of 25°S, and support for implementation in the areas previously assumed to be at low risk, i.e., 25°-20°S. It should be noted that the exemptions of the CCMs and territories whose EEZs are exempt of the requirements in 30°-25°S are not the source of the observed discrepancy between mitigation use and seabird distribution as their joint fishing effort equated to only 0.22% of the effort in 30°-25°S.

The apparent preferences in applied combinations of bycatch mitigation methods mirrors the estimated effectiveness of these combinations, but only to a certain extent. In the Southern Hemisphere, the order of most common combinations were I) tori lines and weighted branch lines, II) tori lines and night setting, and III) night setting and weighted branch lines, from most to least commonly observed. Analyses of the relative effectiveness of bycatch mitigation methods (Fischer *et al*. 2024b) showed that the most effective combination of two mitigation methods was indeed tori lines and weighted branch lines, but the second most effective method was night setting and weighted branch lines. However, it should be noted that the combination of all three methods is still the most effective approach (~54% more effective than two out of three methods combined), but such a combination of bycatch mitigation methods was only used in 24% and 12% of the fishing effort south of 30°S and in 30°-25°S, respectively. These insights indicate that applying the most effective seabird bycatch mitigation methods is not impossible and that further implementation should be encouraged, particularly in those areas where seabirds vulnerable to bycatch occur.

Trends were difficult to establish in the analysis, but non-reporting was initially on the rise in most latitudinal bands. The COVID-19 pandemic undoubtedly has had impacts on observer programmes and thus reported observed bycatch mitigation rates in the WCPFC Convention Area. Several CCMs stated this as explicitly as the cause for non-reporting. However, post-2022, our results show signs of recovery of observer programmes post-COVID-19, and thus recovery of reporting rates, which deserves further attention and support.

To improve the reporting rates and the quality of reported data, some potential changes could be made to the current reporting templates in CMM 2018-03. Firstly, hook-shielding devices do not explicitly feature on the template in CMM 2018-03, even though they are an approved bycatch mitigation method, and the template allows for inclusion of additional mitigation methods or combinations. Consequently, to gain insights into their use throughout the WCPO, the inclusion of hook-shielding devices on the reporting template would be useful.

Furthermore, the reporting of the Northern Hemisphere mitigation methods was variable, ranging from explicit stating of percentages of the different combinations allowed under Table 1 in CMM 2018-03 to aggregate reporting of "Northern Hemisphere methods". Such inconsistencies prevent insights into efficacies, and as such should be improved upon. One option to improve the reporting of the Northern Hemisphere mitigation methods is a general simplification of the methods allowed in Table 1. This table contains several ineffective methods (blue-dyed bait, line shooters, and offal discard management; see Fischer *et al*. 2024b for a thorough analysis) and removal of these methods would significantly reduce the complexity of the requirements and thus simplify the reporting, overcoming the current ambiguity. Moreover, in acknowledgement of the variety of vulnerable seabirds that do forage in the area 25°-20°S, observed mitigation use could be reported specifically for this latitudinal band as well.

Finally, decades of research around the globe are invested into understanding what the most effective specification for seabird bycatch mitigation methods consist of (e.g., Pierre 2023, Fischer et al. 2024b), yet current reporting template of CMM 2018-03 does not allow for the inclusion of such specifications. The WCPFC Regional Observer Programme (ROP) Minimum Standard Data Fields & Instructions (WCPFC 2016) do allow for the reporting on these specifications for some mitigation methods. For weighted branch lines, the weight as well as the distance to the hook are to be recorded and for night setting the time and coordinates for the start and the end of the set are to be recorded. Yet, for tori lines (referred to as tori pole in the WCPFC ROP Minimum Standard Data Fields & Instructions) a simple Yes/No suffices, which, given the complexity of tori line designs and their implications for effectiveness (Pierre 2023, Fischer et al. 2024b) seems insufficient. At least reporting on length, attachment height, estimated aerial extent, and composition of streamers seems more adequate to assess if effective tori lines are being used in the WCPO. Replacing "tori pole" with "tori line" would also ensure consistency in terminology between CMM 2018-03 and the ROP Minimum Standard Data Fields & Instructions. Furthermore, the inclusion of recording the use of hook-shielding devices in the ROP Minimum Standard Data Fields & Instructions, even as a simple Yes/No appears appropriate given that it is an approved mitigation method. However, even if these data fields and instructions in the ROP allow for the recording of these specifications, these likely would not automatically result in summaries in Annual Reports – Part 1 as per the data reporting requirements under CMM 2018-03. Consequently, some adjustments to the tables in Annex 2 of CMM 2018-03 appear warranted to ensure more informative reporting, but the additional reporting burden should need to be balanced against the information obtained.

In summary, this analysis highlights the current benefits gained from the reporting requirements under CMM 2018-03, but also underscores that the reported observed bycatch mitigation use does not fully align with the distribution of vulnerable seabirds, or the most efficient mitigation methods. Non-reporting was on the rise but seems to be decreasing as observer programmes are recovering following COVID-19 impacts, and not all mitigation methods are reported on in a consistent fashion. Consequently, the review of CMM 2018-03, both at SC20 and TCC20, should take the insights provided here into consideration.

ACKNOWLEDGEMENTS

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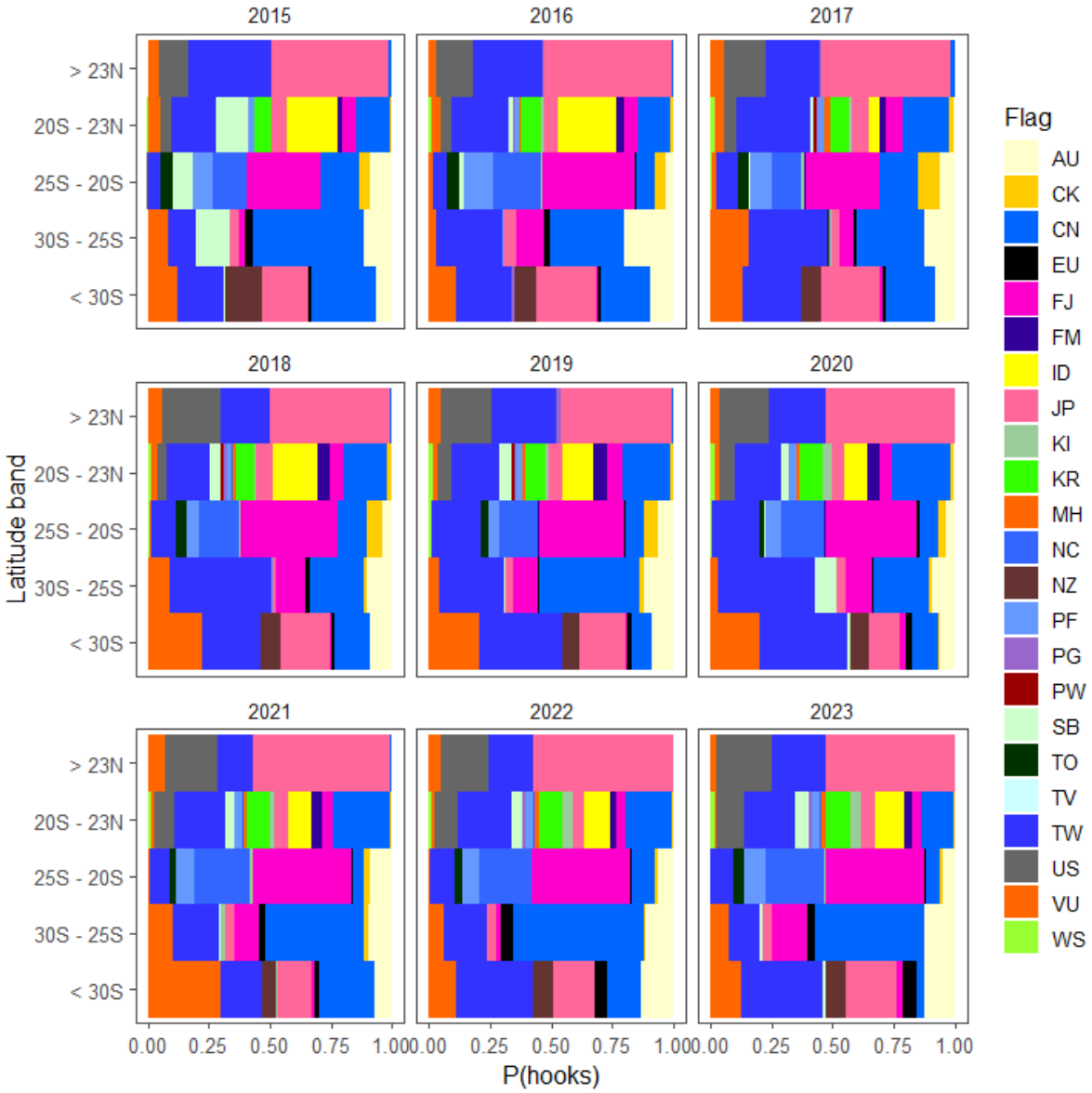
SUPPLEMENTARY MATERIAL 1.



Sup. Fig 1. Graphical representation of the relative fishing effort used in this assessment as provided by SPC following approval from WCPFC.