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UPDATED ASSESSMENT OF BLACK-FOOTED ALBATROSS *Phoebastria nigripes* OVERLAP WITH PELAGIC LONGLINE FISHERIES IN THE NORTH PACIFIC

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Submitted by

Thomas A. Clay[1,2], Alyssa Piauwasdy[3], Michelle Hester[3], Jessie Beck[4], Scott A. Shaffer[5], André F. Raine[6], K. David Hyrenbach[3,7]

[1] Environmental Defense Fund, Monterey, CA, USA.
[2] Institute of Marine Sciences, University of California, Santa Cruz, Santa Cruz, CA, USA.
[3] Oikonos Ecosystem Knowledge, Kailua, HI, USA.
[4] Ecology and Evolutionary Biology Department, University of California, Santa Cruz, Santa Cruz, CA, USA.
[5] Biological Sciences, San Jose State University, San Jose, CA, USA.
[6] Archipelago Research & Conservation, Kauai, HI, USA.
[7] Marine Science Programs at Oceanic Institute, Hawaiʻi Pacific University, Waimanalo, HI, USA.

Corresponding author: Thomas A. Clay; tclay@edf.org

Executive Summary

Black-footed Albatrosses (*Phoebastria nigripes*), listed as Near Threatened, are among the seabirds most vulnerable to bycatch in pelagic longline fisheries across the North Pacific. We present an updated fisheries-overlap assessment incorporating new tracking data collected between 2024 and 2026 from Kure Atoll, Laysan Island and Lehua Islet, increasing near year-round tracking coverage from 44% to 84% of the global breeding population (561 tracks from 345 individuals across five populations). The expanded dataset confirmed substantial differences in fisheries overlap among populations: birds from Kure and Midway overlapped predominantly with fisheries in the northwest Pacific, whereas overlap for central and eastern breeding populations was concentrated north of the main Hawaiian Islands. When distributions were combined, the principal hotspot extended across a broad region of the subtropical North Pacific, between approximately 150°E and 150°W, and 25–40°N. For four of five populations, ≥88% of overlap occurred within the WCPFC Convention Area and for all populations >97% of overlap was north of 23°N where mitigation measures are required. Fleets flagged to the United States, Chinese Taipei and Japan collectively accounted for approximately three-quarters of total overlap, although their relative importance differed markedly among populations. These findings provide the most comprehensive assessment of Black-footed Albatross exposure to pelagic longline fisheries to date, reinforce the northwest and

north-Central Pacific as principal regions of potential interaction, and provide strengthened evidence supporting review of the northern hemisphere provisions of the Conservation and Management Measure 2025-05.

We recommend the Scientific Committee (SC22):

- *Note* the updated fisheries-overlap assessment for Black-footed Albatrosses based on expanded tracking data from Kure, Laysan and Lehua, increasing year-round tracking coverage to 84% of the global population.
- *Note* that three quarters of the overlap is with Chinese Taipei, Japan the United States flagged vessels.
- *Recognize* that potential interactions remain concentrated in the northwest Pacific and that western breeding populations have higher bycatch risk than eastern populations.
- *Revise* the northern hemisphere mitigation provisions of CMM 2025-05 to better align with current best practice, including the removal of mitigation measures for which there is limited evidence of effectiveness in reducing seabird bycatch.
- *Encourage* continued improvement in seabird bycatch monitoring and reporting, including increased observer and electronic monitoring coverage where feasible.

1. Introduction

Incidental mortality (bycatch) in pelagic longline fisheries remains the principal threat to many albatross and petrel species throughout the Pacific Ocean (Dias et al. 2019; Fischer, Rowley, et al. 2024). As long-lived species with low reproductive rates, albatrosses are particularly sensitive to increases in adult mortality, making effective bycatch mitigation a conservation priority (Phillips et al. 2016). Within the Western and Central Pacific Ocean, the WCPFC has adopted a range of measures to reduce seabird bycatch in pelagic longline fisheries as part of its ecosystem-based fisheries management framework (WCPFC 2018, 2025; Fischer, Rowley, et al. 2024). More recently, Conservation and Management Measure (CMM) 2025-05 replaced 2018-03, introducing updated mitigation measures, technical specifications and reporting requirements (WCPFC 2025) However, the revised measure predominantly targeted regulations in the Southern Hemisphere, whereas those north of 23°N remain largely unchanged. Continued improvement of seabird bycatch mitigation depends on an accurate understanding of the spatial and temporal overlap between seabirds and fishing activity (Clay et al. 2019; Rowley et al. 2024; Rexer-Huber et al. 2025).

The Black-footed Albatross (*Phoebastria nigripes*) breeds almost exclusively in the Northwestern Hawaiian Islands and ranges widely across the North Pacific throughout the annual cycle (Shaffer et al. 2021). Demographic studies indicate that bycatch may be unsustainable for some populations (Lewison et al. 2003, Veran et al. 2007, Arata et al. 2009) and the species is classified as Near Threatened by the IUCN and listed under the Agreement of Conservation of Albatrosses and Petrels (ACAP) because of the threats posed by fisheries (ACAP 2012). Tracking studies have consistently demonstrated extensive overlap with pelagic longline fisheries throughout the WCPFC Convention Area, with the highest potential exposure occurring in the northwest and north-central Pacific (Nishizawa et al. 2025; Žydelis et al. 2011; Hyrenbach and Dotson 2003; Wren et al. 2019; Clay et al. 2024). Consistent with these findings, fisheries-dependent data indicate that bycatch susceptibility varies among breeding populations, likely reflecting differences in their at-sea distributions (Beck et al. 2025). However, previous overlap assessments were based on relatively limited sample sizes from several major breeding colonies, highlighting the need for an updated population-wide risk assessment that includes more extensive sampling at under-represented colonies.

Since these earlier assessments, new tracking data have become available from Kure Atoll (Hōlanikū), Laysan Island (Kamole) and Lehua Islet, considerably improving representation of Black-footed Albatross breeding populations. Here, we combine these data with existing datasets from Midway Atoll, Tern Island and Kure (from Clay et al. 2024) to produce the most comprehensive assessment of Black-footed Albatross overlap with pelagic longline fisheries to date. Specifically, we identify the regions, seasons, jurisdictions and flag States associated with the greatest fisheries overlap and quantify differences in exposure among breeding populations. The results provide updated evidence to support future evaluation of seabird bycatch risk and the implementation and review of CMM 2025-05 (WCPFC 2025).

2. Materials and Methods

2.1. Tracking data collection

All available tracking data were collated for Black-footed Albatross and were requested through direct email contact with researchers or through the BirdLife International Seabird Tracking Database (2002–2018; Table 1; www.seabirdtracking.org). Recent tracking data (2024-2026) were obtained by current authors and field crews deploying and retrieving satellite (PTT) and geolocator tags on BFAL during incubation and chick-rearing on three colonies (Kure, Laysan, and Lehua), each requiring variable support, logistics, challenges, and permitting agencies (see Acknowledgments). We collated and standardized datasets from all tracked populations from colonies in Hawaiʻi (the small Japan population excluded in this revision), breeding stages (incubation, brood, post-brood and non-breeding) and device types (GPS, PTT or geolocator).

2.2. Tracking data processing

Data processing and spatial analyses were conducted in R *v.* 4.5.2 (R Core Team, 2025). Information on processing of historic geolocator data is provided in (Clay et al. 2024). Briefly, geolocator positions were estimated from light-level data using established procedures, incorporating sea surface temperature (SST) recorded by the tags and remotely sensed SST fields to improve latitude estimates (Jordan et al. 2022; Shaffer et al. 2005). Locations occurring within approximately two weeks of the spring and autumn equinoxes were excluded because of reduced latitude accuracy. To minimize the influence of spurious locations on subsequent overlap analyses, we also removed geolocator positions falling outside the species' known range, defined as the 99% kernel utilization distribution estimated from all geolocator locations using adehabitatHR (Calenge 2006). Locations north of 60°N were also excluded, as Black-footed Albatrosses have not been recorded at these latitudes (Kuletz et al. 2014).

All GPS and PTT tracks were visually inspected, and obviously erroneous locations were removed. GPS and PTT data were processed using the packages *track2KBA* (Beal et al. 2021) and *aniMotum* (Jonsen et al. 2023). Breeding-season tracks were divided into individual foraging trips using colony-specific spatial buffers selected to exclude locations around the colony and incomplete trips. Tracks were then regularized and filtered using a maximum flight speed of 90 km h^{-1}. Regularized locations were interpolated at 4-hour intervals for breeding-season trips and non-breeding PTT tracks.

2.3. Calculating distribution grids

For each breeding population, utilization distributions (UDs) were estimated using *adehabitatHR* (Calenge 2006). GPS and PTT data during the breeding season were grouped by breeding stage (incubation, brood and post-brood), whereas geolocator data and PTT data during the non-breeding season were grouped by calendar month. Locations were projected to a Lambert Equal Area projection centered on the median latitude and longitude of each population, and kernel UDs were calculated using smoothing parameters of 50 km for GPS/PTT data and 186 km for geolocator data, corresponding to the average positional error of light-level geolocation (Phillips et al. 2004). Individual UDs were summed to generate population-level distributions, which were standardised to sum to one and resampled to a 2° × 2° grid.

Monthly population distributions were generated by combining breeding-stage and non-breeding UDs according to the average phenology of each population, following the approach of Clay et al. (2019) and Carneiro et al. (2020). Breeding-stage distributions were weighted by the proportion of each month occupied by incubation, brood and post-brood periods, whereas monthly geolocator UDs represented non-breeding distributions directly.

2.4. Fishing effort data and overlap analyses

Automated Identification System (AIS)-derived fishing effort data were obtained from Global Fishing Watch via the *gfwr* package(Sánchez-Tapia et al. 2026) for 2016-2025. This period was chosen because AIS coverage is considered more reliable and aligns with the tracking period for the newly collected albatross data. Global Fishing Watch estimates fishing effort by combining vessel tracking data, public vessel registries and machine-learning algorithms to identify fishing vessels and periods of active fishing (Kroodsma et al. 2018). Fishing effort was obtained at a 0.01° resolution but aggregated to a 2° × 2° monthly grid, with total fishing hours calculated separately for flag State.

Monthly fisheries overlap, used as an index of potential bycatch risk, was calculated for each grid cell by multiplying the relative utilization distribution of Black-footed Albatrosses by the corresponding fishing effort (fishing hours). Overlap was summarized by breeding population, flag State and jurisdiction, distinguishing Exclusive Economic Zones (EEZs) from the high seas using Marine Regions EEZ boundaries (version 11; https://www.marineregions.org/downloads.php). National jurisdictions included EEZs associated with overseas territories and disputed areas.

Because annual-cycle coverage differed among breeding populations, monthly overlap estimates were averaged across all available months when comparing populations. To generate species-level estimates, population-specific overlap grids and flag-State totals were weighted by the relative size of each breeding colony, ensuring that overall estimates reflected the global tracked breeding population rather than giving equal weight to colonies of different sizes. Population sizes were taken from Flint and Fraiola (2021) (Table 1). To examine geographic patterns in fisheries overlap, flag-State-specific overlap was correlated with breeding colony longitude using Spearman's rank correlation. Finally, overlap was summarized north and south of 23°N to evaluate interactions relative to the latitudinal boundary at which seabird bycatch mitigation requirements are mandated under CMM 2025-05.

Results

Between February 2024 and January 2026, >550 processed tracks were obtained from three breeding populations (Kure, Laysan and Lehua), increasing near year-round tracking coverage of the global Black-footed Albatross population from 43.6% to 83.5% (Table 1, Fig. 1a). Tracking data from Kure revealed extensive use of the North Pacific during both breeding and non-breeding seasons, including waters off Japan, the Sea of Okhotsk, the Bering Sea, Aleutian Islands, Gulf of Alaska and California Current, together with a broad region of the subtropical central North Pacific (Fig. 1). Birds from Laysan primarily used the northeast Pacific year-round, whereas Lehua birds were concentrated in the central and northeast Pacific, although one individual travelled to the western North Pacific (Fig. 1b).

The contrasting distributions resulted in marked differences in fisheries overlap among breeding populations (Fig. 2). Kure birds overlapped predominantly with pelagic longline fisheries in the northwest Pacific, whereas overlap for Laysan, Tern and Lehua populations was concentrated north of the main Hawaiian Islands, with secondary hotspots in the northwest Pacific. When distributions from all breeding populations were combined, fisheries overlap formed a broad hotspot extending across the subtropical North Pacific between 150°E and 150°W and 25–40°N (Fig. 3). Weighting overlap by breeding population size had little influence on the overall spatial pattern, although it slightly reduced the relative importance of the northwest Pacific.

For all populations except Laysan, most overlap occurred within the WCPFC Convention Area (88-99%) (Figs. 4-5). In contrast, 48% of overlap for Laysan birds occurred within the IATTC Convention Area, largely reflecting interactions with the U.S. fleet during August (Fig. 5). The vast majority (93%) of fisheries overlap occurred on the high seas, exceeding 87% for every breeding population (Fig. 6). Overlap within EEZs was limited, with only the Tern (11%) and Lehua (10%) populations showing appreciable overlap within U.S. waters.

Overall fisheries overlap was greatest for Kure birds, followed by Midway, and lowest for Laysan (Fig. 5a). Across all populations, overlap was highest with vessels flagged to the United States (30%), followed by Chinese Taipei (22%), Japan (22%), Vanuatu (8%), China (5%) and South Korea (2%), with similar values after weighting by breeding population size. Together, the fleets of the United States, Chinese Taipei and Japan accounted for 74% (71% weighted) of total fisheries overlap. There was also a clear longitudinal gradient in fleet-specific overlap (Fig. 5b): overlap with U.S.-flagged vessels increased eastwards across the breeding range, whereas overlap with Japanese and Chinese Taipei fleets tended to increase westwards. Consequently, overlap for western breeding populations (Kure and Midway) was dominated by Japanese and Chinese Taipei fleets, whereas eastern populations (Tern, Lehua) overlapped predominantly with U.S. vessels.

Fisheries overlap was generally greatest during the albatross breeding season (November-May), although seasonal patterns differed among fleets (Figure 4). Overlap with U.S.-flagged vessels peaked between November and May, whereas overlap with Japanese and Taiwanese fleets was greatest between May and November, particularly for birds from Kure and Midway. Only 2.7% of total overlap occurred below 23°N, where no mitigation measures are mandated, decreasing to 0.5% after weighting by breeding population size.

3. Discussion

This study provides the most comprehensive assessment to date of spatial overlap between Black-footed Albatrosses and pelagic longline fisheries in the North Pacific. Incorporating new tracking data from Kure Atoll, Laysan Island and Lehua Islet increased near year-round tracking coverage increased from 44% to 84% of the global breeding population, substantially improving representation of breeding colonies throughout their range. Despite this expanded dataset, the overall pattern of fisheries overlap was broadly consistent with a previous assessment based on four populations (Torishima, Kure, Midway and Tern; Clay et al. 2024), reinforcing confidence that the most fisheries overlap within the North Pacific lies within the WCPFC Convention Area and that bycatch risk differs markedly among breeding populations.

The updated analyses confirm the northwest Pacific as a principal hotspot region of fisheries overlap. Newly collected tracking data from Kure revealed extensive use of waters off Japan, the Sea of Okhotsk and the western North Pacific throughout much of the annual cycle, resulting in substantially greater overlap with Japanese- and Chinese Taipei-flagged fleets than for more easterly breeding populations. In contrast, birds breeding at Lehua, Tern and Laysan overlapped predominantly with U.S.-flagged fisheries. This pattern is consistent with genetic analyses showing that most Black-footed Albatrosses retained as bycatch in U.S. federally managed fisheries originated from Tern Island and surrounding islets (Beck et al., 2025). Tracking data from Laysan also filled an important gap for the world's second-largest breeding colony and revealed unexpectedly low overall fisheries exposure, reflecting extensive use of the eastern Pacific where pelagic longline effort is relatively low. Together, these findings highlight the importance of considering colony-specific distributions when interpreting bycatch data and prioritizing conservation actions.

The area of overlap in the northwest Pacific is particularly important because this region is dominated by the Japanese offshore longline fleet (<24 m), for which reported seabird bycatch rates remain among the highest in the WCPFC (Japan 2026). Observer coverage in this and other fleets remain low (<2–5%), severely reducing confidence in estimates of rare bycatch events such as Black-footed Albatross interactions (Wakefield et al. 2018) and undermining the WCPFC's ability to accurately assess fisheries impacts to seabirds. More broadly, fleets of the United States, Chinese Taipei and Japan accounted for approximately three-quarters of total fisheries overlap, indicating that continued implementation of effective seabird mitigation by these fleets offers the greatest opportunity to reduce interactions (Japan 2026; USA 2026; Chinese Taipei 2026). The recent introduction of mandatory tori lines in the Hawaiʻi deep-set fleet is an important step towards reducing risk in the central North Pacific (NOAA 2024), where overlap is particularly high for birds breeding at Laysan and Tern.

More than 90% of fisheries overlap occurred on the high seas and over 97% occurred north of 23°N, where seabird mitigation measures are required under CMM 2025-05. These findings indicate that future improvements in the conservation status of Black-footed Albatrosses will depend primarily on the effectiveness of seabird mitigation measures implemented in this region. Nevertheless, notable bycatch events have also been recorded south of 23°N, including by the U.S. fleet during 2021 (146 out of 581 birds caught; USA 2026), suggesting that the drivers of these interactions warrant further investigation to determine whether the current latitudinal boundary remains appropriate (Hyrenbach et al. 2021).

Although CMM 2025-05 introduced important improvements, including updated technical specifications and strengthened reporting requirements, mitigation requirements north of 23°N remained largely unchanged. Recent evaluations suggest that adopting ACAP best-practice mitigation standards could improve the effectiveness of individual mitigation measures in the Northern Hemisphere by at least 30%, with further gains achieved through improved combinations of mitigation measures (Fischer, Bell, et al. 2024). These improvements arise principally from strengthened specifications for weighted branch lines and bird-scaring lines and the removal of measures, such as blue-dyed bait, for which evidence of effectiveness remains limited. Given that almost all Black-footed Albatross exposure occurs north of 23°N, future reviews of CMM 2025-05 should prioritize updating the northern provisions to better reflect current best practice (ACAP 2024).

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References

ACAP. 2012. *Species Assessments: Black-Footed Albatross Phoebastria Nigripes*. Agreement for the Conservation of Albatrosses and Petrels.

ACAP. 2024. "ACAP Review of Mitigation Measures and Best Practice Advice for Reducing the Impact of Pelagic Longline Fisheries on Seabirds." Agreement for the Conservation of Albatrosses and Petrels.

Beal, Martin, Steffen Oppel, Jonathan Handley, et al. 2021. "track2KBA: An R Package for Identifying Important Sites for Biodiversity from Tracking Data." *Methods in Ecology and Evolution* 12: 2372–78. https://doi.org/10.1111/2041-210X.13713.

Beck, Jessie N., Diana S. Baetscher, Claire Tobin, et al. 2025. "Quantifying Impacts of Seabird Bycatch Using Genetic Assignment: A Case Study of Black-Footed Albatross in U.S. Fisheries." *Biological Conservation* 303 (March): 110965. https://doi.org/10.1016/j.biocon.2025.110965.

Calenge, Clément. 2006. "The Package 'Adehabitat' for the R Software: A Tool for the Analysis of Space and Habitat Use by Animals." *Ecological Modelling* 197: 516–19. https://doi.org/10.1016/j.ecolmodel.2006.03.017.

Carneiro, Ana P. B., Elizabeth J. Pearmain, Steffen Oppel, et al. 2020. "A Framework for Mapping the Distribution of Seabirds by Integrating Tracking, Demography and Phenology." *Journal of Applied Ecology* n/a (n/a). https://doi.org/10.1111/1365-2664.13568.

Chinese Taipei. 2026. *Annual Report to the Commission - Part 1: Information on Fisheries, Research, and Statistics*. Scientific Committee Twenty-Second Regular Session (SC22) WCPFC-SC22-2026-AR-CCM23. WCPFC.

Clay, T. A., S. A. Shaffer, Josh Adams, et al. 2024. *Predicting Albatross Bycatch Hotspots across the North Pacific Ocean*. 12th Regular Session of the Scientific Committee WCPFC-SC20-2024/EB-IP-23. Western and Central Pacific Fisheries Commission.

Clay, Thomas A., Cleo Small, Geoffrey N. Tuck, et al. 2019. "A Comprehensive Large-Scale Assessment of Fisheries Bycatch Risk to Threatened Seabird Populations." *Journal of Applied Ecology* 56 (May): 1882–93. https://doi.org/10.1111/1365-2664.13407.

Dias, Maria P., Rob Martin, Elizabeth J. Pearmain, et al. 2019. "Threats to Seabirds: A Global Assessment." *Biological Conservation* 237: 525–37. https://doi.org/10.1016/j.biocon.2019.06.033.

Fischer, J. H., J. Bell, and Igor Debski. 2024. *Meta-Analysis of Standardised Interaction Rates Reveals Performance of Seabird Bycatch Mitigation Methods for Pelagic Longline Fisheries in the Light of the Review of CMM 2018-03*. 20th Regular Session of the Scientific Committee WCPFC-SC20-2024/EB-WP-11. WCPFC.

Fischer, J. H., O. Rowley, A. P. B. Carneiro, et al. 2024. *An Update on the New Zealand Large-Scale Seabird Monitoring and Tracking Programme with Improved Insights into Trends, Distribution, and Overlap with Pelagic Longline Fisheries*. 12th Regular Session of the Scientific Committee WCPFC-SC20-2024/EB-WP-10. Western and Central Pacific Fisheries Commission.

Flint, E. N., and K. Fraiola. 2021. "Status and Trends of Albatross Populations in the Northwestern Hawaiian Islands." *NOAA Technical Memorandum*, In: Hyrenbach, K.D., Ishizaki, A., Polovina, J., and Ellgen, S. [eds]. The factors influencing albatross interactions in the Hawai'i longline fishery: towards identifying drivers and quantifying impacts., 163 pp.

Hyrenbach, K. D., Asuka Ishizaki, Jeff J. Polovina, and Sarah Ellgen. 2021. *The Factors Influencing Albatross Interactions in the Hawaii Longline Fishery: Towards Identifying Drivers and Quantifying Impacts*. NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-122. U.S. Department of Commerce.

Japan. 2026. *Annual Report to the Commission - Part 1: Information on Fisheries, Research, and Statistics*. Scientific Committee Twenty-Second Regular Session (SC22) WCPFC-SC22-2026-AR-CCM10. WCPFC.

Jonsen, Ian D., W. James Grecian, Lachlan Phillips, et al. 2023. "aniMotum, an R Package for Animal Movement Data: Rapid Quality Control, Behavioural Estimation and Simulation." *Methods in Ecology and Evolution* 14 (3): 806–16. https://doi.org/10.1111/2041-210X.14060.

Jordan, Fredrick Dallas, Scott A. Shaffer, Melinda G. Conners, et al. 2022. "Divergent Post-Breeding Spatial Habitat Use of Laysan and Black-Footed Albatross." *Frontiers in Ecology and Evolution* 10: 1028317. https://doi.org/10.3389/fevo.2022.1028317.

Kroodsma, David A., Juan Mayorga, Timothy Hochberg, et al. 2018. "Tracking the Global Footprint of Fisheries." *Science* 359 (6378): 904–8. https://doi.org/10.1126/science.aao5646.

Kuletz, Kathy J., Martin Renner, Elizabeth A. Labunski, and George L. Hunt. 2014. "Changes in the Distribution and Abundance of Albatrosses in the Eastern Bering Sea: 1975–2010." *Deep Sea Research Part II: Topical Studies in Oceanography*, Understanding Ecosystem Processes in the Eastern Bering Sea III, vol. 109 (November): 282–92. https://doi.org/10.1016/j.dsr2.2014.05.006.

NOAA. 2024. "Tori Line Requirement for Stern-Setting Vessels in Hawaiʻi Deep-Set Longline Fishery." FR Doc. 2024-04236.

Phillips, R. A., R. Gales, G. B. Baker, et al. 2016. "The Conservation Status and Priorities for Albatrosses and Large Petrels." *Biological Conservation* 201: 169–83. https://doi.org/10.1016/j.biocon.2016.06.017.

Phillips, R. A., J. R. Silk, J. P. Croxall, V. Afanasyev, and D. R. Briggs. 2004. "Accuracy of Geolocation Estimates for Flying Seabirds." *Marine Ecology Progress Series* 266: 265–72.

Rexer-Huber, Kalinka, Thomas A. Clay, Paulo Catry, et al. 2025. "Metapopulation Distribution Shapes Year-Round Overlap with Fisheries for a Circumpolar Seabird." *Ecological Applications* 35 (3): e70019. https://doi.org/10.1002/eap.70019.

Rowley, O., Te Arawhetu Waipoua, Igor Debski, et al. 2024. *Fine Scale Overlap Analysis of Antipodean and Gibson's Albatross with Pelagic Longline Fishing Effort*. Joint Twelfth Meeting of the Seabird Bycatch Working Group and Eighth Meeting of the Population and Conservation Status Working Group Joint SBWG12/PaCSWG8 Doc 07. Agreement on the Conservation of Albatrosses and Petrels.

Sánchez-Tapia, A., T. Clavelle, Rocio Joo, Nathan Miller, and J. Cornejo-Donoso. 2026. *Gfwr: Access Data from Global Fishing Watch APIs*. V. R package version 3.0. Released. https://github.com/globalfishingwatch/gfwr.

Shaffer, S. A., R. A. Orben, S. E. Gutowsky, and K. D. Hyrenbach. 2021. *Population-Level Assessment of Black-Footed Albatross Foraging Distributions and Habitat Use in the North Pacific*. NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-122. In: Hyrenbach, K.D., Ishizaki, A., Polovina, J., and Ellgen, S. [Eds]. The Factors Influencing Albatross Interactions in the Hawai'i Longline Fishery: Towards Identifying Drivers and Quantifying Impacts. U.S. Dept. of Commerce.

Shaffer, S. A., Y. Tremblay, J. A. Awkerman, et al. 2005. "Comparison of Light- and SST-Based Geolocation with Satellite Telemetry in Free-Ranging Albatrosses." *Marine Biology* 147: 833–43.

USA. 2026. *Annual Report to the Commission - Part 1: Information on Fisheries, Research, and Statistics*. Scientific Committee Twenty-Second Regular Session (SC22) WCPFC-SC22-2026-AR-CCM27. WCPFC.

Wakefield, Corey B., Sybrand A. Hesp, Stuart Blight, Brett W. Molony, Stephen J. Newman, and Norman G. Hall. 2018. "Uncertainty Associated with Total Bycatch Estimates for Rarely-Encountered Species Varies Substantially with Observer Coverage Levels: Informing Minimum Requirements for Statutory Logbook Validation." *Marine Policy* 95: 273–82. https://doi.org/10.1016/j.marpol.2018.05.018.

WCPFC. 2018. "Conservation and Management Measure 2018-03: Conservation and Management Measure to Mitigate the Impact of Fishing for Highly Migratory Fish Stocks on Seabirds." Western and Central Pacific Fisheries Commission.

WCPFC. 2025. "CMM 2025-05 - Conservation and Management Measure to Mitigate the Impact of Fishing on Seabirds." Western and Central Pacific Fisheries Commission.

Table 1. Summary of tracking data according to population (Flint and Fraiola 2021). Recently tracked populations are indicated in bold.

Population	Coordinates	Breeding pairs	% global pop.	Annual-cycle coverage	N		New tracking data
					Ind.	Tracks	
Kure Atoll (Hōlanikū)	**23°03'N, 161°56'W**	**3,398**	**4.9**	**All**	**54**	**195**	**Yes**
Midway Atoll (Pihemanu)	28°15'N, 177°20'W	25,615	36.5	All	58	59	No
Laysan Island (Kamole)	**25°46'N, 171°45'W**	**24,565**	**35.0**	**Post-brood, non-breeding**	**30**	**73**	**Yes**
Tern Island (Lalo)	23°45'N, 166°10'W	4,944	7.1	All	196	227	No
Lehua Islet	**22°01'N, 160°06'W**	**39**	**<0.1**	**All**	**7**	**7**	**Yes**
Total		70,096	83.5		345	561	

"All" under the Annual-cycle coverage column represents that there were sufficient data for incubating, chick-rearing and non-breeding birds.

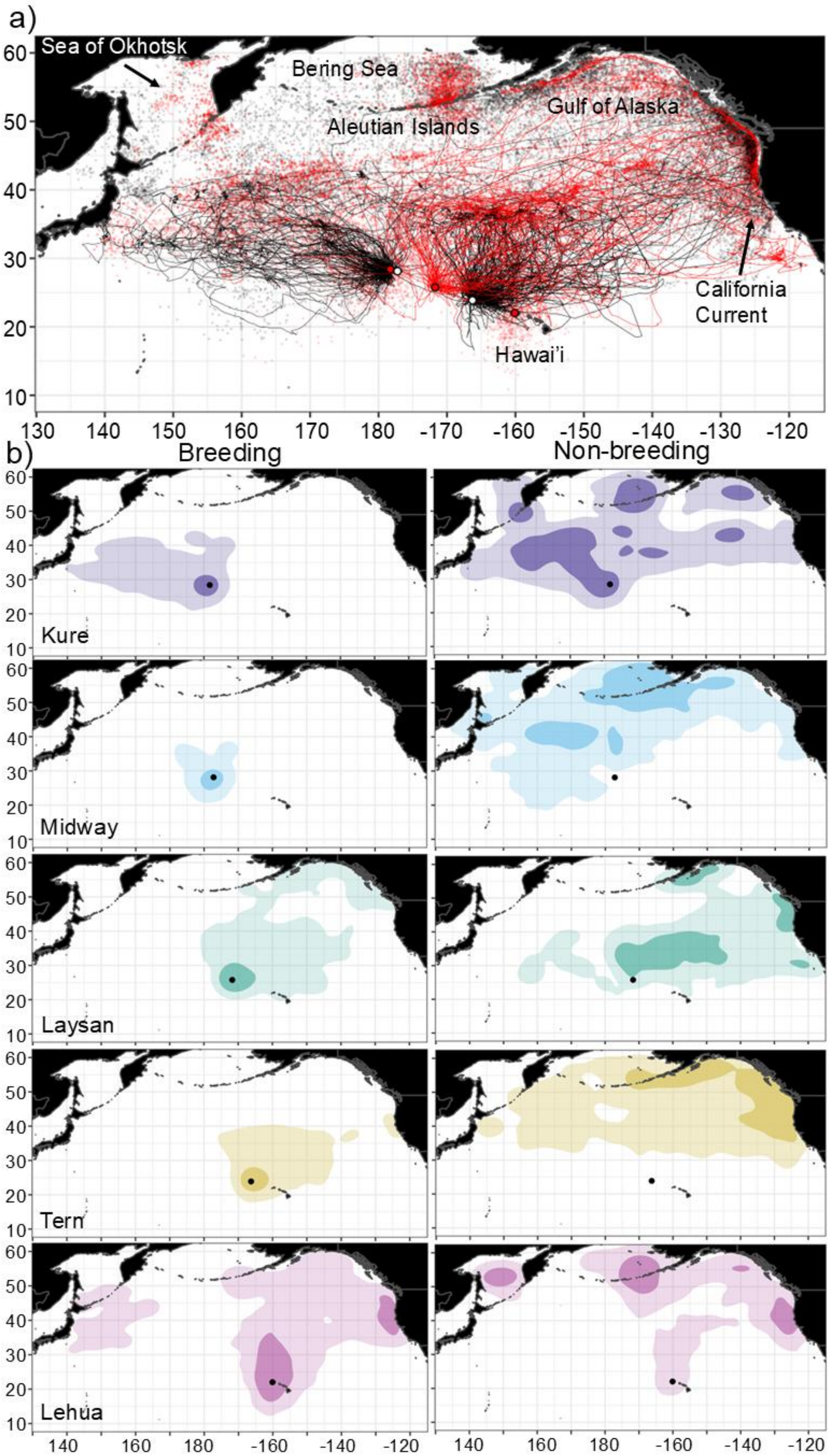

Figure 1. a) Compilation of tracking data from five populations of Black-footed Albatross in the North Pacific Ocean. Newly collected tracking data are shown in red and previously published tracking data (reported in Clay et al. 2024) are shown in black. Lines represent breeding-season

foraging trips, and dots represent non-breeding locations derived from geolocators. Newly tracked and previously tracked breeding colonies are indicated by red and white circles, respectively. b) utilization distributions (UDs) during the breeding (mid-November to June) and non-breeding (July to mid-November) seasons for each of the five populations. The 50% and 95% UDs are shown in darker and lighter shading, respectively.

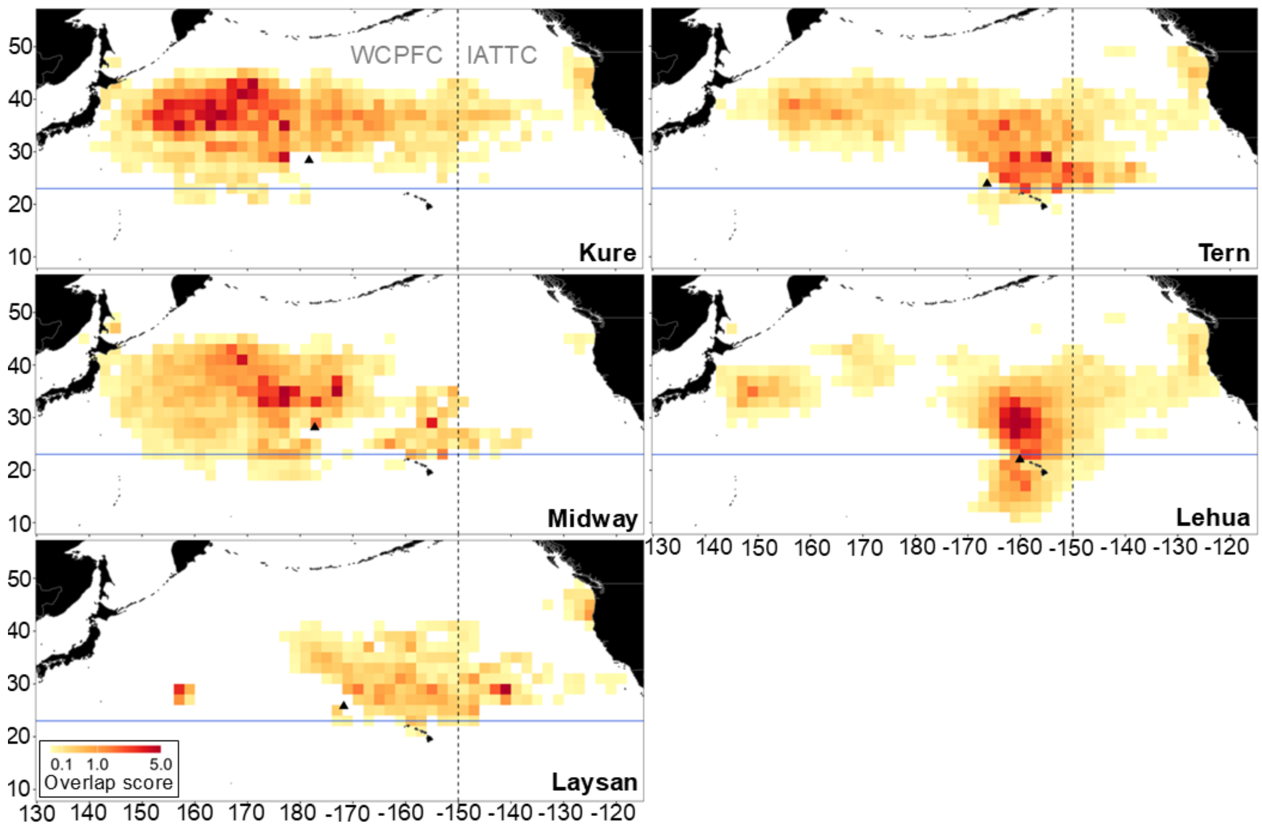

Figure 2. Year-round fisheries-overlap hotspots for five Black-footed Albatross populations in the North Pacific Ocean with pelagic longline fisheries. The color gradient indicates increasing fisheries-overlap from light yellow (lowest) to red (highest), displayed on a square-root scale. Breeding locations are indicated by black triangles. The dashed vertical line marks the boundary between the Convention Areas of the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC), and the blue horizontal line indicates 23°N, north of which seabird bycatch mitigation measures are required.

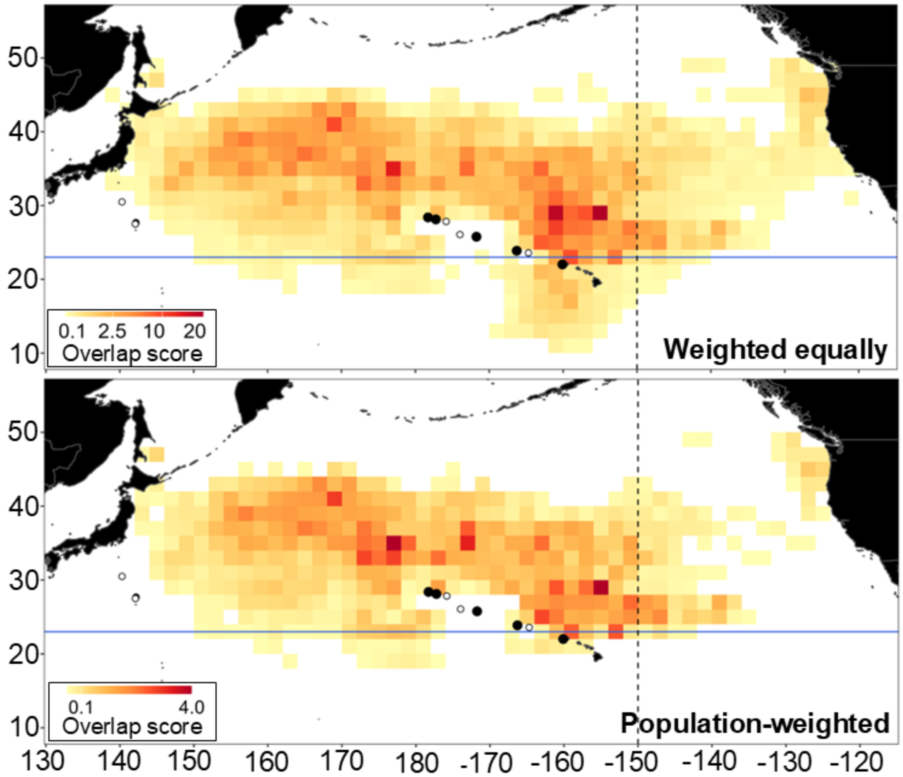

Figure 3. Year-round fisheries-overlap hotspots for Black-footed Albatross in the North Pacific Ocean based on the five Hawaiian populations combined. The top row shows overlap after weighting each population equally before summing across populations, whereas the bottom row shows overlap after weighting populations by their population size before summing. The color gradient indicates increasing fisheries-overlap from light yellow (lowest) to red (highest), displayed on a square-root scale. Tracked and untracked colonies are shown by black filled and unfilled circles, respectively. The dashed vertical line marks the boundary between the Convention Areas of the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC), and the blue horizontal line indicates 23°N, north of which seabird bycatch mitigation measures are required.

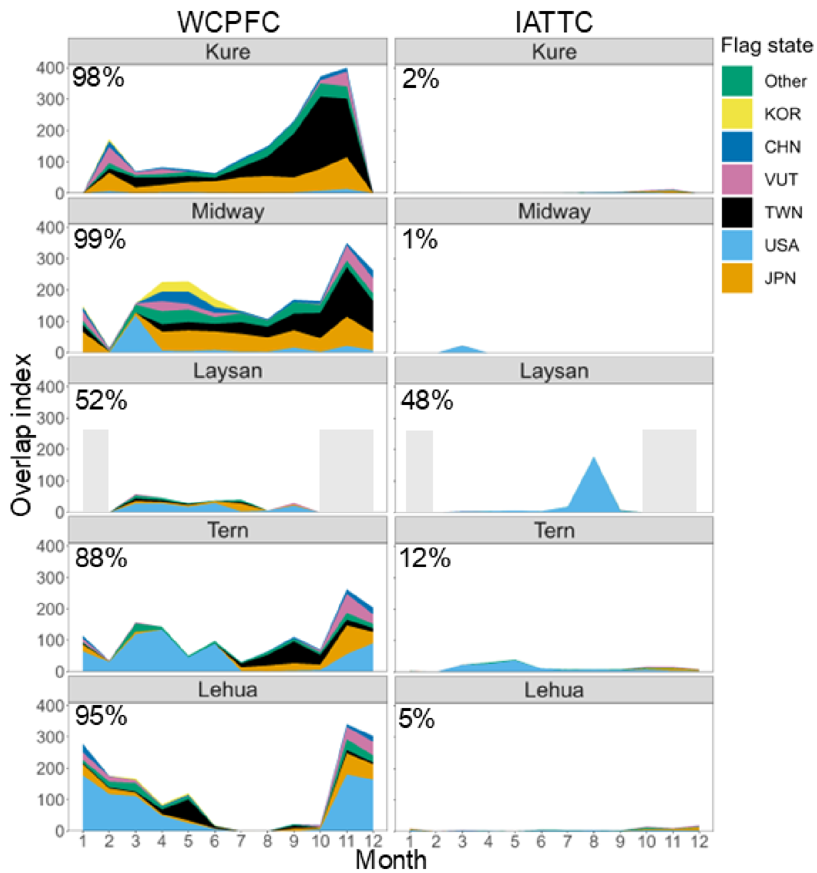

Figure 4. Monthly fisheries overlap by Regional Fisheries Management Organization (RFMO), population and flag state. For each population (rows), the total monthly fisheries-overlap score is shown, with the contribution of each flag state indicated by a different colour. Populations are arranged from the westernmost (top) to the easternmost (bottom) breeding population. Gray shaded areas indicate periods for which no tracking data were available. The percentages in the upper-left corner of each panel indicate the percentage of total fisheries overlap occurring within the Western and Central Pacific Fisheries Commission (WCPFC) and Inter-American Tropical Tuna Commission (IATTC). Flag states: CHN = China; JPN = Japan; KOR = South Korea; Other = all other flag states combined; TWN = Chinese Taipei; USA = United States of America; VUT = Vanuatu.

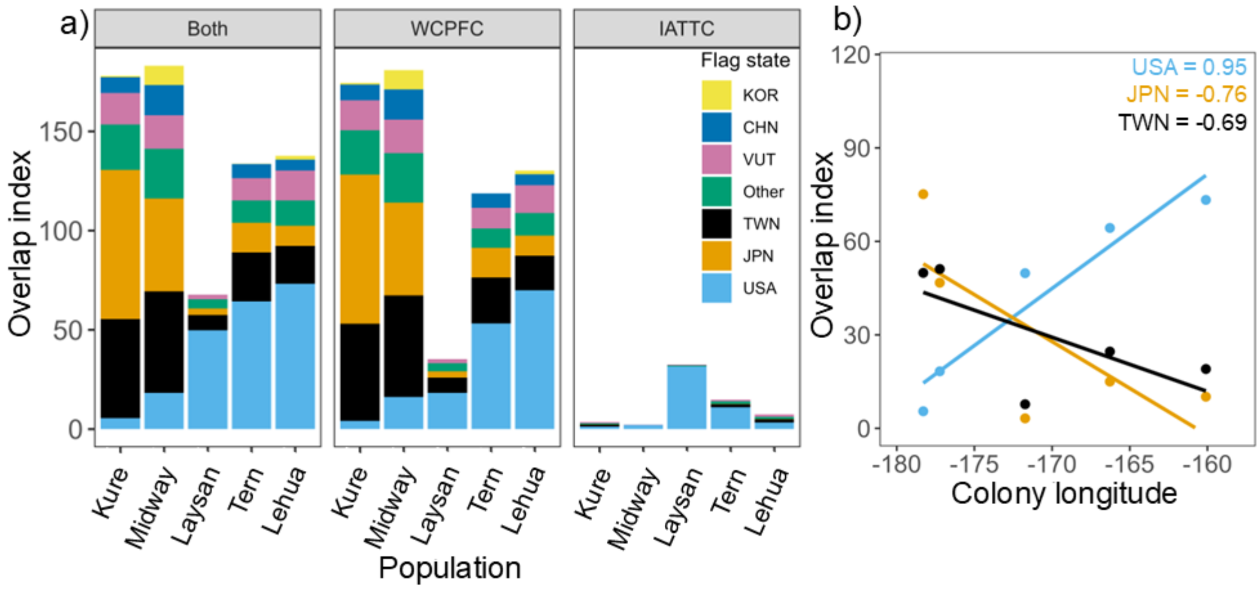

Figure 5. a) Mean annual fisheries overlap by Regional Fisheries Management Organization (RFMO), population, and flag state. b) Relationship between breeding colony longitude and mean fisheries-overlap score for the three major flag states: United States of America (USA, light blue), Japan (JPN, orange) and Chinese Taipei (TWN, black). The Spearman rank correlation coefficient between colony longitude and fisheries-overlap score is shown in the upper-right corner of b). Flag states: CHN = China; KOR = South Korea; Other = all other flag states combined; VUT = Vanuatu.

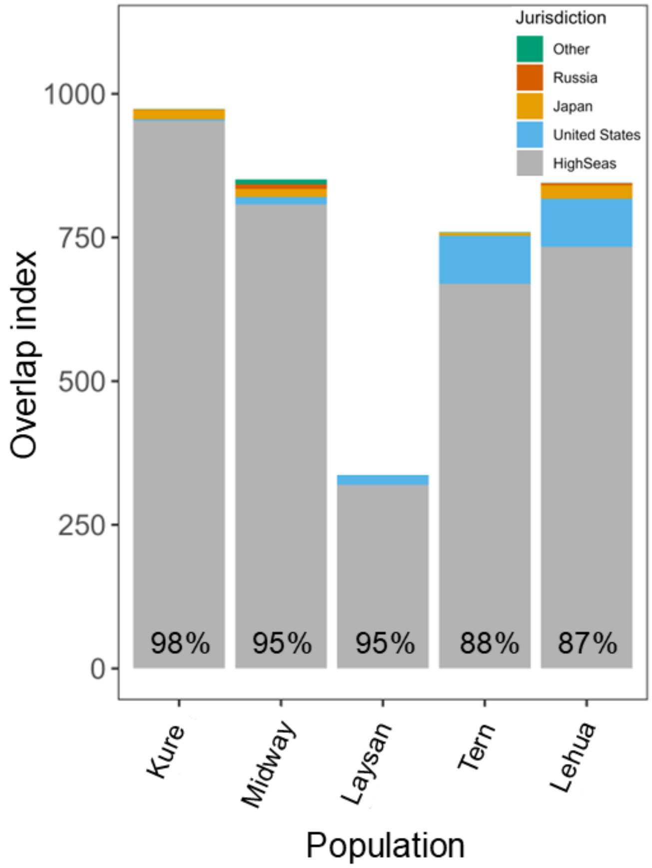

Figure 6. Fisheries overlap by jurisdiction (Exclusive Economic Zone [EEZ] or High Seas) and population (bar). Bars show the mean annual fisheries-overlap scope for each population, arranged from the westernmost (left) to the easternmost (right) breeding population. Each bar is partitioned by jurisdiction, and the percentage of overlap occurring in the High Seas is indicated at the base of each bar.