Fisheries New Zealand
Tini a Tangaroa

CCSBT-ERS/1905/15
(ERSWG Agenda Item 5.1.3)

Analysis to identify potential high-risk areas (using method 3A)

Edward Abraham[a], Yvan Richard[a], Nathan Walker[b], Will Gibson[b]

[a]Dragonfly Data Science, PO Box 27535, Wellington, New Zealand
[b]Fisheries New Zealand, PO Box 1020, Wellington, New Zealand

New Zealand

Prepared for the 13th Meeting of the Ecologically Related Species Working Group (ERSWG13) of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

May 2019

New Zealand Government

Disclaimer

While every effort has been made to ensure the information in this publication is accurate, Fisheries New Zealand does not accept any responsibility or liability for error of fact, omission, interpretation or opinion that may be present, nor for the consequences of any decisions based on this information.

Contents

Page

1 Abstract

This paper addresses the definition of high-risk areas for seabirds, based on the recommendations of the most recent meeting of the Ecologically Related Species Working Group (ERSWG 12). The meeting recommended that the summed mean risk, across assessed species, be used as a basis for defining high-risk areas.

We applied this definition to the recent risk assessment of surface-longline fishing to seabirds in the Southern Hemisphere, including 26 albatross and petrel taxa that are listed by the Agreement for the Conservation of Albatrosses and Petrels (ACAP) and breed south of 20°S.

The risk to the albatross and petrel species was highest in the mid-latitudes of the Southern Hemisphere, with most of the aggregated mean risk (86.5%) in the core Commission for the Conservation of Southern Bluefin Tuna (CCSBT) statistical areas (other than statistical areas 11, 12, and 13). Most (87.6%) of the surface longline fishing in the core CCSBT areas was by CCSBT member countries.

If a risk threshold was chosen so that all 5-degree cells with a mean aggregated risk over 0.96 were considered high-risk areas, then there are four 5-degree cells that were high risk (two areas in the southern Indian Ocean, near South Africa, and two areas in the Tasman Sea). In this case, 26.1% of the total mean risk and 18% of the CCSBT fishing effort was in high-risk areas. If a risk threshold was chosen so that all 5-degree cells with a mean aggregated risk over 0.32 were considered high-risk areas, then there are 17 5-degree cells that were high risk. In this case, 50.1% of the total mean risk and 39% of the CCSBT fishing effort was in high-risk areas.

There were nine species with a mean aggregated risk over one (meaning that fisheries bycatch is higher than the population sustainability threshold). Reducing the bycatch within the high-risk areas by 50% would reduce the mean risk for wandering albatross to below one. A 50% reduction in captures across all surface longline fishing would leave three species (sooty albatross, Tristan albatross, and Amsterdam albatross) with a mean risk above one.

2 Introduction

This paper addresses the definition of high-risk areas for seabirds. It was based on the recommendations of the most recent meeting of the Ecologically Related Species Working Group (ERSWG). A number of options were presented for defining risk, such as using 1) seabird distributions, 2) estimated captures, or 3) total estimated risk, where the risk to each seabird species is the ratio of estimated fatalities to a measure of population productivity (Walker et al. 2017). The meeting recommended that the summed mean risk (option 3), across assessed species, be used as a basis for defining high-risk areas.

The meeting also considered whether the risk measure should be applied a) to all assessed species, b) to species that had risk above an agreed threshold, or c) to a fixed number of species (the top five). In the application of these measures to results from the New Zealand seabird risk assessment (Richard 2016) it was found that the selection of species had little impact on the area with high aggregate risk, and the meeting recommended that all species (option a) be used.

Since the meeting, the risk assessment method has been applied to the twenty-five albatross and petrel species listed by the Agreement for the Conservation of Albatrosses and Petrels (ACAP) and which breed south of 20°S. The risk to these species from Southern Hemisphere surface longline fishing was estimated, based on observer data from Japan, New Zealand, South Africa and Australia (Abraham et al. 2019). Nine taxa were identified for which the estimated annual captures in surface longline fisheries exceeded the population productivity, namely: Amsterdam albatross (*Diomedea amsterdamensis*), sooty albatross (*Phoebetria fusca*), Tristan albatross (*D. dabbenena*), Gibson's albatross (*D. antipodensis gibsoni*), grey-headed albatross (*Thalassarche chrysostoma*), Buller's albatross (*T. bulleri*), black petrel (*Procellaria parkinsoni*), spectacled petrel (*Pr. conspicillata*) and wandering albatross (*D. exulans*).

In this study, we applied the method for identifying high-risk areas (option 3a) to the results from the seabird risk assessment (Abraham et al. 2019).

3 Methods

The risk to seabirds from surface longline fishing was estimated by Abraham et al. (2019). This risk was estimated for 26 taxa, including all albatrosses (*Diomedea* spp., *Thalassarche* spp., and *Phoebetria* spp.), giant petrels (*Macronectes* spp.) and all large petrels (*Procellaria* spp.) that breed south of 20°S: wandering albatross (*D. exulans*), Antipodean albatross (*D. antipodensis antipodensis*), Gibson's albatross (*D. antipodensis gibsoni*), Tristan albatross (*D. dabbenena*), Amsterdam albatross (*D. amsterdamensis*), southern royal albatross (*D. epomophora*), northern royal albatross (*D. sanfordi*), Atlantic yellow-nosed albatross (*T. chlororhynchos),* Indian yellow-nosed albatross (*T. carteri*), black-browed albatross (*T. melanophris*), Campbell black-browed albatross (*T. impavida*), grey-headed albatross (*T. chrysostoma*), Buller's albatross (*T. bulleri*), shy albatross (*T. cauta*), white-capped albatross (T. steadi), Chatham Island albatross (*T. eremita*), Salvin's albatross (*T. salvini*), sooty albatross (*P. fusca*), light-mantled sooty albatross (*P. palpebrata*), southern giant petrel (*Macronectes giganteus*), northern giant petrel *(M. halli*), white-chinned petrel (*Pr. aequinoctialis*), Westland petrel (*Pr. westlandica*), black petrel (*Pr. parkinsoni*), grey petrel (*Pr. cinerea*) and spectacled petrel (*P. conspicillata*). These species included two subspecies of Antipodean albatross, and are the 25 southern species species that are included in the Agreement on the Conservation of Albatrosses and Petrels (ACAP).

In this analysis, the risk from high-seas surface longline fishing to seabirds was only considered for these taxa. Out of over 4900 observed seabird captures included in the analysis from Japan, New Zealand, South Africa and New Zealand, there were only three observed captures of species that were not included in the risk assessment–one great crested tern (*Sterna bergii*), one flesh-footed shearwater (*Puffinus carneipes*), and one Cape pigeon (*Daption capense*).

In the current study, the risk is represented as a ratio of estimated annual captures to a measure of the population productivity (the Population Sustainability Threshold, PST; Abraham et al. 2019). The captures were estimated from observer data, on the assumption that, for any species and fleet, the captures are the product of a vulnerability term and the overlap between the species distribution and the distribution of fishing effort (Abraham et al. 2019). The captures were estimated for 2016, which was considered to be a year representative of recent fishing patterns. The captures were estimated on a 5 by 5 latitude-longitude grid throughout the Southern Hemisphere. The mean risk was then summed across the 26 taxa, to derive a risk score for each 5-degree cell. For any single taxon, a risk score larger than one indicated that the fisheries mortalities were higher than the PST. When the species risks are summed together, a high mean risk score may result from either a few high-risk species, or many low-risk species.

A threshold was set on the risk scores, selecting the 5-degree cells above the threshold, and these cells were taken to represent high-risk areas.

The risk was derived by applying a fitted statistical model to all tuna fishing within the Southern Hemisphere. The effort was derived from public datasets provided by Tuna Regional Fishery Management Organizations (t-RFMOs); where effort was reported by a flag state to multiple t-RFMOs (in the same 5-degree cell, year, and quarter), the reporting with the largest number of hooks was selected (Abraham et al. 2019). In the reporting here, fishing effort was considered to be relevant to the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) if it was in the core CCSBT statistical areas (statistical areas 1 to 10, 14 and 15), and if the fishing was by one of the members of the extended commission (Australia, European Union, Fishing Entity of Taiwan, Indonesia, Japan, Republic of Korea, New Zealand or South Africa).

4 Results

4.1 TOTAL FISHING EFFORT

The total fishing effort in CCSBT core areas during 2016 was 146.4 million hooks (Table 1). Of this total, 128.0 million (87.6%) hooks were set by CCSBT member countries. Of the total number of hooks, 96.1 million (65.7%) hooks were set at latitudes between 30 and 40°S. There were few (less than 50 000) surface longline hooks reported from latitudes south of 45°S.

4.2 RISK DISTRIBUTION

There was some risk to the ACAP-listed albatross and petrel species throughout most of the mid-latitude Southern Hemisphere (where there is both surface longline fishing and presence of at least one of the 26 taxa) (Figure 1). The total mean risk, over the whole Southern Hemisphere was 24.2. The total mean risk in the CCSBT core areas was 20.9, indicating that 86.5% of the risk to the ACAP-listed species was within the CCSBT core areas.

There was little surface longline fishing, or risk at higher latitudes, south of 45°S. The highest risk was in a cell to the south and east of South Africa (the 5-degree cell centered on 32.5°E, 37.5°S). The total risk in this cell was 2.89, reflecting 12.0% of the total mean risk. The CCSBT effort in this cell was the highest of any cell, with 12.8 million hooks set by CCSBT members during 2016; this effort was over twice the effort of that in the next highest cell, which had 5.5 million hooks set by CCSBT members.

4.3 RELATIONSHIP BETWEEN EFFORT AND RISK IN HIGH-RISK AREAS

When the risk threshold was decreased, it resulted in an increasing number of cells within the defined high-risk areas (Figure 2). There was no value of the risk threshold that would protect a high proportion of the risk, while impacting on only a small proportion of the total effort. With a risk threshold of 0.96, there were four cells at or above the threshold, with a total of 26.1% of the total mean risk within those four cells. With a risk threshold of 0.32, there were seventeen cells at or above the threshold, with a total of 50.2% of the total mean risk within the high-risk area.

4.3.1 High-risk threshold scenario

In this scenario, the threshold was set so that around one quarter (26.1%) of the total mean risk was in high-risk areas. With this threshold (set so that all cells with a mean risk higher than 0.96 were in the high-risk area), there were four cells that would be identified as high-risk areas (Figure 3): two cells in the southern Indian Ocean, close to South Africa, and two cells in the Tasman Sea. The total number of hooks set by CCSBT member countries in these areas during 2016 was 26.4 million, which is 18% of the total hooks of all hooks set in CCSBT areas by CCSBT member countries. The total number of hooks set in these high-risk areas by non-CCSBT countries was 4.5 million.

In these areas, there were 17.7 million hooks set by the Fishing Entity of Taiwan, 4.5 million hooks set by the Seychelles, 4.0 million hook set by Japan, and 0.2 million hooks set by other countries during 2016.

Under the high-risk threshold scenario, Gibson's albatross was the taxon with the highest risk inside the high-risk areas (Table 2). This risk was in the Tasman Sea areas, close to the breeding colony for Gibson's albatross at Auckland Islands. The mean risk outside these high-risk areas was reduced below one for Gibson's albatross and for wandering albatross.

4.3.2 Medium-risk threshold scenario

In this scenario, the threshold was set so that around one half (50.1%) of the total mean risk was in high-risk areas. With this threshold (set so that all cells with a mean risk higher than 0.32 were in the high-risk area), there were 17 cells that defined the high-risk area (Figure 4): nine cells in the southern Indian Ocean, three cells in the south Atlantic Ocean, close to Gough Island, five cells in the Tasman Sea, and one cell by north-east New Zealand. The total number of hooks set by CCSBT member countries in these areas during 2016 was 49.6 million, which was 39% of the total hooks of all hooks set in CCSBT areas by CCSBT member countries. The total number of hooks set in these high-risk areas by non-CCSBT countries was 7.8 million.

In these areas, there were 33.3 million hooks set by the Fishing Entity of Taiwan, 9.8 million hooks set by Japan, 4.9 million hooks set by the Seychelles, 4.0 million hooks set by Korea, 2.3 million hooks set by China, 1.2 million hooks set by New Zealand, and 1.8 million hooks set by a range of other countries in 2016.

Under the medium-risk threshold scenario, Amsterdam albatross was the taxon with the highest risk inside the high-risk areas, followed by Gibson’s albatross, sooty albatross and Tristan albatross (Table 3). The mean risk outside these high-risk areas was reduced below one for Gibson’s albatross, Bulletr’s albatross and wandering albatross.

4.3.3 Species in high-risk areas

In the highest risk cell (in the southern Indian Ocean, to the east of South Africa; 32.5°E, 37.5°S), there were five species that had a mean risk of between 0.3 and 0.5 within that cell alone: Amsterdam albatross, sooty albatross, wandering albatross, light-mantled sooty albatross, grey-headed albatross and Tristan albatross. As an indication of the potential impact of an increase in mitigation in areas above the threshold, we considered the number of species that would have a mean risk higher than one, if the risk from the high-risk areas was reduced by 50%, and the risk outside these areas remained the same (Figure 5).

To understand the potential impact of increased management of seabird bycatch in the high-risk areas, we considered a scenario in which bycatch in the high-risk areas was reduced by 50% (while bycatch outside the high-risk areas remained the same)(Figure 5). As the risk threshold was decreased, the size of the high-risk areas increased and the bycatch reduction applied to an increasing proportion of the total bycatch. The number of species with a mean risk above one decreased. With the threshold set so that around one-quarter of the risk was in the high-risk area (the high-risk threshold scenario), the mean risk to wandering albatross declined below one, whereas the mean risk to the other eight species remained above one. As the risk threshold increased to close to 100% (so the bycatch reduction applied to all Southern Hemisphere surface longline fishing), the mean risk fell below one for all but three species (sooty shearwater, Amsterdam albatross and Tristan albatross).

5 Discussion

5.1 HIGH-RISK AREAS

The risk assessment of ACAP-listed albatross and petrels found that there were nine species with a risk threshold that was higher than one (Abraham et al. 2019). These species included all the wandering albatross taxa (with the exception of Antipodean albatross), and also sooty albatross, grey-headed albatross, Buller’s albatross, black petrel and spectacled petrel.

The risk to the albatross and petrel species was highest in the mid-latitudes of the Southern Hemisphere, with most of the aggregated mean risk (86.5%) in the core CCSBT areas. Most (87.6%) of the surface longline fishing in the core CCSBT areas was by CCSBT member countries.

Reducing the risk within the high-risk areas by 50% would reduce the mean risk for wandering albatross to below one. A 50% reduction in captures across all surface longline fishing would leave three species (sooty albatross, Tristan albatross, and Amsterdam albatross) with a mean risk above one.

5.2 FUTURE IMPROVEMENTS

There is scope to continue the development of the risk assessment, including updated seabird tracking data, updated observer data, accounting for cryptic mortality and for the survival of live releases.

The current risk assessment was based on seabird distributions derived from seabird tracking data, where these data were available. For many species and colonies, tracking data are limited. The risk assessment was based on the best information available at the time; however, there may be marked changes for some species as tracking data improve. For example, tracking data for spectacled petrel was limited, and the finding of high risk for this species was not consistent with the population data, which show a long-term increase in the population.

In addition, other applications of the risk assessment method have allowed both for cryptic mortality (seabird bycatch that would not be recorded by observers, such as seabirds that are hooked but fall off the line before the haul) and for the survival of live releases (e.g., Richard et al. 2017). Future updates of the risk assessment may be able to incorporate cryptic mortality and the survival of captures.

There is also potential for other improvements to the methods. A key assumption in estimating the risk was that the catchability of high-seas fleets not included in the analysis (such as Taiwan and Korea) was the same as for the Japanese fleet. The collection of species-resolved observer data on seabird captures would help to improve the risk assessment.

6 References

Abraham, E.R.; Richard, Y; Walker, N.; Gibson, W.; Daisuke, O.; Tsuji, S., and others (2019). Assessment of the risk of surface-longline fisheries in the Southern Hemisphere to albatrosses and petrels, for 2016. CCSBT-ERS/19xx/xx. Draft.

Francis, M.; Hoyle, S.D. (2019). Estimation of fishing effort in the Southern Hemisphere. Draft New Zealand Aquatic Environment and Biodiversity Report. Ministry for Primary Industries, Wellington, New Zealand.

Richard, Y.; Abraham, E.R.; Berkenbusch, K. (2017). Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2014–15. New Zealand Aquatic Environment and Biodiversity Report No. 191. Ministry for Primary Industries, Wellington, New Zealand.

Walker, N.; Vallieres, D.; Richard, Y. (2019). Defining “high risk areas” in southern bluefin tuna fisheries New Zealand. Paper presented to the 12th Meeting of the CCSBT Ecologically Related Species Working Group (ERSWG12). CCSBT-ERS/1703/13.

7 Appendix

7.1 TABLES

Table 1. Fishing effort within the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) core areas during the 2016 calendar year, summarised by flag country. Fishing effort is presented as reported to the tuna Regional Fisheries Management Organisations (t-RFMOs) (Francis & Hoyle 2019). Shown for each flag country is the CCSBT membership status (via Eur) and the reported number of hooks set (in millions of hooks) in 2016.

Flag country	CCSBT	Hooks (millions)
Fishing Entity of Taiwan	✔	68.42
Japan	✔	34.21
Spain	✔	8.46
Republic of Korea	✔	7.91
Seychelles		5.91
China		5.40
Reunion		3.10
Australia	✔	2.82
New Zealand	✔	2.38
Namibia		1.99
South Africa	✔	1.84
Portugal	✔	1.67
Other		2.27
Total		**146.4**

Table 2. Risk to each species inside the high-risk areas (for the high risk-threshold scenario). Shown are for each species with a mean risk over 0.5, the total mean risk, the mean risk inside the high-risk areas, and the mean risk outside the high-risk areas.

Taxon	Mean risk	Mean risk inside high-risk areas	Mean risk outside high-risk areas
Amsterdam albatross	3.71	0.71	3.03
Sooty albatross	2.74	0.62	2.12
Tristan albatross	2.40	0.68	1.78
Gibson's albatross	1.80	1.10	0.73
Black petrel	1.60	0.01	1.63
Grey-headed albatross	1.59	0.56	1.04
Buller's albatross	1.53	0.53	1.00
Spectacled petrel	1.48	0.00	1.50
Wandering albatross	1.26	0.63	0.64
Light-mantled sooty albatross	0.93	0.54	0.40
Campbell black-browed albatross	0.75	0.09	0.65
Indian yellow-nosed albatross	0.59	0.17	0.41

Table 3. Risk to each species inside the high-risk areas (for the medium-risk threshold scenario). Shown are for each species with a mean risk over 0.5, the total mean risk, the mean risk inside the high-risk areas, and the mean risk outside the high-risk areas.

Taxon	Mean risk	Mean risk inside high-risk areas	Mean risk outside high-risk areas
Amsterdam albatross	3.71	2.35	1.39
Sooty albatross	2.74	1.49	1.25
Tristan albatross	2.40	1.31	1.16
Gibson's albatross	1.80	1.52	0.30
Black petrel	1.60	0.30	1.34
Grey-headed albatross	1.59	0.95	0.65
Buller's albatross	1.53	0.82	0.71
Spectacled petrel	1.48	0.04	1.47
Wandering albatross	1.26	0.84	0.42
Light-mantled sooty albatross	0.93	0.74	0.19
Campbell black-browed albatross	0.75	0.16	0.58
Indian yellow-nosed albatross	0.59	0.27	0.31

7.2 FIGURES

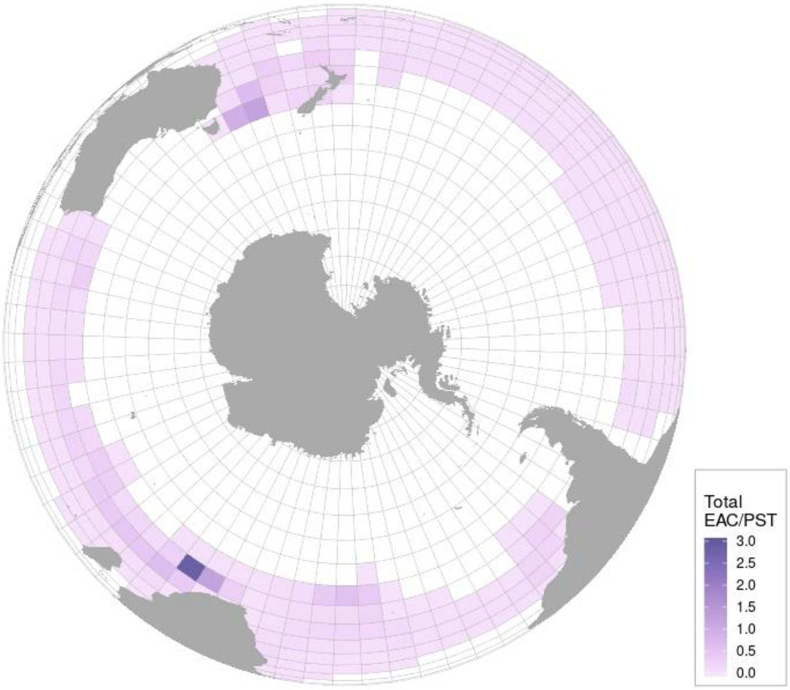

Figure 1. Aggregate risk (Estimated Annual Captures to Population Sustainability Threshold, EAC/PST) to seabirds from surface-longline fishing in the Southern Hemisphere. Risk is the summed risk ratio from each of the 26 seabird taxa included in this analysis.

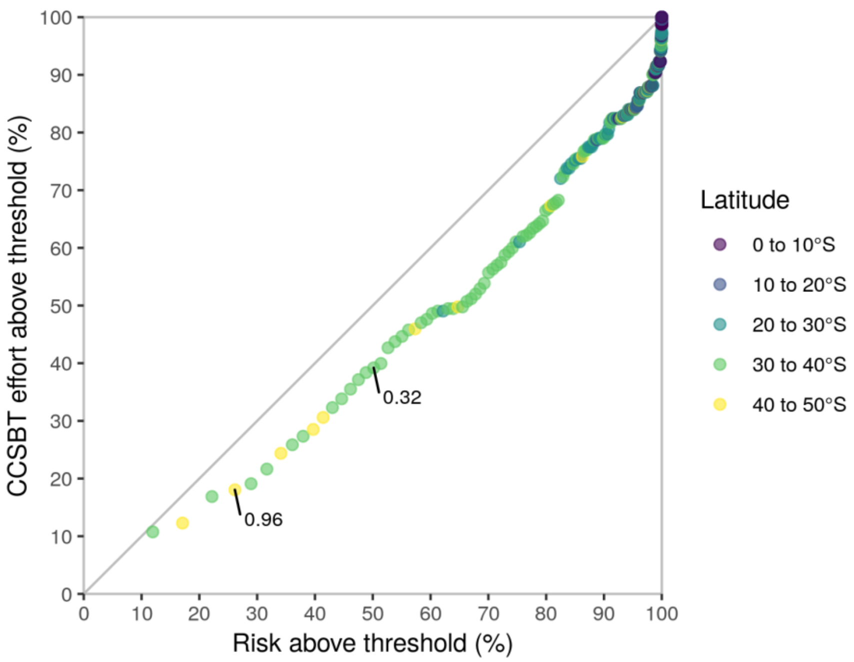

Figure 2. Change in the proportion of surface-longline effort in Commission for the Conservation of Southern Bluefin Tuna (CCSBT) areas and the proportion of the total risk, within high-risk areas, as the risk threshold was decreased. Dots are coloured by the 10° latitude band and values are marked at which more than 25% and 50% of the risk was above the risk threshold.

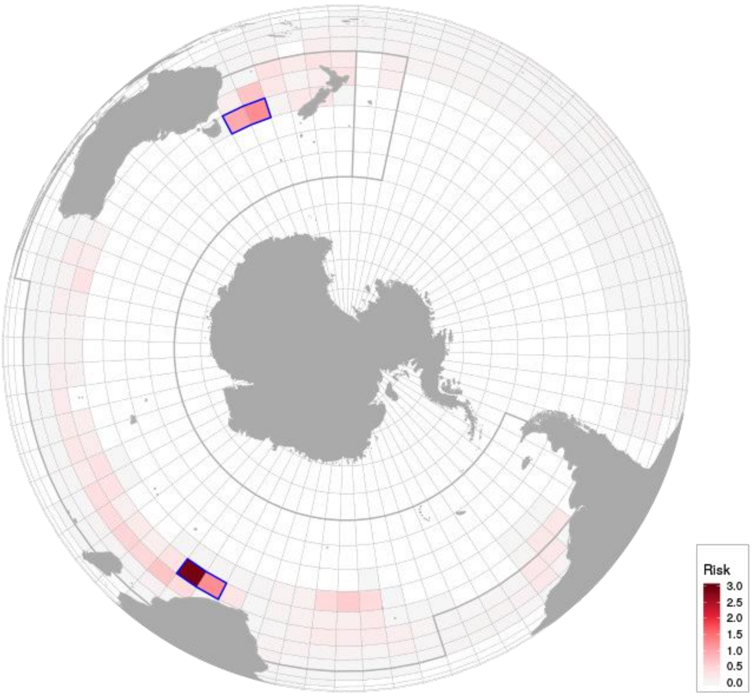

Figure 3. High-risk areas identified by a threshold of a mean risk of 0.96 (high risk-threshold scenario). The colour of each cell is proportional to the aggregate mean risk within the cell. Blue borders mark high-risk areas, grey lines indicate the outer boundary of the core Commission for the Conservation of Southern Bluefin Tuna statistical areas (excluding statistical areas 11, 12, and 13).

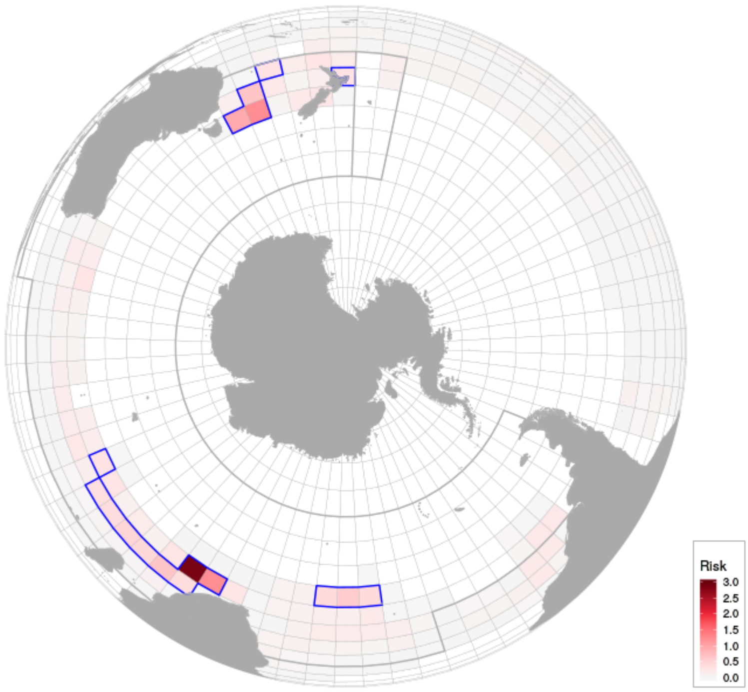

Figure 4. High-risk areas identified by a threshold of a mean risk of 0.32 (medium risk-threshold) scenario. The colour of each cell is proportional to the aggregate mean risk within the cell. Blue borders mark the high-risk areas, grey lines indicate the outer boundary of the core Commission for the Conservation of Southern Bluefin Tuna statistical areas (excluding statistical areas 11, 12, and 13).

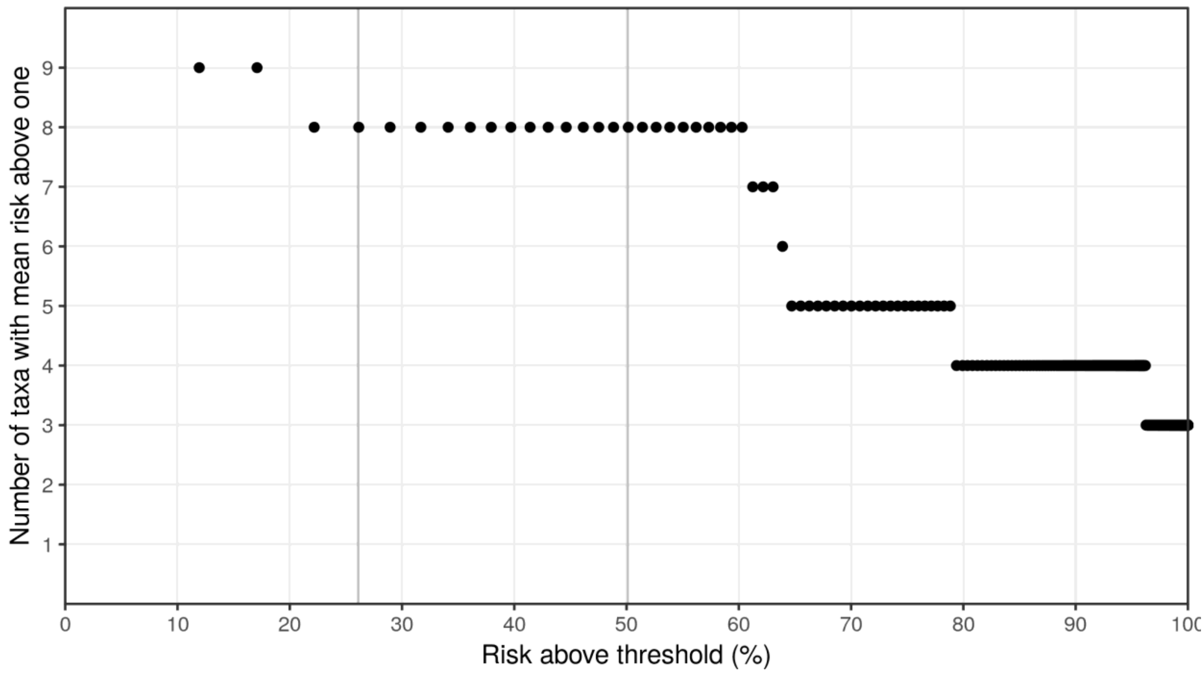

Figure 5. Change in the number of taxa with a total mean risk above one, if risk in the cells above the threshold was reduced by 50%, in relation to the cumulative risk above the threshold. Dots indicate the addition of an extra cell to the high-risk area, vertical lines indicate the values at which more than 25% and 50% of the risk was above the risk threshold.