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Fine scale overlap analysis of Antipodean and Gibson's albatross with pelagic longline fishing effort

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SUMMARY

The Antipodean (*Diomedea antipodensis antipodensis*) and Gibson's Albatross (*D. a. gibsoni*) are two declining populations of high conservation concern, one of which is already recognized as an ACAP High Priority Population. Both populations are particularly vulnerable to bycatch in commercial fisheries, as highlighted in recent fisheries risk assessments. This paper provides insights from four years (2019-22) of PTT satellite tracking of 153 Antipodean Albatross and four years (2019, 2022-24) of GPS/PTT satellite tracking of 82 Gibson albatross. For both populations, tracking data comprised of adult and juvenile cohorts, and was used alongside Automated Identification System (AIS) data, sourced from Global Fishing Watch, to assess spatiotemporal overlap of tracked birds with pelagic longline fishing effort. Our findings indicate that i) the range of tracked Antipodean and Gibson's albatross were largely consistent across years, ii) the spatial distribution of birds differed between populations and age status - with Antipodean albatross primarily utilizing the waters off the east coast of Aotearoa New Zealand through to the coastal waters of Chile and Gibson's albatross more concentrated in the central Tasman Sea and the Great Australian Bight, iii) 77% of the 235 tracked birds in this study (115 Antipodean Albatross and 65 Gibson's Albatross) overlapped with fishing vessels, iv) the areas of highest bird-vessel overlap occurred in High Seas areas of CCSBT and WCPFC and v) albatrosses overlapped with pelagic longline fishing vessels of eight key flag states.

RECOMMENDATIONS

We recommend that PaCSWG and SBWG:

1. note the updated spatial information for these two vulnerable populations.
2. use the findings from this study to focus engagement activities in CCSBT and WCPFC to inform management actions that will provide adequate protection to these populations across their foraging range.

Análisis de superposición a escala fina del *Diomedea antipodensis antipodensis* y del *Diomedea antipodensis gibsoni* con el esfuerzo pesquero con palangre pelágico

RESUMEN

Las especies *Diomedea antipodensis antipodensis* y *D. a. gibsoni* son dos poblaciones en declive de alta preocupación para la conservación, una de las cuales ya está reconocida como una población de mayor prioridad del ACAP. Ambas poblaciones son particularmente vulnerables a la captura secundaria en las pesquerías comerciales, como se ha puesto de relieve en recientes evaluaciones de riesgo de las pesquerías. En este documento se proporciona información de cuatro años (2019-2022) de seguimiento satelital PTT de 153 ejemplares de *D. a. antipodensis* y cuatro años (2019, 2022-2024) de seguimiento satelital GPS/PTT de 82 ejemplares de *D. a. gibsoni*. Para ambas poblaciones, los datos de seguimiento comprendieron cohortes de adultos y jóvenes, y se utilizaron junto con los datos del sistema de identificación automática (AIS), obtenidos de Global Fishing Watch, para evaluar la superposición espacio-temporal de las aves rastreadas con el esfuerzo pesquero con palangre pelágico. Nuestros hallazgos indican que i) el rango del *D. a. antipodensis* y del *D. a. gibsoni* observados fue en gran medida constante a lo largo de los años; ii) la distribución espacial de las aves difirió entre las poblaciones y el estado de edad: el *D. a. antipodensis* utilizó principalmente las aguas de la costa este de Nueva Zelanda, hasta las aguas costeras de Chile, mientras que el *D. a. gibsoni* se concentró más en el centro del mar de Tasman y la Gran Bahía Australiana; iii) 77 % de las 235 aves rastreadas en este estudio, (115 *D. a. antipodensis* y 64 *D. a. gibsoni)* se superpusieron con los buques pesqueros; iv) las áreas de mayor superposición de aves y buques ocurrieron en áreas de alta mar de la CCSBT y la WCPFC; y v) los albatros se superpusieron con los buques de pesca con palangre pelágico de ocho estados del pabellón claves.

RECOMENDACIONES

Recomendamos que el GdTPEC y el GdTCS tomen las siguientes medidas:

1. Tomar nota de la información espacial actualizada para estas dos poblaciones vulnerables.
2. Utilizar los resultados de este estudio para enfocar las actividades de interacción con la CCSBT y la WCPFC para informar las acciones de gestión que brindarán una protección adecuada a estas poblaciones en toda su área de distribución de alimentación.

Analyse fine du chevauchement entre les albatros *Diomedea antipodensis antipodensis* et *D. a. gibsoni*, et l'effort de pêche à la palangre pélagique

RÉSUMÉ

Les albatros *Diomedea antipodensis antipodensis* et *D. a. gibsoni* sont deux populations dont le déclin est très préoccupant sur le plan de la conservation. L'une de ces deux espèces est déjà reconnue comme population hautement prioritaire de l'ACAP. Les deux populations sont particulièrement vulnérables aux captures accessoires dans les pêcheries commerciales, comme l'ont souligné de récentes évaluations des risques liés aux pêcheries. Cet article donne un aperçu de quatre années (2019-22) de suivi par satellite PTT de 153 *D. a. antipodensis,* et de quatre années (2019, 2022-24) de suivi par satellite GPS/PTT de 82 *D. a. gibsoni*. Pour les deux populations, les données de suivi comprennent des cohortes d'adultes et de juvéniles. Elles ont été croisées avec les données du système d'identification automatique (SIA), provenant de Global Fishing Watch, pour évaluer le chevauchement spatio-temporel des oiseaux suivis et des efforts de pêche à la palangre pélagique. Nos résultats indiquent que i) l'aire de répartition des albatros *D. a. antipodensis* et *D. a. gibsoni* suivis était largement cohérente d'une année à l'autre ; ii) la répartition spatiale des oiseaux différait selon les populations et l'âge – *D. a. antipodensis* et *D. a. gibsoni* utilisant principalement les eaux au large de la côte est de l'Aotearoa Nouvelle-Zélande jusqu'aux eaux côtières du Chili, *D. a. gibsoni* étant plus concentré au centre de la mer de Tasman et dans la Grande Baie australienne ; et iii) 77 % sur les 235 oiseaux suivis dans le cadre de cette étude (115 *D. a. antipodensis* et 64 *D. a. gibsoni)* se chevauchaient avec des navires de pêche; iv) les zones de chevauchement oiseau-navire les plus étendues se trouvaient dans les zones de haute mer de la CCTRS et de la WCPFC ; et v) il existe un chevauchement entre les albatros et les palangriers pélagiques de huit États du pavillon.

RECOMMANDATIONS

Nous recommandons que le GTSPC et le GTCA :

1. Notent les informations spatiales mises à jour pour ces deux populations vulnérables.
2. Utilisent les résultats de cette étude pour cibler les activités de mobilisation de la CCTRS et de la WCPFC afin d'éclairer les mesures de gestion qui assureront une protection adéquate à ces populations dans leur aire d'alimentation.

1. INTRODUCTION

Antipodean Albatross (*Diomedea antipodensis*) are endemic to New Zealand and consists of two subspecies, Antipodean albatross (*D.a. antipodensis*) and Gibson's Albatross (*Diomedea antipodensis gibsoni*). The subspecies Antipodean albatross breeds almost exclusively on Moutere Mahue | Antipodes Island, with this population recognised as a High Priority

Population by the Agreement on the Conservation of Albatrosses and Petrels (ACAP). Conversely Gibson's albatross, breed exclusively on Maukahuka | Auckland Islands, in the Subantarctic of Aotearoa New Zealand, with 92% of the population breeding on Adams Island, 7% on Disappointment Island, and 1% scattered on Auckland Island. The species is classified as 'Endangered' on the International Union for Conservation of Nature, and each subspecies is classified individually as 'Nationally Critical' under the New Zealand Threat Classification System (Birdlife International, 2018; Robertson et al., 2021).

Previous tracking studies on this species showed distinct differences between Antipodean and Gibson albatross. The at-sea distribution of Antipodean albatross extends across the Southern Pacific Ocean, east of New Zealand to the Chilean coast, and to a lesser extent in the Tasman Sea (Walker & Elliott, 2006; Bose & Debski, 2020). Whereas Gibson's albatross extends throughout the Tasman Sea and along the continental shelf of southeastern Australia, the Great Australian Bight, and eastern Aotearoa New Zealand (Walker & Elliott, 2006; Elliott et al. 2020).

The Antipodean albatross population has been declining since 2007, with a decline of ~5% per year, due to a decrease in female survival, breeding success and an increase in recruitment age. Their current population is estimated at around 3200 breeding pairs, and under the current projected decline, only about 400 pairs may remain in 2050 (Richard, 2021). Gibson's albatross has experienced similar trends, with population declines of 5.7% per year after a sudden population crash in 2005 (Francis et al., 2015; Elliott et al., 2020). Since then, population recovery has been very slow to limited with the current population estimated at ~5400 breeding pairs (Fischer et al, 2024). This number comprises less than half of the estimated breeding pairs pre-population crash (Rexer-Huber et al., 2020, Walker et al. 2023).

The population declines of Antipodean and Gibson's albatross is exposed to a number of at-sea threats. Fishing-related mortality from bycatch in commercial fisheries is a key threat to Antipodean and Gibson's albatross, mainly from pelagic longline fisheries, in New Zealand waters and in areas beyond Aotearoa New Zealand's jurisdiction (Francis et al., 2015; Richard & Abraham, 2020). As a result, since December 2019, The New Zealand Department of Conservation – Te Papa Atawhai (DOC) and Ministry for Primary Industries (MPI) have been undertaking a multi-year tracking project, deploying satellite transmitting devices on Antipodean and Gibson's Albatross across various age classes and breeding states. These tracking projects are aimed to provide insights into the species' distribution and provide a detailed understanding of spatiotemporal overlap with pelagic longline fishing effort throughout its range.

2. METHODS AND MATERIALS

2.1 Tracking devices

A total of 153 Antipodean albatross and 82 Gibson's albatross were fitted with GPS/PTT satellite transmitters to their back feathers using water-proof tape and tracked over four years (2019-22 and 2019, 2022-24, for Antipodean and Gibson's albatross respectively). Full details of the fieldwork, technical details of transmitting devices, and attachment methods for Gibson's albatross are reported by Rexer-Huber et al. (2020), Parker et al. (2022) and Walker et al. (2023), and for Antipodean albatross Elliott & Walker (2019, 2020) and Walker & Elliott (2022). These devices provide location data for as long as they are attached to the birds (mean = 230 days Antipodean albatross, mean = 184 days Gibson's albatross).

2.2 Tracking data

Following deployment, data were compiled and cleaned to evaluate bird location data. Location data was cleaned as following: 1) PTT-derived locations with an Argos quality of A, B and Z were discarded (Douglass et al., 2012), 2) Argos-generated error ellipse variable of >10km error radius were eliminated, and 3) a speed filter was applied removing flight speeds greater than 50 m/s as sustained flight at this speed was deemed unrealistic (Merkel et al., 2016; Bose & Debski, 2020). In the circumstance that both a GPS fix and PTT-derived location were available, GPS fixes with a consistent fix interval (6 hours) were chosen and the PTT-derived location was discarded. If the fix interval was >6 hours and a PTT-derived location was available, then this was chosen. Following this cleaning process, 61,412 Antipodean albatross and 53,918 Gibson's albatross locations were retained and used as the final data sets.

To generate insights into the relative occurrence of Antipodean and Gibson's albatross within geopolitical areas, we first quantified bird occurrence, which was calculated by dividing the number of bird hours spent in an area by the total number of bird hours in that particular year. Relative occurrence was then allocated into various jurisdictions: 1) Exclusive Economic Zones (EEZs) and the high seas, as well as per Regional Fisheries Management Organisations (RFMOs) (including EEZs), including the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Western and Central Pacific Fisheries Commission (WCPFC), the Inter-American Tropical Tuna Commission (IATTC), and the Indian Ocean Tuna Commission (IOTC). As some RFMOs overlap, the total sum of the relative occurrence exceeded 100%.

2.3 Point-based fishing effort overlap estimation

To quantify spatiotemporal overlap of fishing effort for each bird location, we identified vessels within a 100 km radius of albatross locations, acquiring vessel information (fishing

effort, gear type, and flag state) from Global Fishing Watch (GFW) at a 0.01° x 0.01° daily resolution (Kroodsma et al., 2018). For the spatiotemporal overlap analyses, we first interpolated albatross tracks at 1 hr intervals. Total spatiotemporal overlap between a fishing vessel and bird location was then calculated by the total fishing effort value for that location, divided by 24 and then multiplied by the mean bird hour for that location. Overlap of fishing effort with bird location was then separated into 5° latitudinal bands, to identify the total percentage overlap within separate latitudinal regions. And presented as percentage overlap. Alongside this, each bird vessel overlap event had an associated Maritime Mobile Service Identity (MMSI) and vessel flag state. This data was used to gain insights into overlap trends with vessel flag states and is presented as percentage of total overlap bird hours.

3. RESULTS

3.1 At-sea distribution

The core at-sea distribution of the Antipodean albatross extends from the east coast of Australia across the Pacific to the coast of Chile, from approximately 25°S to 60°S (Figure 1). Year-on-year the highest occurrence was recorded in the vicinity of Antipodes Island south-east of Aotearoa New Zealand. As mentioned above this is the breeding site for this species. Other high occurrence areas were regions to the east of Aotearoa New Zealand bordering the edge of the Aotearoa New Zealand EEZ, the mid-Tasman Sea, and areas off the southern Chile coast. These broad patterns match and expand on earlier tracking efforts of this population (Walker & Elliott 2006; Elliott & Walker 2018; Bose & Debski 2020).

Whilst this general spatial pattern was consistent between years, some differences were noted when comparing different stage and sexes. For adult birds between 30 and 50% of their occupancy was within the Aotearoa New Zealand EEZ (mean of 45.2% and 37.1% for females and males respectively across tracking years) and following this in proportional order, the Chilian and Australian EEZ (mean of 12.3% and 9.5%, and, 2.0% and 0.11% female and male respectively across tracking years figure 2). Male birds also tended to disperse further south that their female counterparts verging on the waters of the Southern Ocean (figure 1). In comparison to the adult distribution, and due to a higher occurrence in Australian waters, the occupancy rates of juvenile Antipodean albatross in the Australian and Chilian EEZ were reversed (mean of 5.5% and 1.1% respectively across tracking years). However, occupancy in the Aotearoa New Zealand EEZ remained dominant (mean occupancy of 42.6% across tracking years). Both adult and juvenile Antipodean albatross distribution largely fell within the high seas (mean occupancy of 48.2% across years and sex/stage) in particular the Convention Areas of CCSBT and WCPFC (mean occupancy of 80.3% and 76.0% respectively across years and sex/stage), with some use of the

Convention Area of IATC (mean occupancy of 17.1% across tracking years and sex/stage). See figure 2 for sex/status by year breakdown.

The at-sea distribution of Gibson's albatross is also shown in figure 1, with birds ranging from 22°S to 65°S into Antarctic waters, as well as extending across to south-western Australia 106°E and east of Rēkohu | Wharekauri | Chatham Islands at 140°W. The general distribution of Gibson's Albatross throughout the years shows consistent utilization of the central and eastern Tasman Sea. Small portions of the adult population are seen to extend off the Chatham Rise and continental shelf of southern Australia, with adult males in particular observed dispersing further than females, into the Southern Ocean (as seen above in Antipodean albatross) and to south-western Australia.

Adult Gibson's Albatross spent the majority of their occupancy in areas outside of national jurisdiction (the high seas - 60.2% and 57.9% females and males respectively across years) but also occupied the EEZs of Aotearoa New Zealand and Australia (mean of 26.6% and 30.8% female and male respectively NZEEZ and mean of % and % female and male respectively AUEEZ across years) and EEZs of other countries such as Fiji, and Tonga. For a full breakdown see figure 1 and figure 2. Adult Gibson's Albatross distribution largely fell within the Convention Areas of CCSBT (mean of 73.9% and 74.4% for female and male birds across tracking years) and WCPFC (mean occupancy of 72.1% and 73.9% females and males respectively), with some use of the Convention Area of IOTC (figure 2).

Similarly to adults, juveniles dispersed widely into the Tasman Sea, southern Australia, and off the east coast of Aotearoa New Zealand. Juvenile distribution, however, extended further east and north compared to the adults, spending almost 40% of their time in the high seas (figure 2). Juveniles occurred in the Aotearoa New Zealand EEZ the most (49.7%), followed by the Australian EEZ (12.5%) and, to some extent, dispersed into other EEZs of countries in the Pacific Ocean. As juvenile Gibson's Albatross dispersed further than adults, they occurred in several RFMO Convention Areas, primarily in CCSBT (92.8%) and WCPFC (94.2%) followed by IOTC (3.9%), and IATTC (0.2%). Calculations allowed for double counting of points that fall within the overlap zones between multiple jurisdictions so occupancy percentages will add to more than 100% - See figure 2 for a full breakdown.

3.2 Spatiotemporal overlap with pelagic longline fishing effort

Spatiotemporal overlap of Antipodean and Gibson's Albatross with pelagic longline fishing effort varied over space and time. In total 105 out of 153 tracked Antipodean Albatross (68.7%) overlapped with pelagic longline fishing vessels translating to approximately 2% of all bird hours spent in overlap (supplementary material table 1). For Gibson's Albatross, this proportion was higher with 78.3% (or 65 out of 83 birds) of all tracked birds exhibiting at least

one overlap event equating to a total of 4.5% of all tracked bird hours in bird-vessel overlap (Table 1).

The overlap of all tracked Antipodean albatross with pelagic longline fishing effort (Figure 1) showed overlap is greatest in the western (mid-Tasman sea) and the eastern (adjacent to the New Zealand EEZ) high seas WCPFC areas, in the northerly parts of the Antipodean albatross distribution. Given the more easterly distribution of juvenile Antipodean albatross compared to adults it not surprising that the predominant area for overlap occurred in the central Tasman high seas area between the EEZs of Aotearoa New Zealand and Australia within the CCSBT convention zone.

Most pelagic longline fishing overlap for Gibson's albatross occurred in the central Tasman Sea, and North-East of Aotearoa New Zealand (Figure 1). Bird-vessel overlap occurred predominantly in the high seas, just outside the Australian EEZ and North-East of the Aotearoa New Zealand EEZ. While overlap was highest in the high seas, there was overlap off the east coast of Australia as well as small amounts of overlap around the coast of Aotearoa New Zealand. The overlap hotspot within the central Tasman Sea appeared consistent across years, sex and status. Overlap between 30°S and 25°S was consistently the highest for adults across all years, while juveniles had equally high overlap further north between 25°S and 20°S. While Gibson's Albatross disperse into four RFMO regions, total overlap hours was highest where birds were observed to occur the most, i.e., in the CCSBT and WCPFC Convention Areas.

For both the Antipodean and Gibson's albatross, the probability of spatiotemporal overlap between tracked birds and pelagic longline effort showed an inverse relationship with latitude (Figure 3). The further north birds occurred, the more likely they were to overlap in space and time with fishing effort. Specifically, for both species, the probability of overlap was the highest between 30°S and 25°S, followed by 25°S and 20°S (figure 3).

3.3 Details of bird-vessel overlap by flag state

During 2019 - 2022, tracked Antipodean albatrosses overlapped with pelagic longline fishing vessels of eight key flag states. the greatest number of overlap events being flagged to Chinese Taipei, China, Vanuatu, and Japan, the remaining vessels being flagged to New Zealand, Fiji, Spain, and Cook Islands (figure 4). While year on year and sex/status-based trends vary slightly, in terms of the proportion of overlap events attributed to each of the eight key flag states, the significance of these vessel flag states in bird overlap does not change. Females tended to overlap with a higher proportion of vessels flagged to Chinese Taipei (accounting for a mean of 28.9% of all overlap events across years) and Japan (mean of 29.8% of all overlap events across years) whereas for Males Vanuatu flagged vessels contributed to a significantly larger proportion of overall bird-vessel overlap events (mean of 49.3% of all overlap events across years).

For Gibson's Albatross trends of Bird-vessel overlap were similar to that observed in Antipodean Albatross. The greatest number of overlap events were flagged to Chinese Taipei, Japan, Spain and China and the remaining vessels were of New Zealand, Fiji, Spain, and Cook Islands origin (figure 4). For all birds (independent of sex and stage) the greatest number of overlap events were flagged to Chinese Taipei (accounting for approximately 43.7% of all overlap across years) and Japan (approximately 31.6% of all overlap across years - figure 3). Spanish flagged vessels appear to account for a higher proportion of overlap events in 2024 however, we believe this this is due to birds grouped into this cohort not having completed their tracked season.

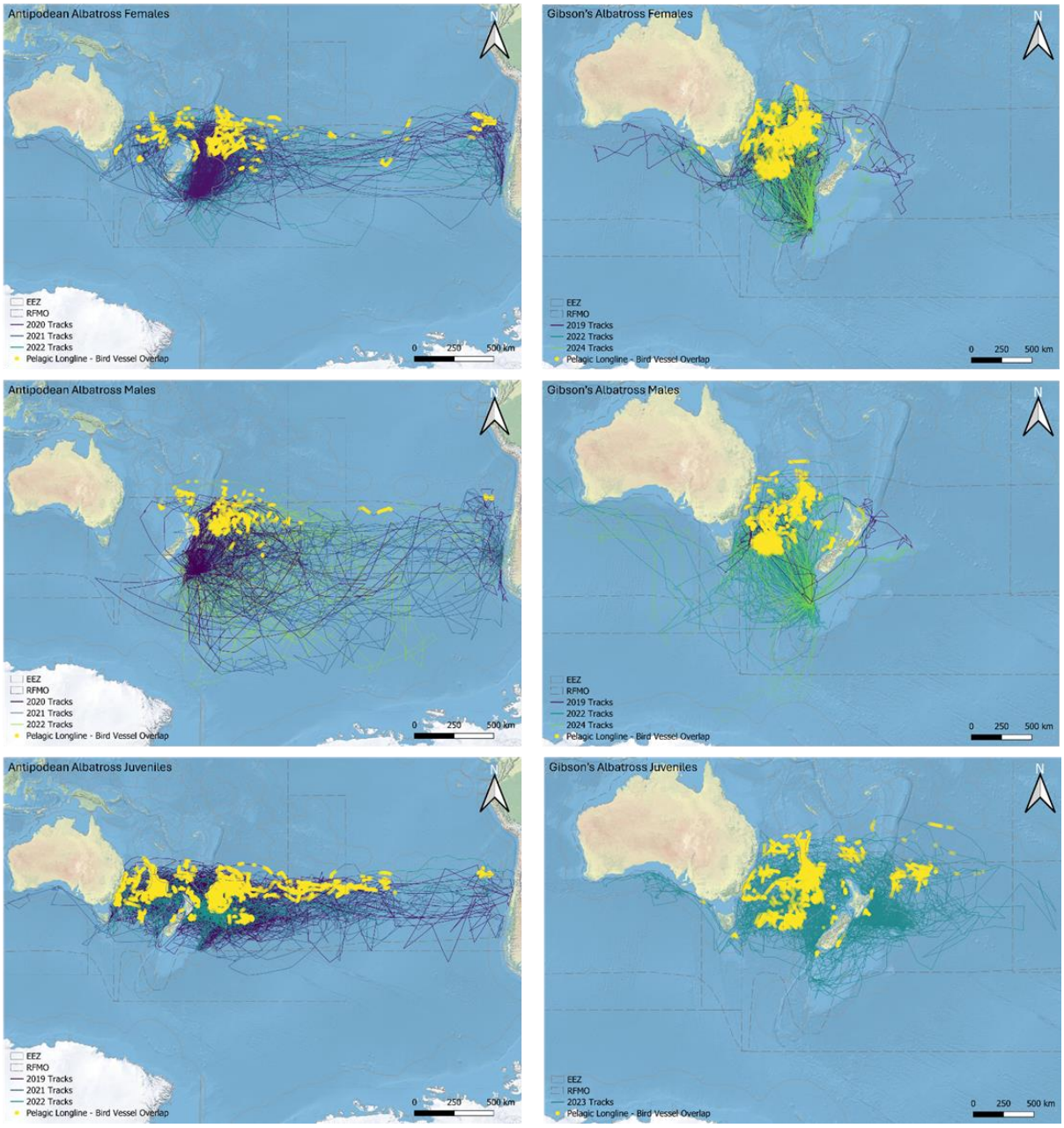

Figure 1. At sea distribution Antipodean and Gibson's albatross 2019-2024.
Panels represent species and sex combinations with descriptions in top corner of panel. Antipodean albatross (left), Gibson's albatross (right), female (top), Male (middle) and juvenile (bottom). Lines represent individual bird tracks interpolated to one fix every hour and respective colours represent cohorts. Bird-vessel overlap events are depicted in yellow for all species/sex combinations. Key RFMO and EEZ boundaries have been plotted in grey.

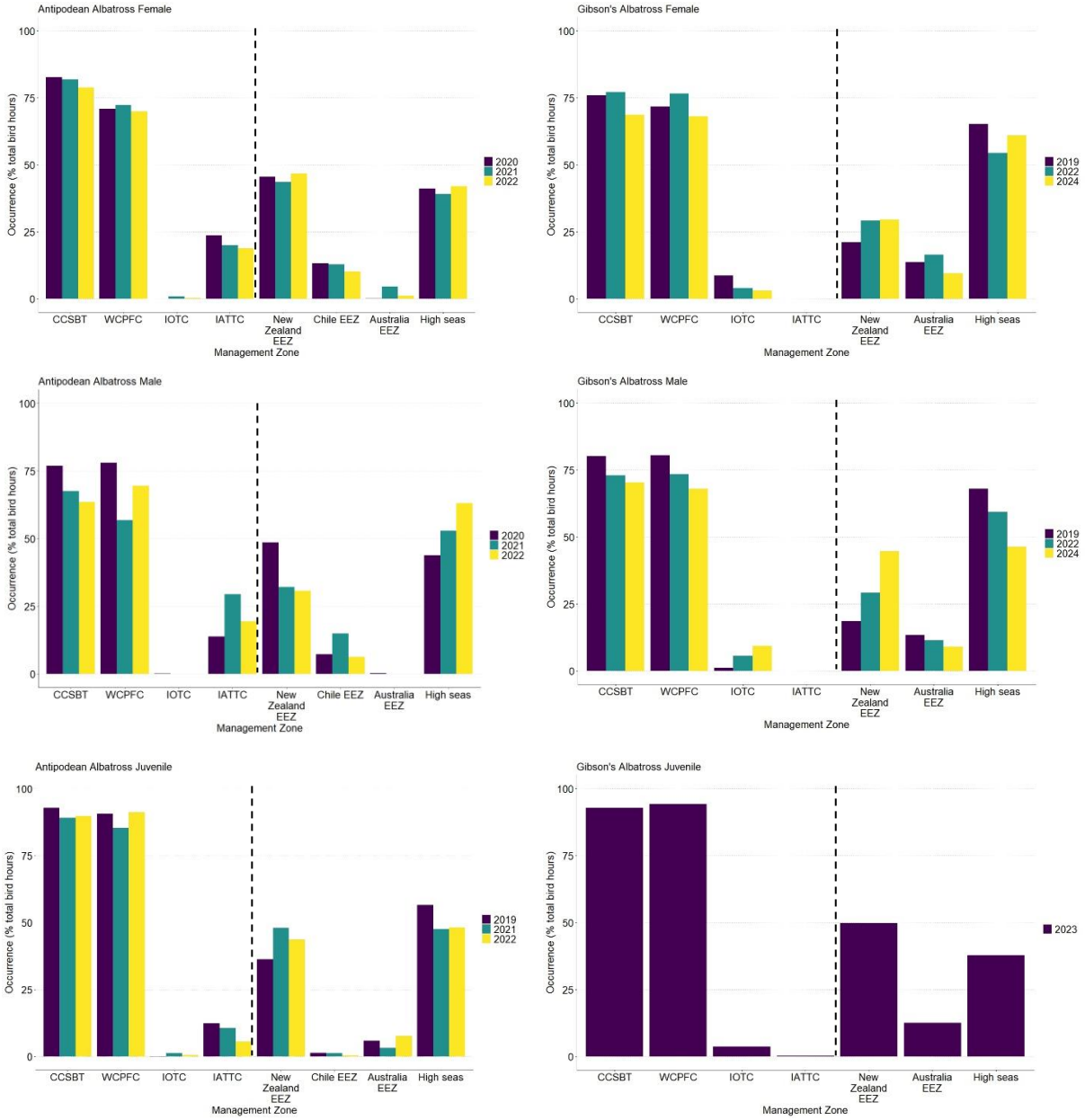

Figure 2. Antipodean and Gibson's albatross proportional occurrence by management zone (RFMO & EEZ).

Panels represent species and sex combinations with descriptions in top corner of panel. Antipodean albatross (left), Gibson's albatross (right), female (top), Male (middle) and juvenile (bottom). Bar colours represent cohorts. Total bird hours (percent occurrence) by regional fisheries management organisation and exclusive economic zone. Zones are denoted as - Exclusive Economic Zones (EEZs) and the high seas, as well as Regional Fisheries Management Organisations (RFMOs) (including EEZs), including the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Western and Central Pacific Fisheries Commission (WCPFC), the Inter-American Tropical Tuna Commission (IATTC), and the Indian Ocean Tuna Commission (IOTC). As some RFMOs overlap, the total sum of the relative occurrence exceeded 100%.

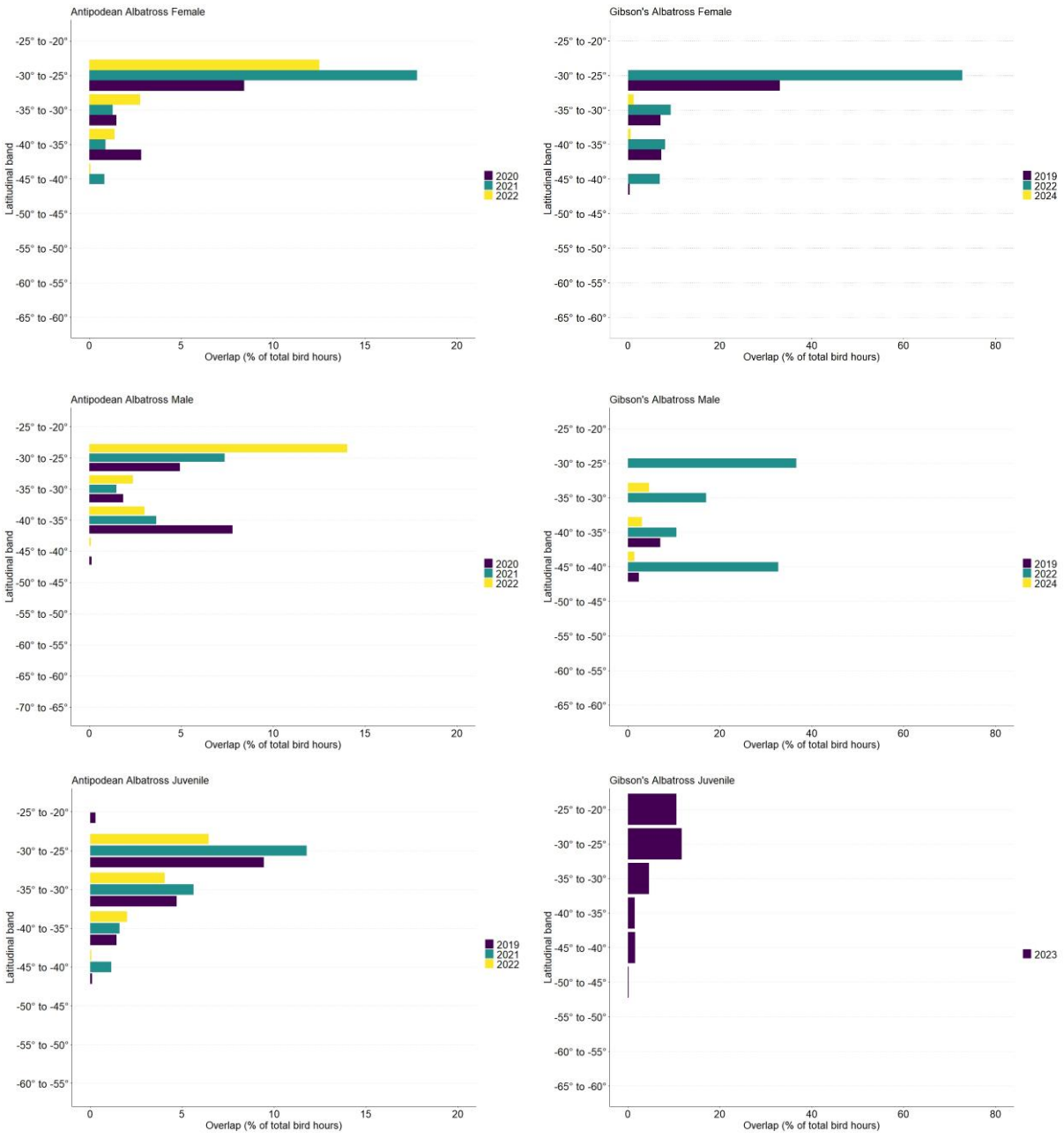

Figure 3. Antipodean and Gibson's albatross bird-vessel overlap by latitudinal band. Panels represent species and sex combinations with descriptions in top corner of panel. Antipodean albatross (left), Gibson's albatross (right), female (top), Male (middle) and juvenile (bottom). Bar colours represent cohorts.

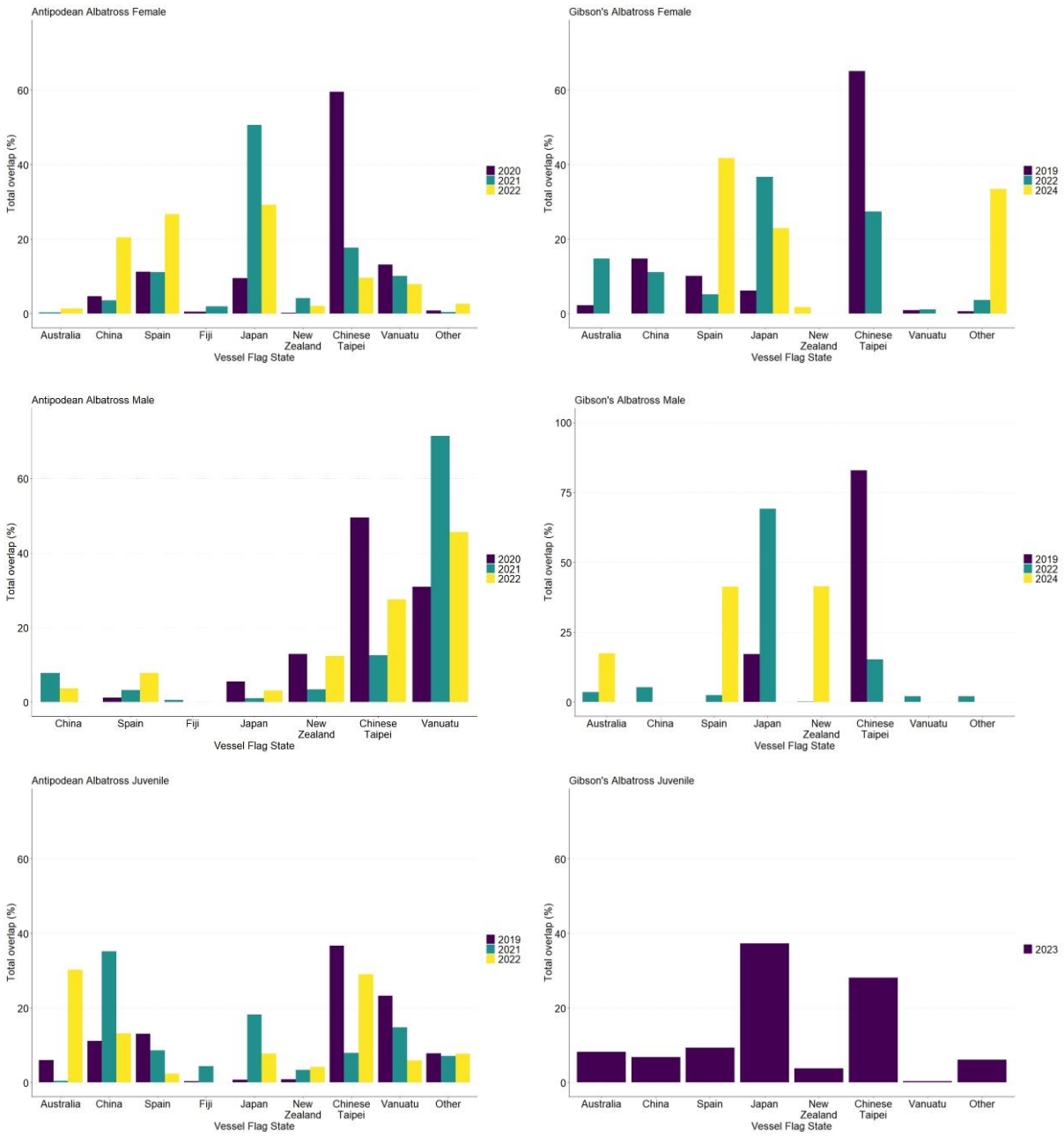

Figure 4. Antipodean and Gibson's albatross bird-vessel overlap by flag state.
Panels represent species and sex combinations with descriptions in top corner of panel. Antipodean albatross (left), Gibson's albatross (right), female (top), Male (middle) and juvenile (bottom). Bar colours represent cohorts.

4. CONCLUSION AND NEXT STEPS

Bycatch in fisheries has been identified as the greatest known threat to the endangered Antipodean and Gibson's albatross - both species which are declining at an alarming rate. What we have presented here are the results of a multi-year tracking study aimed at better understanding the distribution of these birds and, perhaps more importantly, to quantify overlap with fishing activity. In doing so we have highlighted a significant level of bycatch risk in the high seas in the convention areas of CCSBT and WCPFC and identified key vessel fleets which overlapped with the birds. It is our hope that this work will become a key resource for conservation management assisting In the protection and recovery of these populations. Future work will include the completion of the Gibson's Albatross 2024 tracking year with a possibility of continuing another year of tracking in 2025. Also, further fine scale analyses will be completed, specifically identifying relative overlap with specific pelagic longline vessels. This process to identify 'high risk' vessels is particularly important as it will allow us to pinpoint ports of interest for focusing outreach efforts, targeting bycatch mitigation education, and facilitating implementation.

However, it must be acknowledged that while further analyses will be undertaken, new data are unlikely to deviate from the results presented here. The data presented are already extensive and provide clear insights into the consistent use of key areas of the high seas (areas outside national jurisdiction) by Antipodean and Gibson's Albatross, particularly in the Tasman Sea and the high seas east of Aotearoa New Zealand. We illustrate that these areas are where most spatiotemporal overlap with pelagic longline fishing is occurring, and thus where bycatch risk is the highest. Given these insights and the dramatic population collapse observed in Antipodean and Gibson's albatross, increased bycatch mitigation efforts, particularly in latitudes between 30°S and 25°S, appear warranted to prevent further population declines. Additionally, as we only analyse overlap, not direct bycatch risk, increased observer coverage, either through human observer programmes or electronic monitoring, would provide further insights into how the identified overlap translates into bycatch risk.

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REFERENCES

Bose, S., & Debski, I. (2020*). Antipodean albatross spatial distribution and fisheries overlap 2019*. Prepared by the Department of Conservation. 23 p.

BirdLife International. (2018). *Diomedea antipodensis*. The IUCN Red List of Threatened Species 2018: e.T22728318A132656045. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22728318A132656045.en

Elliott, G. & Walker, K. (2019*). Antipodean wandering albatross census and population study on Antipodes Island 2019.* Report prepared for the Department of Conservation. 27p.

Elliott, G., & Walker, K. (2020). *Antipodean wandering albatross: Satellite tracking and population study – Antipodes Island 2020*. Report prepared for the Department of Conservation. 54 p.

Walker, K., & Elliot, G. (2022). *Antipodean wandering albatross satellite tracking and population study on Antipodes Island in 2021 and 2022*. Report prepared for the Department of Conservation. 28 p.

Elliott, G.P., Walker, K.J., Parker, G.C., Rexer-Huber, K., Miskelly, C.M. (2020). Subantarctic Adams Island and its birdlife. *Notornis 67*(1): 153–187.

Fischer, J.H., Carnerio, A., Rowley, O.C., & Debski, I. (2024). *An update on the New Zealand Large-scale monitoring and tracking programme with improved insights into trends and distribution*. ACAP working paper, Eighth Meeting of the Population and Conservation Status Working Group.

Francis, R.I.C.C., Elliott, G., & Walker, K. (2015). *Fisheries risks to the population viability of Gibson's wandering albatross Diomedea gibsoni.* Wellington, Ministry for Primary Industries.

Kroodsma, D.A., Mayorga, J., Hochberg, T., Miller, N.A., Boerder, K., Ferretti, F., Wilson, A., Bergman, B., White, T.D., Block, B.A., Woods, P., Sullivan, B., Costello, C., & Worm, B. (2018). Tracking the global footprint of fisheries. *Science 359*(6378), 904-908. http://dx.doi.org/10.1126/science.aao5646

Merkel, B., Phillips, R.A., Descamps, S., Yoccoz, N.G., Moe, B., & Strom, H. (2016). A probabilistic algorithm to process geolocation data. *Movement Ecology 4*: 26. https://doi.org/10.1186/s40462-016-0091-8

Parker, G.C., Elliott, G., Walker, K., & Rexer-Huber, K. (2022). *Gibson's albatross and white-capped albatross in the Auckland Islands 2021–22.* Final report. Parker Conservation, Dunedin. 26 p.

Rexer-Huber, K., Elliott, G., Walker, K., Thompson, D., & Parker, G. (2020). *Gibson's albatross and whitecapped albatross in the Auckland Islands 2019–20*. Wellington, Prepared by Parker Conservation for Department of Conservation. 30 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marineconservation-services/reports/final-reports/pop2017-04-auckland-island-seabirds-researchfinal-report-2019-20.pdf

Richard, Y., & Abraham, E.R. (2020). *Assessment of the risk of commercial fisheries to New Zealand seabirds,* 2006-07. New Zealand Aquatic Environment and Biodiversity Report No. 237. 61 p. https://mpi.govt.nz/dmsdocument/39407

Robertson, H.A., Baird, K.A., Elliott, G., Hitchmough, R., McArthur, N., Makan, T., Miskelly, C., O'Donnell, C.F., Sagar, P.M., & Scofield, R.P. (2021). *Conservation status of birds in Aotearoa Aotearoa New Zealand, 2021*. Department of Conservation, Te Papa Atawhai. 43 p

Walker, K., & Elliott, G. (2006). At-sea distribution of Gibson's and Antipodean wandering albatrosses, and relationships with longline fisheries*. Notornis 53*(3), 265–290.

Walker, K., Elliott, G., Parker, G.C., & Rexer-Huber, K. (2023). *Gibson's wandering albatross population study*. DRAFT Final report to the Conservation Services Programme, Department of Conservation. 28 p

Supplementary Material

Table 1 – Summary of Antipodean and Gibson's Albatross tagging and overlap.

Albatross species	Cohort	Sex/Status	Total number of tracked birds	Total bird hours	Total birds with overlap[1]	Total bird hours in overlap[1]	% total tracked birds with overlap	% total bird hours in overlap[2]
Antipodean	**Total**	**Total**	**153**	**827,911**	**105**	**17,993**	**68.7**	**2.2**
Antipodean	2020	Female	12	60,163	11	967	91.7	1.6
Antipodean	2021	Female	19	90,225	12	1,242	63.2	1.4
Antipodean	2022	Female	19	90,645	16	1,423	84.2	1.6
Antipodean	2020	Male	8	34,900	6	748	75.0	2.1
Antipodean	2021	Male	23	97,099	11	803	47.9	0.8
Antipodean	2022	Male	12	51,435	6	428	50.0	0.8
Antipodean	2019	Juvenile	20	139,345	19	5,240	95.0	3.8
Antipodean	2021	Juvenile	30	201,274	27	5,598	90.0	2.8
Antipodean	2022	Juvenile	10	62,825	7	1,544	70.0	2.5
Gibson's	**Total**	**Total**	**83**	**335,437**	**65**	**15,043**	**78.3**	**4.5**
Gibson's	2019	Female	10	23,453	5	1,025	50.0	4.4
Gibson's	2022	Female	15	57,553	14	3,307	93.0	5.7
Gibson's	2024	Female	10	24,349	7	222	70.0	0.9
Gibson's	2019	Male	2	9,182	2	560	100.0	6.1
Gibson's	2022	Male	14	44,268	13	3,217	92.9	7.3
Gibson's	2024	Male	10	24,285	5	434	50.0	1.8
Gibson's	2023	Juvenile	22	152,347	19	6,278	86.4	4.1

[1]*Bird-vessel overlap calculations only accounted for overlap events with vessels classified as 'drifting longline'*

[2] *Percent total overlap was calculated as a proportion of all total bird hours from all tracked birds*