SCIENTIFIC COMMITTEE
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PROJECT 60: PROGRESS TOWARDS ACHIEVING SC18 RECOMMENDATIONS

WCPFC-SC19-2023/ST-IP-03

T. Peatman[1], P. Williams[2], S. Nicol[2]

[1] Independent fisheries consultant for the Pacific Community (SPC), Oceanic Fisheries Programme
[2] Pacific Community (SPC), Oceanic Fisheries Programme (OFP), Nouméa, New Caledonia

Introduction

The objective of Project 60 is to improve the accuracy and precision of species composition data for tuna (skipjack, yellowfin and bigeye) caught by purse-seine fisheries in the WCPO, in order to improve species-specific catch histories and size compositions that are used in the stock assessments of these key target species in the WCPO. The project history is provided in Appendix A of this report.

The achievements from July 2022 to June 2023 are summarised in Table 1. In addition, corrected species composition estimates for purse seine catches have been updated to include 2022 (see Figure 1 and Figure 2) using the agreed estimation procedure (see Peatman et al., 2020). Effect plots for the updated species composition models are provided in Appendix B. Observer data for 2022 had not been fully submitted to SPC and loaded into the master observer database at the time of preparing this report, and so the catch estimates and observer coverage rates for 2022 should be considered preliminary.

A proposed workplan for 2023-24 is provided in Table 2, and the Scientific Committee is invited to review the workplan and prioritise the associated activities.

Issues arising

Observer coverage rates of WCPFC purse seine fisheries were substantially reduced in mid-2020 due to the impacts of COVID-19, particularly for regions 7 and 8 from the 2022 skipjack assessment (Figure 3, Figure 4). The reductions in observer coverage rates also varied between purse seine fleets, with the weakest reductions for purse seiners flagged to Papua New Guinea and the Solomon Islands. The reduction in observer coverage since mid-2020 is reflected in the corresponding increase in the proportion of total purse seine catch with model-based estimates of species compositions (Table 3). Estimates of species proportions for the period of low observer coverage will have relatively low precision, particularly for bigeye (Peatman et al., 2022), and may also be biased due to the variation in observer coverage between purse seine fleets and areas. Cannery data has the potential to inform, or be used to verify, estimates of purse seine catch compositions. This is particularly relevant given the low coverage of grab-sample based estimates in since the onset of the COVID-19 pandemic. However, coverage rates of cannery data are currently relatively low (Table 4). We note that WCPFC Project 114 is ongoing, which aims to improve cannery receipts data for WCPFC scientific work (SPC-OFP, 2023).

We note the decision to return to 100% purse seine observer coverage at the beginning of 2023, as soon as it is safe and logistically feasible. Observer coverage rates for the fourth quarter of 2022 increased for regions 6 to 8 (Figure 4), along with increases in the number of purse seine fleets with available observer data in regions 7 and 8.

Currently, species composition estimates are based directly on observer samples for strata with a minimum observer coverage rate of 20%. The 20% threshold originated in Lawson (2013), who noted that it was set arbitrarily and suggested testing of alternative thresholds. The 20% threshold may result in imprecise estimates of species compositions for strata with high rates of observer coverage, but limited levels of catches and so relatively few grab samples. Comparisons of model-based and observer sample-based species composition estimates with estimates from independent data sources would provide a means for assessing the performance of, and potentially improving, the 20% threshold used to switch between observer sample-based and model-based estimates. This is proposed to be a focus for collaborative research in 2023-24. Note adjustment of the 20% threshold may not have a substantial impact on catch estimates at an MFCL region, however it is expected to improve catch estimates at finer-scales which are needed for other work of the Scientific Committee.

Recommendations

We invite the Scientific Committee to:

1. Note the progress towards the Project 60 workplan agreed at SC18.
2. Review the proposed activities and their priority for Project 60 in the year ahead with reporting to SC20 (Table 2).

Acknowledgements

T. Peatman's contribution was supported by the WCPFC and the European Union's "Pacific-European Union Marine Partnership Programme".

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Tables

Table 1 Progress towards addressing SC18 recommendations (continued on following page).

Activity	Progress
Paired grab-spill trips (target: 4 to 6): • Targeting fleets with likely availability of comprehensive Final Outturn data (to be provided on a voluntary basis). • Additional data should allow for improved estimates of bias correction factors, and provide a more powerful dataset for testing for species and/or school association specific correction factors	No paired grab-spill trips were undertaken in 2022-23. Opportunities for paired trips will be explored for 2023-24.
Continue to explore opportunities for collaboration with members to support the Project 60 workplan, including comparisons of observer samples, and potentially model-based, species composition estimates, with accurate unloadings / landings / cannery data	No collaborative analyses were undertaken in 2022-23. Opportunities for collaboration will continue to be sought to support the proposed workplan for 2023-24, with consideration of activity priority.
Investigation of video-based sampling for estimation of species and size compositions	Trials of Electronic Monitoring (EM) on purse seine vessels in the WCPO have shown this technology can be used for estimating species and size composition. EM service providers have made progress in developing automated analysis tools (using Artificial Intelligence and Machine Learning) where proprietary and publicly available databases of annotated images are used to run these tools. However, differences between vessels' setup and operations means there is a need for developing vessel specific databases to ensure efficient analysis. Paired EM and observer trips are also needed to measure accuracy of species and size composition data provided through EM. Further trials are expected in 2023 or later, once travel to PICTs resumes and the necessary logistics can be arranged.

Table 2 Proposed activities for Project 60 for 2023-24 and their priority.

<table>
<tr><th>Recommendation</th><th>Priority</th></tr>
<tr><td>Paired grab-spill trips (target: 4 to 6):
Targeting fleets with likely availability of comprehensive Final Outturn data (to be provided on a voluntary basis).
Additional data should allow for improved estimates of bias correction factors, and provide a more powerful dataset for testing for species and/or school association specific correction factors
Due to the continuing impacts of COVID-19, the 2020 Budget allocated for this activity (~USD40,000) to be used in 2023–2024</td><td>High</td></tr>
<tr><td>Continue to explore opportunities for collaboration with members to support the Project 60 workplan, including comparisons of observer samples, and potentially model-based, species composition estimates, with accurate unloadings / landings / cannery data (i.e. extensions of comparative analyses reported in Peatman et al., 2017a; Peatman, 2022).</td><td>High</td></tr>
<tr><td>Investigation of video-based sampling for estimation of species and size compositions</td><td>Medium</td></tr>
<tr><td>Cost-benefit analysis of alternative sampling approaches for long-term estimation of species compositions (i.e. at-sea sampling vs port sampling)</td><td>Medium</td></tr>
</table>

Table 3 The proportion of purse seine catch with model-based species composition estimates by year and quarter from 2000 to 2022 (excludes Indonesia, Philippines and Vietnam domestic fisheries).

Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
2000	0.975	0.958	0.986	0.954
2001	0.952	0.944	0.969	0.993
2002	0.963	0.877	0.903	0.951
2003	0.912	0.987	0.971	0.986
2004	0.968	0.884	0.918	0.965
2005	0.974	0.938	0.874	0.887
2006	0.901	0.877	0.907	0.873
2007	0.836	0.830	0.841	0.873
2008	0.863	0.804	0.834	0.897
2009	0.796	0.849	0.656	0.830
2010	0.222	0.245	0.125	0.174
2011	0.135	0.130	0.131	0.193
2012	0.236	0.145	0.073	0.105
2013	0.212	0.232	0.087	0.132
2014	0.156	0.086	0.056	0.097
2015	0.082	0.107	0.089	0.046
2016	0.073	0.036	0.038	0.042
2017	0.043	0.034	0.051	0.028
2018	0.017	0.027	0.034	0.017
2019	0.009	0.016	0.030	0.029
2020	0.053	0.155	0.837	0.843
2021	0.861	0.913	0.852	0.850
2022	0.899	0.959	0.985	0.880

Table 4 Coverage of matched logsheet/observer/cannery trip data for the WCPFC tropical purse seine fishery (excludes Indonesia, Philippines and Vietnam domestic fisheries).

YEAR	Total Purse seine Tuna catch (MT)						
	WCPFC Estimates	Processor data	%	Matched Log / Cannery	%	Matched Log / Obs / Cannery	%
2013	1,570,125	498,424	31.7%	421,356	26.8%	373,440	23.8%
2014	1,737,573	509,689	29.3%	420,219	24.2%	380,278	21.9%
2015	1,544,180	436,504	28.3%	389,748	25.2%	336,345	21.8%
2016	1,544,386	467,132	30.2%	413,006	26.7%	353,175	22.9%
2017	1,469,031	473,818	32.3%	415,617	28.3%	382,596	26.0%
2018	1,676,092	529,670	31.6%	487,478	29.1%	474,088	28.3%
2019	1,821,164	543,828	29.9%	496,994	27.3%	492,647	27.1%
2020	1,600,556	689,068	43.1%	602,392	37.6%	218,735	13.7%
2021	1,546,518	669,531	43.3%	543,097	35.1%	37,785	2.4%
2022	1,601,315	615,196	38.4%	532,661	33.3%	41,415	2.6%

Figures

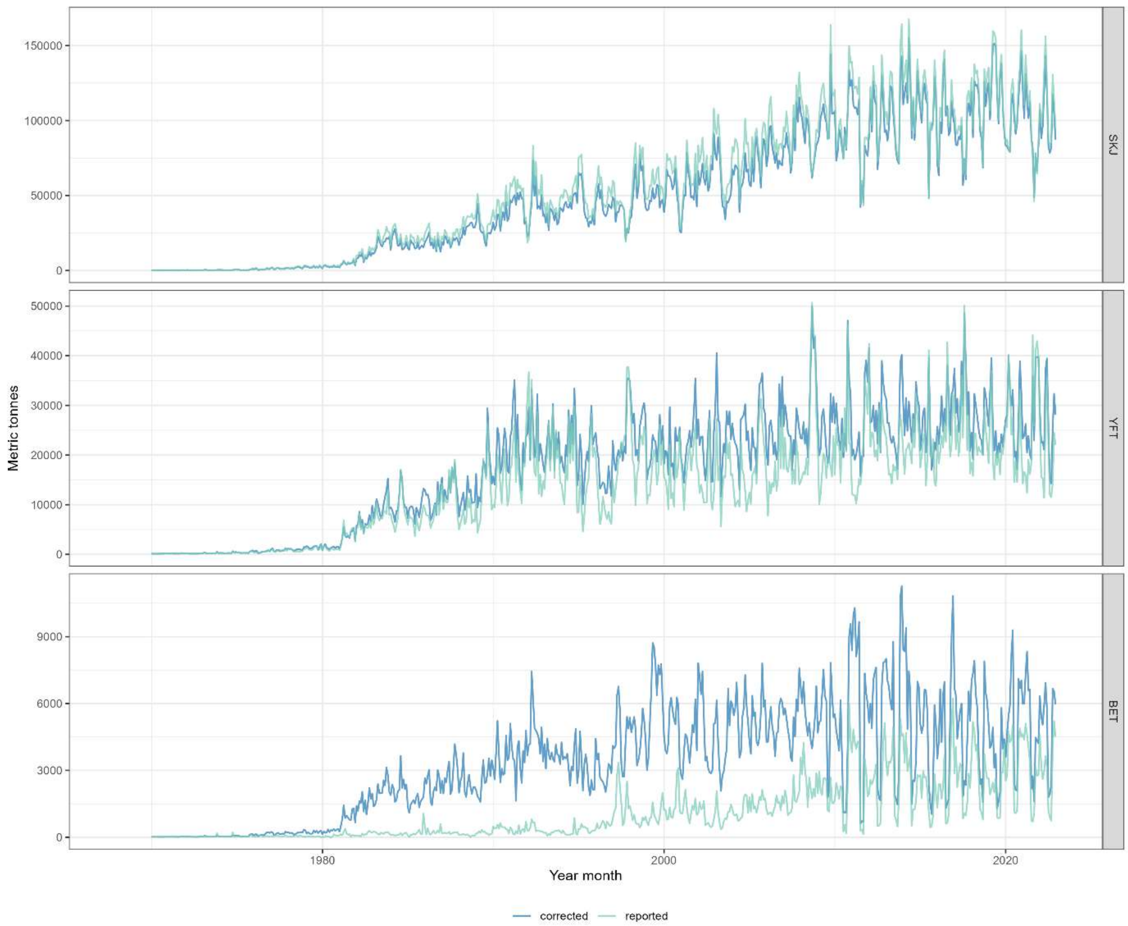

Figure 1 Corrected (blue) and reported (turquoise) purse seine catch by year and month for skipjack (top), yellowfin (middle) and bigeye (bottom panel).

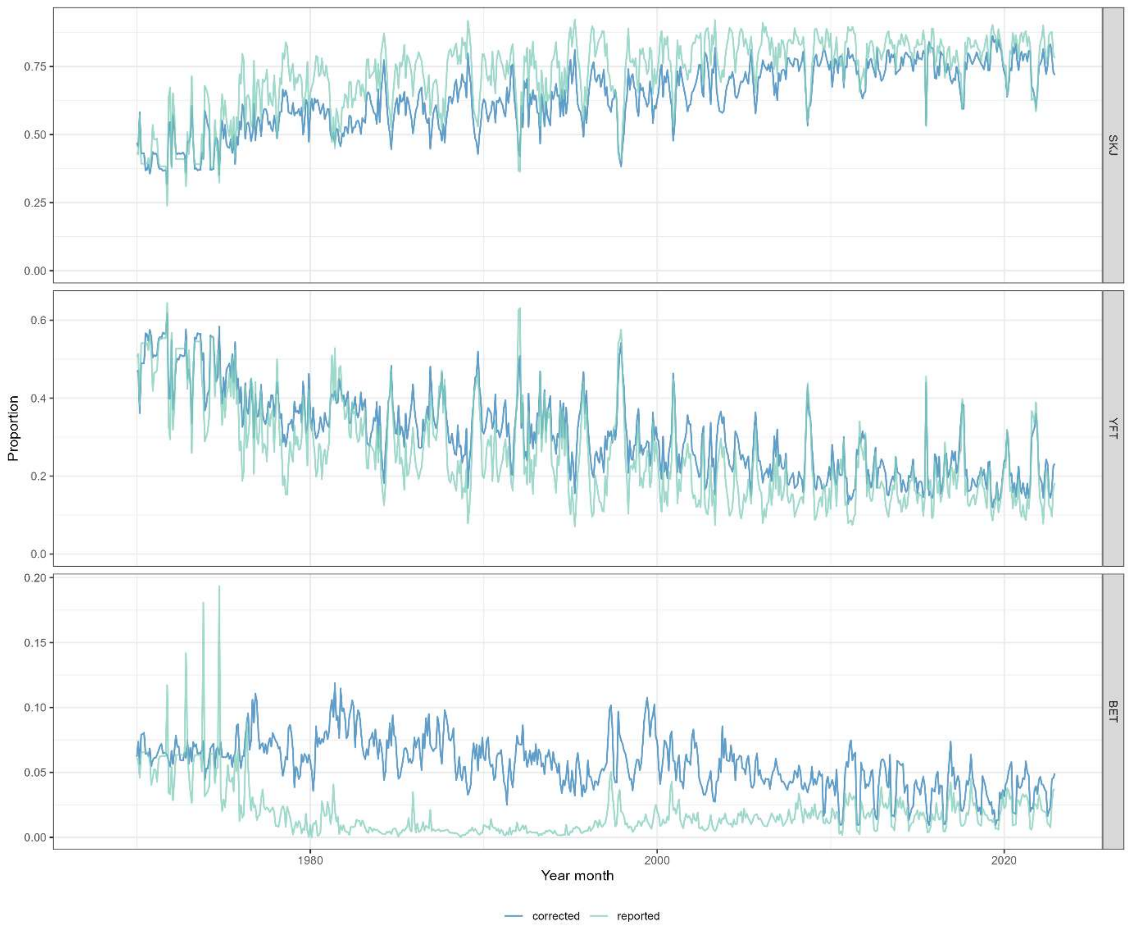

Figure 2 Corrected (blue) and reported (turquoise) purse seine catch proportions by year and month for skipjack (top), yellowfin (middle) and bigeye (bottom panel).

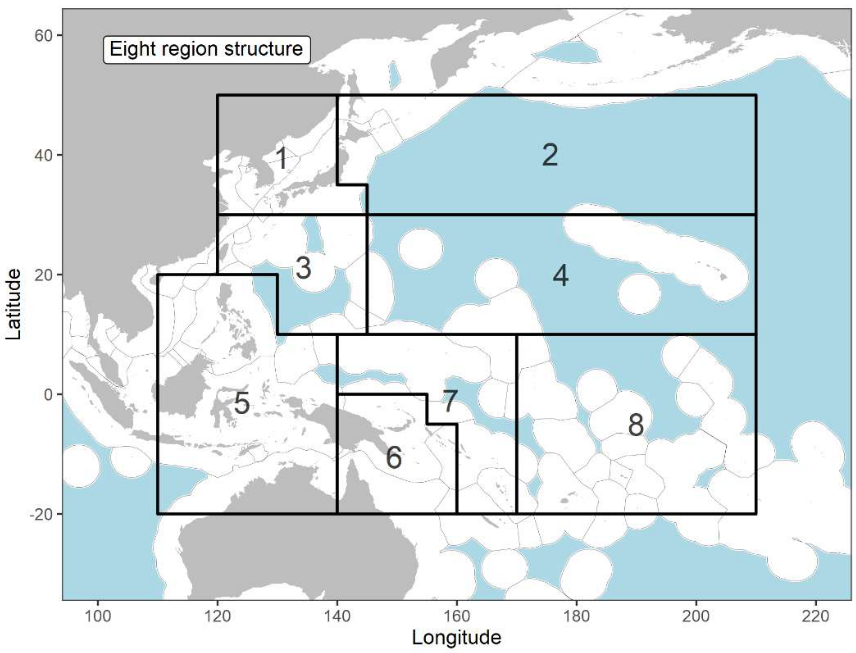

Figure 3 The eight region structure from the 2022 skipjack assessment.

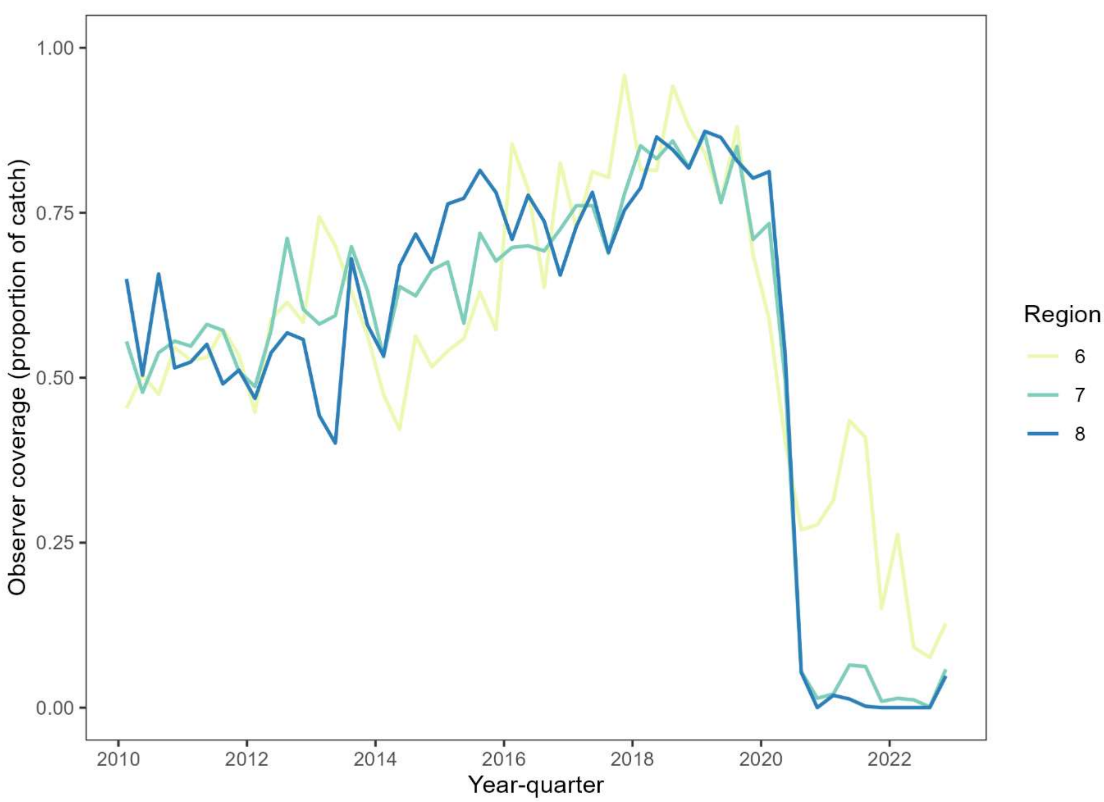

Figure 4 Observer coverage rates by assessment model region (6, 7 and 8) from 2010 to 2022.

Appendix A

Project history

Project 60 and work on the collection and evaluation of purse seine species composition data through paired sampling and unloading data comparisons began in April 2009. The initial duration of the project was from April 2009 to the end of January 2010. The project was extended in April 2010 through January 2011, and then from February 2011 to 31 January 2012.

Following discussion of the "Plan for the improvement of the availability and use of purse-seine composition data" (SPC-OFP 2012), the Scientific Committee made the following recommendation (Anon., 2012a) at para 89, section d: *"Project 60 be continued through 2013. The study has a target of 50 trips to be sampled, of which 35 trips will be completed by the end of 2012".*

The Commission (Anon., 2012b) supported the SC8 recommendation and approved the project with funding to cover the cost of the remaining 15 trips for further analysis. In 2014 further research for project 60 was supported under the SC9 unobligated budget, with additional funding from PNG.

SC11 noted that future work should include finalisation of analyses of existing data, the collection of further paired sampling data where these results can be compared to accurate estimates of landed weights by species, and simulation modelling to assess alternative sampling protocols (Anon., 2015a). The Scientific Committee made the following recommendation (Anon., 2015a) at para 107:

a) The WCPFC science/data service provider produce an update to Table 1 in ST-WP-02 annually (until an agreement on methodology can be reached) as it provides a very useful summary of the purse-seine catch estimates derived using the four different methods to ascertain catch composition.

b) In regards to the implementation of observer spill sampling in the tropical purse seine fishery,

> *i. The WCPFC Secretariat and the WCPFC scientific services provider investigate operational aspects including alternatives for spill sampling on purse seine vessels where the current spill sampling protocol is difficult to implement and report back to SC12.*
>
> *ii. The WCPFC scientific services provider will undertake additional data collection and analyses to evaluate the benefits of spill sampling compared to corrected grab sampling.*

To implement the 2015 Scientific Committee recommendations, and after approval from the Commission (Anon., 2015b), the WCPFC Secretariat contracted the Scientific Services Provider to continue Project 60. In 2016, the Scientific Service Provider proposed a work plan for the continuation of Project 60 (Smith and Peatman, 2016) which was subsequently endorsed by the 2016 Scientific Committee (Anon., 2016). In 2017, the Scientific Service Provider presented work undertaken between SC12and SC13, along with a proposed work plan (Peatman et al., 2017b). The 2017 Scientific Committee recommended that future work proposed by the Scientific Service provider continue over the coming year, with reporting to SC14, and agreed that the work should continue in the medium term subject to annual review (Anon., 2017). Since 2017, the Scientific Service Provider has reported annually to the Scientific Committee progress against the agreed Project 60 workplan, and a proposed work plan for Project 60 moving forward.

Appendix B

Effect plots for revised species composition models

Skipjack – free school

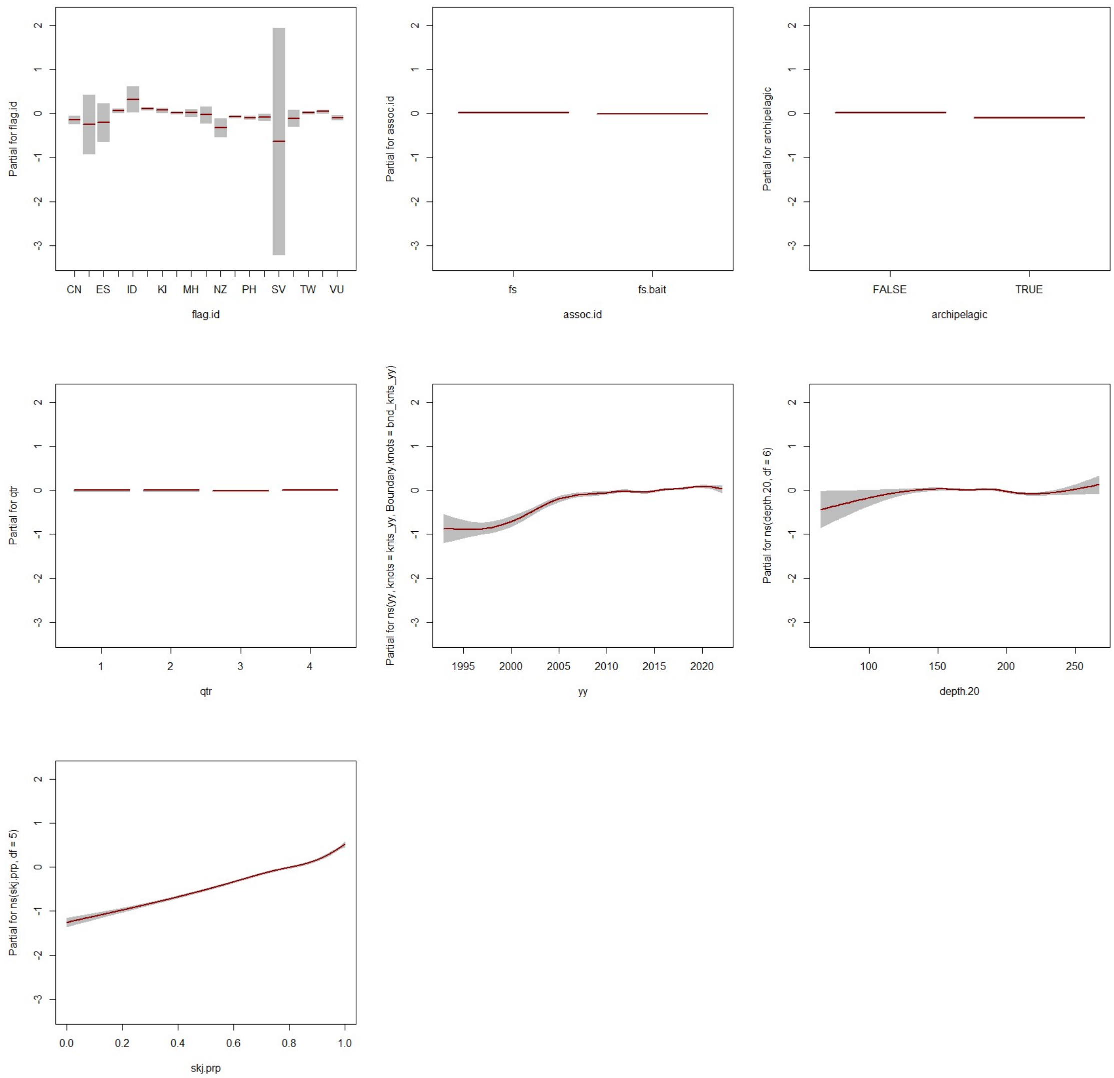

Figure 5 Effect plots for the mean of the beta-component of the skipjack free-school model. Top row, left to right: flag; association type (free school – fs, and free school feeding on baitfish – fs.bait); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

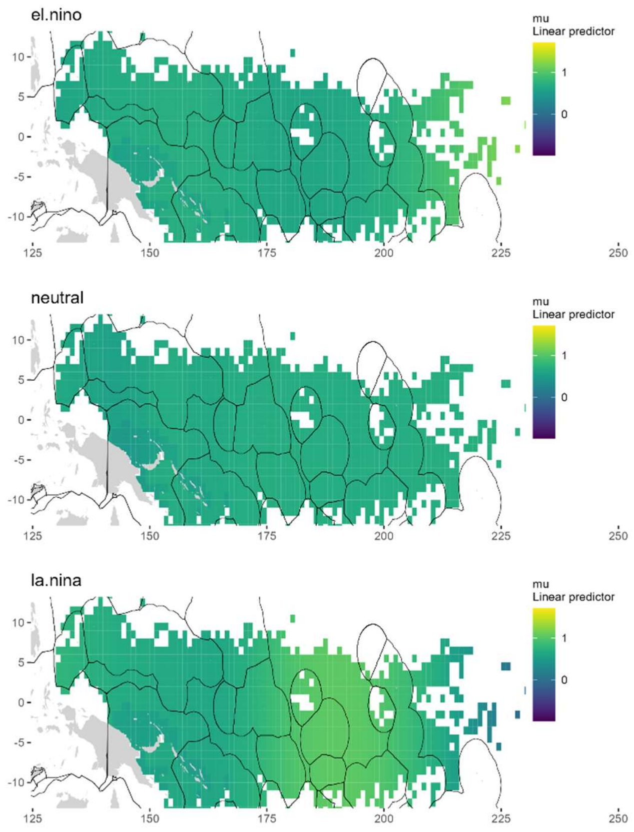

Figure 6 The combined effect of the archipelagic term and the longitude:ONI interaction on the mean of the beta component of the skipjack free-school model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

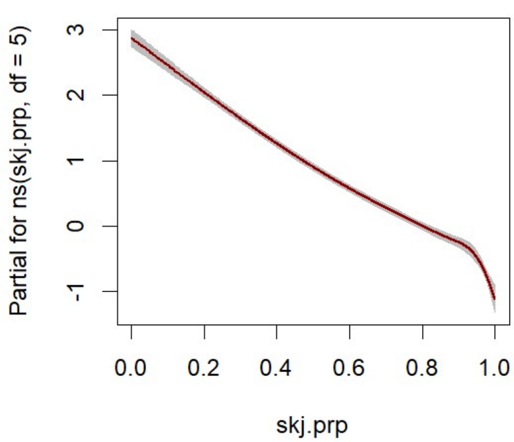

Figure 7 Effect plot for the zero-inflation component of the skipjack free-school model: uncorrected skipjack proportion from vessel logbooks.

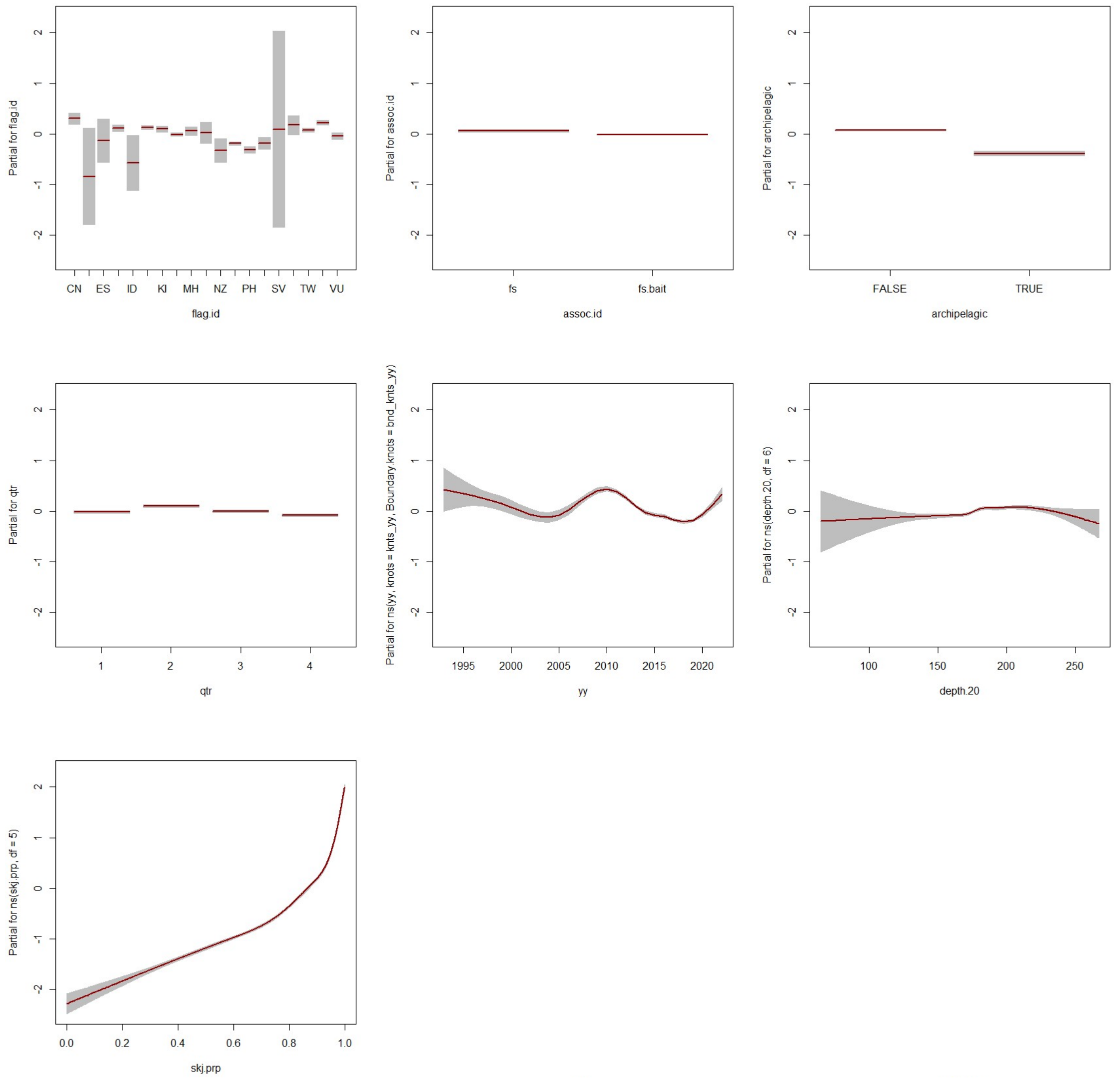

Figure 8 Effect plots for the one-inflation component of the skipjack free-school model. Top row, left to right: flag; association type (free school – fs, and free school feeding on baitfish – fs.bait); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

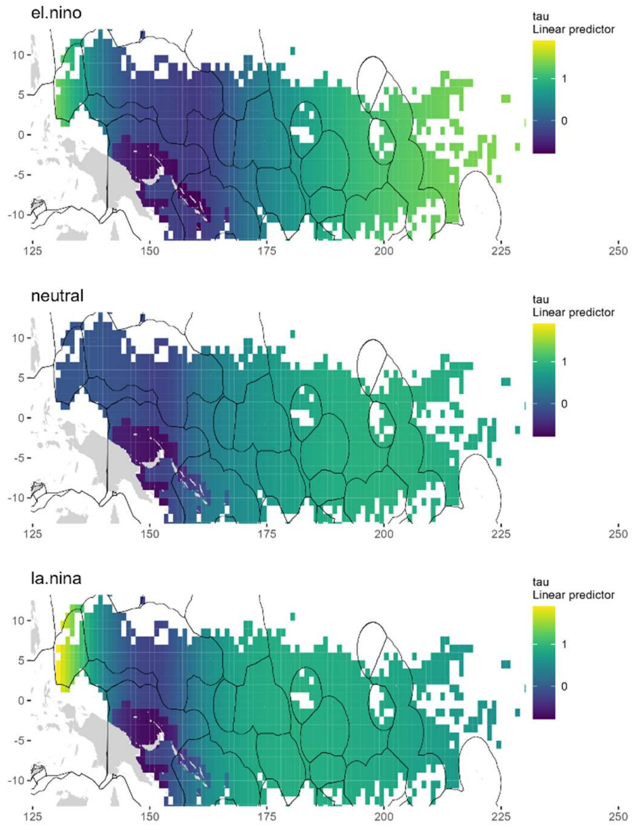

Figure 9 The combined effect of the archipelagic term and the longitude:ONI interaction on the one-inflation component of the skipjack free-school model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

Yellowfin – free school

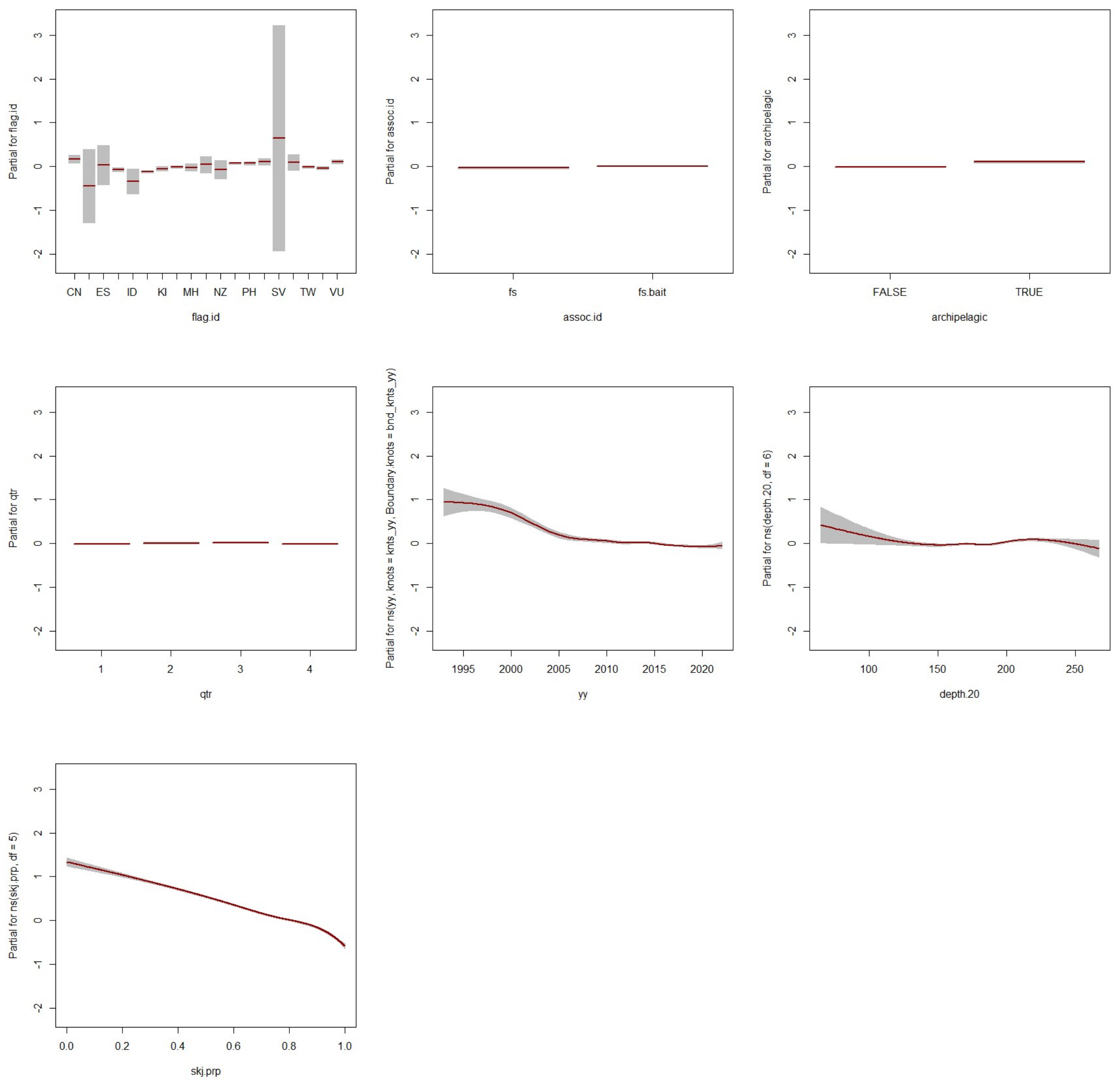

Figure 10 Effect plots for the mean of the beta-component of the yellowfin free-school model. Top row, left to right: flag; association type (free school – fs, and free school feeding on baitfish – fs.bait); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

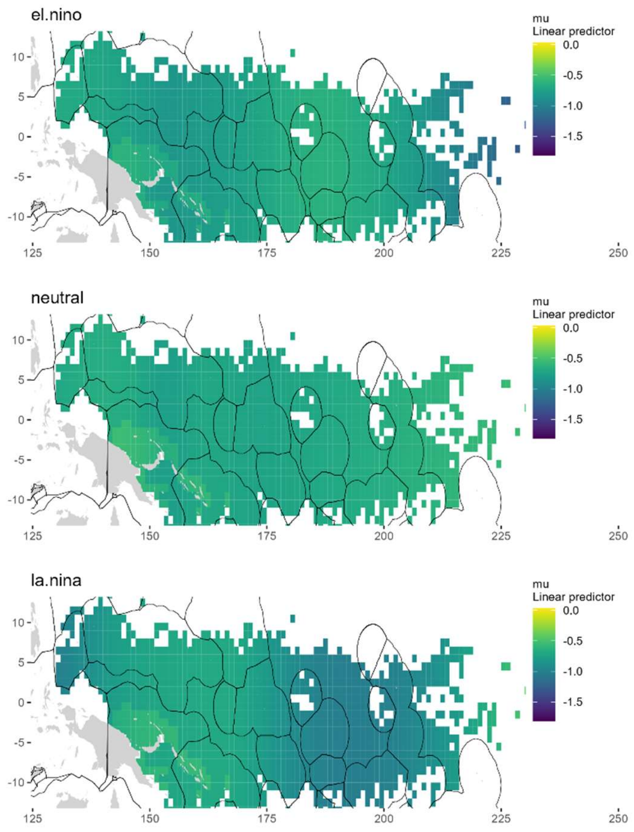

Figure 11 The combined effect of the archipelagic term and the longitude:ONI interaction on the mean of the beta component of the yellowfin free-school model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

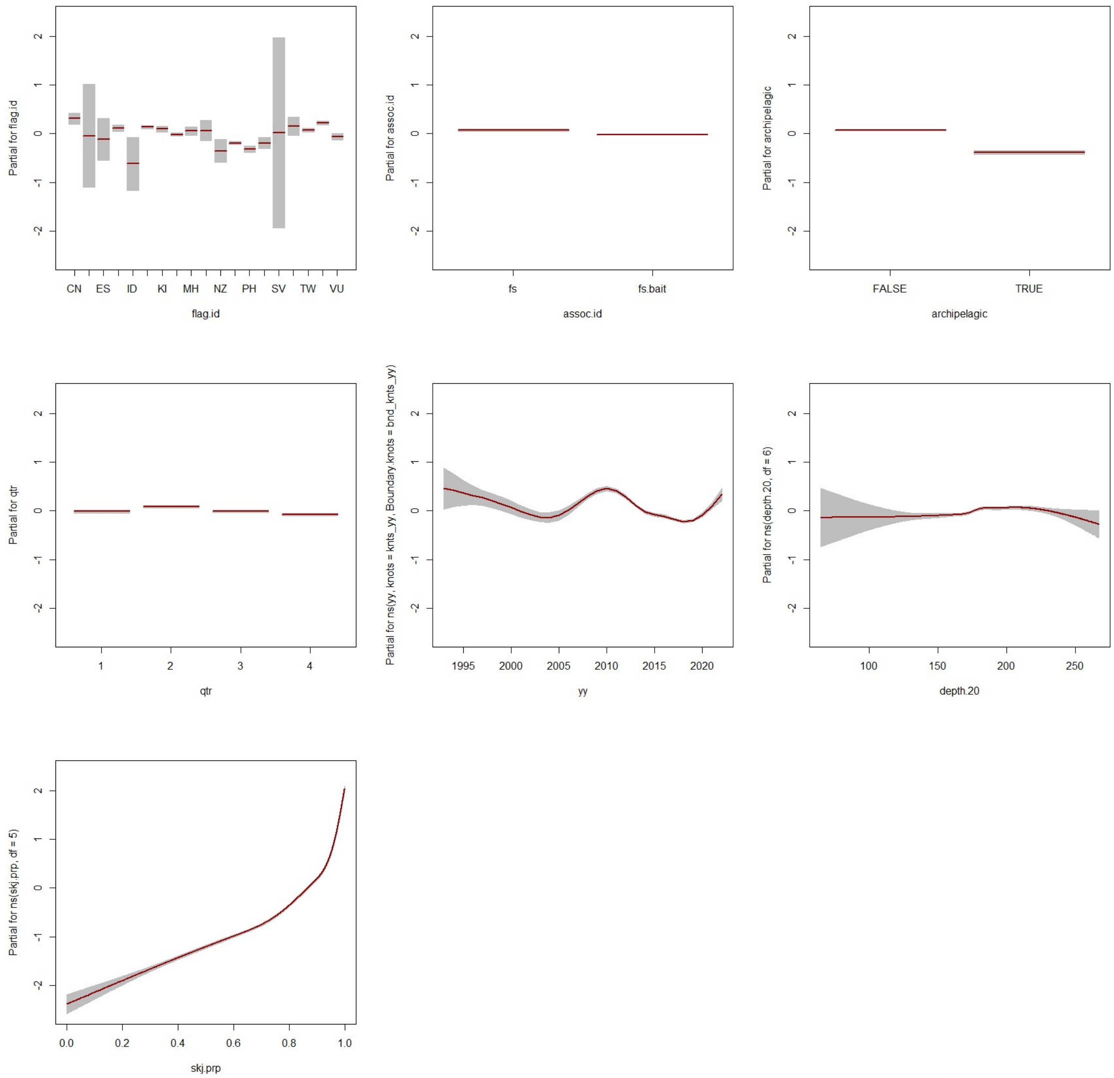

Figure 12 Effect plots for the zero-inflation component of the yellowfin free-school model. Top row, left to right: flag; association type (free school – fs, and free school feeding on baitfish – fs.bait); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

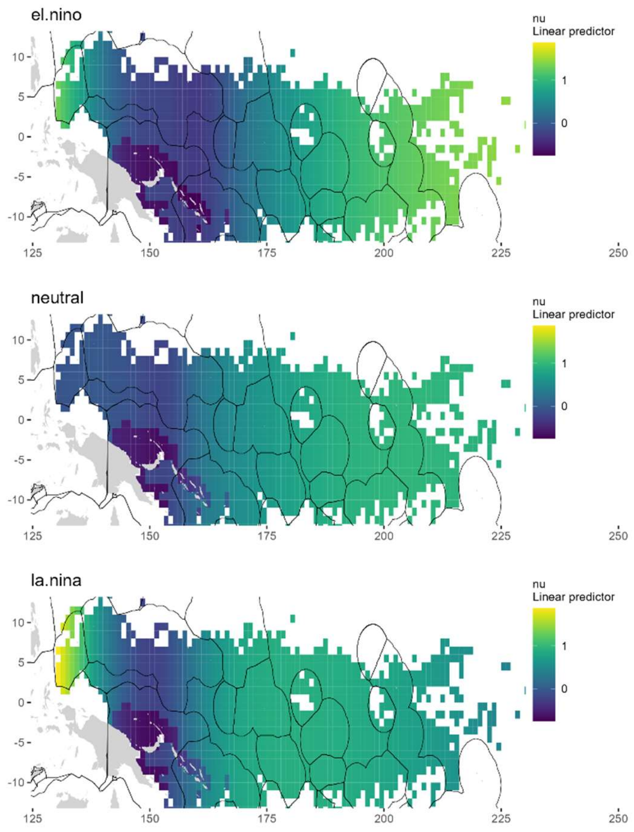

Figure 13 The combined effect of the archipelagic term and the longitude:ONI interaction on the zero-inflation component of the yellowfin free-school model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

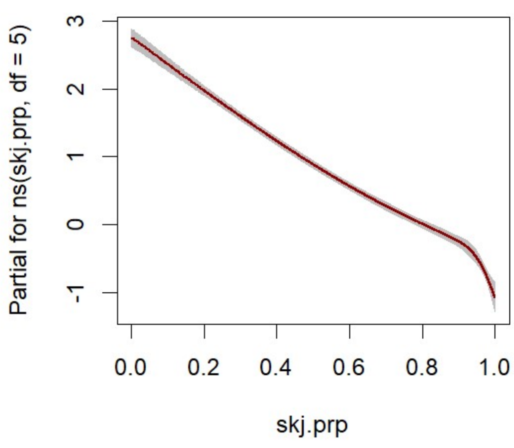

Figure 14 Effect plots for the one-inflation component of the yellowfin free-school model: uncorrected skipjack proportion from vessel logbooks (right).

Bigeye – free school

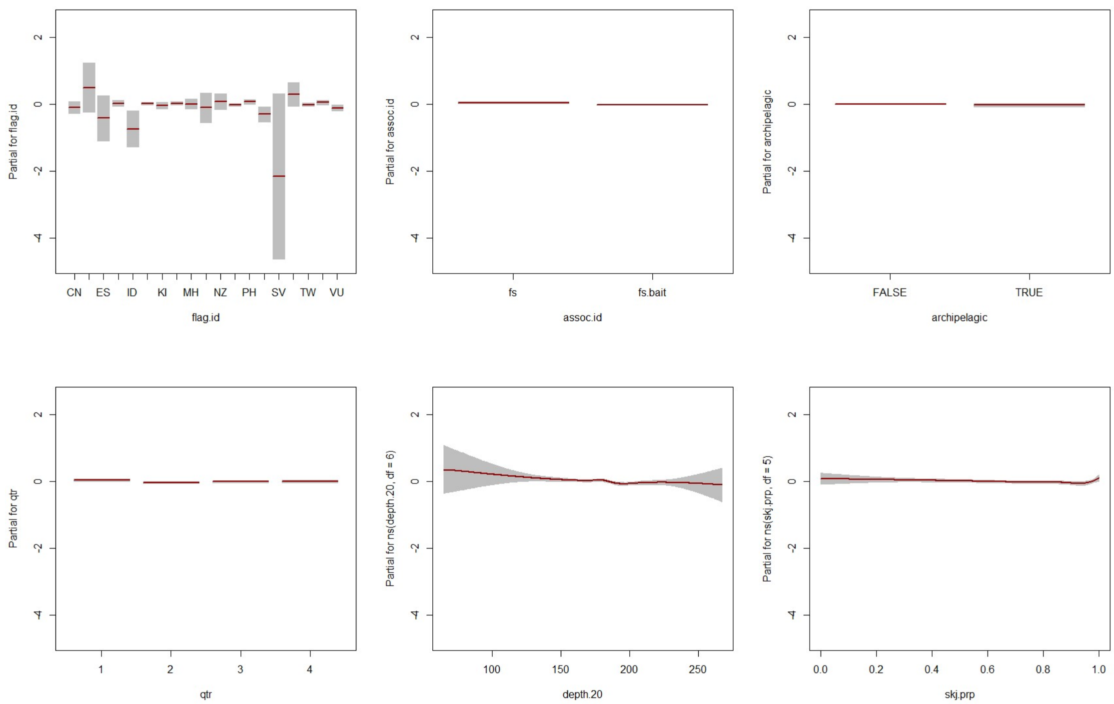

Figure 15 Effect plots for the mean of the beta-component of the bigeye free-school model. Top row, left to right: flag; association type (free school – fs, and free school feeding on baitfish – fs.bait); archipelagic waters. Bottom row, left to right: quarter; isotherm depth; and, uncorrected skipjack proportion from vessel logbooks.

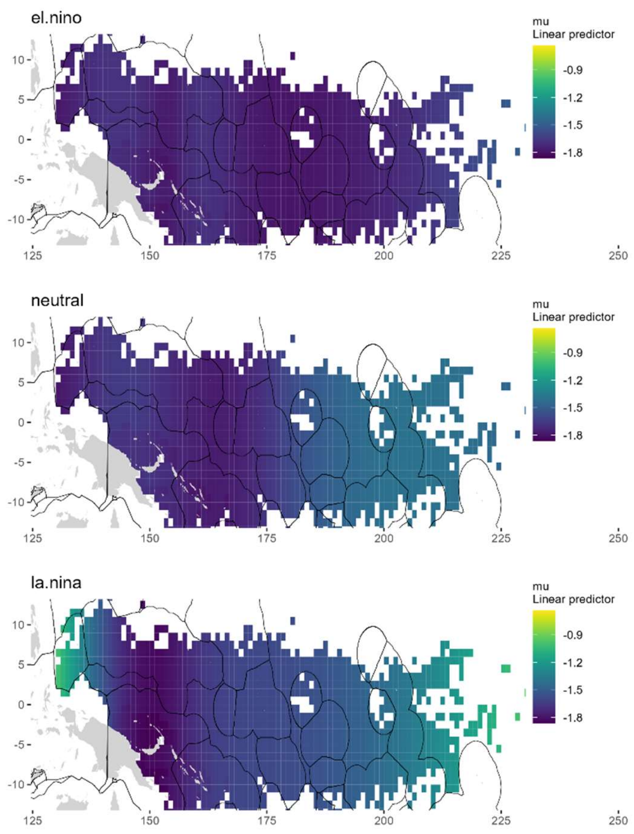

Figure 16 The combined effect of the archipelagic term and the longitude:ONI interaction on the mean of the beta component of the bigeye free-school model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

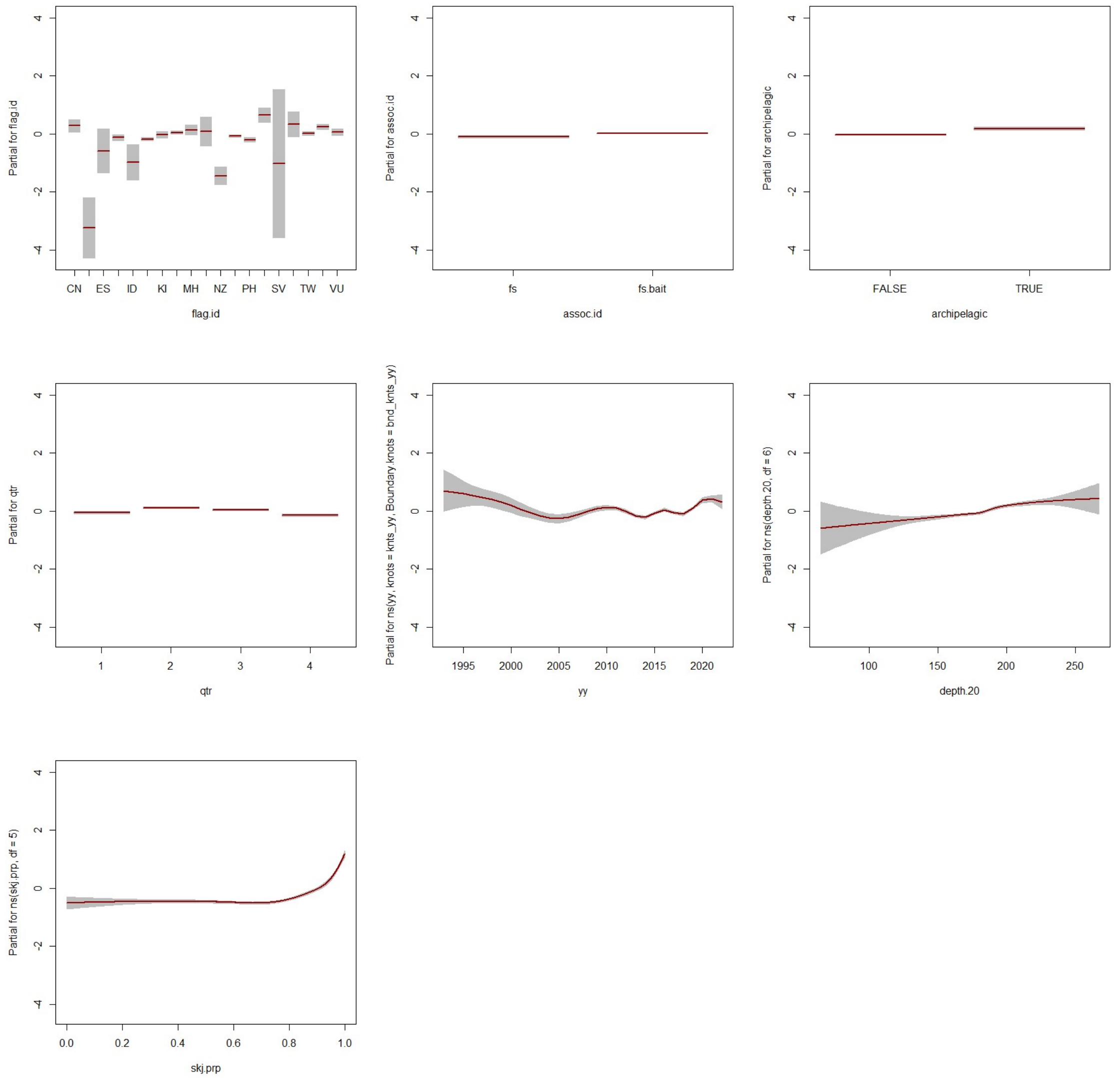

Figure 17 Effect plots for the zero-inflation component of the bigeye free-school model. Top row, left to right: flag; association type (free school – fs, and free school feeding on baitfish – fs.bait); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

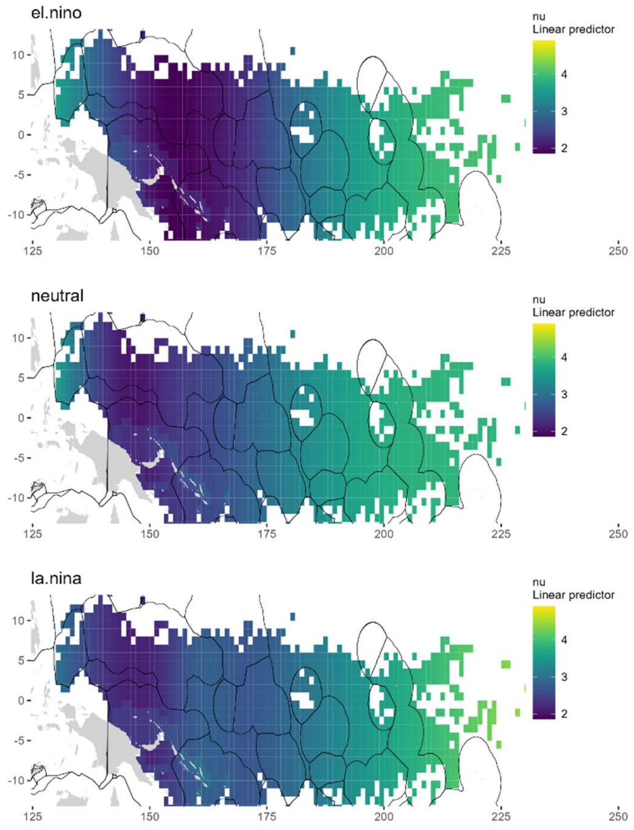

Figure 18 The combined effect of the archipelagic term and the longitude:ONI interaction on the zero-inflation component of the bigeye free-school model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

Skipjack – associated

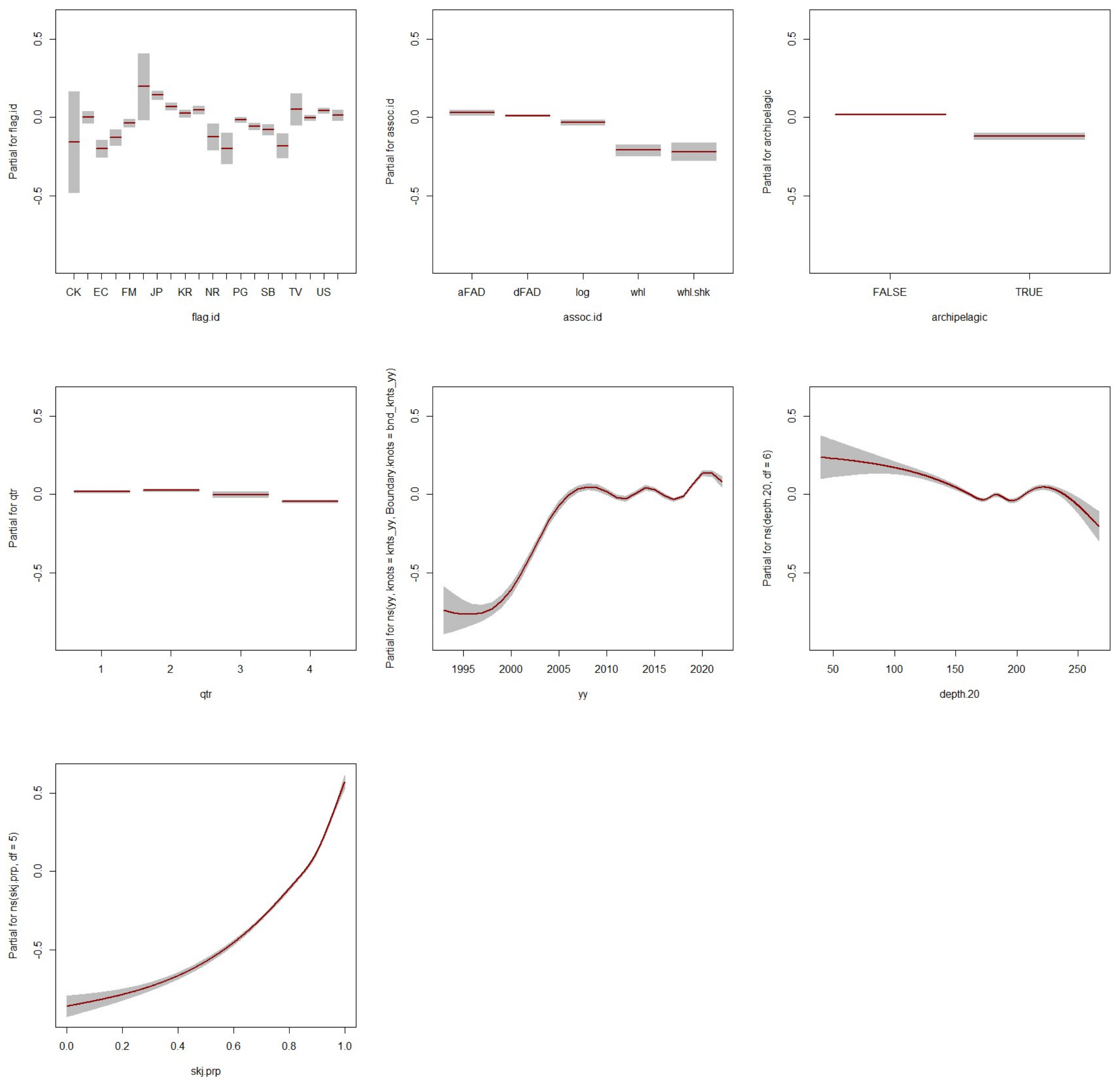

Figure 19 Effect plots for the mean of the beta-component of the skipjack associated model. Top row, left to right: flag; association type (anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

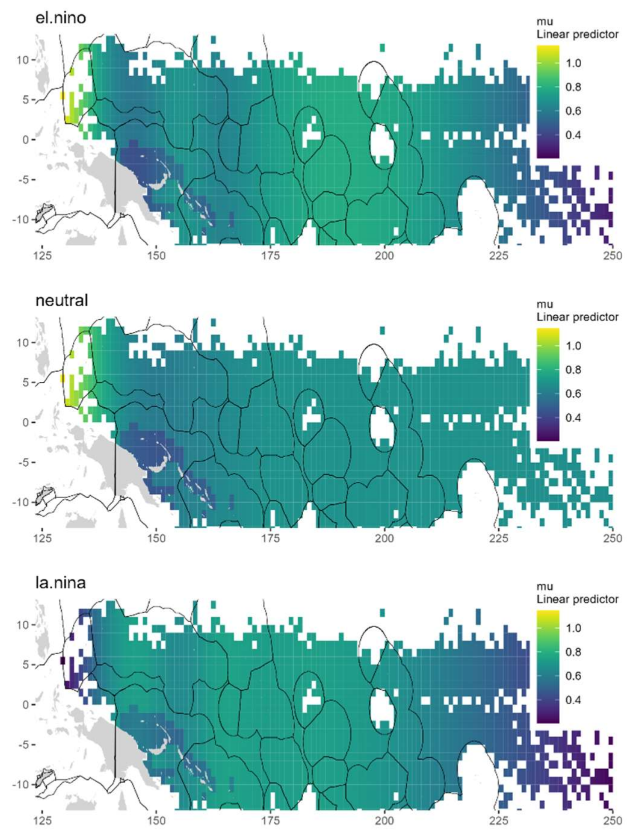

Figure 20 The combined effect of the archipelagic term and the longitude:ONI interaction on the mean of the beta component of the skipjack associated model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

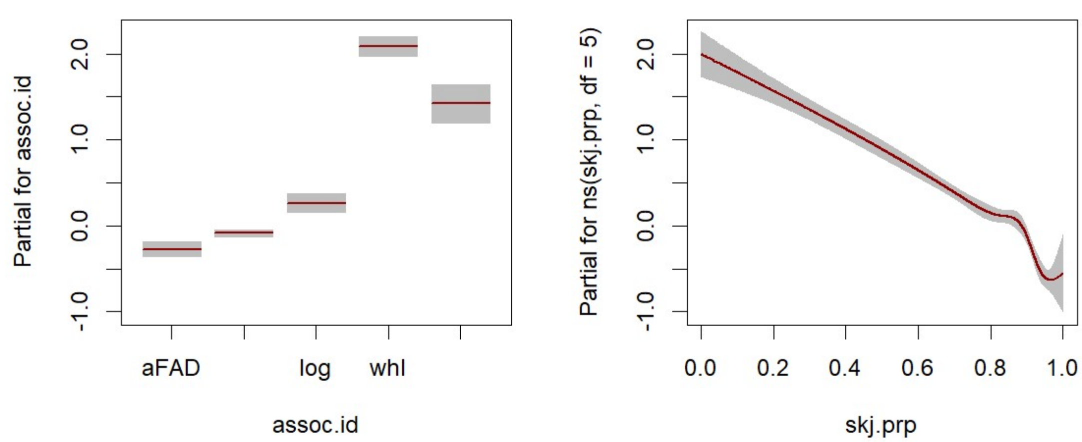

Figure 21 Effect plots for the zero-inflation component of the skipjack associated model: association type (left panel, anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk) and, uncorrected skipjack proportion from vessel logbooks (right panel).

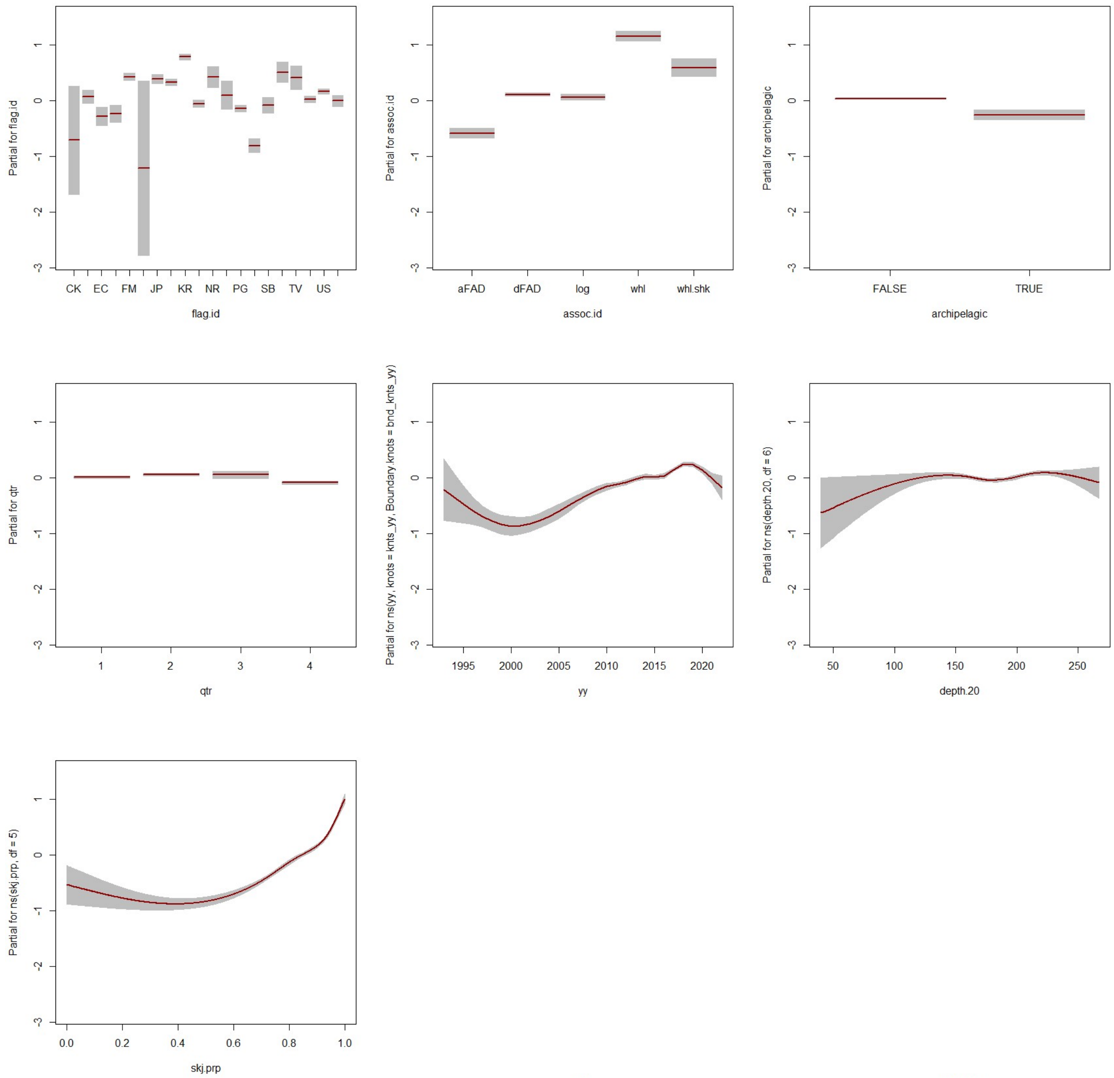

Figure 22 Effect plots for the one-inflation component of the skipjack associated model. Top row, left to right: flag; association type (anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

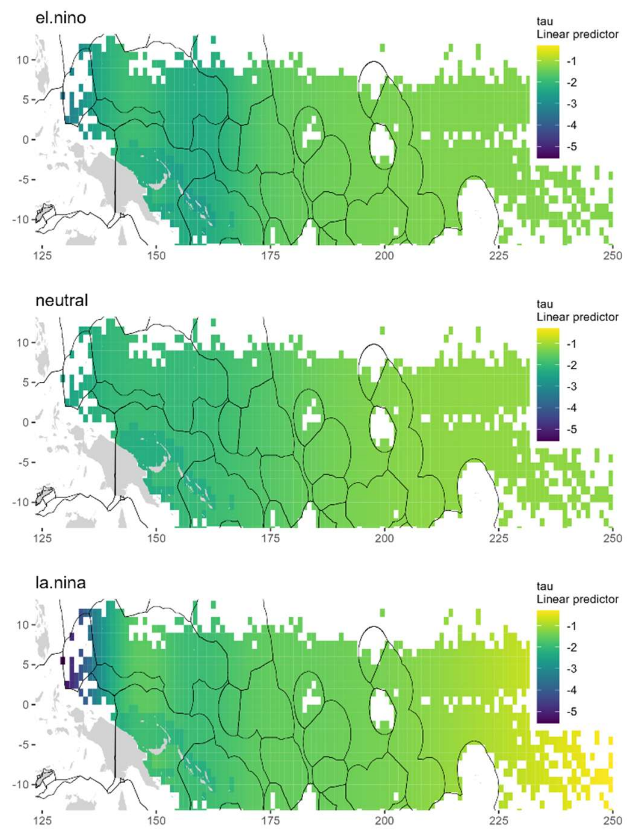

Figure 23 The combined effect of the archipelagic term and the longitude:ONI interaction on the one-inflation component of the skipjack associated model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

Yellowfin – associated

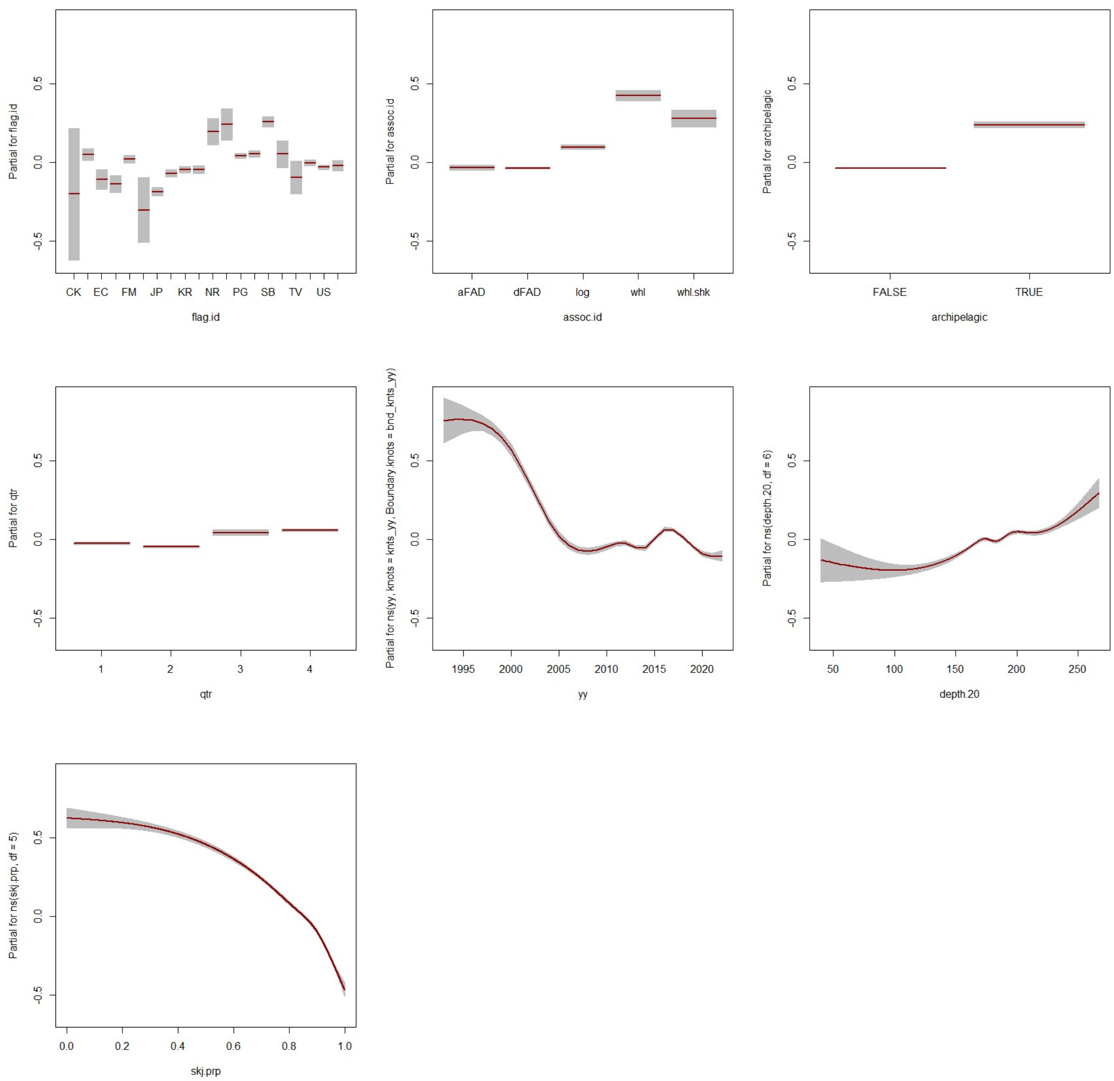

Figure 24 Model effects for the mean of the beta-component of the yellowfin associated model. Top row, left to right: flag; association type (anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

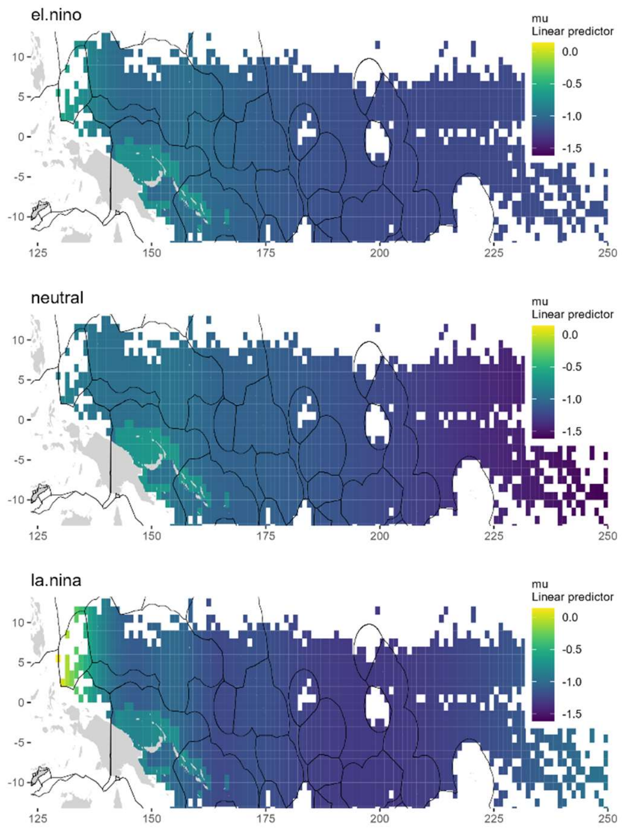

Figure 25 The combined effect of the archipelagic term and the longitude:ONI interaction on the mean of the beta component of the yellowfin associated model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

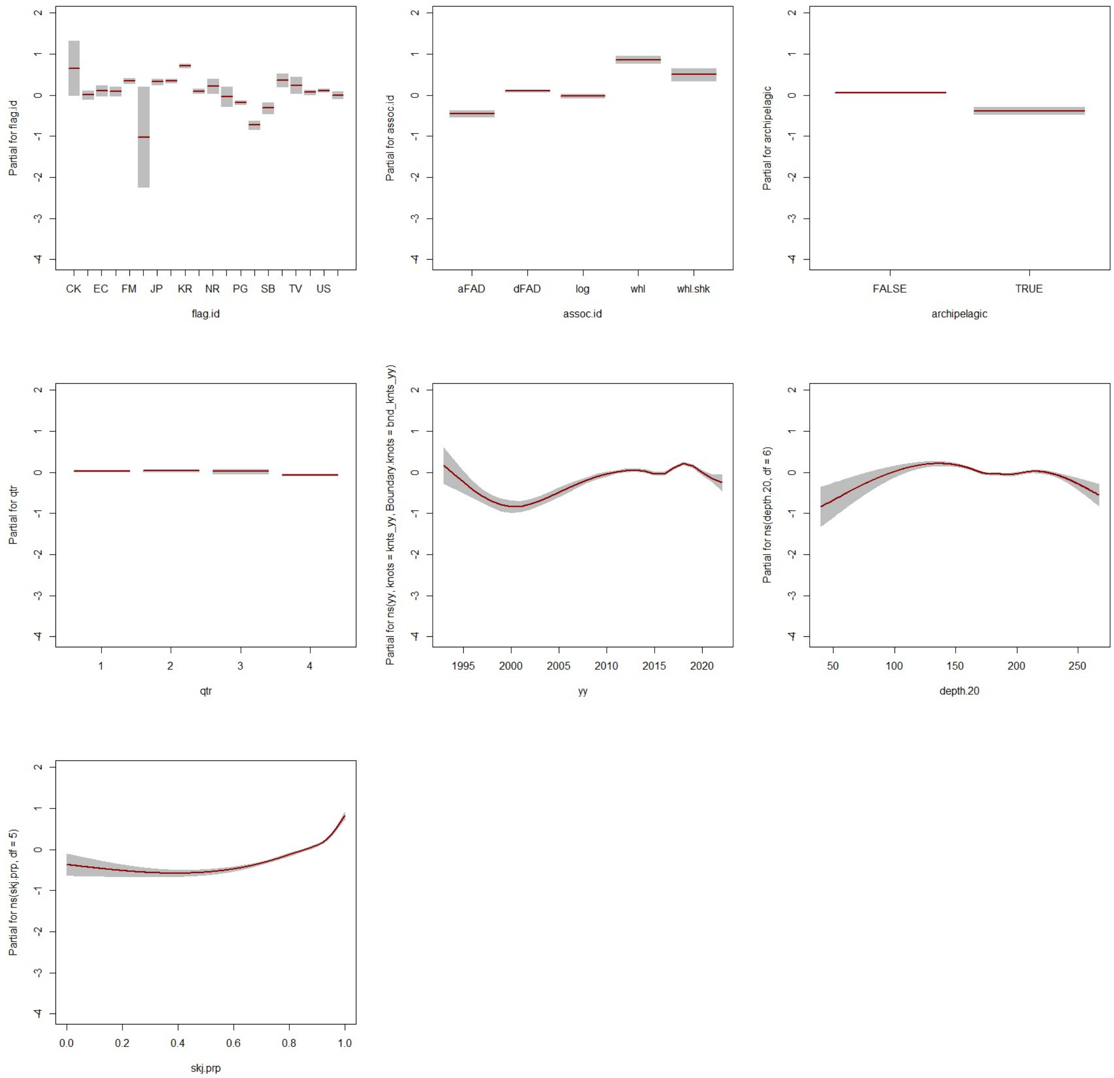

Figure 26 Model effects for the zero-inflation component of the yellowfin associated model. Top row, left to right: flag; association type (anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

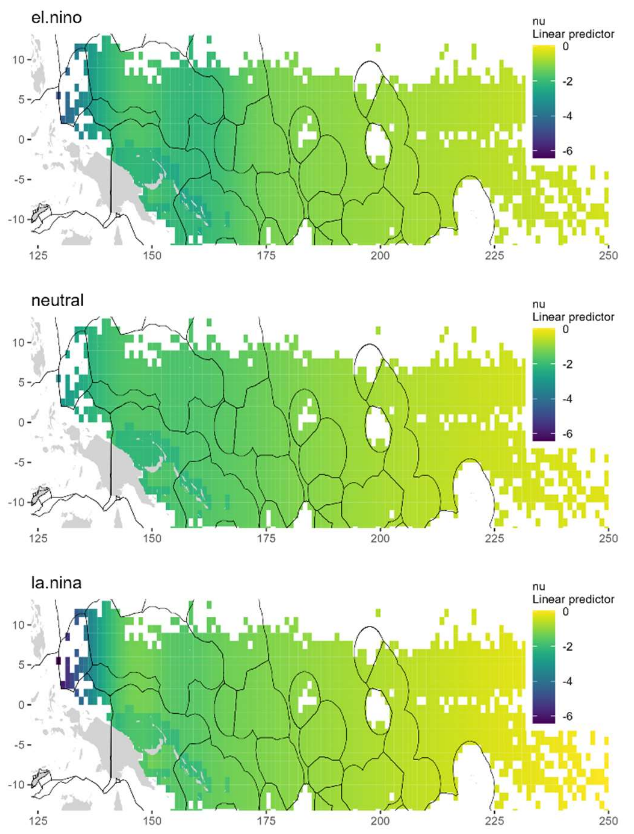

Figure 27 The combined effect of the archipelagic term and the longitude:ONI interaction on the zero-inflation component of the yellowfin associated model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

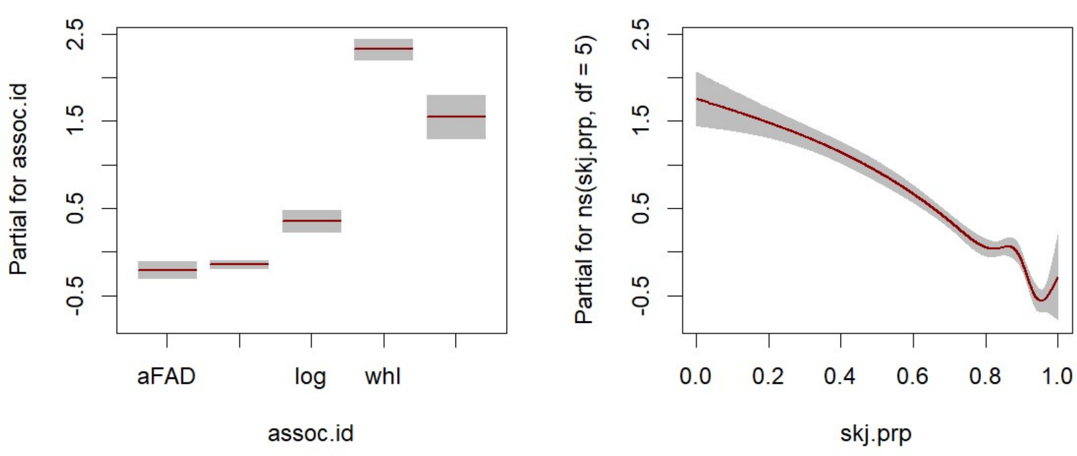

Figure 28 Effect plots for the one-inflation component of the yellowfin associated model: association type (left panel- anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk) and, uncorrected skipjack proportion from vessel logbooks (right panel).

Bigeye – associated

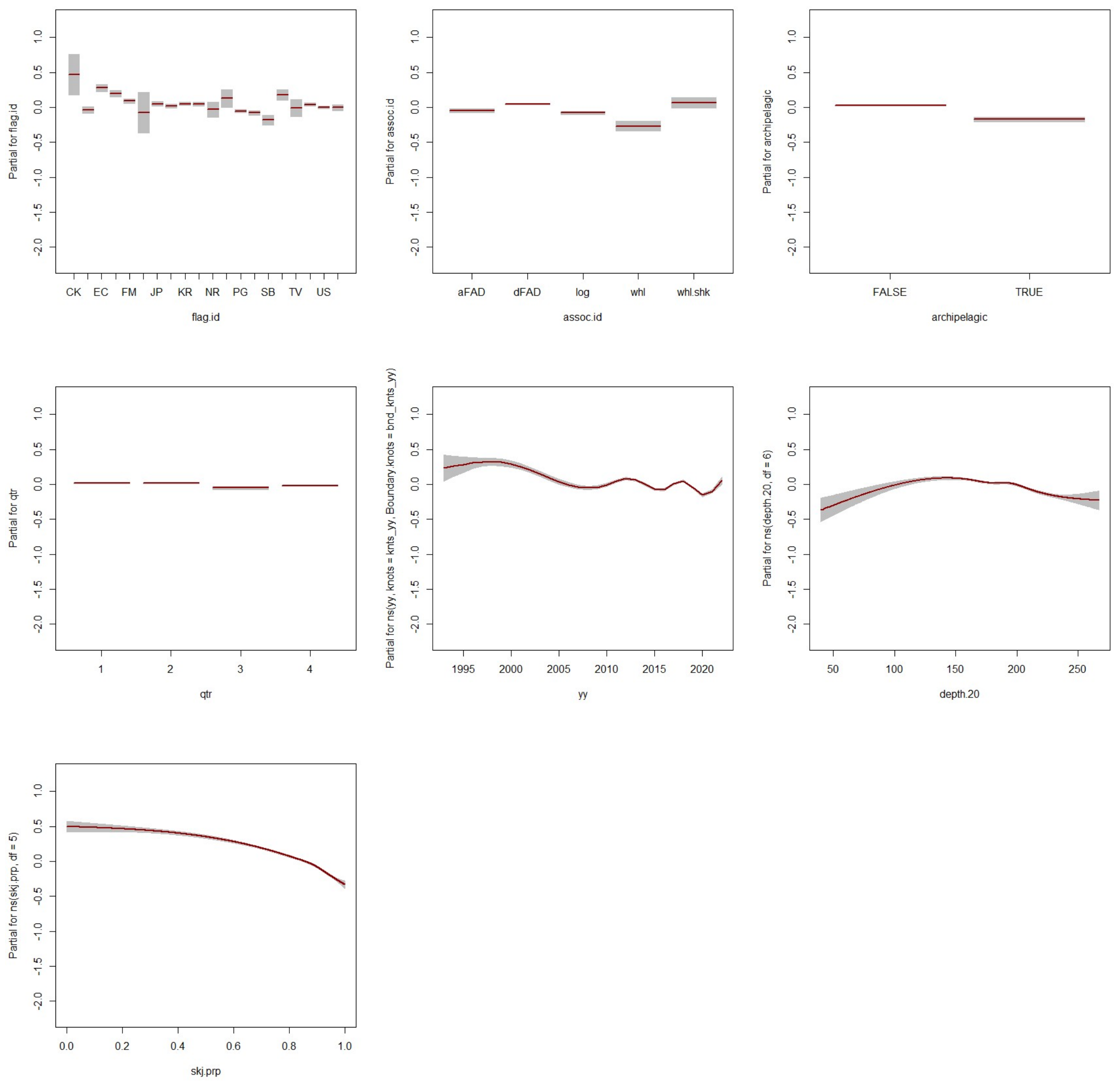

Figure 29 Effect plots for the mean of the beta-component of the bigeye associated model. Top row, left to right: flag; association type (anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk); archipelagic waters. Middle row: left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

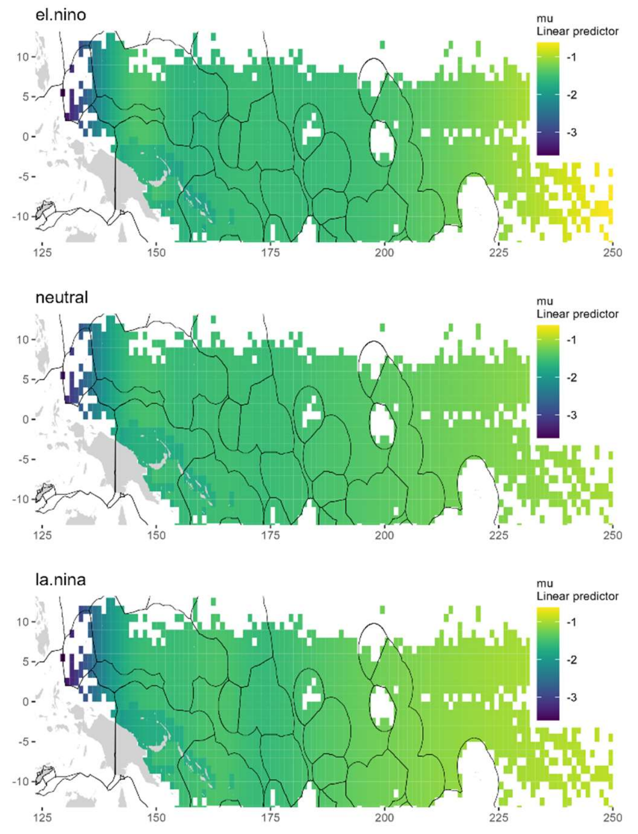

Figure 30 The combined effect of the archipelagic term and the longitude:ONI interaction on the mean of the beta component of the bigeye associated model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

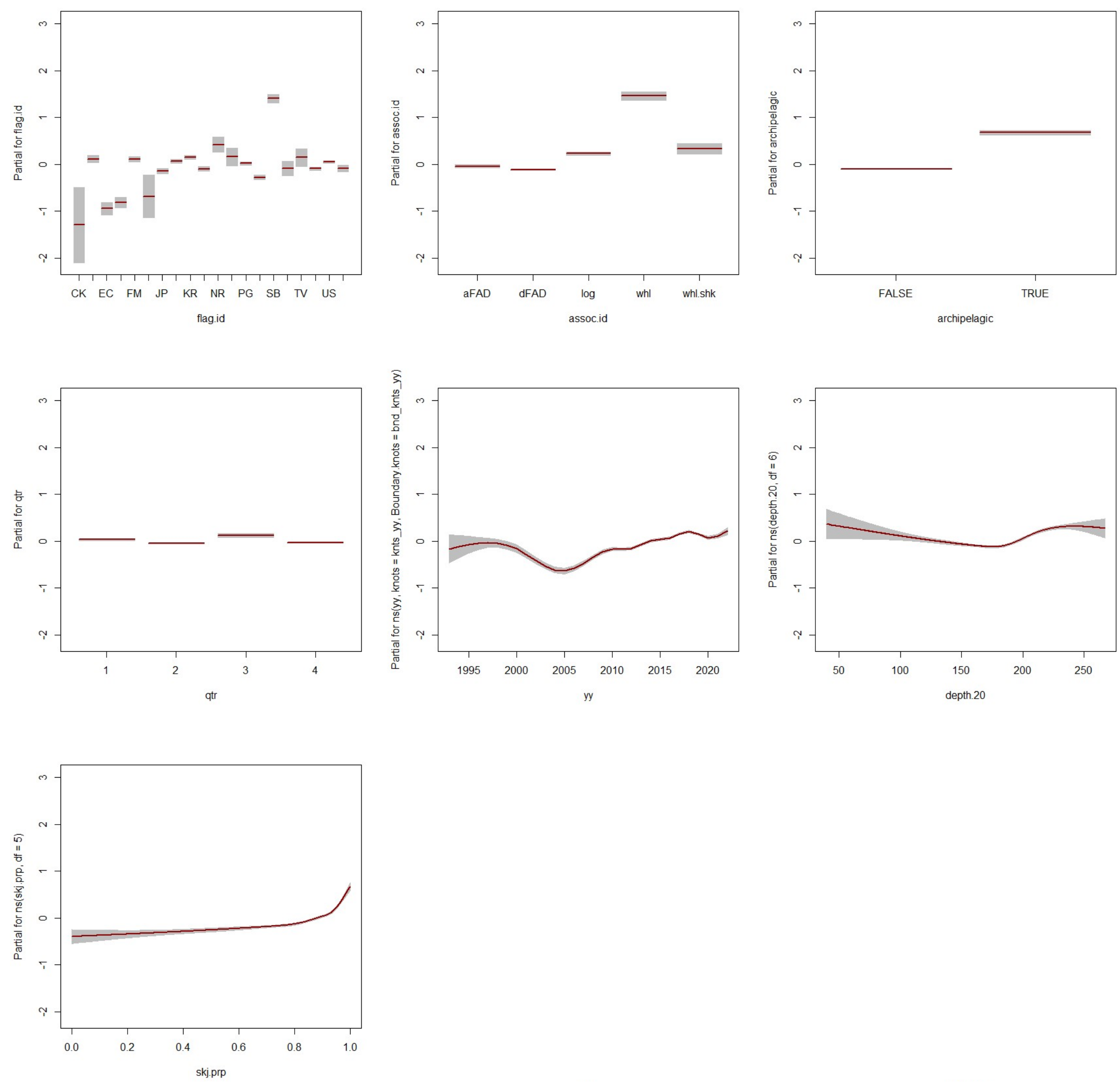

Figure 31 Effect plots for the zero-inflation component of the bigeye associated model. Top row, left to right: flag; association type (anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk); archipelagic waters. Middle row, left to right: quarter; year; isotherm depth. Bottom row: uncorrected skipjack proportion from vessel logbooks.

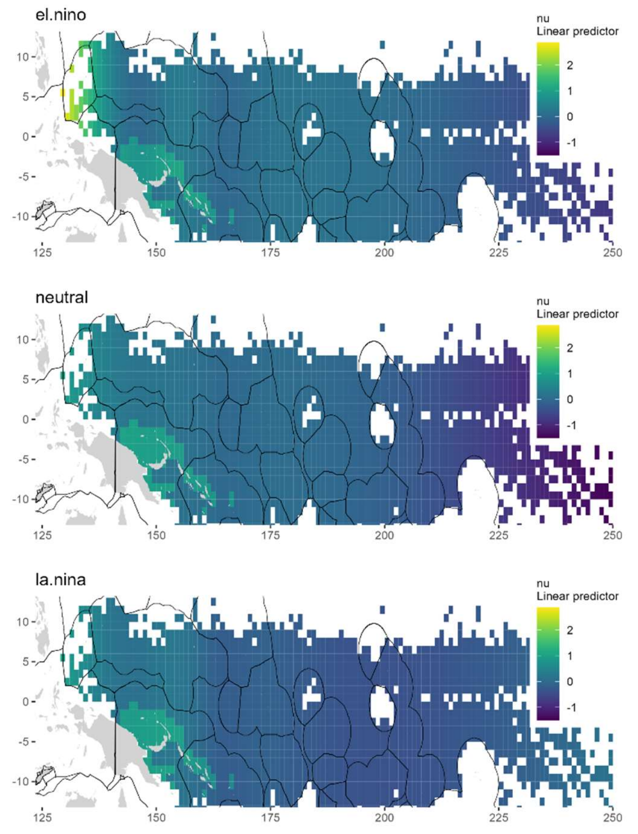

Figure 32 The combined effect of the archipelagic term and the longitude:ONI interaction on the zero-inflation component of the bigeye associated model (top panel – El Nino, middle panel – neutral, bottom panel – La Nina).

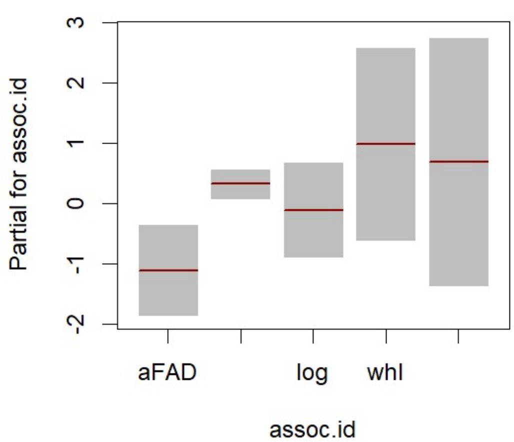

Figure 33 Effect plot for the one-inflation component of the bigeye associated model: association type (anchored FAD – aFAD, drifting FAD – dFAD, log sets, whale associated – whl, and whale shark associated – whl.shk).