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**Potential Impact of Fishing Activity in the SPRFMO Area to Seabirds**

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# 1.0 Introduction

Incidental mortality in fisheries is widely acknowledged to be a major threat to marine biodiversity, with the potential for deleterious long-term impacts on species of seabirds, turtles and sharks (Alverson *et al* 1996). For seabirds, albatrosses, petrels and shearwaters are the most susceptible to incidental mortality in longline and trawl fisheries. Seventeen of the 22 species of albatross are threatened with extinction, with the major threat to most species recognised as incidental mortality. A further seven species of petrel listed under the Agreement for the Conservation of Albatrosses and Petrels (ACAP), face similar threats (ACAP 2012).

Seabirds are vulnerable as they are attracted to vessels by the availability of bait and discards. Increases in adult mortality readily result in significant adverse impacts on populations, several times more so than the loss of young birds (Robertson & Gales, 1998). Risks to seabirds from gillnet fisheries and demersal and pelagic long lines are well recognised. It is estimated that at least 160,000 (and potentially in excess of 320,000) seabirds are killed annually in all longline fisheries globally (Anderson *et al,* 2011). Simple and cost effective measures exist capable of dramatically reducing seabird bycatch in longline fisheries, and there are now a range of examples worldwide in which longline fisheries have reduced bycatch by over 80% (Croxall, 2008, Abraham & Finlay 2009). For pelagic longline fisheries, recognised best practice is to use a combination of bird streamer lines, line weighting and night setting (ACAP 2011). Seabird bycatch in trawl fisheries is also increasingly documented: seabirds can become entangled during shooting and hauling in nets or killed by collision with warp cables as they forage behind the vessel (Sullivan et al 2006). Trawl fisheries in New Zealand's EEZ have killed significant numbers of albatrosses, but reductions have resulted from mandatory application of warp mitigation, use of paired bird scaring lines and offal management (Bull, 2007; Abraham & Thompson, 2011). Little information is available on purse seine fisheries, however they have largely been considered not to catch birds. However, recent evidence from work carried out by the Albatross Task Force in South America suggests that, for some fisheries using purse seining, there may be significant risk to seabirds (ATF, 2012)

The FAO Code of Conduct for Responsible Fisheries (1995) and the UN Fish Stocks Agreement (1995) established the duty of states and Regional Fisheries Management Organisations (RFMOs) to minimise bycatch of non-target species, and established the 'Ecosystem Approach' and the 'Precautionary Approach' as key principles. Globally, RFMOs are increasingly adopting conservation management measures to require vessels to use bycatch mitigation measures. One of the first and most recognised examples is the Commission for the Conservation of Antarctic Marine Living

Resources (CCAMLR), which has successfully reduced seabird bycatch in its demersal longline fisheries by over 90% (Croxall 2008).The South East Atlantic Fisheries Organisation (SEAFO) has also established requirements for seabird bycatch mitigation measures to be used by its longline and trawl fisheries. In addition, all five tuna RFMOs now require longline vessels to use seabird bycatch mitigation measures in areas overlapping with albatross distribution.

The convention text of the South Pacific Fisheries Management Organisation (SPRFMO) establishes as a core principle the mitigation of impacts on non-target and associated species. There are a variety of SPRFMO fisheries with potential impacts to seabirds, and requirements have been established for data collection. However, as yet very few bycatch data are available for SPRFMO fisheries. This paper therefore undertakes an initial step by assessing how SPRFMO fisheries overlap with seabird distribution and the potential for interaction with these fisheries.

## 2.0 Data Sources and Methods.

Information used in this report has been obtained from a number of sources.

### *2.1 Seabird distribution data*

Birdlife International manages a database which brings together remote tracking data for albatrosses, petrels and shearwaters (www.seabirdtracking.org). Data owners gave permission to use these remote tracking data to estimate density distribution maps for seabird species for this analysis. Maps were created for the breeding and non-breeding distributions for each South Pacific seabird species for which data were available. Methods for estimating density distribution followed the standardised methods. Tracking data was filtered to remove erroneous locations, interpolated to represent hourly locations and aggregated to groups based on the species, breeding population and life history stage of the tracked bird. Kernel Density Estimation was applied to each group (hereafter termed datagroup). Kernel Density Estimation is a measure of point density and here allows us to identify the areas of highest hourly location density, i.e. the areas most heavily used by all tracked birds. Each datagroup's Kernel density output is then multiplied by the proportion of the global population it represents and the duration of its life history stage, and the results are summed within species to calculate the most accurate representations of breeding and non-breeding distributions possible for each species. By calculating the cumulative total of each of these breeding and non- breeding distributions we identified the Utilisation Distributions (UDs) illustrating the area in which the species spends the most of its time at-sea - 50, 75, 95 and 99%. Maps were also made for all species aggregated. To calculate these, all species were treated equally and summed accordingly. UDs were calculated in the same way. We also calculated the percent time that each species spends in the SPRFMO Area and adjacent EEZs.

Seabird tracking data were available for 22 species of albatross, petrel and shearwater, but is not a complete list of species likely to be affected by bycatch in the South Pacific. No tracking data were available in the database for species such as penguins and pelicans. In addition, for some species, colonies or breeding stage, sample sizes are small or there are data gaps. Information on sample sizes is available at www.seabirdtracking.org. While data gaps restrict the analysis for some species, deficiencies in seabird distribution data are matched by gaps in available fishing catch data. This paper is intended as a first scoping for SPRFMO on areas of potential seabird interaction, and should be interpreted in this fashion.

### 2.2 Fishing distribution data

Catch data for the period 2007-2009 were supplied by the SPRFMO Secretariat where it met the '3 vessel rule[1] . This included data from Belize, Chile, China, EU, Korea, Russia and Chinese Taipei, and enabled us to plot average annual catch for the major fisheries of Chilean jack mackerel (CJM), chub mackerel (MAS) and jumbo squid (GIS). Some data held by the Secretariat couldn't be provided to us, either because it didn't meet the '3 vessel' rule or it wasn't supplied in a form that allowed the secretariat to extract it at this stage.

Data from New Zealand (NZ) were supplied to the SPRFMO Secretariat for an unknown number of vessels so could not be supplied to BirdLife for this analysis and for Australia there were less than 3 vessels fishing in the region during that period. However, fishing distribution data were used from the Bottom Fishery Impact Assessments for both NZ and Australia, available on the SPRFMO web site. These reports give an indication of the nature and effort of those fisheries, though for a different time series.

Significant gaps in catch data for the SPRFMO area remain. The SPRFMO catch data included in this analysis, for CJM, MAS and GIS represents around 59, 64 and 65 %, respectively, of total SPRFMO catch reported(excluding EEZ data), as determined from the catch data submitted to the secretariat and total catch reported on the SPRFMO web site, (Table 1).

Table 1. Total catch mapped for CJM, MAS and GIS in this analysis versus total catch reported to SPRFMO

| Year | CJM (t) catch mapped | Total CJM catch (t) | % CJM mapped | MAS (t) catch mapped | Total MAS catch (t) | % MAS mapped | GIS (t) catch mapped | Total GIS catch (t) | % GIS mapped |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 480,741 | 690,858 | 69.6 | 56,468 | 82,470 | 68 | 46,400 | 64,713 | 72 |
| 2008 | 584,373 | 922,423 | 63.4 | 38,102 | 62,598 | 61 | 110,225 | 111,029 | 99 |
| 2009 | 300,866 | 717,062 | 42 | 18,827 | 32,835 | 57 | 12,319 | 82,319 | 15 |
| Average | 455,327 | 776,781 | 59 | 37,799 | 59,301 | 64 | 56,315 | 86,020 | 65 |

As a consequence of data gaps, the availability of catch data rather than effort data, and the relatively short time period of available data (3 years), our maps must be therefore considered only indicative of effort. The distribution of the fishing effort appears to change yearly and seasonally, moving between EEZs and the SPRFMO area.

### 2.3 Seabird threat data

Where seabird species are mentioned in the text the notation following represents the IUCN threat category http://www.iucnredlist.org . There is also a link to ACAP listed species assessments for information on species potentially at most risk http://www.acap.aq/acap-species.

## 3.0 Distribution of seabirds in SPRFMO area

The combined breeding and non-breeding distributions for the 22 seabird species for which tracking distribution data were available are shown in Maps 1 & 2. Many species breed in New Zealand, resulting in highest concentrations in the SW Pacific during the breeding season. However, during the non-breeding season, many species migrate across the South Pacific, with high concentrations of non-breeding birds foraging in the Humboldt Current (Spear *et al* 2003), but with distributions also

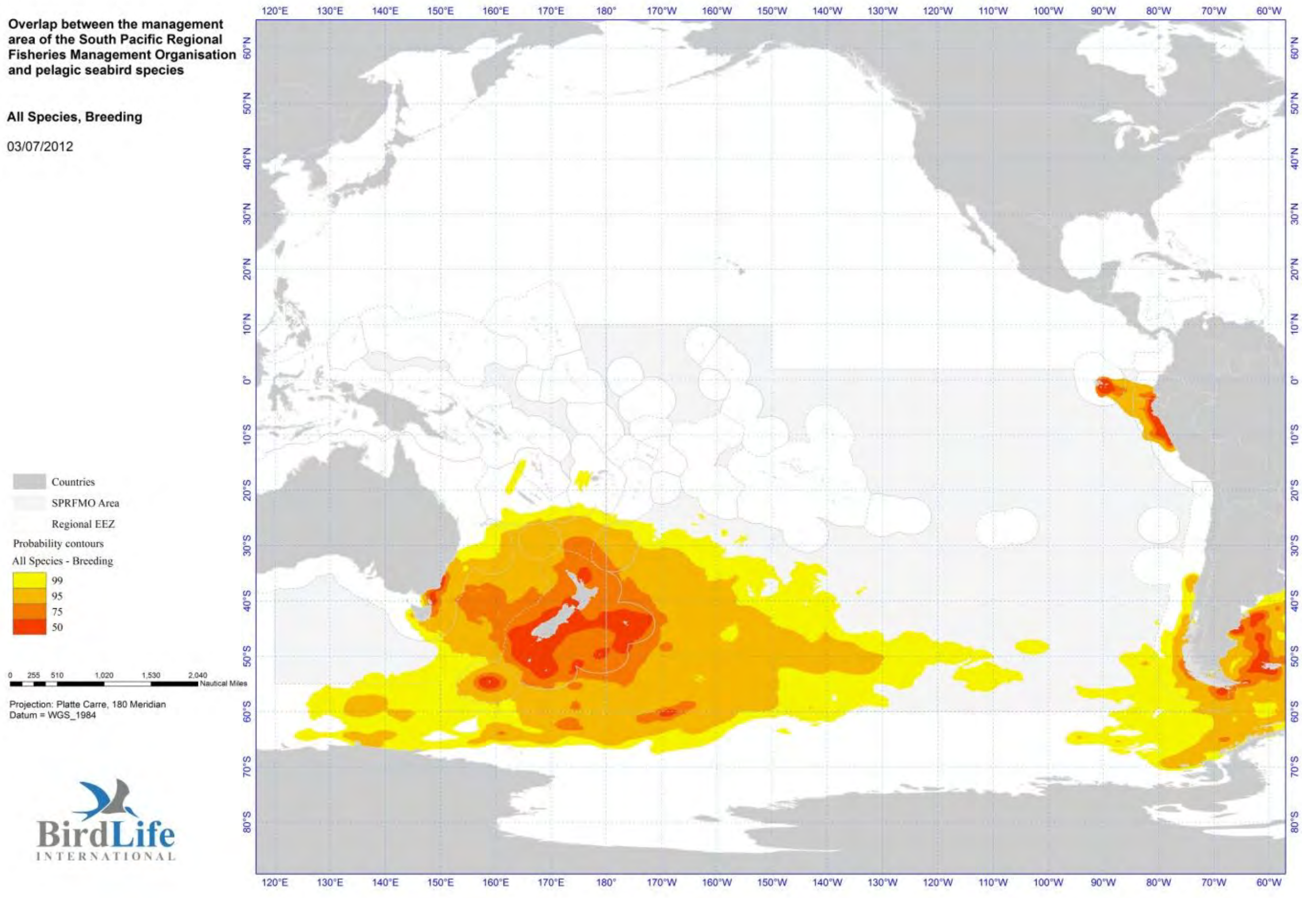
[1] Standards for the collection, reporting, verification and exchange of data (3 Feb 2012), SPRFMO web site

including wide areas of the high seas. In addition, species breeding in Southern Chile migrate further north in the non-breeding season.

Table 3 summarises the estimated percent time spent by each seabird species in the high seas SPRFMO area and in the EEZs of Chile, New Zealand, Australia, Peru and Ecuador (percentages of 20% or more are highlighted in red in the table). Other EEZs, not shown in Table 3, had negligible percent time spent by the seabirds in this analysis.

Nine seabird species spent a significant period of time in the SPRMO area during their non-breeding, breeding or both seasons. These were Antipodean (*Diomedea antipodensis,* VU), Buller's (*Thalassarche bulleri*, NT), Chatham (T. *eremita,* VU) and Salvin's (*T. salvini,* VU) albatrosses; Chatham (*Pterodroma axilaris*, CR), Cooks (*P. Cooki*, VU), grey (*Procellaria cinerea,* NT) and Parkinson's (*Procellaria parkinsoni*, VU) petrels; and sooty shearwater (*Puffinus griseus*, NT). Maps for each of the 22 seabirds species are given in Appendix 2.

### *Map 1: Density distributions of 22 species during breeding in the SPRFMO Convention area*



## *Map 2: Density distributions of 22 species during non-breeding in the SPRFMO Convention area*

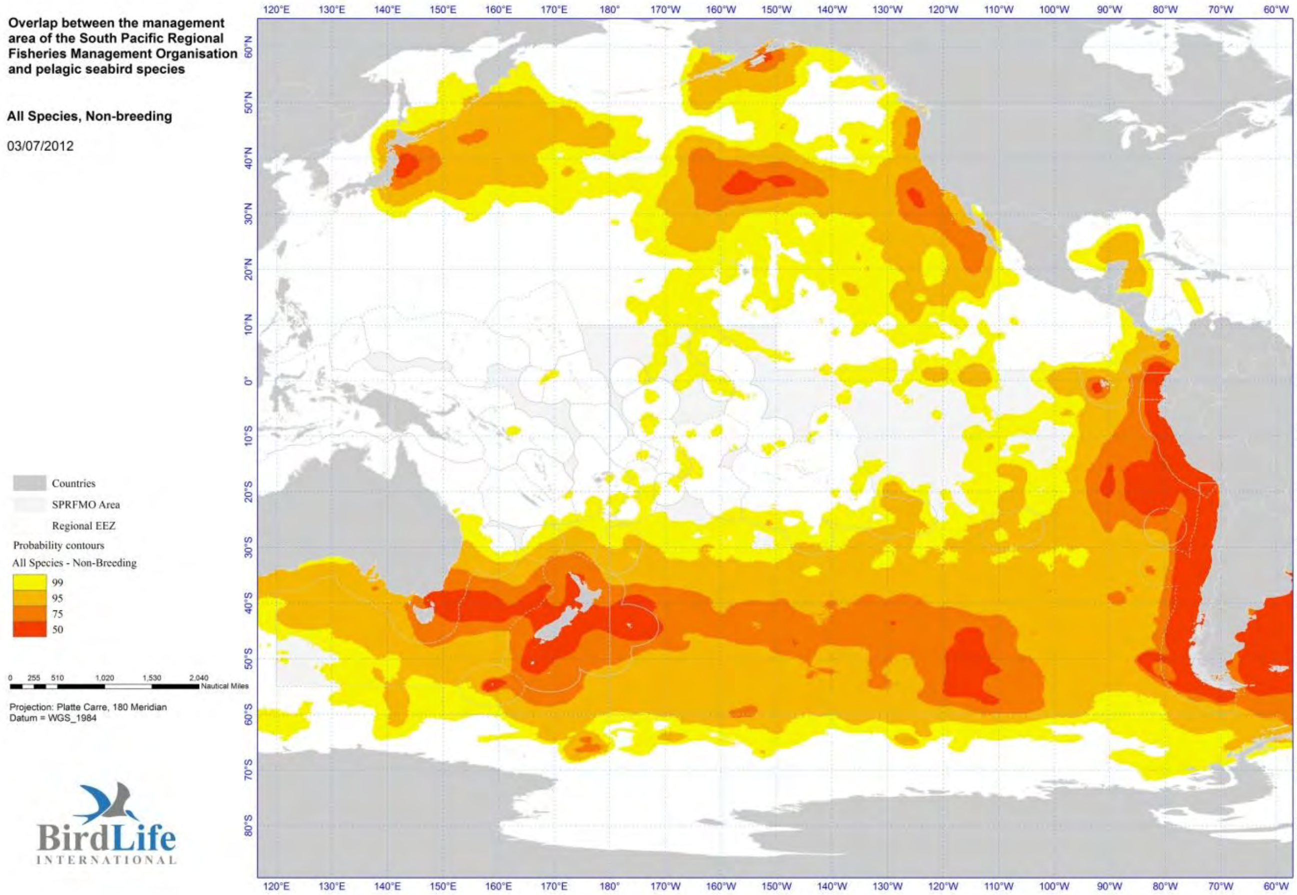


*Table3. Percentage time spent by17albatrosses and petrels in SPRFMO area and some EEZs (percentages over 20% are highlighted in red)*

| *Bird* | *Species* | *IUCN threat status* | *Breeding status* | *SPRFMO Area* | *Chile* | *NZ* | *Australia* | *Ecuador* | *Peru* |
|---|---|---|---|---|---|---|---|---|---|
| **Antipodean albatross** | *Diomedea antipodensis* | Vulnerable | Breeding | 38.2 | 0.2 | 55.5 | 4.8 | - | - |
| **Antipodean albatross** | *Diomedea antipodensis* | Vulnerable | Non-breeding | 60. 8 | 1.4 | 22.6 | 12.1 | - | - |
| **Black-browed albatross** | *Thalassarche melanophris* | Endangered | Breeding | 0.3 | 23.6 | - | 0.0 | - | - |
| **Black-browed albatross** | *Thalassarche melanophris* | Endangered | Non-breeding | 7.3 | - | 4.0 | 0.8 | - | - |
| **Parkinson's petrel** | *Procellaria parkinsoni* | Vulnerable | Breeding | 37.5 | - | 44.4 | 4.6 | - | - |
| **Parkinson's petrel** | *Procellaria parkinsoni* | Vulnerable | Non-breeding | 27.4 | 0.8 | 0.2 | - | 25.3 | 12.8 |
| **Buller's albatross** | *Thalassarche bulleri* | Near Threatened | Breeding | 3.2 | - | 81.7 | 2.0 | - | - |
| **Buller's albatross** | *Thalassarche bulleri* | Near Threatened | Non-breeding | 31.7 | 46.9 | 1.3 | - | - | 5.6 |
| **Campbell albatross** | *T. impavida* | Vulnerable | Breeding | - | - | 52.2 | 0.3 | - | - |
| **Campbell albatross** | *T. impavida* | Vulnerable | Non-breeding | n/a | n/a | n/a | n/a | n/a | n/a |
| **Chatham albatross** | *T. eremita* | Vulnerable | Breeding | 2.0 | - | 96.4 | - | - | - |
| **Chatham albatross** | *T. eremita* | Vulnerable | Non-breeding | 24.2 | 19.1 | 26.0 | - | 0.2 | 25.3 |
| **Chatham petrel** | *Pterodroma axilaris* | Endangered | Breeding | 61.7 | - | 37.9 | | - | - |
| **Chatham petrel** | *Pterodroma axilaris* | Endangered | Non-breeding | 89.8 | 5.4 | 1.8 | | 1.0 | 1.3 |
| **Cook's petrel** | *P. cookii* | Vulnerable | Breeding | 37.7 | - | 52.1 | 0.0 | - | - |
| **Cook's petrel** | *P. cookii* | Vulnerable | Non-breeding | 7.3 | 0.0 | 2.9 | - | 0.1 | 0.7 |
| **Grey-headed albatross** | *T. chryostoma* | Vulnerable | Breeding | 2.8 | 5.9 | - | 0.1 | - | - |
| **Grey-headed albatross** | *T. chryostoma* | Vulnerable | Non-breeding | 13.7 | 19.8 | 0.2 | 0.1 | - | - |
| **Grey petrel** | *Procellaria cinerea* | Near Threatened | Breeding | 40.7 | - | 48.7 | 0.9 | - | - |
| **Grey petrel** | *Procellaria cinerea* | Near Threatened | Non-breeding | 93.6 | 0.0 | 3.3 | 0.1 | - | - |
| **Northern royal albatross** | *Diomedea sanfordi* | Endangered | Breeding | - | - | 97.5 | - | - | - |
| **Northern royal albatross** | *Diomedea sanfordi* | Endangered | Non-breeding | 16.5 | 18.1 | 2.9 | 0.4 | - | 0.4 |
| **Salvin's albatross** | *T. salvini* | Vulnerable | Breeding | 10.4 | - | 79.0 | - | - | - |
| **Salvin's albatross** | *T. salvini* | Vulnerable | Non-breeding | 24.2 | 35.6 | 6.9 | 0.7 | - | 6.0 |
| **Southern royal albatross** | *D. epomophora* | Vulnerable | Breeding | 0.1 | - | 98.1 | 0.1 | - | - |
| **Southern royal albatross** | *D. epomophora* | Vulnerable | Non-breeding | n/a | n/a | n/a | n/a | n/a | n/a |
| **Sooty shearwater** | *Puffinus griseus* | Near Threatened | Breeding | 24.5 | 0.0 | 39.0 | 0.2 | - | - |
| **Sooty shearwater** | *Puffinus griseus* | Near Threatened | Non-breeding | 11.9 | 0.8 | 4.4 | 0.2 | - | 0.1 |
| **White-capped albatross** | *T. steadi* | Near Threatened | Breeding | 13.4 | - | 61.0 | 17.6 | - | - |
| **White-capped albatross** | *T. steadi* | Near Threatened | Non-breeding | 18.6 | - | 36.9 | 16.7 | - | - |
| **White-chinned petrel** | | | Breeding | 4.6 | 0.0 | 5.4 | 0.0 | - | - |
| **White-chinned petrel** | | | Non-breeding | 3.6 | 17.4 | 0.1 | - | - | 0.6 |
| **Waved albatross** | | | Breeding | 3.3 | - | - | - | 77.5 | 4.1 |

# 4.0 Characteristics of Fisheries in the SPRFMO Region

## *4.1 Major Fisheries in the Region*

### *4.1.1 Chilean Jack Mackerel (Trachurus murphi) and Chub Mackerel (Scomber japonicas)*

(i) Fishing effort

Chilean Jack Mackerel are distributed across a "jack mackerel belt" from South America to New Zealand and Australia[2].

Around 700,000t of Chilean jack mackerel are taken annually in the SPRFMO high seas area, and around 60,000t of Chub mackerel are taken in the course of the same fishing operations (Table 1).

In addition to the catch reported to SPRFMO, there is also significant catch of CJM in neighbouring EEZs. In 2007-2009, an average of 51% of the total Chilean jack mackerel catch reported to SPRFMO was caught in the EEZs of Peru, Chile and Ecuador. We obtained this data from the SPRFMO web site (Table 2). There is also a small New Zealand fishery for jack mackerel and other mackerels, which occurs only in the NZ EEZ. Australia also had a small catch of *Trachurus* in its EEZ in 2007, but none since.

Table2. Total catch for CJM, MAS and GIS in the adjacent EEZs vs. total catch in both SPRFMO area and EEZs. (Source: SPRFMO web site data)

| Year | EEZ totals CJM (t)for Chile, Peru, Ecuador | Total caught (t)SPRFMO + EEZ's | % caught in EEZ's |
|---|---|---|---|
| 2007 | 1,321,782 | 2,012,640 | 65.7 |
| 2008 | 552,407 | 1,474,830 | 37.5 |
| 2009 | 523,603 | 1,240,665 | 33.2 |
| Average for 3 years | 799,264 | 1,576,045 | 51 |

Based on data available to this analysis, the states fishing for CJM and other mackerels in the high seas are Belize, Chile, China, EU, Faroe Islands, Korea, Peru, Russian Federation, Vanuatu and Cuba.

(ii) Gear types

In Chile, jack mackerel is targeted extensively by purse-seine vessels, with Northern Chilean vessels using a 'Marco' type of purse seiner, while in Central Chile they use a purse seine where fishing gear is at deck level similar to a Scandinavian design. Other nations operating in the high seas appear to use mostly trawlers[2]. In New Zealand, jack mackerel is caught using pelagic and midwater trawlers.

(iii) Potential Impacts on seabirds

The overlap between high seas catches of CJM and MAS and seabird distribution is shown in Maps 3 & 4 in Appendix 1. Most of the reported catch is in the SE Pacific between 30-50°S, which are latitudes typically associated with high concentrations of albatross species. The major jack mackerel

[2] Table 1, revised Jack Mackerel species profile in seventh meeting documents http://www.southpacificrfmo.org/seventh-meeting

season runs from January to October, generally peaking in April to August. This is a critical time for many albatross and some petrel species which have finished their breeding in the southern summer and have moved across to their wintering grounds in the Humboldt Current off South America (see maps in 3b & 4b, showing overlap with non-breeding season). Species which indicate the most overlap with this fishery are non-breeding black browed albatross, Buller's albatross, Salvin's albatross, Chatham albatross and white-chinned petrel, and to a lesser extent Antipodean, Northern Royal, and wandering albatross. The other species at risk in this region for which we have insufficient tracking data is the pink-footed shearwater *Puffinus creatopus* (VU), which only breeds on three islands off Chile and is likely to overlap extensively with fishing in this region.

In terms of data available on seabird bycatch in these areas, the draft species profile for jack mackerel (SPRFMO 2012a) states that there are no estimates available of catches for associated and dependent species, and we were unable to find any direct information on the impacts of the high seas SPRFMO jack mackerel and associated fish species fisheries on seabirds.

However, bycatch information within EEZs is available from the NZ mackerel fishery, and from non-mackerel trawl and purse seine fisheries in Chile.

a. New Zealand jack mackerel trawl.
   Generally capture of marine mammals has been a greater problem than capture of birds in the NZ jack mackerel trawl fishery, and is related to the time of day when tows are made, dusk and dawn being vulnerable times. A Marine Mammal Operating Procedure is now in operation to reduce the capture of common dolphins and long finned pilot whales. In 2009/10, 10 seabirds were observed killed in the Jack Mackerel trawl fishery including Buller's albatross and Westland petrel *Procellaria westlandica* (VU). Other species caught included white chinned petrel *Procellaria aequinoctialis* (VU), sooty shearwater, cape petrel *Daption capense* (LC), fairy prion *Pachyptila turtur* (LC) and storm petrels.
b. Chilean hake trawl.
   In the Chilean Hake trawl fishery, which operates mostly within the EEZ, birds become attracted to trawlers during net shooting, especially if offal and waste is being discarded. Birds are killed or injured when they hit warps lines and sonde cables or are trapped by the net (Cabezas &Suazo, 2012). On the haul, birds try to extract fish from the net and can get caught or injured as the net tightens. In one study the species most frequently observed around these boats were black browed albatross *Thalassarche melanophris* (EN), Salvin's albatross, pelican *Pelecanus thagus* (NT) and pink-footed shearwater and these same 4 had the most observed collisions with the trawl warp cables, net sonde cable and entangled in nets (Cabezas & Suazo, 2012).
c. Purse seine nets.
   In Chile, preliminary exploratory monitoring trips were conducted in 2011 on purse seiners targeting sardinas including 3 trips (3 sets) in the artisanal fleet and a single trip (5 sets) in the industrial fleet(ATF Chile, 2012). From this limited sample, seabirds observed killed included mostly pink-footed shearwaters *Puffinus creatopus*, but also Dominican gulls *Larus dominicanus* (LC) and a Magellanic penguin *Spheniscus magellanicus* (NT). Sardinas in purse seine nets are removed from the nets by large suction devices and birds can get sucked into the driers and killed. Other mechanisms for interaction are net entanglement and subsequent mortality in the power block (ATF Chile, 2012). It is unknown whether the same method of extraction of fish

occurs with jack mackerel purse seine nets as for the sardinas or what other potential mechanisms of interaction may occur.

In summary, there are no direct data available on seabird bycatch interactions from the high seas SPRFMO Chilean jack mackerel and other mackerel fisheries. However data on the overlap between seabird distribution and available catch data, and data from other trawl and purse seine fisheries in Chile suggest potential interactions in this fishery.

#### *4.1.2 Squid (Jumbo squid Dosidicus gigas and Nototodarus spp).*

(i) Fishing effort

Jumbo squid are endemic to the Eastern Pacific ranging from Northern California to Southern Chile distributed west to around 140$^{o}$ W. About 80,000t of squid are caught annually in the SPRFMO area, particularly focused offshore from Chile and Peru (Map 5). Squid is caught by large jigging vessels from Japan, China, Chinese Taipei and Korea, as well as artisanal vessels in Chile and Peru[3].

(ii) Gear types

Most squid is caught by the jigging vessels (see above), although the artisanal fleet uses drift nets, purse seine nets, manual jigs and handlines inside EEZs. Fishing occurs at night using powerful lights to attract the squid.

(iii) Potential impacts on seabirds

The location of the fishery across the latitudes 10-45°S offshore from the EEZs of Peru and Chile has overlap with non-breeding albatrosses and petrels (Map 5). Based on available data, overlap is highest for non-breeding Buller’s albatross, Salvin’s albatross, Chatham petrel and also, to a lesser extent, Chatham albatross, black-browed albatross and Parkinson’s petrel.

There is no information on seabird bycatch within SPRFMO squid fisheries though it is assumed to be negligible where the greater selectivity of the jigging method is used (SPRFMO 2012b,; Rowe *et al* 2010) There may, however, be impacts to small seabirds (such as storm petrels) attracted by the powerful lights to the ships, with mortalities associated with birds colliding with the vessel or becoming trapped on board. The tracking data shown in Map 5 do not fully reflect the distribution of smaller seabird species such as storm petrels, and their distributional overlap with SPRFMO squid fisheries would need further investigation. Seabird bycatch by artisanal squid fishing gear types is also unknown.

#### *4.1.3. Orange roughy (Hoplostethus atlanticus) and other species associated with bottom and demersal mid-water trawl.*

(i) Fishing effort

The amount of orange roughy taken annually by SPRFMO fisheries is very variable. In 2010 only NZ fished, taking around 1400t, based on data from the SPRFMO website. In 2009-10, 7 boats fished outside the EEZs in the SPRFMO area. Other states who have fished for orange roughy are Australia, Chile, Belize and China. Map 6 gives an indication of the distribution of the New Zealand and Australian fisheries, based on reports from New Zealand and Australia[4] The main areas for orange roughy outside the New Zealand and Australian EEZs have been the Lord Howe Rise, South Tasman Rise, Tasman Basin and Northwest Challenger Plateau in the Tasman Sea area, and also the Gascoyne and Standard seamounts and the Louisville Ridge east of New Zealand. Chile also fish for orange roughy inside their EEZ on seamounts especially associated with the Juan Fernandez area.

(ii) Gear types

Orange roughy and species such as alfonso, cardinal fish, bluenose, ribald, seal sharks, rattails and oreos are targeted mostly using deepwater bottom trawl nets, although a few Australian vessels have used 'midwater' nets which are fished close to the bottom.

(iii) Potential impacts on seabirds

Based on data shown in Map 6, some of the fishery operates outside the highest seabird concentrations around New Zealand, except over the Challenger Plateau which coincides with the non-breeding season for seabirds (Map 6b)and the fishing season for orange roughy from April to August (Bottom Fishery Report for NZ). The Louiseville Ridge produced 66% of the NZ flagged catch from 1990-2007. This region lies across the migration route as seabirds are moving across the Pacific following breeding.

The potential impacts of the bottom trawl fishery for New Zealand were assessed in the NZ Bottom Fishery Impact Report, which suggests a low risk to seabirds as there are low bycatch rates when fishing for orange roughy within NZ's EEZ. The assessment, however, was not based on bycatch data from the SPRFMO area. Abraham and Thompson (2011) estimated 12-40 birds killed in the NZ EEZ. A risk assessment (Richard 2011) also concluded low risk to seabirds from these deep water trawls.

Factors which are likely to contribute to seabird capture in this fishery include offal discharge and lack of tori (bird scaring) lines. NZ's catch of orange roughy has increased in 2010, following the reopening of the fishery on the Challenger Plateau (data of SPRFMO web site, NZ National Report 2010), Australia has not bottom trawled since 2008, but does intend to in the future (Australian Bottom Fishery Report). Although the likely impact is low, there is no direct evidence of this, so it is important for data on bycatch to be collected for the orange roughy fishery for the SPRFMO so that a direct assessment of risk to seabirds can be made.

## *4.2 Minor fisheries*

### *4.2.1 Bluenose (blue eye trevella), bass and associated species 250t most by bottom longline.*

(i)Fishing effort

A total of around 250t annual catch of bluenose, bass and associated species are reported to SPRFMO by New Zealand and Australia. In NZ a small percentage of bluenose is caught outside the EEZ focused on the Challenger Plateau, West Norfolk and Three Kings Ridge, and the Hjort Trench south of the subantarctic islands[4]. In Australia effort for blue-eyed trevella, morwongs, ocean blue-eye trevella and yellowtail kingfish was largely focused on the Gascoyne and Standard seamounts

[4] Bottom Fishery Impact reports for NZ and Australia on the SPRFMO web site http://www.southpacificrfmo.org/benthic-impact-assessments

area, Capel Bank and a large area skirting the Australian EEZ from the Great Australian Bight to 140$^o$ E.

(ii)Gear types

Bottom long lines are most commonly used in this fishery. These use a combination of weights and floats to keep the lines on or near the bottom. Larger autoline vessels may use lead-core weighted bottom lines to keep lines on the bottom, while fishers for hapuku/bass and bluenose use short lines with few hooks to target specific seabed features.

(iii)Potential impacts on seabirds.

The Bottom Fishery Impact Report for NZ suggests a medium to high risk to seabirds from this type of fishing. This is supported by Abraham and Thompson (2011) and Richards (2011) although the data are from within NZ's EEZ. Risks occur when lines are being set when buoys maintain the baited hooks at or near the surface and they are available to birds. Also when lines are hauled, uneaten baits can become available again or are discarded attracting birds to these boats. Integrated weighted lines were introduced in NZ in 2002, which reduced the capture of white-chinned petrels in those boats that use them, required when fishing during the day. Possible species at risk include Chatham, Salvin's, Buller's, Campbell and wandering albatross (*Diomedea exulans*, VU) and black petrel[4] (Abraham and Thompson 2011). The NZ bottom fishery report suggests better information is needed on high seas bycatch rates and industry fishing practices for example mitigation measures are not mandatory on the high seas permits for boats fishing in the SPRFMO area (J. Brown MPI, *pers. comm.*). A code of practise requiring use of mitigation in higher risk areas exists in NZ and fishers use circle hooks to minimise seabird bycatch (although this is not recognised as best practise for seabirds, rather for turtles).

Of the two New Zealand vessels fishing in the high seas area in 2010, one was observed for 27 sets with no seabird bycatch. In Australia three vessels bottom fished 2008-2010 and in 2010 caught just 106 tonnes. The Australian Bottom Fishing impact report states one bird was reported caught by Australian vessels – a grey petrel in 2009 caught on a longline. Australian high seas permits require deployment of tori lines in line fisheries, with 17% observer coverage achieved on these vessels, and are required to report bycatch.

### *4.2.2. Alfonsino and associated species (Beryx spp) demersal and mid-water trawl.*

Around 750t of alfonsino are taken annually in SPRFMO fisheries, mostly by New Zealand and Cook Islands vessels. Most are taken by bottom trawlers, often on seamounts. There is no information in the species profile on bycatch of associated and dependent species, but it is recognised that bottom trawling has a potentially major impact on Vulnerable Marine Ecosystems, not the subject of this report.

### *4.2.3 Other fisheries.*

Other demersal industrial and artisanal fishing occurs within the SPRFMO area for which data were not available in this analysis, and for which few data are available on the SPRFMO website. Small scale fisheries along the Pacific coast of South America (Ecuador and Peru) are extensive (Mangel *et al* 2011). While it appears that most fishing takes place within EEZs (Mangel *et al* 2011), in Peru

(Ayala *et al* 2008) longline fishers targeting common dolphinfish, blue shark and mako shark appear to also fish within the SPRFMO area beyond 200nm. Seabird species at risk in demersal and driftnet fisheries for hake and sharks offshore from Peru include the Critically Endangered waved albatross (*Phoebastria irrorata*, CR) and black petrel, also white-chinned petrel and black-browed albatross (Mangel *et al*, 2011; Alfaro-Shigueto *et al* 2010, ATF 2011).

# 5.0 Discussion

## *5.1 Overlap between SPRFMO fisheries and the distribution of seabird species vulnerable to bycatch*

Few data on bycatch are currently available from the SPRFMO fisheries on the high seas of the South Pacific. Given knowledge of seabird bycatch occurring in trawl and longline fisheries elsewhere, this paper undertook a review of likely overlaps between SPRFMO fisheries and seabird species that are vulnerable to bycatch.

The fisheries for jack mackerel and chub mackerel, by far the largest fishery, overlap with distributions of non-breeding albatrosses and petrels in the SE Pacific. This, together with the interactions identified in adjacent fisheries for hake and sardinas, and in New Zealand, suggests that seabird interactions may be occurring in the jack mackerel fishery. The jumbo squid fishery also overlaps with the distributions of non-breeding albatrosses and petrels in the SE Pacific. The types of interactions which may occur with this fishery are unknown although powerful lights are known to attract birds which may crash into the ships infrastructure. Other types of interactions are also possible.

Orange roughy trawling and longline fishing for bluenose and other demersal species on the Challenger Plateau overlaps with high densities of non-breeding albatrosses. Although risks to seabirds from the deepwater trawl fishery in NZ appear low, mitigation is not mandatory in the high seas and effort has increased on the Challenger Plateau. Longline fishing is higher risk to seabirds especially if mitigation is not used. Longliners should be using integrated weighted lines or other weighting regimes and tori lines to reduce this risk. The extent that other demersal fisheries occur in the SPRFMO area is not clear, however the overlap of albatrosses and petrels particularly during the non-breeding season, suggest this needs further investigation.

Further investigation is also required to determine the extent of interactions and possible mitigation for all fisheries in the SPRFMO area.

## *5.2 Data gaps*

The review presented here also highlights existing gaps in fishing distribution data and the current lack of bycatch data from the high seas fisheries.

Data requirements for SPRFMO in relation to seabird bycatch are reasonably good in that observers are required to collect data on numbers and species of seabirds caught per tow for trawlers and sets for purse seiners and bottom longliners[5] In addition, observers are required to record use of any mitigation used and life status/release of birds. However, we are not clear whether seabird bycatch data is being collected as virtually none has been reported to the Secretariat (C. Loveridge, SPRFMO Secretariat, *pers. comm*.) or reported in National Reports. In addition, current data collection requirements omit other fishing gears such as squid jigging, potting drop/dahn lining.

### 5.3 Conclusions

This review flags up the need for data on bycatch rates within SPRFMO fisheries, and the current lack of data on SPRFMO fishing effort distribution.

While data gaps dominate, the review has identified that there are high levels of overlap between the distribution of seabird species vulnerable to bycatch and the high intensity fishing areas of the mackerel and squid fleets.

In relation to jack and chub mackerel, indications are that the SPRFMO high seas fleet involves trawlers. Elsewhere, interactions between seabirds and trawl vessels are well documented, highlighting the need for bycatch data from this fishery. Seabird bycatch mitigation measures are also well developed for trawl vessels: seabird bycatch can be significantly reduced through the use of bird scaring lines and management of offal discharge. Experience from fisheries in New Zealand, Chile and Argentina could help inform SPRFMO management responses.

The potential impact of purse seining for mackerel species on seabirds needs investigation, particularly possible methods of interaction.

In relation to the other major SRFMO fishery, jumbo squid, interactions between seabirds and squid jigging vessels are not well documented, but require further investigation, particularly in relation to the impact of vessel lights on smaller seabird species

There is also indication of overlap between non-breeding seabird distributions and demersal trawling and longline for orange roughy, bluenose and other demersal species on the Challenger Plateau.

The SPRFMO Convention under Article 3 (3) (a) (ii) requires use of the precautionary principle and that the absence of adequate scientific information is not a reason for postponing or failing to take conservation and management measures. Many countries have National Plans of Action for Seabirds (NPOA-S) which guide the development and implementation of seabird bycatch prevention measures within EEZs. The Convention recognises the need for Conservation and Management Measures (CMMs) in the high seas and those under national jurisdiction to be compatible to protect fishery resources in their entirety. For seabirds this is critically important as they don't recognise international boundaries and in the SPRFMO region highest seabird densities occur in states especially New Zealand and Chile.

On this basis, SPRFMO could decide to put in place precautionary conservation measures to ensure that impacts on seabirds are minimized. A similar approach was taken in the South East Atlantic

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[5] SPRFMO data standards available on the SPRFMO web site
http://www.southpacificrfmo.org/assets/PrepCon-3/Meeting-Report/PrepCon3-2012-Data-Standards-Adopted-03Feb2012-Final-Clean.pdf

Fisheries Organisation. Mechanisms for reducing interaction with seabirds in deep water trawls and demersal long lines are well known in New Zealand fisheries and elsewhere such as CCAMLR. Similar requirements could be applied to areas within SPRFMO that overlap with vulnerable seabird species.

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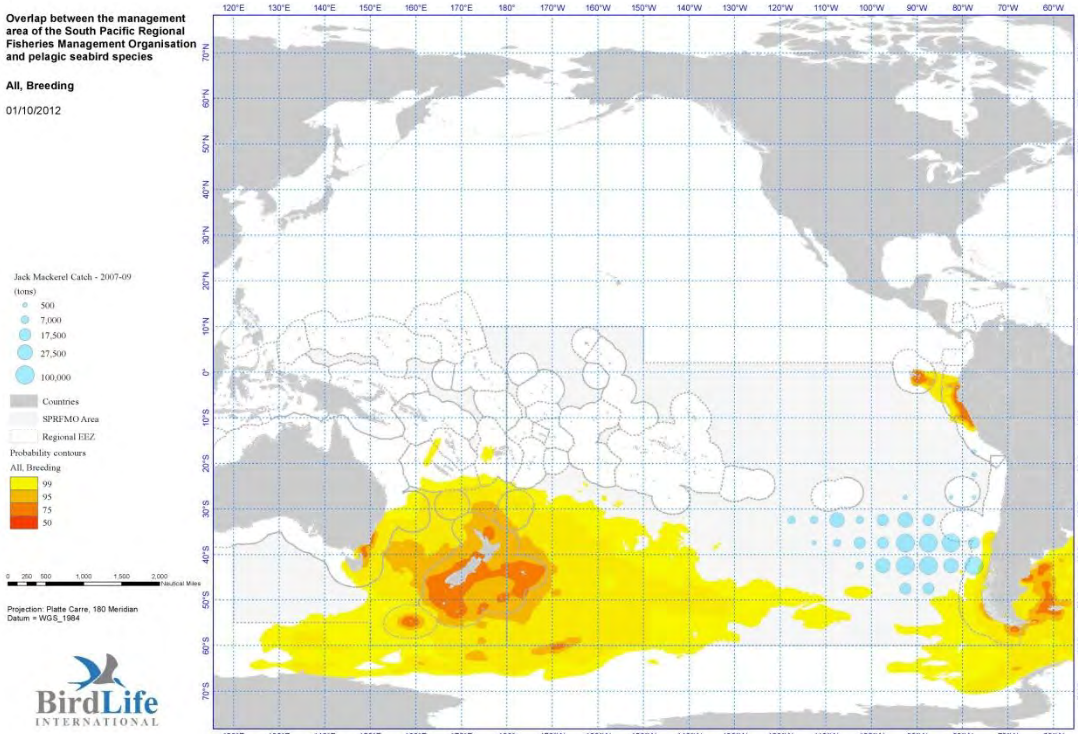
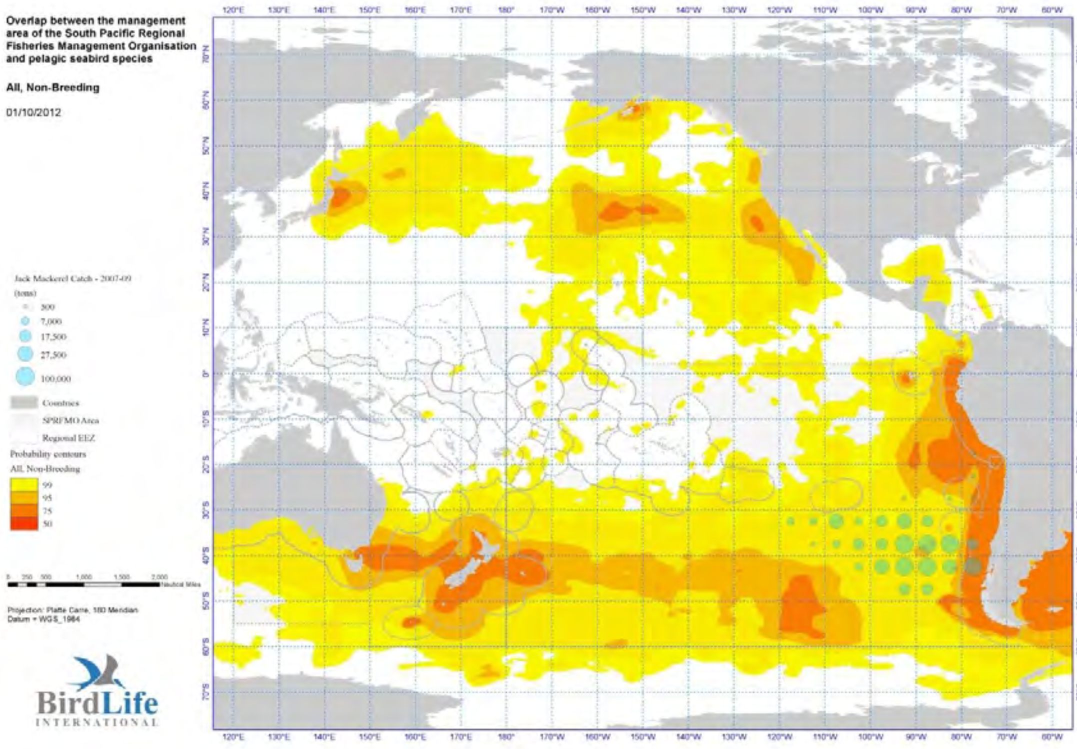
## Appendix1.

Map 3. Overlap between high seas catches of Chilean jack mackerel and seabird distribution

a) Overlap of breeding distribution of 22 albatrosses and petrels with the Jack mackerel catch

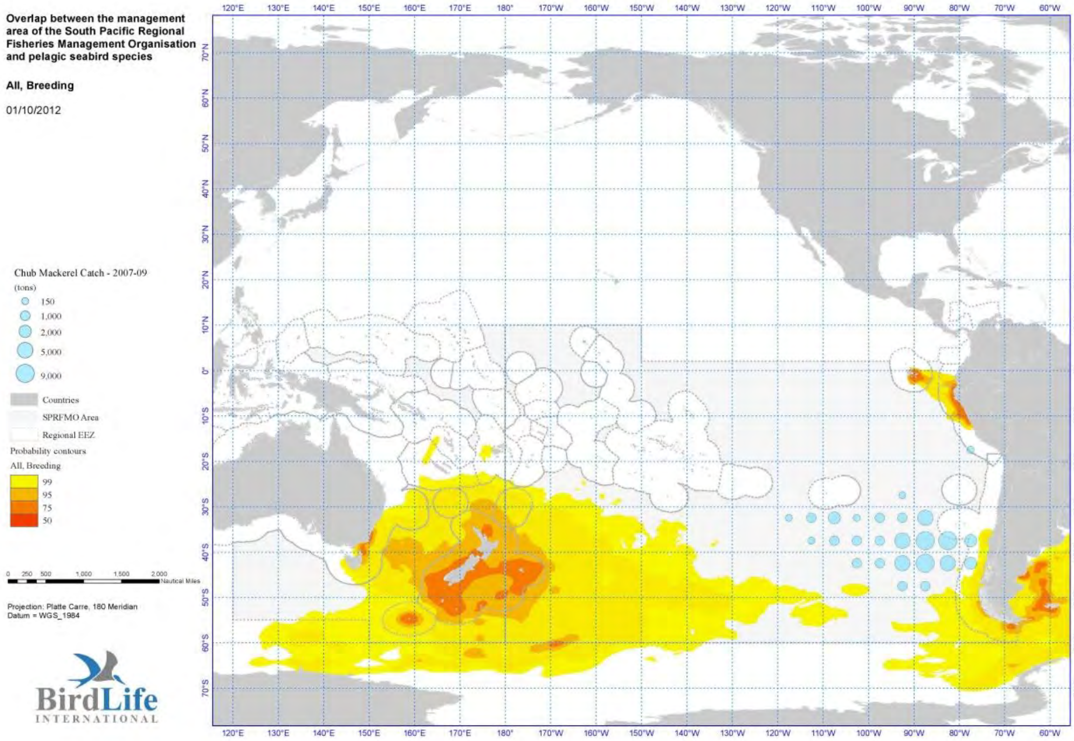



b) Overlap of non-breeding distribution of 22 albatrosses and petrels with the Jack mackerel catch

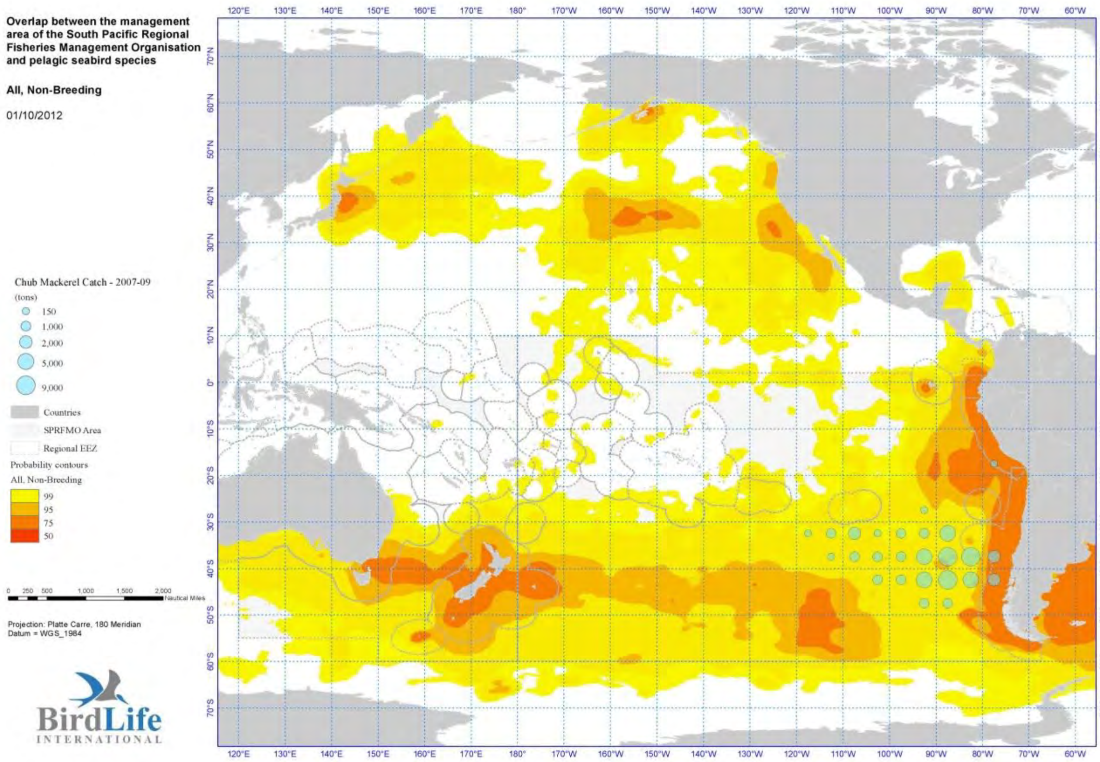


Map 4. Overlap between high seas catches of chub mackerel and seabird distribution

a) Overlap of breeding distribution of 22 albatrosses and petrels with the chub mackerel catch

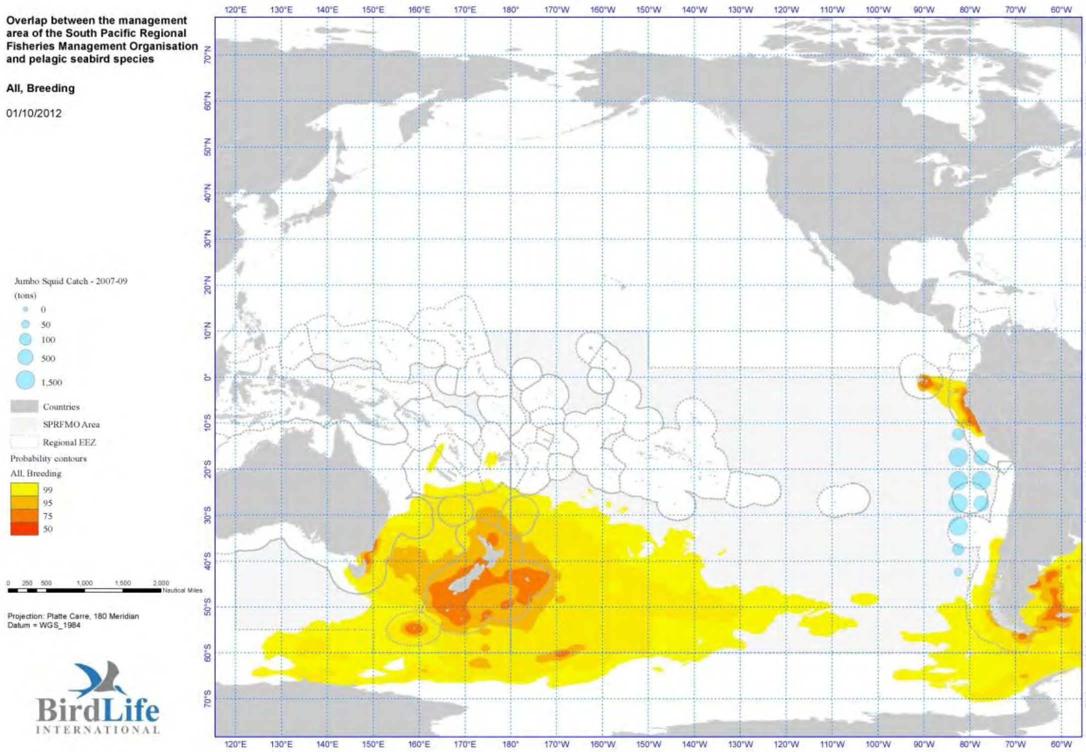



b) Overlap of non-breeding distribution of 22 albatrosses and petrels with the chub mackerel catch

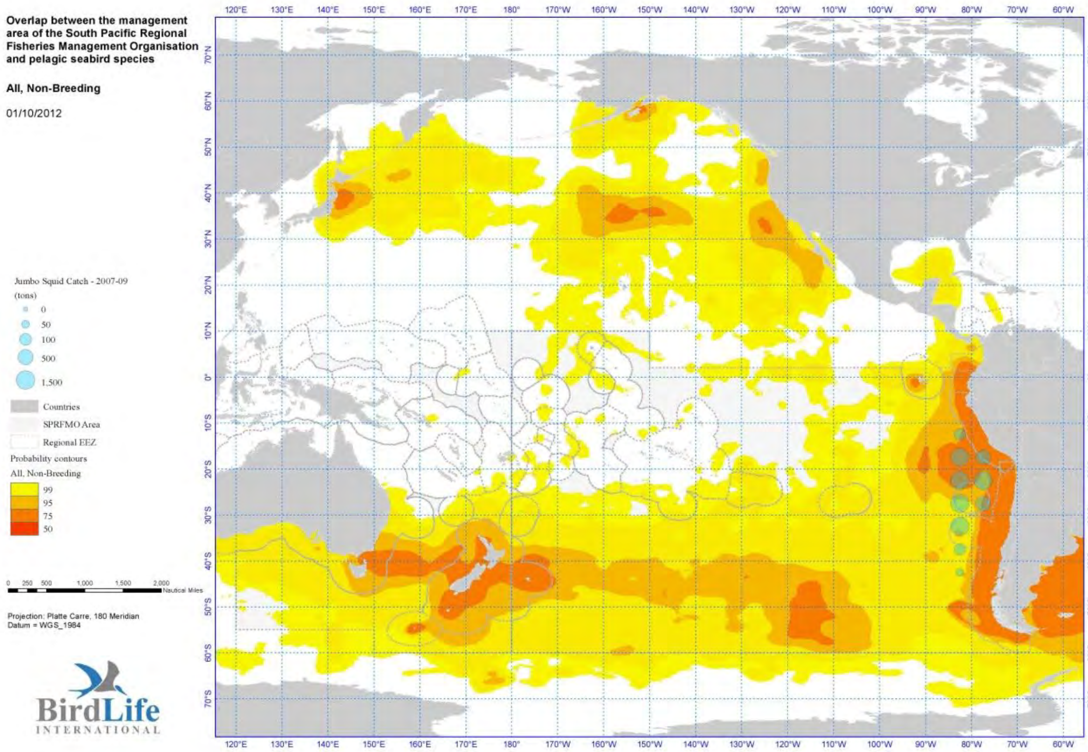


Map 5. Overlap between high seas catches of jumbo squid and seabird distribution

a) Overlap of breeding distribution of 22 albatrosses and petrels with the jumbo squid catch

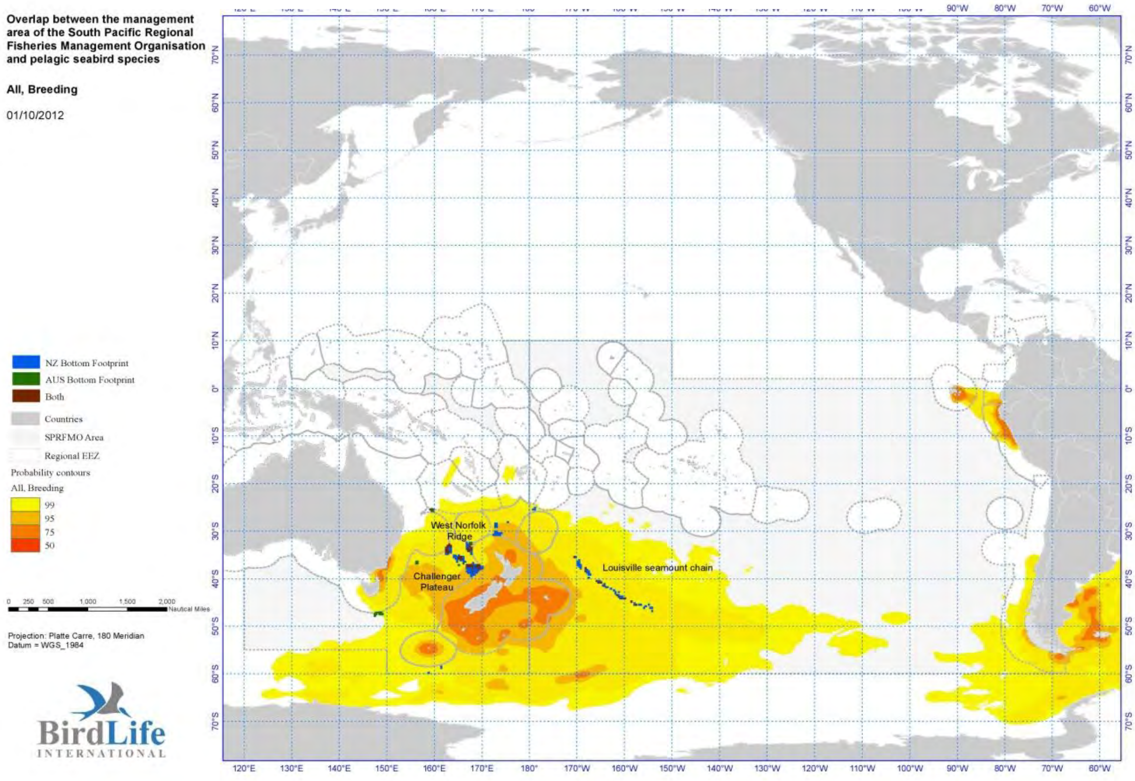



b) Overlap of non-breeding distribution of 22 albatrosses and petrels with the jumbo squid catch



Map 6. Overlap of high seas bottom fishing footprint with seabird distribution

a) Overlap of breeding distribution of 22 albatrosses and petrels with bottom fishing




b) Overlap of non-breeding distribution of 22 albatrosses and petrels with bottom fishing