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THE IATTC SEABIRD ACTION PLAN: SEABIRD DISTRIBUTION AND ASSOCIATED FISHERY IMPACTS

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In 2024, the IATTC Ecosystem and Bycatch Working Group (EBWG) recommended a Seabird Action Plan to undertake scientific analyses of existing data to support further research, conservation and management of seabirds in the EPO. This document presents the results of the first two components of this plan, which focus on i) seabird distribution overlap with longline fishing effort and ii) collation of seabird longline bycatch rates.

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SUMMARY

Seabirds are often an unavoidable incidental catch in tuna fisheries worldwide, especially pelagic longline, including throughout the IATTC Convention Area in the eastern Pacific Ocean (EPO). Given the low reproductive capacity of most seabird species, there are widespread concerns over the potential

consequences of fishing impacts on their sustainability. In the EPO, the IATTC has been proactive in implementing conservation and management measures for seabirds since 2005 (Resolution C-05-01). Improved data provision on seabird interactions have resulted in incremental strengthening of these measures in 2010 (C-10-02) and 2011 (C-11-02). In 2024, the IATTC Ecosystem and Bycatch Working Group (EBWG) recommended a Seabird Action Plan to undertake scientific analyses of existing data to support further research, conservation and management of seabirds in the EPO. This document presents the results of the first two components of this plan, which focus on i) seabird distribution overlap with longline fishing effort and ii) collation of seabird longline bycatch rates. Three different longline fishing effort datasets, including the IATTC public logbook data, Global Fishing Watch estimated longline sets, and small-scale coastal ('artisanal') fishing areas were used to represent general longline fishing effort in the IATTC Convention Area. Seabird utilization distributions were created from tracking data collated by BirdLife and Agreement on the Conservation of Albatrosses and Petrels (ACAP) and shared with IATTC staff. Overlap between seabird distributions and fishing effort was calculated using multiple approaches. The species with the highest potential interaction risk based on these analyses includes the adult non-breeding Black Petrel (*Procellaria parkinsoni*), followed by adult non-breeding Chatham (*Thalassarche eremita*), Buller's, Antipodean (*Thalassarche bulleri*), Salvin's Albatrosses (*Thalassarche salvini*), breeding Laysan Albatross (*Phoebastria immutabilis*), and White-chinned Petrel (*Procellaria aequinoctialis*). Bycatch rates are often unknown but varied across species and region within the IATTC Convention Area, indicating the need for additional more accurate and representative bycatch rate measurements. In addition, preliminary seabird bycatch rate estimates were calculated from the longline observer program data submitted by CPCs to IATTC.

1. BACKGROUND

Seabirds are a known group of bycatch species for tuna longline fisheries worldwide. Within the EPO, many species of seabirds reside, including albatrosses and petrels, some of which are threatened or endangered. With the Antigua Convention calling for the adoption of conservation and management measures and recommendations for species belonging to the same ecosystem and that are affected by fishing for fish stock, IATTC is responsible in reducing catch of non-target species like seabirds. In the EPO, the IATTC has implemented conservation and management measures for seabirds since 2005 (C-05-01). In 2006, multiple documents (SAR-7-05b, SAR-7-05c, SAR-7-05e, SAR-7-10) were produced for the 7th Meeting of the Working Group on Stock Assessments that described seabird distribution relative to longline fisheries and seabird bycatch rates in the Pacific. Improved data provision on seabird interactions have resulted in incremental strengthening of these measures in 2010 (C-10-02) and 2011 (C-11-02). Despite this work, more information is required concerning seabird distributions relative to longline fishing and seabird bycatch interaction rates in the EPO. Further, in the intervening 14 years since the most recent update of the IATTC's seabird resolution, the amount of data of seabird movements and the knowledge of seabird mitigation measures in the longline fishery has greatly improved. In 2024, the IATTC EBWG recommended (see EB-02 recommendations) a Seabird Action Plan to undertake scientific analyses of existing data to support further research, conservation and management of seabirds in the EPO. As part of the Seabird Action Plan for the IATTC Convention Area in the EPO, the IATTC staff was tasked with conducting seabird assessment consisting of four components as described in Annex 1 of the recommendations:

1. A comparison between IATTC seabird mitigation measures described in C-11-02 and mitigation measures in other tuna RFMOs,
2. Update SAR-7-05b (published in 2006), which examined the spatial distribution of seabird species in the IATTC Convention Area relative to longline fishing effort,
3. Overview of mitigation measures in use by CPCs in the IATTC Convention Area, including those

CPCs that may have vessels fishing in areas where bycatch mitigation measures are not required, and,

4. Summarize observed and estimated seabird bycatch rates in the IATTC Convention Area.

The scientific staff separated these four components into two separate documents. This document (EB-03-02) addresses components 2 and 4, while EB-03-03 addresses components 1 and 3. As a part of the recommendation by the EBWG, the scientific staff conducted an intersessional meeting in January 2025 to update interested parties on the progress of the four components and to seek feedback. Overall, meeting participants were satisfied with the progress made (see the intersessional report). The Seabird Action Plan requires the staff to share the results of these four components with the EBWG in 2025. Additionally, and as stated in the Seabird Action Plan, between the EBWG meeting in 2025 and the 2025 IATTC Commission meeting, interested CPCs will coordinate intersessionally to draft a proposal to update pertinent aspects of Resolution C-11-02.

The primary objective of the present document is to describe the methods and results of components 2 and 4 of the assessment included in the IATTC Seabird Action Plan. Although related, components 2 and 4 have been addressed independently below. Therefore, the methods, results and conclusions have been detailed for each of these components separately below.

2. METHODS

2.1 Seabird spatial distribution and longline effort overlap

Seabird and longline fishing overlap in the IATTC Convention Area was conducted from distribution data informed by seabird tracks and multiple longline fishing effort data sets including both industrial and small-scale coastal longline fisheries. To showcase the robustness of seabird-longline effort overlap multiple methods were used to calculate overlap.

2.1.1 Seabird distribution data

In collaboration with the Agreement on the Conservation of Albatrosses and Petrels (ACAP) and BirdLife International, IATTC scientific staff were provided spatial distribution data for several seabird species that are ACAP-list species and have been shown to occur within the IATTC Convention Area. Many of the spatial distributions were generated for the ACAP Species Assessment distribution maps: 2024 update, which were developed from seabird movement tracks uploaded to the Seabird Tracking Database by many data owners who collected these data for varying purposes using a variety of electronic tagging devices, including Global Positioning System (GPS), Platform Terminal Transmitters (PTTs), and Global Location Sensor (GLS).

Tracking data for each species were cleaned and standardized following the protocols detailed in the ACAP Species Assessment distribution maps: 2024 update. Data derived from each tag type were classified into age categories (adult vs juvenile) and annual cycle (breeding vs non-breeding). The annual cycle refers to the time of year an individual is either in its breeding or non-breeding phase. For corresponding categories, data were combined from GPS and PTT devices. Utilization distributions (UDs) were created using kernel analysis for species subpopulations and associated device type (GPS/PTT or GLS), age category, and annual cycle. A fixed smoothing parameter (h) of 50 km was used for GPS and PTT data while a 200 km was used for GLS data both at a grid cell size of 10 km^2. To create global (i.e., worldwide) population UDs, the UDs from each subpopulation (while keeping device type, age category, and annual cycle separate) were weighted by the proportion of the global breeding population represented and then combined by summing across subpopulations. If the sum of the global UD did not add up to 1, it indicated that part of the global population was not represented in the UD. For example, for adult Antipodean

Albatross (*Diomedea antipodensis*), four UDs were created: breeding/GLS, non-breeding/GLS, breeding/GPS/PTT, and non-breeding/GPS/PTT. Each of the four UDs represented 100% of the global population and the sum of each UD was 1. On the other hand, for the adult Wandering Albatross (*Diomedea exulans*), the same four UDs were also created, and the global population represented in breeding/GLS, non-breeding/GLS, breeding/GPS/PTT, and non-breeding/GPS/PTT UDs were 55%, 55%, 100% and 36%, respectively. This implies that some Wandering Albatross subpopulations were missing (i.e., no tracked individuals) for breeding/GLS, non-breeding/GLS, and non-breeding/GPS/PTT UDs, which resulted in those summed global UDs being 0.55, 0.55, and 0.36. A more detailed description of these steps and associated citations can be found in the ACAP Species Assessment distribution maps: 2024 update. As a result of this missing data, it is important to note that it could lead to underestimating habitat use and overlap with the longline fishery.

IATTC scientific staff received permission from the data owners whose data informed the UDs of species that occupied the IATTC Convention Area. Specifically, permission was granted to use the global UDs for those species for any combination of device type, age category, and annual cycle. The global UDs were used for all analyses described hereafter.

The total list of seabird species analyzed in this study, their associated characteristics (device type, age category, annual cycle), number of individuals tracked, number of tracks, the tracking years, and the proportion of the global population each UD represented, are found in Table 1. It is important to note that due to the much larger spatial error of GLS (~200 km) than GPS/PTT, UDs and fishing overlap metrics (described in the next sections) based on GLS tracks could be overestimating habitat use area and longline effort overlap.

2.1.2 Longline fishing effort data

Two datasets were used to represent the large-scale and medium-scale longline fleet (SAC-16-09) fishing effort in the IATTC Convention Area. The first dataset included fishing effort data for 2000–2023 recorded by individual CPCs in logbooks and submitted annually to the IATTC Secretariat. These data consist of monthly fishing effort in total number of hooks at 5°x5° resolution, so the number of sets and time of day of the sets are unknown. The second dataset was derived by a model developed by Global Fishing Watch (GFW) using the Automatic Identification System (AIS), which is a vessel tracking system designed to prevent vessel collisions. GFW data have been used, among others, to develop proxies for fishing effort and activities (Kroodsma et al. 2023) and identify potential overlap with species of special interest, illegal fishing activities or unreported marine species interactions (McCauley et al. 2016, Welch et al. 2024). However, temporal and spatial gaps frequently exist in AIS data for a number of technical or behavioral reasons such as poor satellite coverage, or if vessels disable—legally or illegally—their onboard AIS devices while at sea. Due to these gaps, GFW estimates of longline activity derived from AIS only represent a portion of vessel activities.

GFW provided the IATTC staff with estimated start and end times of longline fishing sets for IATTC registered vessels within the IATTC Convention Area from 2016 to 2023, developed using the methods in Kroodsma et al. (2023). Although these data do not account for all fishing effort, it allows for a much finer spatial resolution (1°x1°) of effort than does the logbook data (i.e., 5°x5°). Given the pros and cons of the two fishing effort datasets, separate analyses were conducted using the IATTC data and GFW data in combination with the seabird spatial distribution data.

A third dataset was used to characterize the effort footprint for the small-scale coastal longline fishery from Mexico to Chile. There is no systematic data collection program for this fishery throughout the EPO and in some countries little data is collected, if at all. Therefore, data were collated from multiple sources—discussed in detail in SAC-13-11—and represented simply as presence or absence of fishing

effort at a spatial resolution of 0.5°x0.5°.

2.1.3 Overlap analysis: Seabird distribution and longline logbook and small-scale fisheries data

Prior to estimating the areal overlap between seabird distributions and longline logbook fishing effort data, the global UDs described in Section 2.1.1 were cropped to the boundaries of the IATTC Convention Area. If the sum of the global UD equaled 1, then the sum of the cropped UDs represented the proportion of the global population that uses the IATTC Convention Area. If the sum of the global UD was less than 1 (meaning the entire global population is not represented in the global UD), then the sum of the cropped UDs represents only the proportion of tracked individuals that were recorded within the IATTC Convention Area. Alternatively, if it was assumed that the missing subpopulations do not use the IATTC area, the sum of the cropped UDs could represent the proportion of the global population that does. For the species that occupied some part of the IATTC area—the categories of some species did not occur in the IATTC area (e.g., breeding versus non-breeding, adult vs juvenile)—the utilized grid cell values were rescaled to sum to 1. The 50, 75, and 95% isopleths were calculated from the cropped UDs to indicate different levels of intensity in area use (ACAP Species Assessment distribution maps: 2024 update). These isopleths were used for the overlap analysis using the logbook data and the small-scale coastal fishery location data. Overlap was calculated only for species whose global UD represented more than 1% of the global population and whose cropped UD in the IATTC area represented more than 3% of the total tracked populations. This was done to prevent overestimating overlap when only a very small proportion of the global population was accounted for.

Number of hooks recorded in the 5°x5° logbook data were summed across CPCs for each grid cell for 2000–2003. To estimate the extent of overlap between fishing effort and seabird distribution overlap in the EPO, grid cells where any part of the grid overlapped with each of the isopleths (i.e., 50, 75, and 95%) were identified and the number of hooks from those grid cells summed. The proportion of total hooks in the EPO that occurred in these identified cells were calculated. It should be noted that the proportion of hooks used as a proxy for longline fishing effort and does not indicate the potential number of hooks seabirds may have interacted with since the years for which seabird distributions were estimated did not necessarily align with the years for which fishing effort data were used. These steps follow similar methods used in the original areal overlap of seabird distribution and longline fishery document (SAR-7-05b), which the staff was tasked to update.

Similar to the 5°x5° logbook data, the percentage of the small-scale coastal longline fishery ('artisanal' longline) fishing effort presence within 0.5°x0.5° grid cells (taken from SAC-13-1 that overlapped with each of the isopleths were calculated. It is well known that along the west coast of the Americas, seabirds interact with small-scale coastal fisheries The estimated fishing area likely underestimates the full spatial extent of the small-scale coastal longline fishery fishing effort from Mexico to Chile. However, these are the best available data until the ABNJ-2 tuna project is completed (HYPERLINK "https://www.iattc.org/GetAttachment/5ec52878-36ba-4266-b44c-a0c63de9ade4/SAC-16-INF-V_ABNJ-Identification-of-available-data-sources-(metadata).pdf"SAC-16 INF-V, SAC-16 INF-W) and areal overlap estimates should be considered to be a minimum estimate.SAC-16 INF-W) and areal overlap estimates should be considered to be a minimum estimate.

2.1.4 Overlap analysis: Seabird distribution and GFW longline sets

The areal overlap between seabird core habitat and GFW longline sets were calculated using the modified equations described in White et al. (2019). Core habitat represents the areas that are used most frequently by a species. The equations calculate the probability that longline sets and species core habitat may overlap in space relative to their probability of overlapping in all other cells where *i* is an individual grid cell and *n* is the total number of grid cells in the IATTC Convention Area.

$$P_{rel}(core\ habitat)_i = \frac{density_i}{\sum_{i=1}^{n} density_i} \quad (1)$$

$$P_{rel}(fishing)_i = \frac{effort_i}{\sum_{i=1}^{n} effort_i} \quad (2)$$

$$P_{rel}(overlap)_i = \frac{P_{rel}(core\ habitat)_i \ x\ P_{rel}(fishing)_i}{\sum_{i=1}^{n}(P_{rel}(core\ habitat)_i \ x\ P_{rel}(fishing)_i)} \quad (3)$$

A grid cell size of 1°x1° was chosen as longline fishing sets can often cover tens to hundreds of kilometers and the timing of setting is coarsely estimated by GFW based on vessel tracks (Kroodsma et al. 2023). The number of longline sets that occurred in each cell over the course of the dataset (2016–2023) represented general aggregated fishing effort in the area. The spatial resolution of the cropped UDs described in Section 2.1.3 were rescaled from approximately 0.083° to 1°—to match the resolution of GFW fishing effort—and the top 50% of non-zero distribution values was considered core habitat. A threshold of 50% was selected because the UDs were developed from empirical tracking data rather than from predictions from a species distribution model, which typically predict a broader area use based on a species' environmental envelope informed by the tagging data. Therefore, adopting a UD using a small threshold (e.g., 25%) may underrepresent core habitat, while a large threshold (e.g., 90%) may overestimate core habitat by the inclusion of more erroneous or uncertain positions. A core habitat calculation rather than the isopleths described in Section 2.1.3 was used for this overlap analysis to follow the methods described in White et al. (2019) and to demonstrate overlap with a different method of area use. Lastly, the percent of core habitat that overlapped with any cells where longlines were set over from 2016 to 2023 was also calculated.

2.2 Seabird bycatch interaction rates

Seabird bycatch interaction rates in the EPO were compiled through literature reviews, consultations with seabird experts, and available published and unpublished data (Table 2). Because the Hawaiian longline fishery often fishes in IATTC waters, bycatch rates from that fishery were also included. In addition to bycatch rates, several other data fields were included, such as the vessel/fleet flag, target species, years of data, gear type, area where data were collected, the seabird species when possible, bycatch information type (e.g., fishery observer), effort observed (e.g., number of sets), seasonality (e.g., month, quarter), and use of mitigation measures were also recorded. Due to data limitations, bycatch rates were often calculated for seabird species aggregations (e.g., albatrosses). If separate seabird bycatch rates were calculated for sets from the same study where different fish species were targeted, different areas and time periods were fished, different seabird species were caught, and various mitigation measures were used, that study received multiple records in the finalized table (Table 2).

To complement other available data, seabird bycatch interaction rates (as individuals per 1000 hooks) were also calculated from available IATTC observer data. Sets observed within the IATTC Convention Area from 2013–2023 were used as prior to 2013 the interaction rates were substantially lower. This is because the original resolution on seabirds (C-05-01) required only voluntary submission of seabird interaction data, while the revised, and current, resolution (C-11-02) entered into force in late 2011. Given the

apparent low incidence of species-specific seabird reporting by CPCs, it was necessary to calculate seabird bycatch rates for four species groupings: all species combined, albatrosses, petrels, and shearwaters. To better understand potential spatial differences in bycatch rates within the IATTC area, data were disaggregated into four spatial strata: 20°N–40°N, 0°–20°N, 0°–20°S, and 20°S–40°S.

Combined seabird bycatch rates from observed sets were also calculated at 1°x1° grid cells in the IATTC Convention Area to identify more fine scale spatial trends relative to where observed longline sets have and have not occurred.

3. RESULTS

3.1 Seabird spatial distribution and longline effort overlap

3.1.1 Seabird UDs in the IATTC Convention Area

Species UDs overlapped only with the IATTC area depending on tag type (e.g., GLS or GPS/PTT), annual cycle (e.g., breeding or non-breeding), and age category (e.g., adult or juvenile). Of the 57 UDs developed, 17 overlapped with the IATTC Convention Area and whose global UD represented more than 1% of the global population and whose cropped UD in the IATTC area represented more than 3% of the total tracked populations (Table 1). These 17 UDs represented 12 species: eight albatross and four petrel species. The majority of overlapping UDs (82%) were during the non-breeding period and some species had two non-breeding UDs that overlapped, one for each tag type, GLS and GPS/PTT. Two of the overlapping UDs represented juveniles, whereas the rest (i.e., 15) represented adults.

The global population UDs for adult non-breeding Waved Albatross (*Phoebastria irrorata*), Salvin's Albatross (*Thalassarche salvini*), Chatham Albatross (*Thalassarche eremita*, Figures. 1a & b), and Black Petrel (*Procellaria parkinsoni*) all represented 100% of the global population and substantially overlapped with the IATTC area (range: 89-99%; Table 1). Other species where global population UDs represented at least 99% of the global population include the adult non-breeding Westland Petrel (*Procellaria westlandica*), non-breeding Antipodean Albatross, breeding Laysan Albatross (*Phoebastria immutabilis*), and breeding Black-browed Albatross (*Thalassarche melanophris*), which constituted a 67%, 17% (for GLS; 13% for GPS/PTT), 4%, and 4% overlap of their global populations with the IATTC Convention Area, respectively. Adult non-breeding Black-browed Albatross, Buller's Albatross (*Thalassarche bulleri*), White-chinned Petrel (*Procellaria aequinoctialis*), and Wandering Albatross (Figure 1c & d) UDs represented 88%, 83% (for GLS; 43% of GPS/PTT), 72%, and 55% of their global populations of which, 6%, 92% (for GLS; 9% for GPS/PTT), 31%, and 7% of tracked populations, respectively, occurred inside the IATTC area. Juvenile Wandering Albatross and Northern Giant Petrel (*Macronectes halli*) UDs represented 55% and 38% of their global populations of which, 7% and 16% of tracked populations, respectively, occurred inside the IATTC area (Table 1). All 17 global and cropped UDs that overlapped with the IATTC area can be found in Annex 1.

3.1.2 Overlap analysis: Seabird distribution and longline logbook data

The 5°x5° logbook longline effort aggregated across 2000–2023 was highest (50–200 million hooks) at 5° N–20°S and between 110°W–150°W (Figure 2a). The lowest effort (<1 million hooks) occurred primarily along the western coast of the Americas.

The home-range sizes in km^2 of the three isopleth levels (50, 75, and 95%) for each of the 17 UDs are shown in Table 1. As a reminder, the isopleths indicate different levels of a species' habitat usage only within the EPO, and not its global population, unless 100% of the global population occurred inside the IATTC Area (e.g., Waved Albatross was 99%). Non-breeding Black Petrel using 95, 75, and 50% thresholds

had substantial areal overlap (38%, 12%, and <1%) with logbook longline fishing effort in the EPO (Figure 3a; Table 1). Higher overlap for the 75% and 95% isopleths was due to the inclusion of some grid cells where high intensity fishing effort occurred (i.e., grid cells with > 50 million hooks). By contrast, the 95, 75, and 50% isopleths of the non-breeding Chatham Albatross overlapped with total longline fishing effort within the IATTC area by 7%, 4%, and 2%, respectively (from GLS; Figure 3b; Table 1). Non-breeding Buller's (from GLS) and Antipodean Albatrosses (GPS/PTT) 95, 75, and 50% isopleths overlapped with 3%, 2%, and <1% (Figure 3c) and 6.2%, 3.8%, and 0.8% (Figure 3d) of total logbook fishing effort, respectively. Figures for each species whose isopleths showed some degree of areal overlap with 5°x5° logbook longline effort are located in Annex 2.

3.1.3 Overlap analysis: Seabird distribution and small-scale coastal longline fishing area

Small-scale artisanal longline fishing occurred primarily from Central America to Peru and out from the coastline to 95°W (Figure 2c; SAC-13-11). Effort was also concentrated around Baja California within the Gulf of California and along the Pacific coast, with some other areas of effort along the Chilean coastline (25°–45°S). Seabird species that occupy neritic habitats tended to overlap with areas of small-scale coastal fishing. Non-breeding Black Petrel 95, 75, and 50% isopleths overlapped with 62%, 49%, and 15% of the grid cells where small-scale coastal fisheries were present, respectively (Table 1). Other species where small-scale fisheries overlap was higher than 10% included non-breeding Chatham Albatross, Buller's Albatross, and White-chinned petrel. Additionally, the 95, 75, and 50% isopleths for Waved Albatross overlapped entirely with this fishery.

3.1.4 Overlap analysis: Seabird distribution and GFW longline sets

Of the over 350,000 GFW estimated longline sets between 2016–2023, only 2% occurred completely at night (between sunset and sunrise). All other sets overlapped with some portion of daylight. The highest number of sets in 1°x1° grid cells (2000–3000) occurred in the vicinity of 10°S and 145°W, while 500–2000 sets occurred between 10°S–20°S and 90°W–135°W (Figure 2b). Between 100–1000 sets also occurred along the western edge of the Convention Area just north of the equator and between 20°–40°N. Of the 17 UDs that overlapped with the IATTC Area, 14 of them had core habitats that overlapped with GFW estimated longline set locations. For non-breeding Black Petrel, 66% of the core habitat (Figure 4a) overlapped with GFW longline fishing effort (Table 1). The highest relative overlap areas occurred around 20°S and 100–140°W (Figure 4b). For adult non-breeding White-chinned Petrel 41% of the core habitat (Figure 4e) overlapped with longline effort, with the highest relative overlap occurring around the Islas Desventuradas, Chile (Figure 4f). Thirty-three (for GLS; 36% for GPS/PTT), 24% (for GLS; 26% for GPS/PTT), 33% (for GLS; 11% for GPS/PTT), and 23% of core habitats for non-breeding Buller's, Antipodean, and Chatham Albatrosses, and breeding Waved Albatross, respectively, overlapped with GFW estimated longline fishing effort (Table 1). All species where their core habitat overlapped with GFW fishing effort occurred around, or south of, the equator. An exception was the breeding Laysan Albatross, where 45% of its core habitat (Figure 4c) overlapped with fishing effort along the northwest corner of the Convention Area (Figure 4d). All species core habitats and overlap maps can be found in Annex 3. To compare these overlap results to where seabird mitigation measures are required according to C-11-02, refer to the map in Annex 4.

3.2 Seabird bycatch interaction rates

All seabird bycatch rates and associated metadata can be found in Table 2. Data came from 25 published and unpublished studies, some of which were found in two seabird bycatch reviews (Anderson 2009, Anderson et al. 2011). Of the 48 bycatch rate records, 23 combined all seabirds, 9 considered just albatrosses, while individual species bycatch rates were recorded for Black-footed Albatross, Black-browed Albatross, Buller's Albatross, Southern-royal Albatross, Sooty Albatross, Wandering Albatross,

White-chinned Petrels, and Grey Petrels. For records that were calculated as individuals per 1000 hooks, bycatch rates ranged from 0 to 0.594, while the median and mean bycatch rates were 0.02 and 0.058, respectively. As pointed out by Anderson et al. (2011), for some of these records, data were based on a low number of observed fishing sets, meaning the precision and reliability of the rates may be poor. The fishery type of every record was pelagic longline and the target species was predominantly swordfish or tuna (e.g., albacore, bigeye), while 2 records targeted sharks and mahi mahi. While records spanned 1994–2023, most records came from 2000–2010.

Bycatch rates were calculated across a wide range of regions with the main focus being the EPO. For example, one record was based on the entire Pacific Ocean, two occurred offshore of Peru, while many were based on the North Pacific, the Southeast Pacific, and the entire EPO. Although most bycatch rates were annual estimates, some were calculated by months or quarters. Only a small number of records provided any information on mitigation measures that were used during their data collection (see companion paper, EB-03-03 for details on mitigation measures used by CPCs).

From over 85,000 observed sets in the IATTC Convention Area from 2013–2023, seabirds were caught on approximately 1% of sets and the bycatch rates for all seabird species combined was 0.015 individuals per 1000 hooks (Table 3). Albatrosses had the highest bycatch rate (0.006) followed by petrels (0.005). When stratifying the IATTC Area by latitude, the majority of the longline effort occurred between 0°-20°S, with associated bycatch rates for all seabirds combined being 0.011, 0.005 for petrels, followed by 0.002 for shearwaters and 0.001 for albatrosses (Table 3). The highest bycatch rates occurred between 20°-40°S, with 0.067, 0.028, 0.026, 0.001 for all seabird species combined, petrels, albatrosses, and shearwaters respectively, although this area had the lowest fishing effort. By contrast, bycatch rates did not exceed 0.001 for any albatrosses, petrels or shearwaters in the 0°–20°N region. In the most northern area (20°N–40°N), seabird bycatch was predominately albatrosses (0.012) (Table 3).

The combined seabird bycatch rates from observed sets in the IATTC Convention Area at 1°x1° grid cells was 0.0027–3.4. The highest bycatch rates occurred between 25°S–35°S and 125°W–150°W (Figure 5). Other spatial hotspots of seabird bycatch rates occurred between 5°N–20°S and west of 120°W and between 20°N-40°N and 130°W-150°W (Figure 5). There also appeared to be regions with longline effort where seabird interactions might be expected (based on overlap between effort and seabird distributions; Section 3.1.2) but were not reported, such as along the coastlines of North and South America. For reference to areas where C-11-02 requires seabird mitigation measures see Annex 4.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Seabird distribution and overlap with longline effort

Seabird and longline fishing overlap in the IATTC Convention Area was conducted using two species distribution metrics (isopleths and core habitat), three longline fishing effort data sets (5°x5° aggregated industrial longline logbook data, small-scale coastal longline effort area, and GFW estimate for longline sets) and three methods to calculate overlap (% of hooks overlap, % fishing area overlap, and relative overlap). Based on the tagging data that informed the UDs, the species with the highest potential risk were adult non-breeding Black Petrels, followed by adult non-breeding Chatham, Buller's, Antipodean, Salvin's Albatrosses, breeding Laysan Albatross, and White-chinned Petrels. Although approximately 100% of the Waved Albatross population overlaps with the IATTC Area, its small range around the Galápagos Islands and low recorded amount of fishing effort in the region, appear to make this species less susceptible to capture by longline fishing. This work also demonstrates the importance of collaborative

networks like ACAP's Seabird Tracking Database, where data is stored and shared among many seabird tag data owners. Despite this, there appears to be gaps in GPS/PTT tag data for multiple species that may use the IATTC's Convention Area, including the non-breeding Laysan Albatross and breeding and non-breeding Black-footed and Salvin's Albatross. It is also important to note that this overlap work only focused on albatrosses and petrels, and similar work may be necessary for other seabird species such as shearwaters, frigatebirds, terns, tropicbirds, and boobies.

4.2 Seabird bycatch interaction rates

When comparing bycatch rates across the studies where seabird longline bycatch rates were recorded or estimated in the EPO, there do not appear to be any consistent trends for particular species or taxonomic aggregations. This is likely due to the majority of observed seabird interactions being recorded in a small number of sets, differences in study spatial domain, and variation in observer coverage. Despite the consistent overlap between longline fishing effort and seabird distributions (Section 4.1), large areas exist where longline effort occurs, but no seabird interactions have been recorded. This may, in part, be explained in that the area north of 23°N corresponding to the EEZ of Mexico is excluded from the compulsory application of seabird mitigation measures described in paragraph 2 of C-11-02. Paragraph 3 of the Resolution encourages CPCs with longline fishing vessels operating in the areas outside of those described in paragraph 2 to implement at least one of the prescribed mitigation measures, but based on the reporting received from CPCs under Paragraph 5, it is not clear to what extent mitigation measures are being applied pursuant to paragraph 3 (see companion document EB-03-03). It is a concern that areas of seabird interaction rates are outside of the shaded regions where no mitigation measures are required. Although this compilation of seabird bycatch rate data from the EPO is a positive first step towards improving our understanding of seabird interactions with IATTC fisheries, this work highlights an imminent need to improve data pertaining seabird bycatch as mandated in Article 7 in Resolution C-11-02. In addition, the low number of studies available and lack of observed interactions along the eastern more coastal areas of the EPO suggest that data and knowledge gaps exist and should ideally be addressed in the future to better understand the potential impacts of longline fisheries on seabird populations.

Throughout the Seabird Action Plan collaborators at ACAP and BirdLife have contributed an immense amount of seabird knowledge and data not directly available for the IATTC scientific staff, at a time where WCPFC is also considering an update of its seabird resolution, and thus, collaboration with leading seabird experts and other RFMOs, both regionally and globally, is appropriate with a goal of improving seabird conservation in the IATTC Convention Area and fisheries. Furthermore, the need for increased seabird bycatch interaction information is clear and thus a lot of knowledge could be gained from improved observer reporting and coverage as well (see Section 7.2 in SAC-16-11).

> The IATTC should continue collaborating with leading seabird experts and organizations both regionally and globally (e.g., ACAP, BirdLife), including other tuna RFMOs (e.g., WCPFC), to better understand and mitigate the potential impacts of tuna and tuna-like fisheries on seabird conservation.

5. TABLES

TABLE 1. Metadata from the seabird species global utilization distributions (UDs), including the common and scientific name, the annual cycle (breeding or non-breeding), age category (adult or juvenile), device type (GLS or GPS/PTT), the number of tracks that made up the global UD, the percent of the global population the global UD represents, the percent of the global population that occurs inside the IATTC Convention Area, and the percent of the tracked populations that occur inside the Convention Area. Overlap was calculated only for species whose global UD represented more than 1% of the global population and whose overlapped UD with the IATTC area represented more than 3% of the total tracked populations. The species that met these criteria are bolded below and had overlap analyses conducted on them. For those species, the following metrics were recorded: isopleth (95, 75, 50%) sizes in 100,000 km, percent of small-scale longline area that overlapped with each isopleth (95, 75, 50%), percent of IATTC logbook effort that overlapped with each isopleth (95, 75, 50%), the core habitat size in 100,000 km, and the percent of core habitat that overlaps with the Global Fishing Watch (GFW) longline (LL) effort.

Common Name	Species Scientific Name	Breeding/ Non-breeding	Adult/ Juv	GLS/ GPS/ PTT	# Global Tracks	% Global Pop	% Global Pop inside CA	% of Tracked Pops inside CA	Isopleth size in 100,000 km^2 (95, 75, 50%)	% Small-Scale LL Grid Overlap w/ Isopleths (95, 75, 50%)	% Logbook Effort Overlap w/ Isopleths (95, 75, 50%)	Core Habitat Size in 100,000 km^2	% Core Habitat that Overlaps with GFW LL Effort
Antipodean Albatross	Diomedea antipodensis	Breeding	Adult	GLS	125	100	1	1					0
Antipodean Albatross	Diomedea antipodensis	Breeding	Adult	GPS/PTT	362	100	1	1					0
Antipodean Albatross	Diomedea antipodensis	Non-breeding	Adult	GLS	125	100	17	17	112, 57, 19	1.2, 1.0, 0.5	4.6, 1.8, 0.5	70	24
Antipodean Albatross	Diomedea antipodensis	Non-breeding	Adult	GPS/PTT	366	100	13	13	88, 34, 8.1	1.0, 0.7, 0.3	6.2, 3.8, 0.8	62	26
Black Petrel	Procellaria parkinsoni	Breeding	Adult	GLS	80	100	0	0					0
Black Petrel	Procellaria parkinsoni	Breeding	Adult	GPS/PTT	37	100	0	0					0
Black Petrel	Procellaria parkinsoni	Non-breeding	Adult	GLS	80	100	89	89	129, 39, 6.5	62, 49, 15	38, 12, 0.1	104	66
Black-browed Albatross	Thalassarche melanophris	Non-breeding	Juv	GLS	17	<1	<1	<1					0
Black-browed Albatross	Thalassarche melanophris	Non-breeding	Juv	GPS/PTT	333	79	0	0					0
Black-browed Albatross	Thalassarche melanophris	Breeding	Adult	GLS	581	79	0	0					0
Black-browed Albatross	Thalassarche melanophris	Breeding	Adult	GPS/PTT	1129	99	4	4	3.3, 1.7, 0.9	1.2, 1.0, 0.5	<0.1, <0.1, 0.0	3.4	0
Black-browed Albatross	Thalassarche melanophris	Non-breeding	Adult	GLS	656	88	5	6	20, 12, 6.3	2.1, 1.2, 0.6	0.8, 0.7, 0.7	20	12
Black-footed Albatross	Phoebastria nigripes	Non-breeding	Juv	GPS/PTT	220	100	0	0					0

Black-footed Albatross	Phoebastria nigripes	Breeding	Adult	GLS	23	<1	<1	3					0
Black-footed Albatross	Phoebastria nigripes	Breeding	Adult	GPS/PTT	209	<1	<1	4					0
Black-footed Albatross	Phoebastria nigripes	Non-breeding	Adult	GLS	84	<1	<1	26					0
Bullers Albatross	Thalassarche bulleri	Non-breeding	Juv	GLS	-	<1	0	0					0
Bullers Albatross	Thalassarche bulleri	Breeding	Adult	GLS	199	83	0	0					0
Bullers Albatross	Thalassarche bulleri	Breeding	Adult	GPS/PTT	606	43	0	0					0
Bullers Albatross	Thalassarche bulleri	Non-breeding	Adult	GLS	199	83	76	92	73, 18, 8.4	19, 7.3, 2.3	3.3, 1.9, 0.4	80	33
Bullers Albatross	Thalassarche bulleri	Non-breeding	Adult	GPS/PTT	466	43	4	9	14, 6.1, 2.0	0, 0, 0	2.9, 2.6, 2.2	20	36
Chatham Albatross	Thalassarche eremita	Breeding	Adult	GPS/PTT	56	100	0	0					0
Chatham Albatross	Thalassarche eremita	Non-breeding	Adult	GLS	15	100	91	91	124, 49, 15	19, 17, 13	7.4, 4.4, 1.7	87	33
Chatham Albatross	Thalassarche eremita	Non-breeding	Adult	GPS/PTT	33	100	73	73	34, 9.7, 3.8	17, 12, 7.6	2.7, 0.8, 0.2	35	11
Grey Petrel	Procellaria cinerea	Breeding	Adult	GLS	86	<1	<1	1					0
Grey Petrel	Procellaria cinerea	Breeding	Adult	GPS/PTT	22	26	0	0					0
Grey Petrel	Procellaria cinerea	Non-breeding	Adult	GLS	86	<1	<1	35					0
Grey-headed Albatross	Thalassarche chrysostoma	Non-breeding	Juv	GPS/PTT	29	<1	<1	<1					0
Grey-headed Albatross	Thalassarche chrysostoma	Breeding	Adult	GPS/PTT	701	84	1	1					0
Grey-headed Albatross	Thalassarche chrysostoma	Non-breeding	Adult	GLS	83	53	1	2					0
Laysan Albatross	Phoebastria immutabilis	Breeding	Adult	GLS	54	<1	<1	<1					0
Laysan Albatross	Phoebastria immutabilis	Breeding	Adult	GPS/PTT	573	100	4	4	7.0, 4.4, 2.2	0, 0, 0	2.2, 1.9, 1.9	21	45
Laysan Albatross	Phoebastria immutabilis	Non-breeding	Adult	GLS	129	<1	<1	3					0
Laysan Albatross	Phoebastria immutabilis	Non-breeding	Adult	GPS/PTT	38	<1	<1	24					0
Northern Giant Petrel	Macronectes halli	Non-breeding	Juv	GPS/PTT	19	38	6	16	37, 17, 6.3	1.5, 0.8, 0.6	0.3, 0.2, 0.1	32	2
Northern Giant Petrel	Macronectes halli	Breeding	Adult	GLS	139	41	0	0					0

Northern Giant Petrel	Macronectes halli	Breeding	Adult	GPS/PTT	180	41	0	0					0
Northern Giant Petrel	Macronectes halli	Non-breeding	Adult	GLS	139	41	<1	<1					0
Northern Royal Albatross	Diomedea sanfordi	Non-breeding	Juv	GPS/PTT	9	<1	<1	30					0
Northern Royal Albatross	Diomedea sanfordi	Non-breeding	Adult	GPS/PTT	62	<1	<1	30					0
Salvin's Albatross	Thalassarche salvini	Breeding	Adult	GLS	99	100	0	0					0
Salvin's Albatross	Thalassarche salvini	Breeding	Adult	GPS/PTT	29	<1	<1	<1					0
Salvin's Albatross	Thalassarche salvini	Non-breeding	Adult	GLS	99	100	92	92	48, 25, 14	5.4, 0.8, 0	3.5, 1.8, 1.6	74	33
Salvin's Albatross	Thalassarche salvini	Non-breeding	Adult	GPS/PTT	29	<1	<1	59					0
Wandering Albatross	Diomedea exulans	Non-breeding	Juv	GPS/PTT	550	55	4	7	18, 1.9, 0.5	0.2, 0.1, 0.1	1.0, 0.2, 0.0	22	11
Wandering Albatross	Diomedea exulans	Breeding	Adult	GLS	272	55	<1	<1					0
Wandering Albatross	Diomedea exulans	Breeding	Adult	GPS/PTT	1360	100	0	0					0
Wandering Albatross	Diomedea exulans	Non-breeding	Adult	GLS	354	55	3	6	50, 25, 9	1.2, 1.0, 0.6	0.4, 0.2, 0.1	33	0
Wandering Albatross	Diomedea exulans	Non-breeding	Adult	GPS/PTT	745	36	<1	2					0
Waved Albatross	Phoebastria irrorata	Breeding	Adult	GPS/PTT	65	100	99	99	5.4, 2.8, 1.1	13, 7.7, 2.9	0.1, 0.1, <0.1	4.3	23
Westland Petrel	Procellaria westlandica	Breeding	Adult	GLS	8	100	0	0					0
Westland Petrel	Procellaria westlandica	Breeding	Adult	GPS/PTT	181	100	0	0					0
Westland Petrel	Procellaria westlandica	Non-breeding	Adult	GLS	8	100	67	67	11, 4.5, 2.2	1.5, 1.1, 0.6	0.1, <0.1, <0.1	12	0
White-chinned Petrel	Procellaria aequinoctialis	Non-breeding	Juv	GPS/PTT	46	73	0	0					0
White-chinned Petrel	Procellaria aequinoctialis	Breeding	Adult	GLS	183	72	1	2					0
White-chinned Petrel	Procellaria aequinoctialis	Breeding	Adult	GPS/PTT	107	80	0	0					0
White-chinned Petrel	Procellaria aequinoctialis	Non-breeding	Adult	GLS	193	72	22	31	44, 24, 12	24, 12, 3.3	2.2, 0.5, 0.4	64	41

TABLE 2. Seabird bycatch rates from the literature for pelagic longline gear for fisheries that overlap with the IATTC Convention Area. Rows are separated by source. Cells that are blank indicate information that could not be found. Source names with a + and ^ after were taken from Anderson 2009 and Anderson et al. 2011, respectively. Bycatch rates in *italics* were deemed to have "poor reliability" from Anderson et al. 2011. Bycatch rates with an * after it means that those rates were calculated by hands from values from the source.

Source	Source Year	Vessel Flag	Target Species	Years	Area/Region	Seabird Species	Bycatch Information Type	Number of Sets observed	Bycatch Rate	Units	Time Period Calculated	Mitigation measures
Cousins et al.	2000	U.S. (Hawaii)	swordfish	1994-1998	North Pacific	albatrosses	fishery observer	488	0.758	catch/set	year-round	
Cousins et al.	2000	U.S. (Hawaii)	tuna/swordfish	1994-1998	North Pacific	albatrosses	fishery observer	946	0.499	catch/set	year-round	
Cousins et al.	2000	U.S. (Hawaii)	tuna	1994-1998	North Pacific	albatrosses	fishery observer	1250	0.013	catch/set	year-round	
Crowder & Myers^	2001	Japan	tuna/swordfish	1994-2000	North Pacific	combined	not reported		no estimate		year-round	
Jahncke et al.	2001	Peru	tuna	1999	offshore of Peru	combined	fisher interviews		0.001-0.002	ind./1000 hooks		
Lewison & Crowder	2003	U.S. (Hawaii)	tuna	1994-2000	Central North Pacific	Black-footed albatross	fishery observer		0.015	ind./1000 hooks	November-February	
Lewison & Crowder	2003	U.S. (Hawaii)	tuna	1994-2000	Central North Pacific	Black-footed albatross	fishery observer		0.024	ind./1000 hooks	March-June	
Lewison & Crowder	2003	U.S. (Hawaii)	tuna	1994-2000	Central North Pacific	Black-footed albatross	fishery observer		0.005	ind./1000 hooks	July-October	
Lewison & Crowder	2003	U.S. (Hawaii)	swordfish	1994-2000	Central North Pacific	Black-footed albatross	fishery observer		0.310	ind./1000 hooks	November-February	
Lewison & Crowder	2003	U.S. (Hawaii)	swordfish	1994-2000	Central North Pacific	Black-footed albatross	fishery observer		0.594	ind./1000 hooks	March-June	
Lewison & Crowder	2003	U.S. (Hawaii)	swordfish	1994-2000	Central North Pacific	Black-footed albatross	fishery observer		0.167	ind./1000 hooks	July-October	
Moon et al.^	2005	Korea	tuna	2004-2005	Eastern Pacific Ocean	combined	fishery observer		*0.020*	ind./1000 hooks	year-round	
L. Enriquez (per. comm)^+	2005	U.S.	tuna/swordfish	2005	Eastern Pacific Ocean	albatrosses	fishery observer		0.230	ind./1000 hooks	September-June	

Dai et al.^+	2006	China	tuna	2003	Eastern Pacific Ocean	combined	fishery observer		*0.020*	ind./1000 hooks	July-November
Melly et al.^	2006	Peru	shark/mahi mahi	2005-2006	offshore of Peru	combined	fishery observer		*0.003*	ind./1000 hooks	year-round
Clemens et al.^+	2006	U.S. (Hawaii)	tuna	2005	North Pacific	albatrosses	fishery observer		0.004	ind./1000 hooks	year-round
Clemens et al.^+	2006	U.S. (Hawaii)	swordfish	2005	North Pacific	albatrosses	fishery observer		0.040	ind./1000 hooks	year-round
Moreno et al.^+	2007	Chile	swordfish	2007	FAO area 87	combined (Wandering albatrosses)	fishery observer		*0.21-0.37*	ind./1000 hooks	March-November
Mejuto & Garcia-Cortes^+	2007	Spain	swordfish	1990, 1998-2005	Eastern Pacific Ocean	combined	fishery observer		*0.040*	ind./1000 hooks	year-round
IATTC-75-06+	2007	Japan	tuna/swordfish	2005	Eastern Pacific Ocean	combined	fishery observers		0.020	ind./1000 hooks	
Chang et al.+	2007	Chinese Taipei	tuna	2005	Eastern Pacific Ocean	combined	fishery observers		0.016	ind./1000 hooks	
Huang et al.^	2008	Chinese Taipei	tuna	2002-2006	entire Pacific	combined	fishery observer		*0.045*	ind./1000 hooks	year-round
Ayala et al.+	2008	Peru	mahi mahi	2006-2008	Eastern Pacific Ocean	combined	fishery observers		0.000	ind./1000 hooks	
Gilman et al.	2008	U.S.	tuna	1994-2001	North Pacific	combined	fishery observers	702	0.080	ind./1000 hooks	year-round	
Gilman et al.	2008	U.S.	tuna	2001-2007	North Pacific	combined	fishery observers	3800	0.021	ind./1000 hooks	year-round	Pre-2001 regulations
Gilman et al.	2008	U.S.	tuna	2003-2007	North Pacific	combined	fishery observers	368	0.015	ind./1000 hooks	year-round	Post-2001 regulations
Gilman et al.	2008	U.S.	tuna	2003-2007	North Pacific	combined	fishery observers	1633	0.012	ind./1000 hooks	year-round	side-setting
Huang & Yeh	2011	Chinese Taipei	albacore	2002-2007	Eastern North Pacific	albatrosses	fishery observers	65	0.023	ind./1000 hooks	October-March	
Huang & Yeh	2011	Chinese Taipei	bigeye	2002-2007	Eastern Tropical Pacific	combined	fishery observers	887	0.001	ind./1000 hooks	year-round	
Huang & Yeh	2011	Chinese Taipei	bigeye	2002-2007	Galápagos Islands	combined	fishery observers	62	0.032	ind./1000 hooks	year-round	

Sato et al.	2014	Japan	bigeye	2011	Southeast Pacific	White-chinned petrels	researchers	81	0.024*	ind./1000 hooks	July-October	mixed
Sato et al.	2014	Japan	bigeye	2011	Southeast Pacific	Grey petrels	researchers	81	0.005*	ind./1000 hooks	July-October	mixed
Sato et al.	2014	Japan	bigeye	2011	Southeast Pacific	Black-browed albatross	researchers	81	0.020*	ind./1000 hooks	July-October	mixed
Sato et al.	2014	Japan	bigeye	2011	Southeast Pacific	Buller's albatross	researchers	81	0.010*	ind./1000 hooks	July-October	mixed
Suazo et al.	2014	Chile	swordfish	2007-2009	Southeast Pacific	combined	fishery observer	2720	0.032-0.104	ind./1000 hooks	year-round	
Gilman et al.	2014	U.S. (Hawaii)	swordfish	2004-2012	North Pacific	combined	fishery observer	11971	0.037	ind./1000 hooks	year-round	mixed
Huang	2015	Chinese Taipei	albacore	2008-2013	Southeast Pacific	non-albatross seabirds	fishery observer		0.003	ind./1000 hooks	Quarter 3	mixed
Huang	2015	Chinese Taipei	albacore	2008-2013	Southeast Pacific	Albatross-large	fishery observer		0.007	ind./1000 hooks	Quarter 4	mixed
Huang	2015	Chinese Taipei	albacore	2008-2013	Southeast Pacific	Albatross-small	fishery observer		0.007	ind./1000 hooks	Quarter 4	mixed
Wang et al.	2021	China	albacore	2010-2018	Southeast Pacific	Black-browed albatross	fishery observer		0.002	ind./1000 hooks	Quarter 3	
Wang et al.	2021	China	albacore	2010-2018	Southeast Pacific	Buller's albatross	fishery observer		0.022	ind./1000 hooks	Quarter 4	
Wang et al.	2021	China	albacore	2010-2018	Southeast Pacific	Southern-royal albatross	fishery observer		0.005	ind./1000 hooks	Quarter 3	
Wang et al.	2021	China	albacore	2010-2018	Southeast Pacific	Sooty albatross	fishery observer		0.002	ind./1000 hooks	Quarter 3	
Wang et al.	2021	China	albacore	2010-2018	Southeast Pacific	Sooty albatross	fishery observer		0.044	ind./1000 hooks	Quarter 4	
Gilman et al.	2023	N/A	albacore	2018-2020	North Pacific	combined	electronic monitoring	1029	0.384	ind./1000 hooks	year-round	stern-setting
NMFS	2023	U.S. (Hawaii)	tuna	2004-2023	North Pacific	combined	fishery observers		0.010	ind./1000 hooks	year-round	
NMFS	2023	U.S. (Hawaii)	swordfish	2004-2023	North Pacific	combined	fishery observers		0.052	ind./1000 hooks	year-round	

TABLE 3. Seabird bycatch rates from observed pelagic longline sets in the IATTC Convention Area from 2013-2023. Bycatch rates were calculated for all seabird species combined, albatrosses, petrels, and shearwaters for the entire IATTC Area as well as four latitudinal regions inside the IATTC area (20°N - 40°N, 0° - 20°N, 0° - 20°S, 20°S - 40°S).

Area/Region	Seabird Species	Number of Sets observed	Number of Hooks observed (millions of hooks)	Bycatch Rate (ind./1000 hooks)
IATTC Area	combined	85903	104.3	**0.015**
IATTC Area	albatrosses	85903	104.3	0.006
IATTC Area	petrels	85903	104.3	0.005
IATTC Area	shearwaters	85903	104.3	0.001
20°N - 40°N	combined	14797	29.5	**0.013**
20°N - 40°N	albatrosses	14797	29.5	**0.012**
20°N - 40°N	petrels	14797	29.5	<0.001
20°N - 40°N	shearwaters	14797	29.5	<0.001
0° - 20°N	combined	13740	8.3	0.003
0° - 20°N	albatrosses	13740	8.3	<0.001
0° - 20°N	petrels	13740	8.3	0.001
0° - 20°N	shearwaters	13740	8.3	<0.001
0° - 20°S	combined	54280	57.9	**0.011**
0° - 20°S	albatrosses	54280	57.9	0.001
0° - 20°S	petrels	54280	57.9	0.005
0° - 20°S	shearwaters	54280	57.9	0.002
20°S - 40°S	combined	2715	8.6	**0.067**
20°S - 40°S	albatrosses	2715	8.6	**0.026**
20°S - 40°S	petrels	2715	8.6	**0.028**
20°S - 40°S	shearwaters	2715	8.6	0.001

6. FIGURES

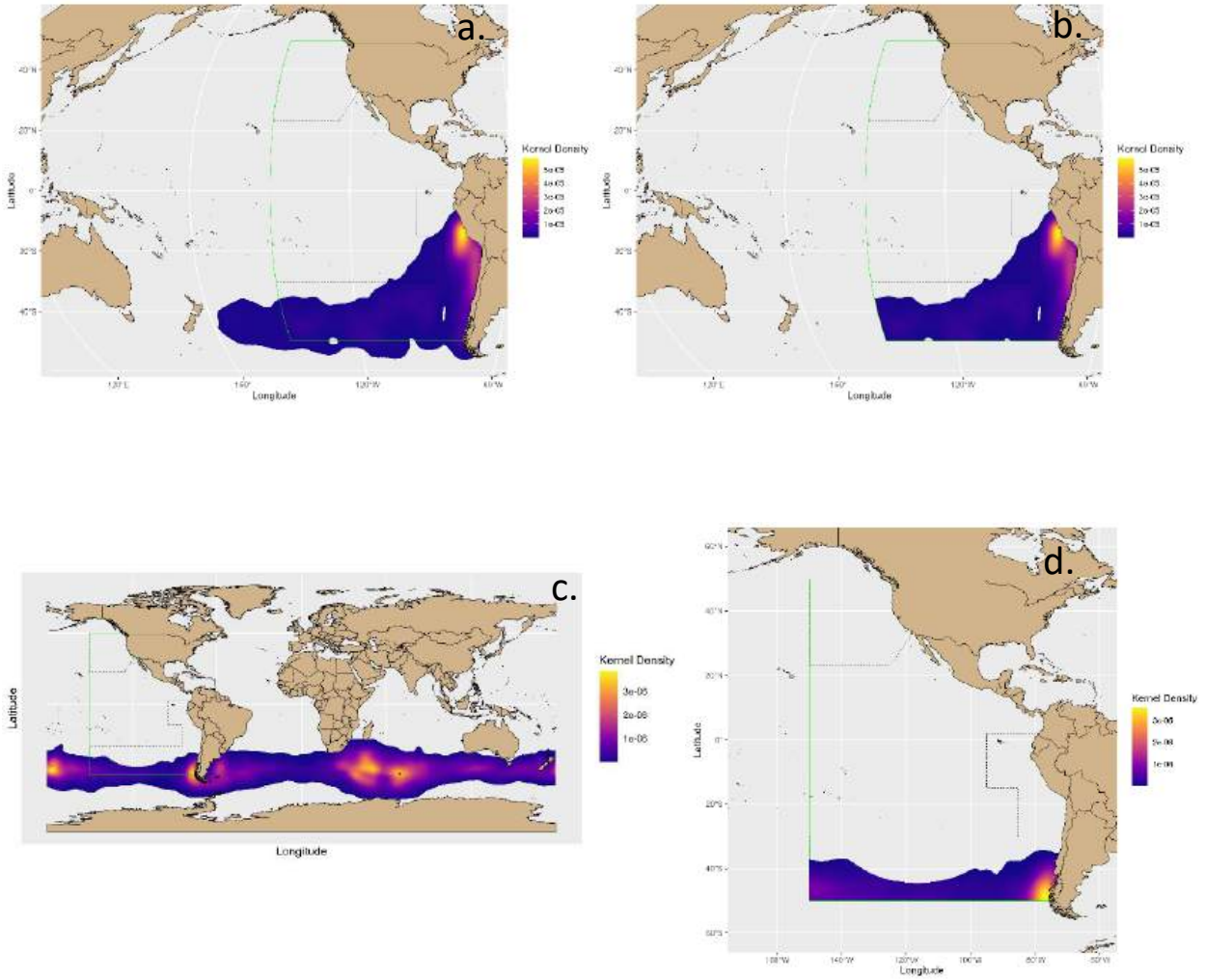

FIGURE 1. Two representative global (a,c) and cropped (b,d) utilization distributions (UDs) for the adult non-breeding Chatham Albatross, *Thalassarche eremita*, (a,b) and Wandering Albatross, *Diomedea exulans*, (c,d). The density scales will likely differ between the global and cropped UDs because the range of density values likely changes after cropping to the IATTC area. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.

FIGURA 2. Spanish caption.

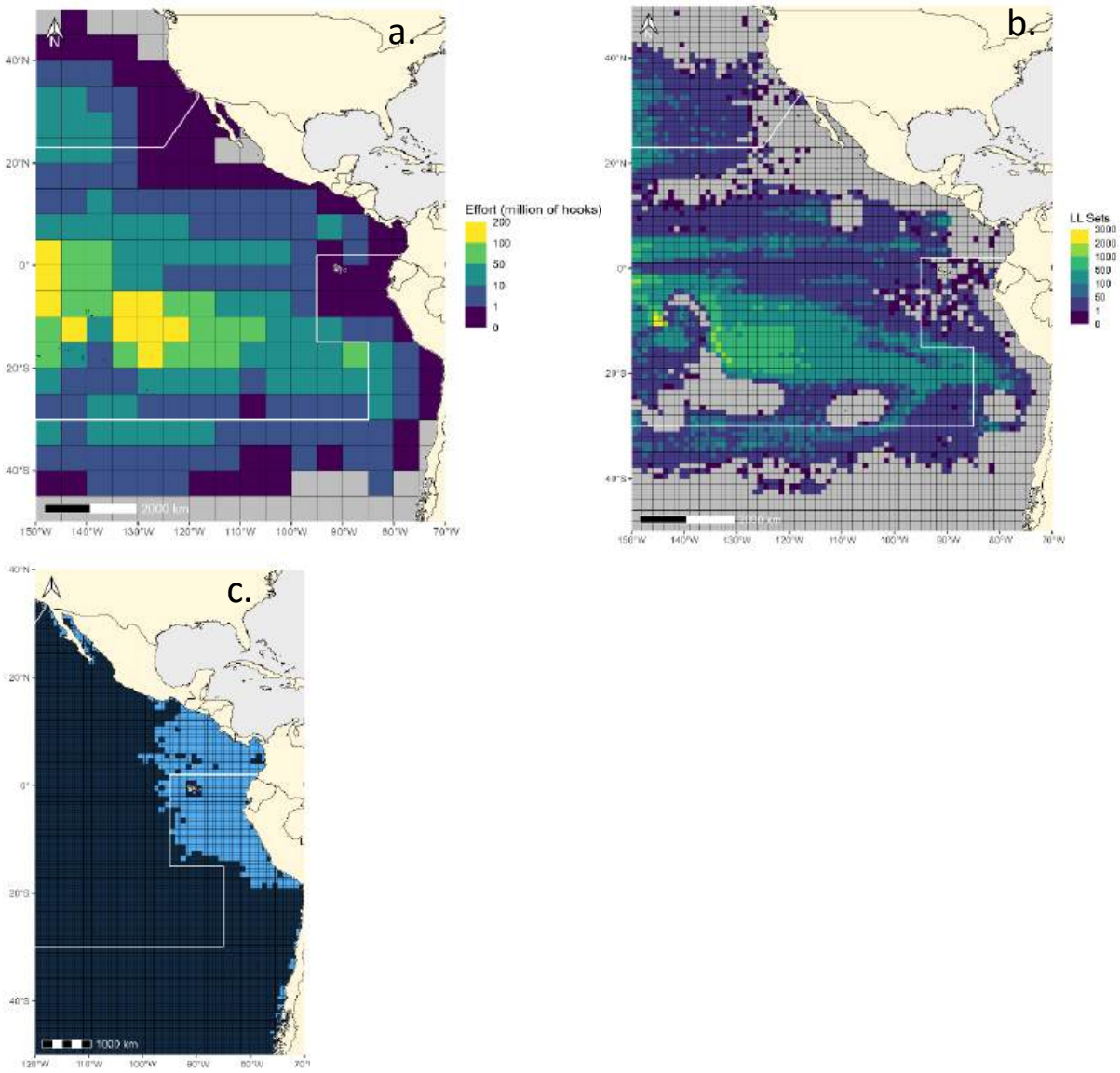

FIGURE 2. a) Longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000–2023. b) The sum of Global Fishing Watch estimated longline fishing sets in 1°x1° grid cells that occurred from 2016–2023. C) Small-scale coastal longline fisheries presence (blue) and absence (dark grey) based on resource review, SAC-13-11, at 0.5°x0.5° grid cells. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.

FIGURA 2. Spanish caption.

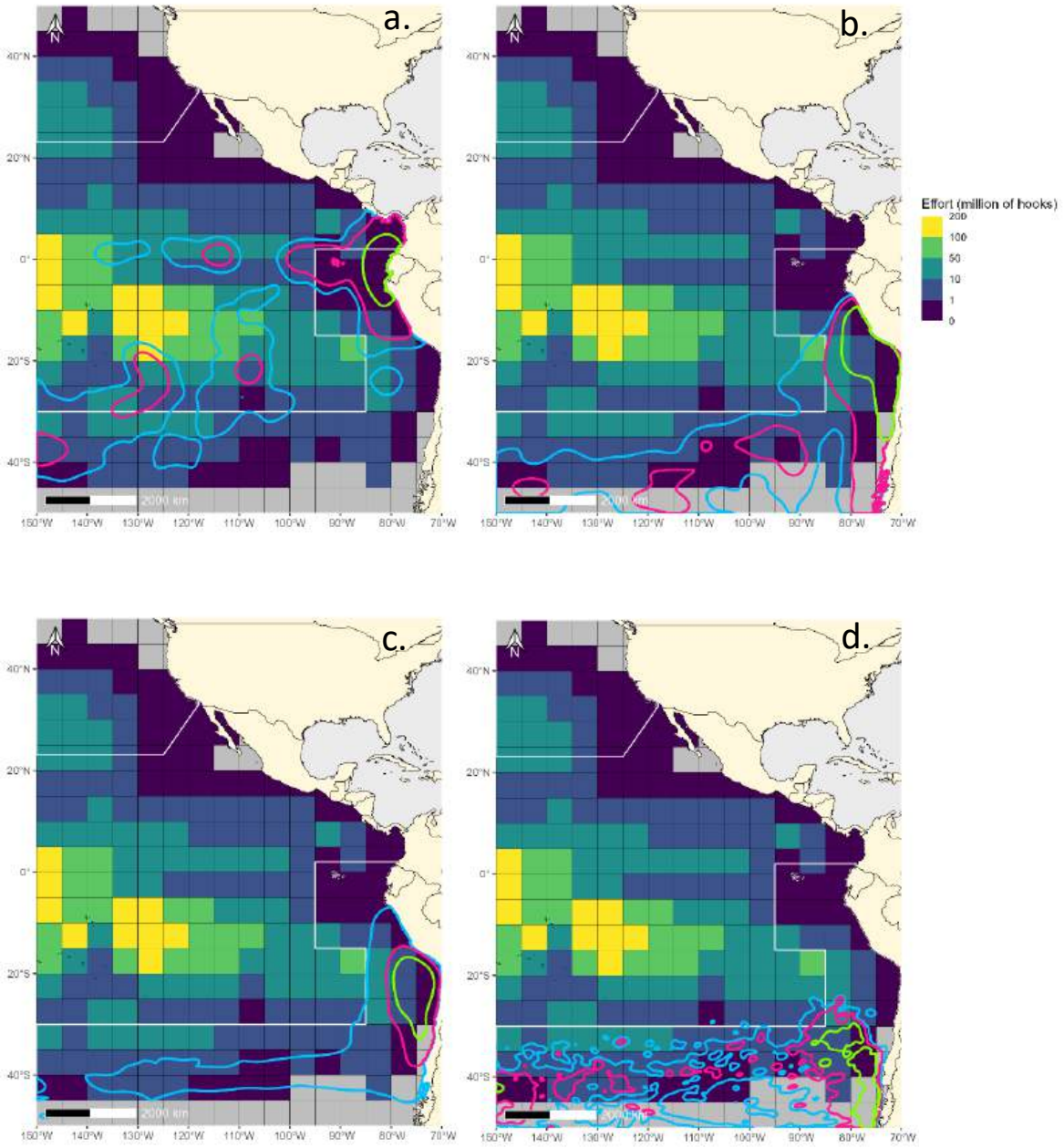

FIGURE 3. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of a) adult non-breeding Black Petrel, *Procellaria parkinsoni*, b) Chatham Albatross, *Thalassarche eremita*, c) Buller's Albatross, *Thalassarche bulleri*, and d) Antipodean Albatross, *Diomedea antipodensis*, with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000–2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.
FIGURA 3. Spanish caption.

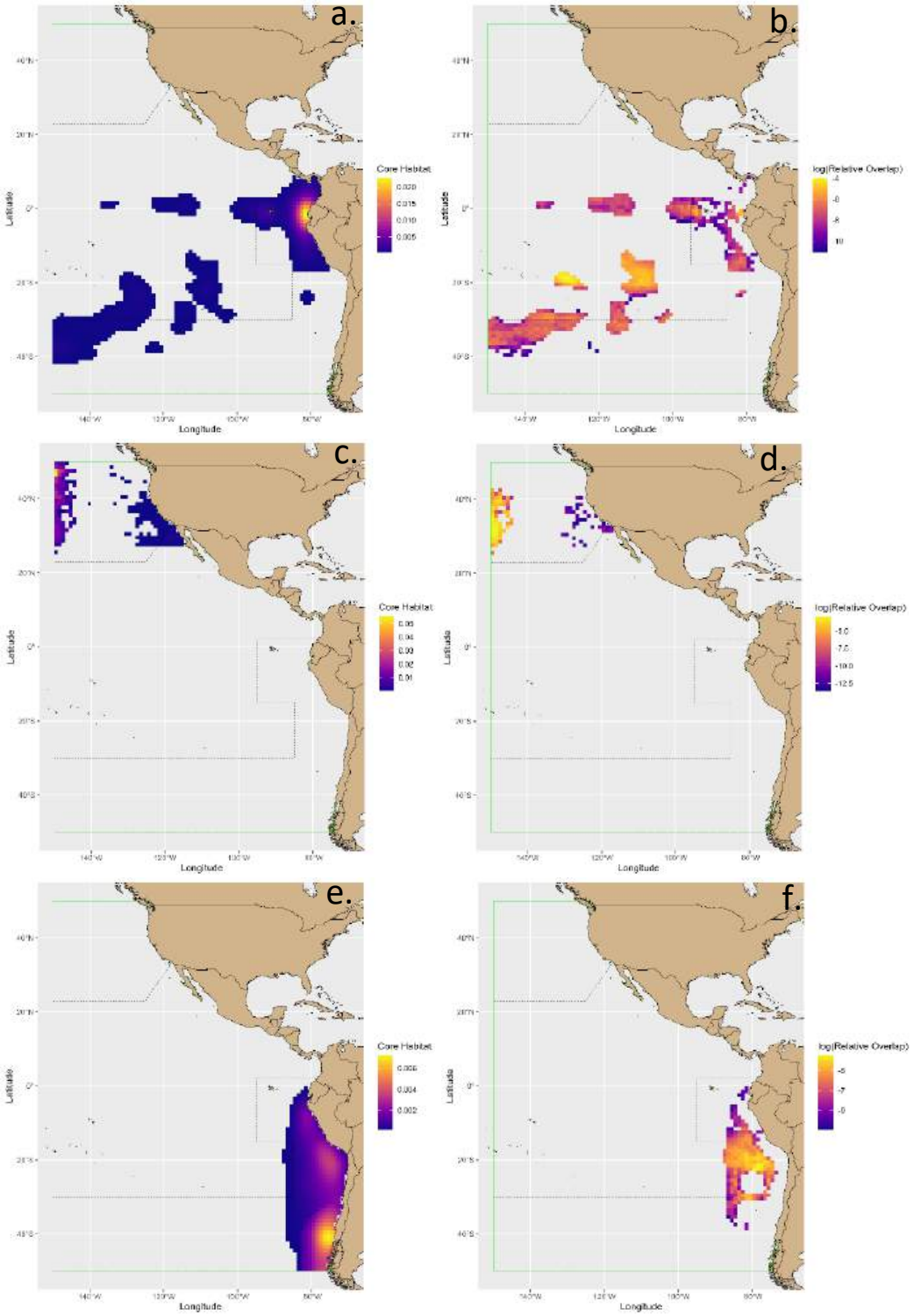

FIGURE 4. Core habitat (a, c, e) extracted from utilization distributions and associated relative overlap (b, d, f) with Global Fishing Watch estimated longline fishing effort for adult non-breeding Black Petrel, *Procellaria parkinsoni*, (a, b), breeding Laysan Albatross, *Phoebastria immutabilis*, (c, d), and adult non-breeding White-chinned Petrel, *Procellaria aequinoctialis*, (e, f). The highest relative overlap are areas in

yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.

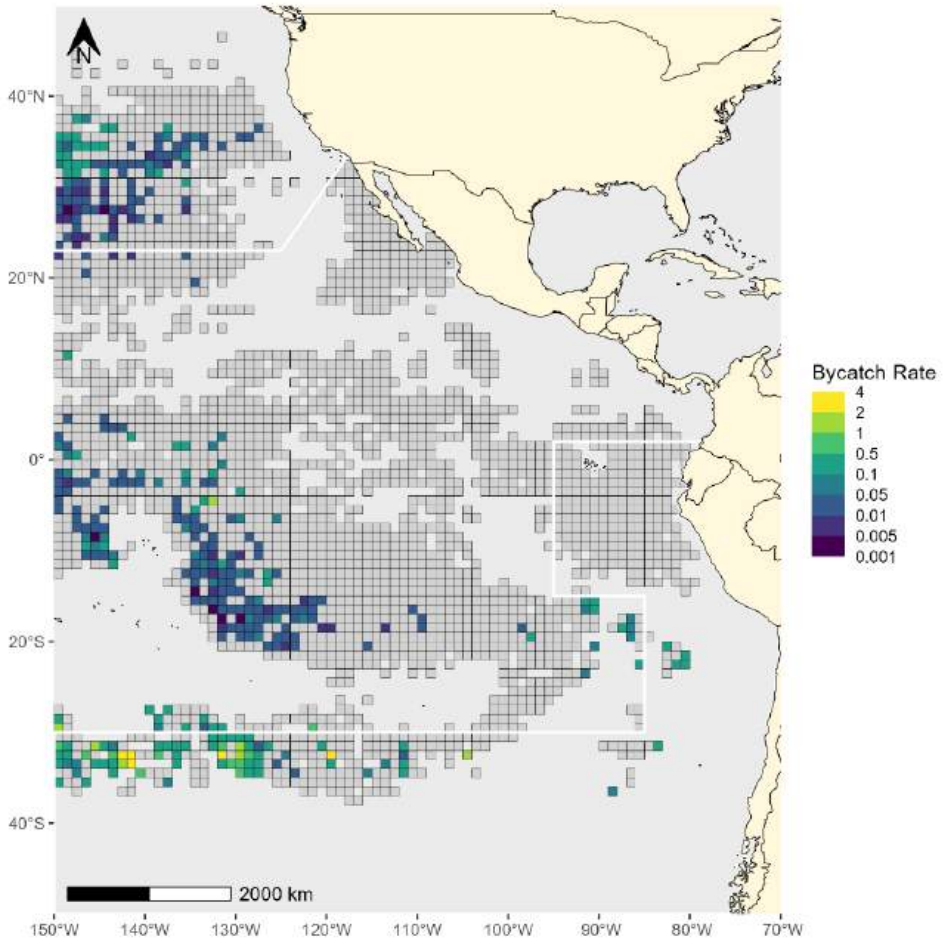

FIGURE 5. Seabird bycatch rates for all species combined calculated from the longline observer program in the IATTC Convention Area at 1°x1° grid cell resolution. The grey boxes indicate grid cells where longline fishing effort occurred, but no seabird interaction was observed or reported. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.

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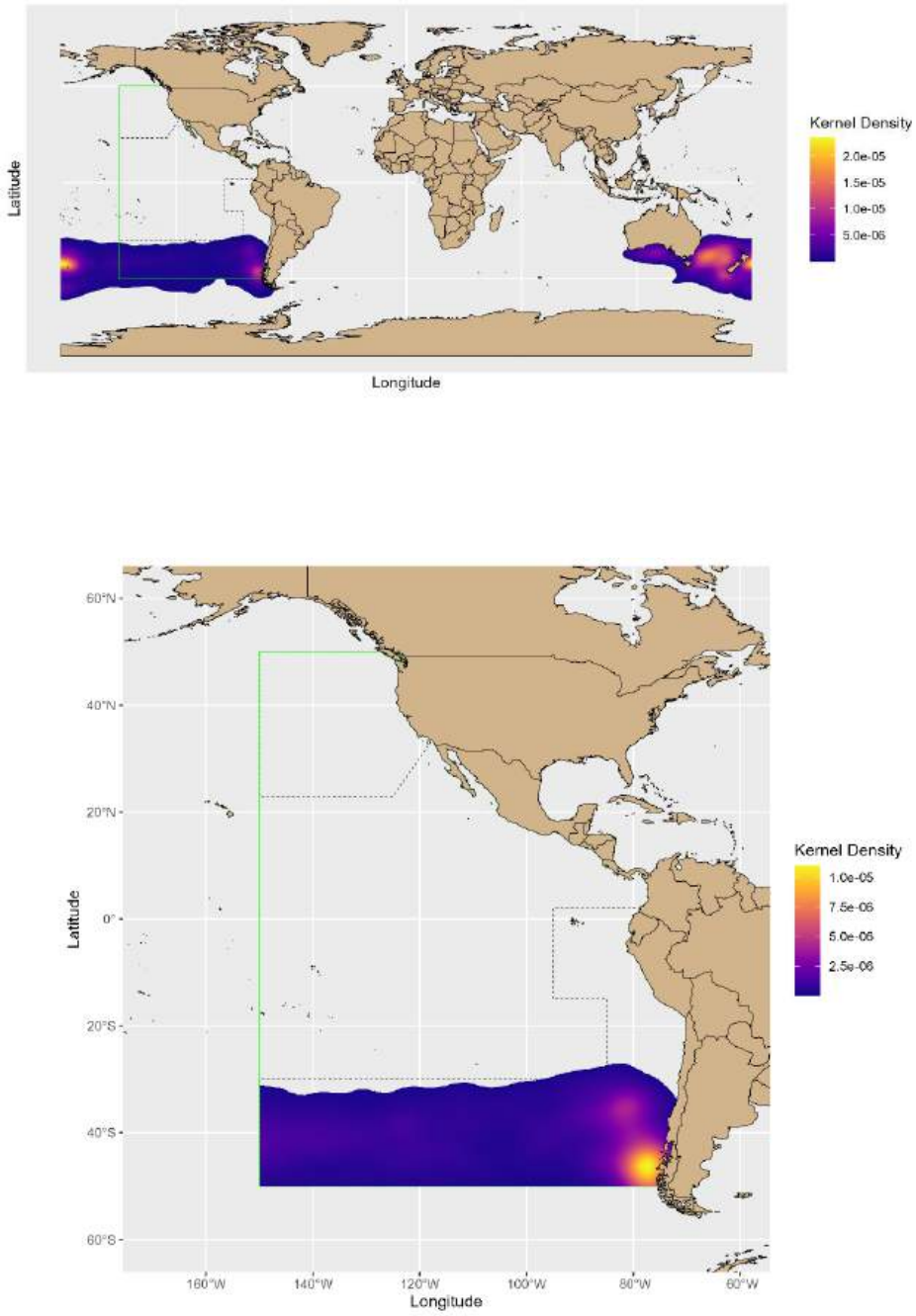
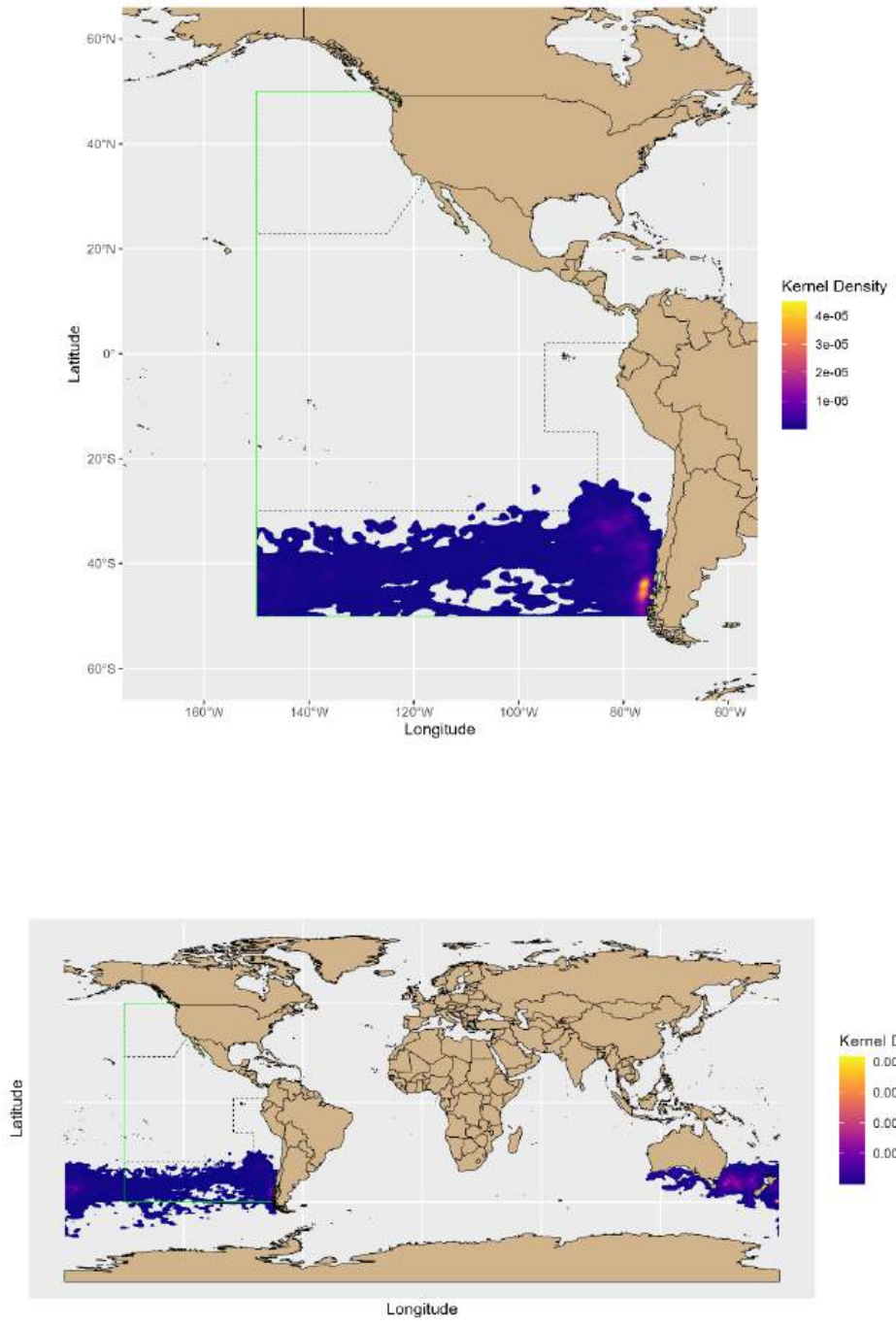
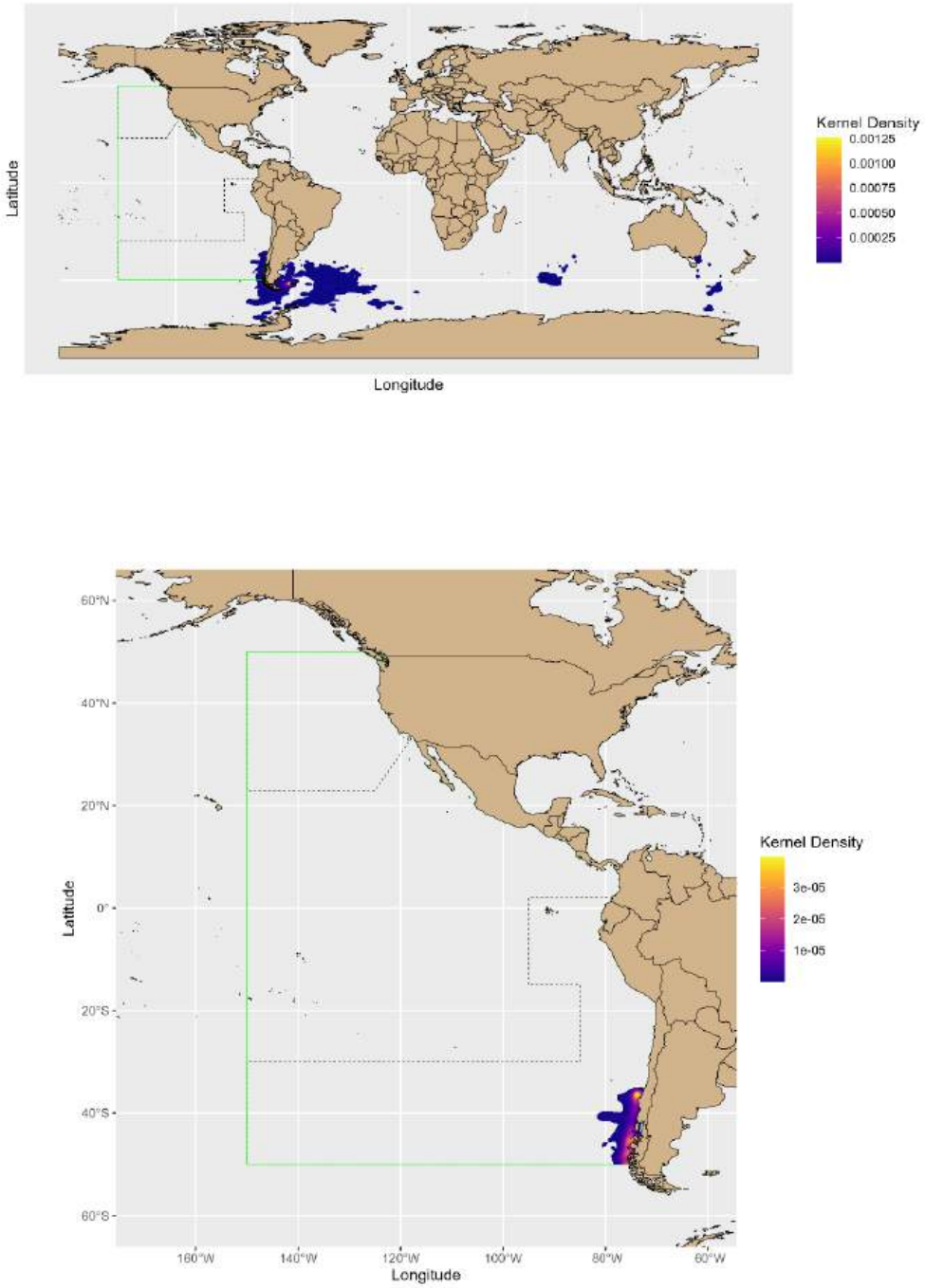
8. ANNEX 1



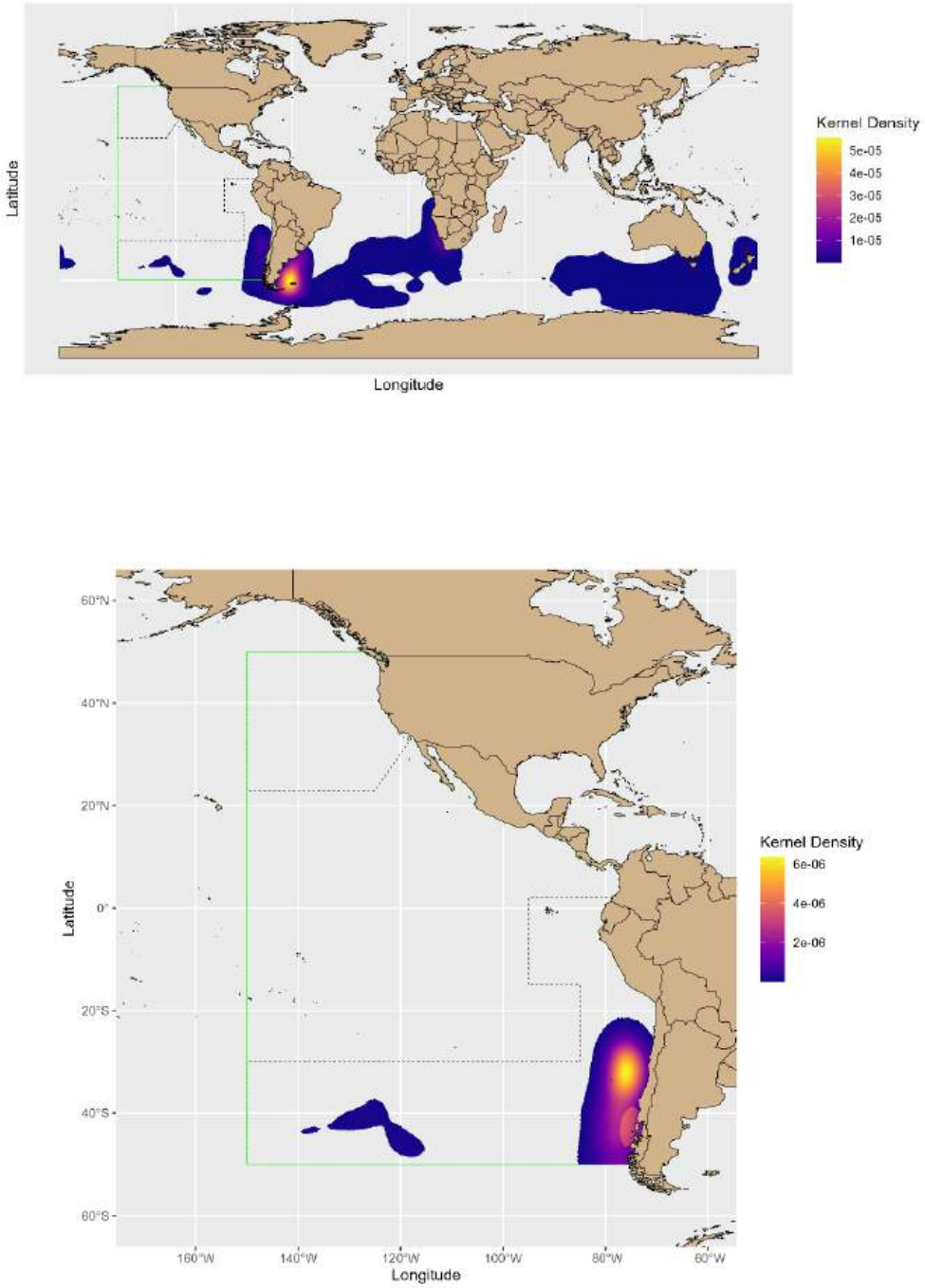
Annex 1 Figure 1. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the adult non-breeding Antipodean Albatross (*Diomedea antipodensis*) based on GLS tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



Annex 1 Figure 2. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the adult non-breeding Antipodean Albatross (*Diomedea antipodensis*) based on GPS/PTT tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



Annex 1 Figure 3. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the breeding Black-browed Albatross (*Thalassarche melanophris*) based on GPS/PTT tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



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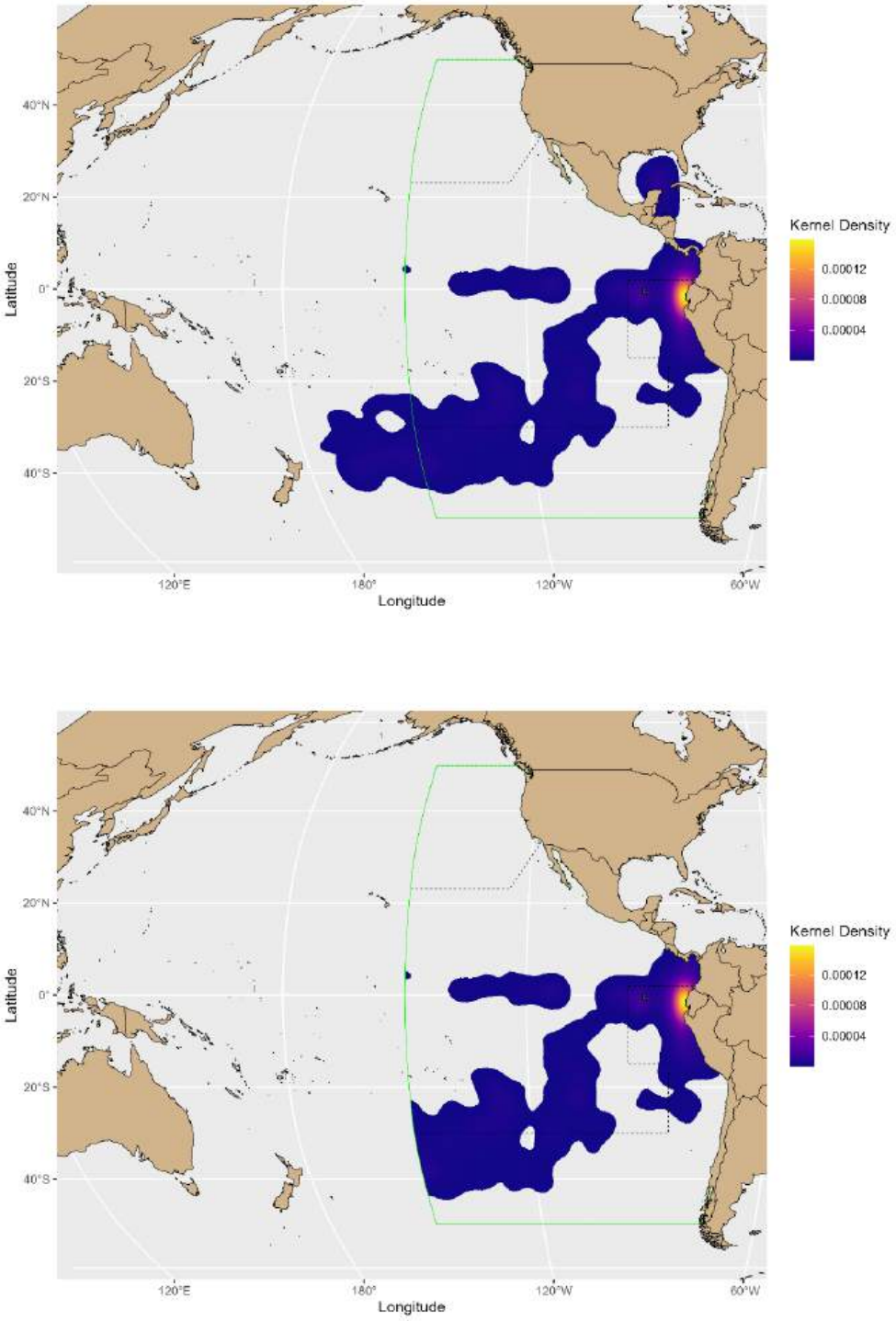

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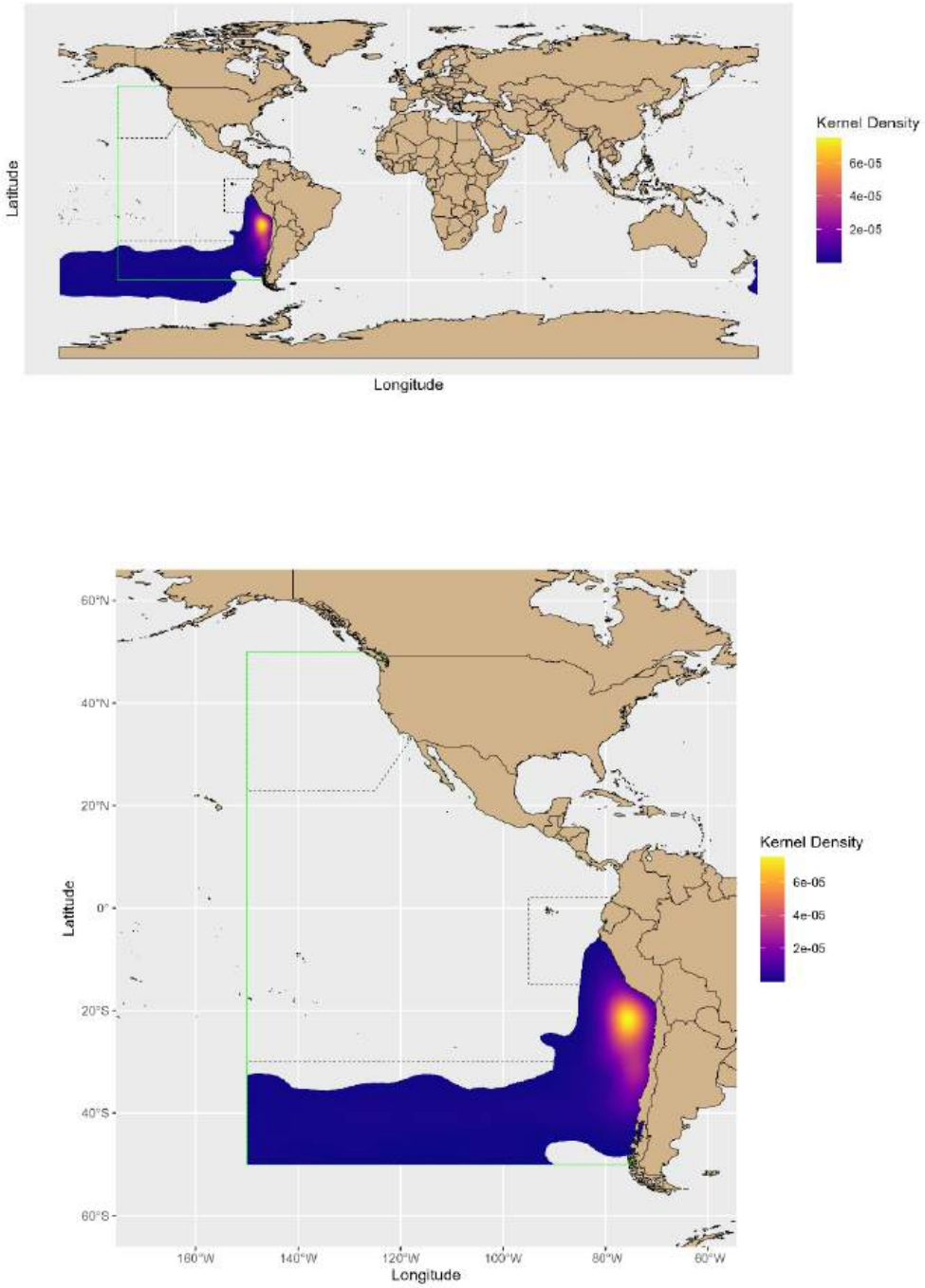

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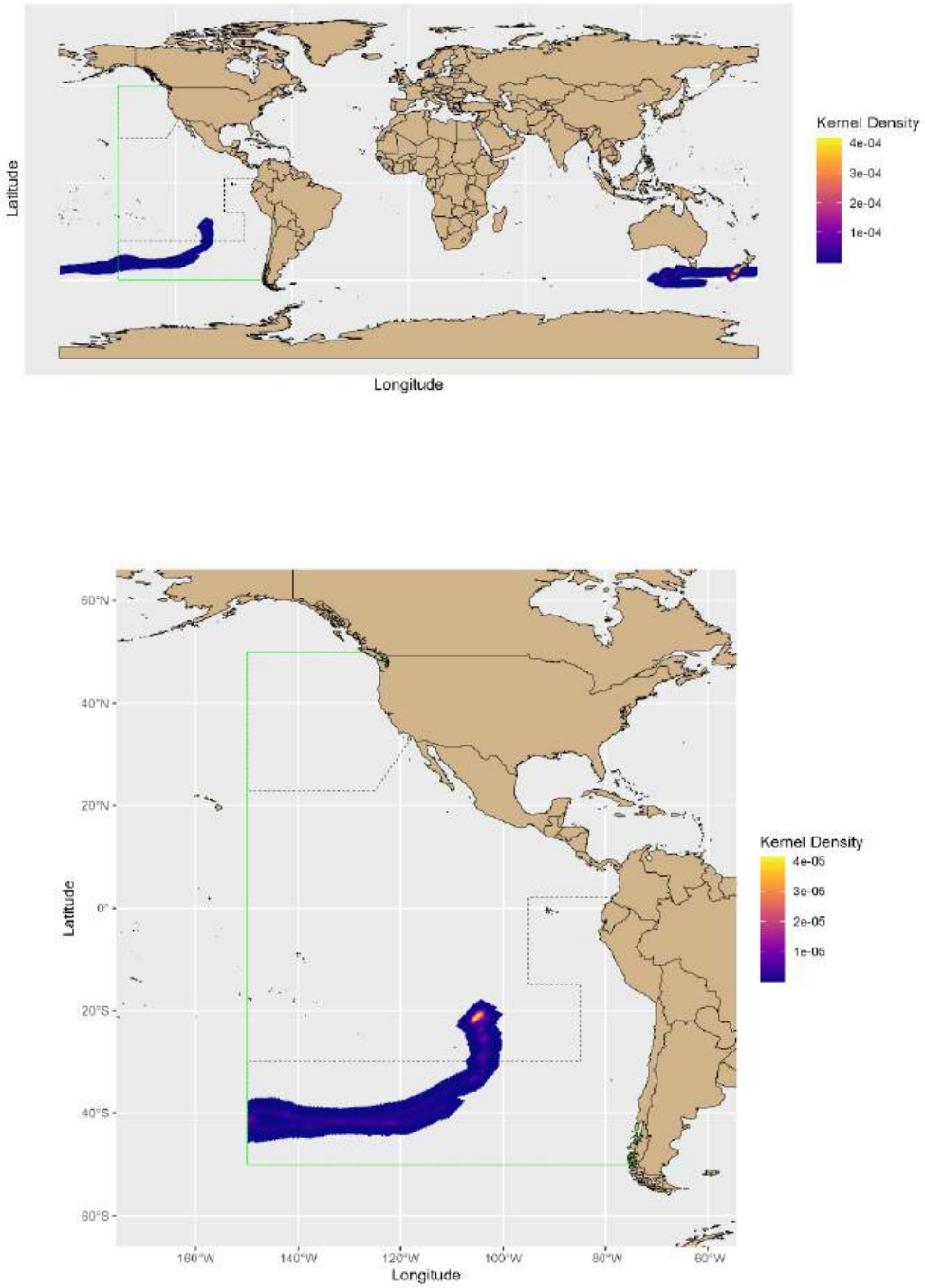

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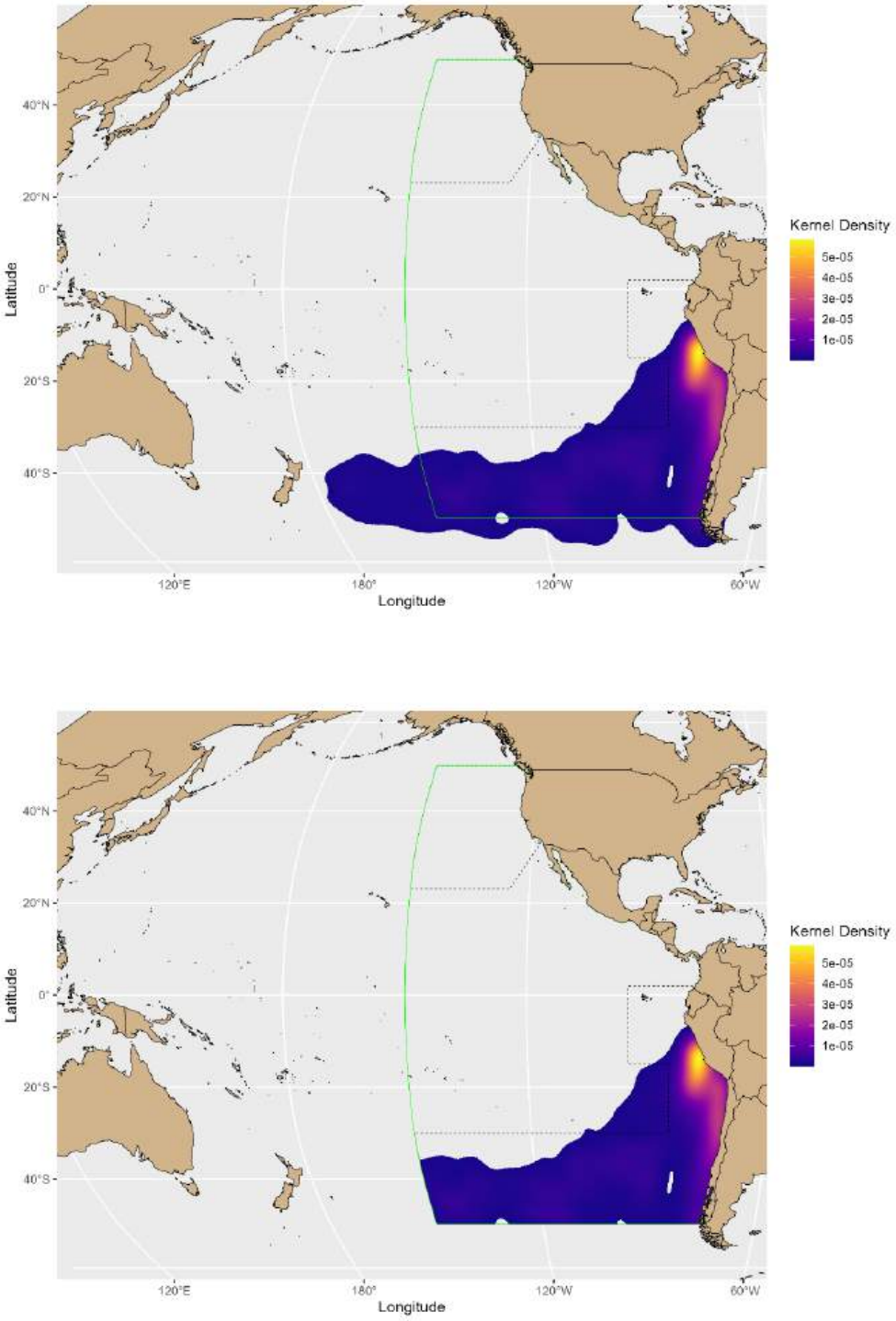
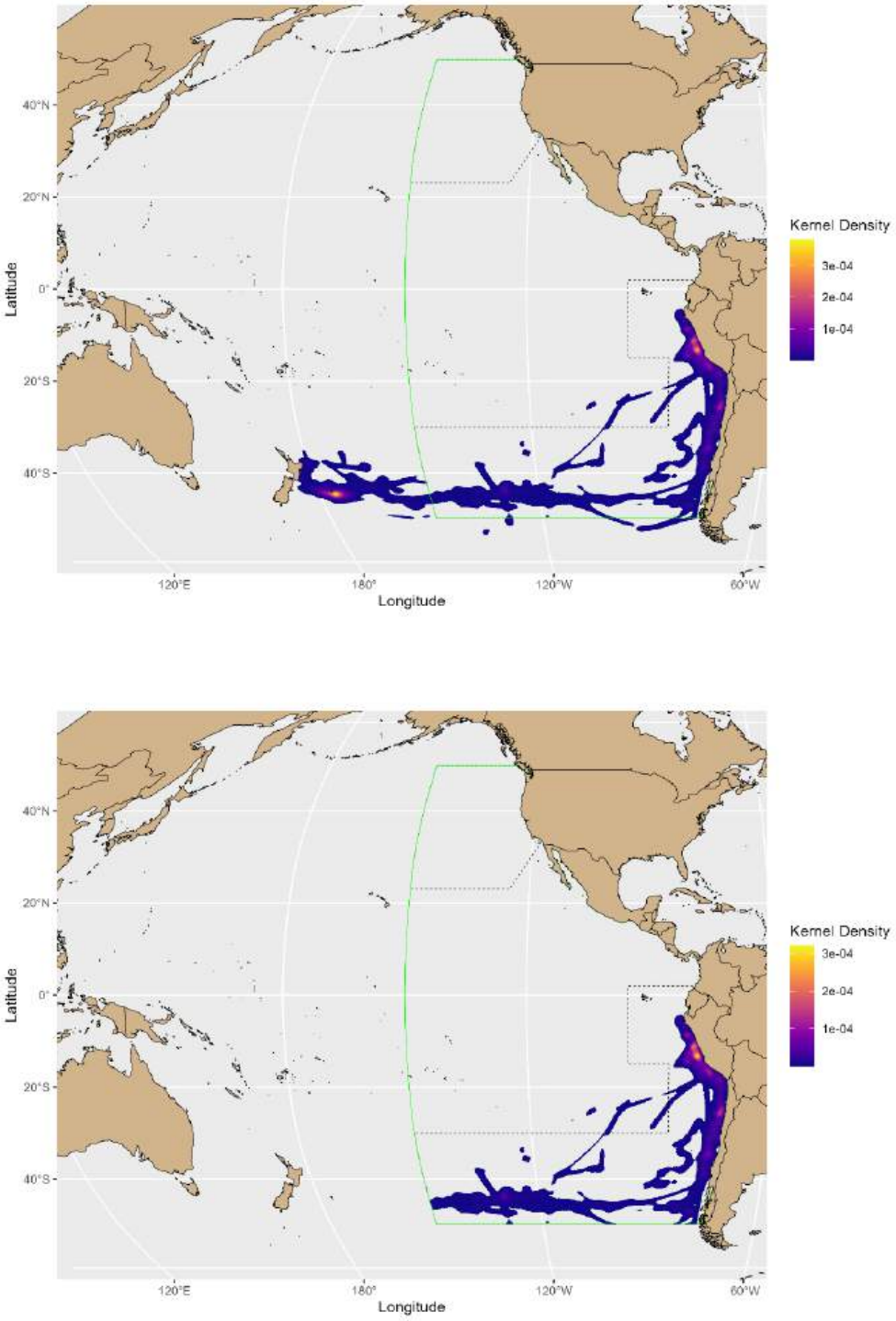


Annex 1 Figure 8. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the adult non-breeding Chatham Albatross (*Thalassarche eremita*) based on GLS tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



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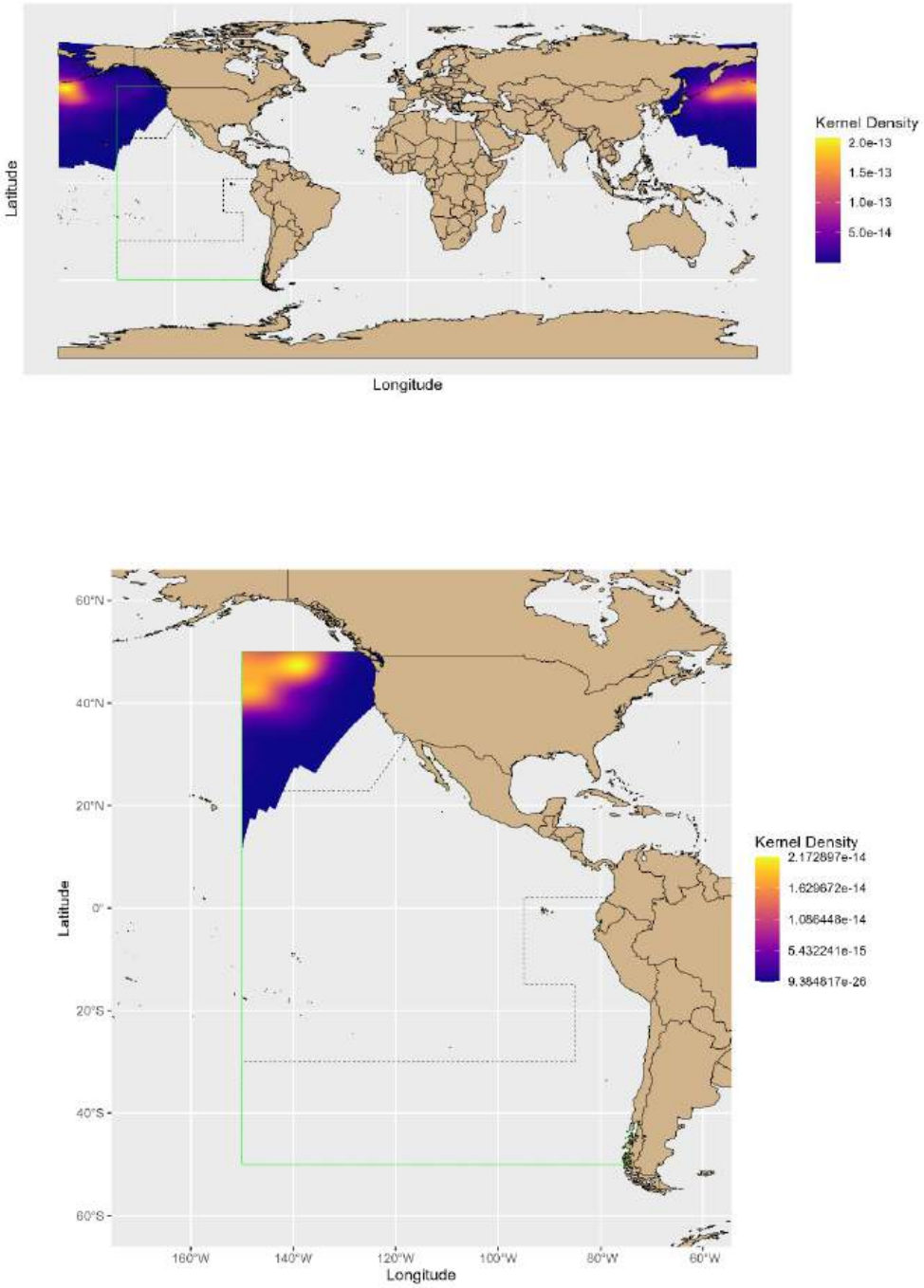
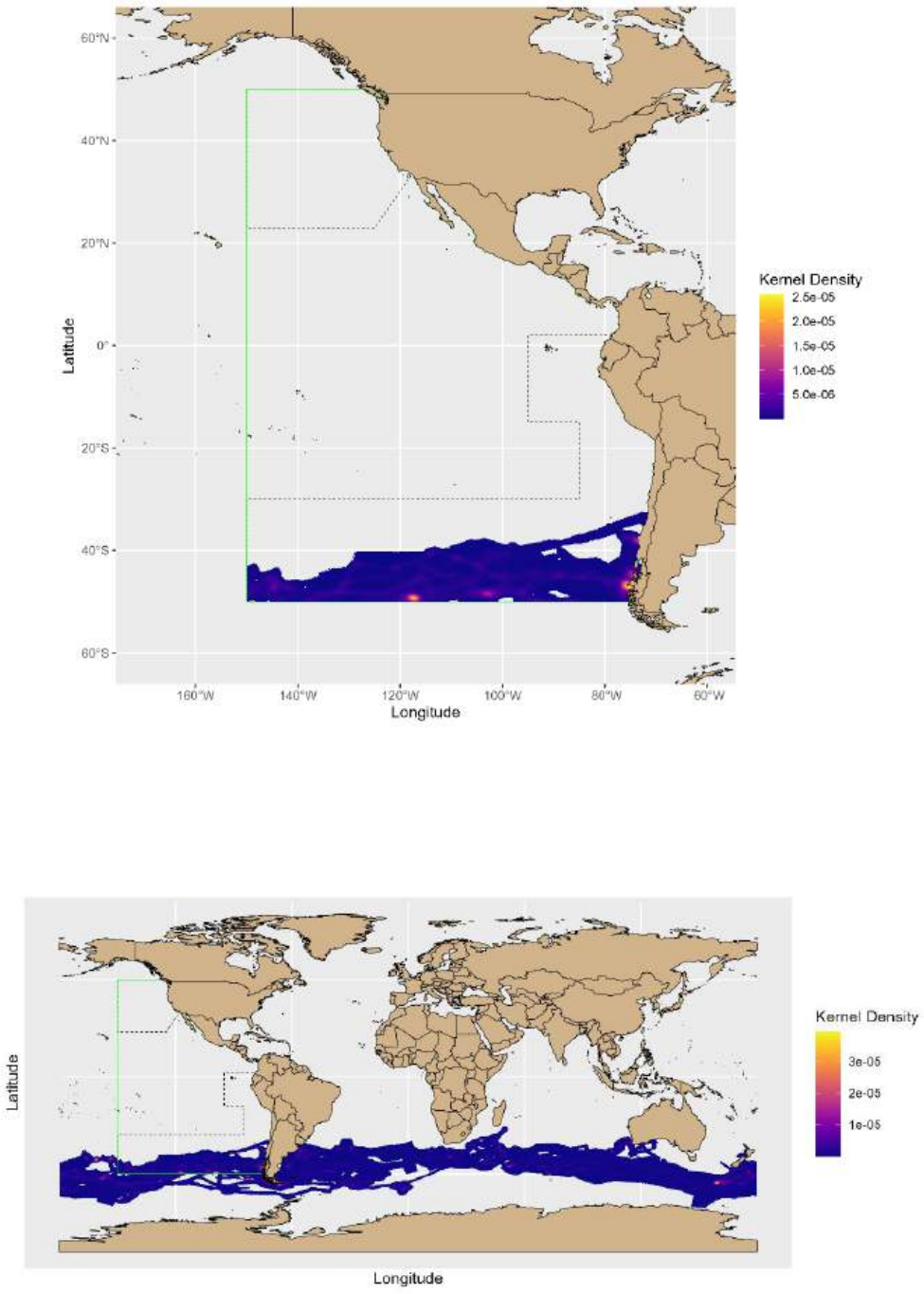
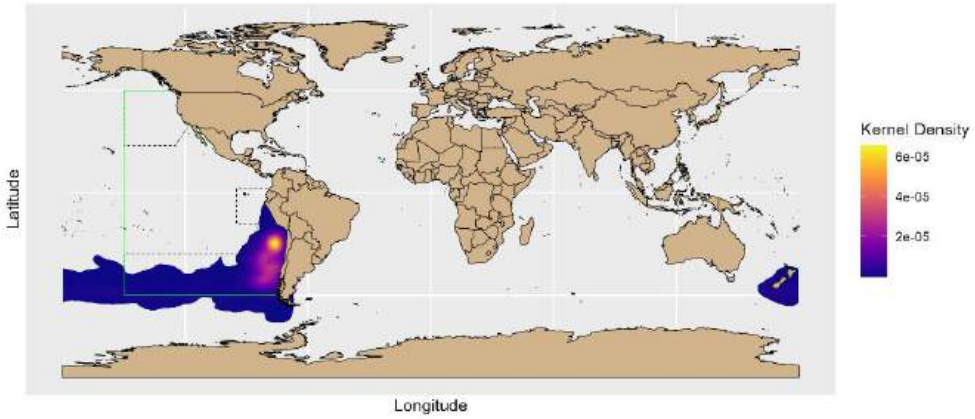
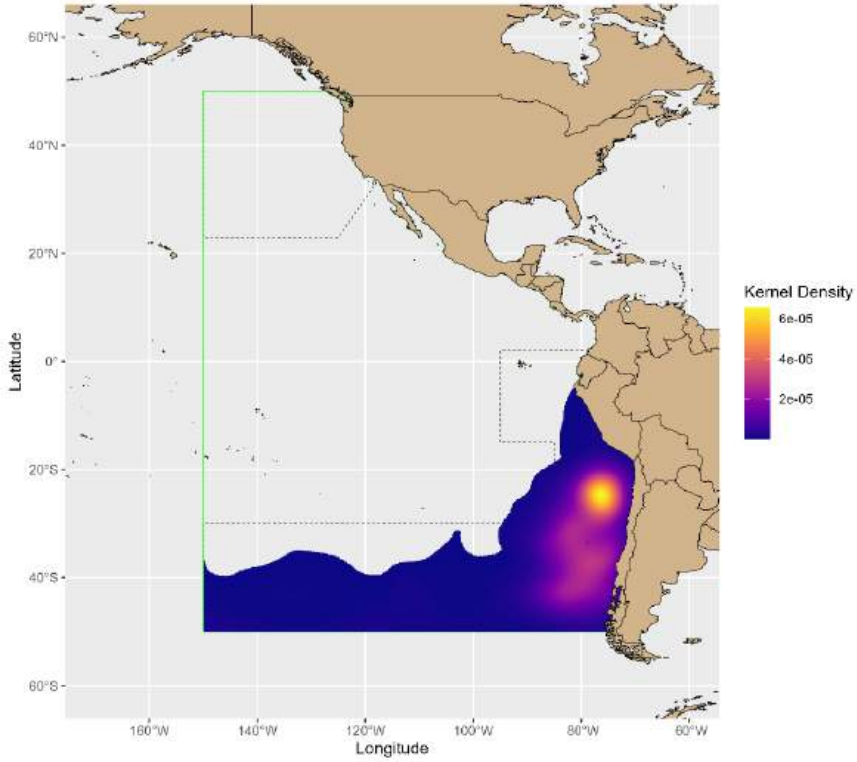


Annex 1 Figure 10. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the breeding Laysan Albatross (*Phoebastria immutabilis*) based on GPS/PTT tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.

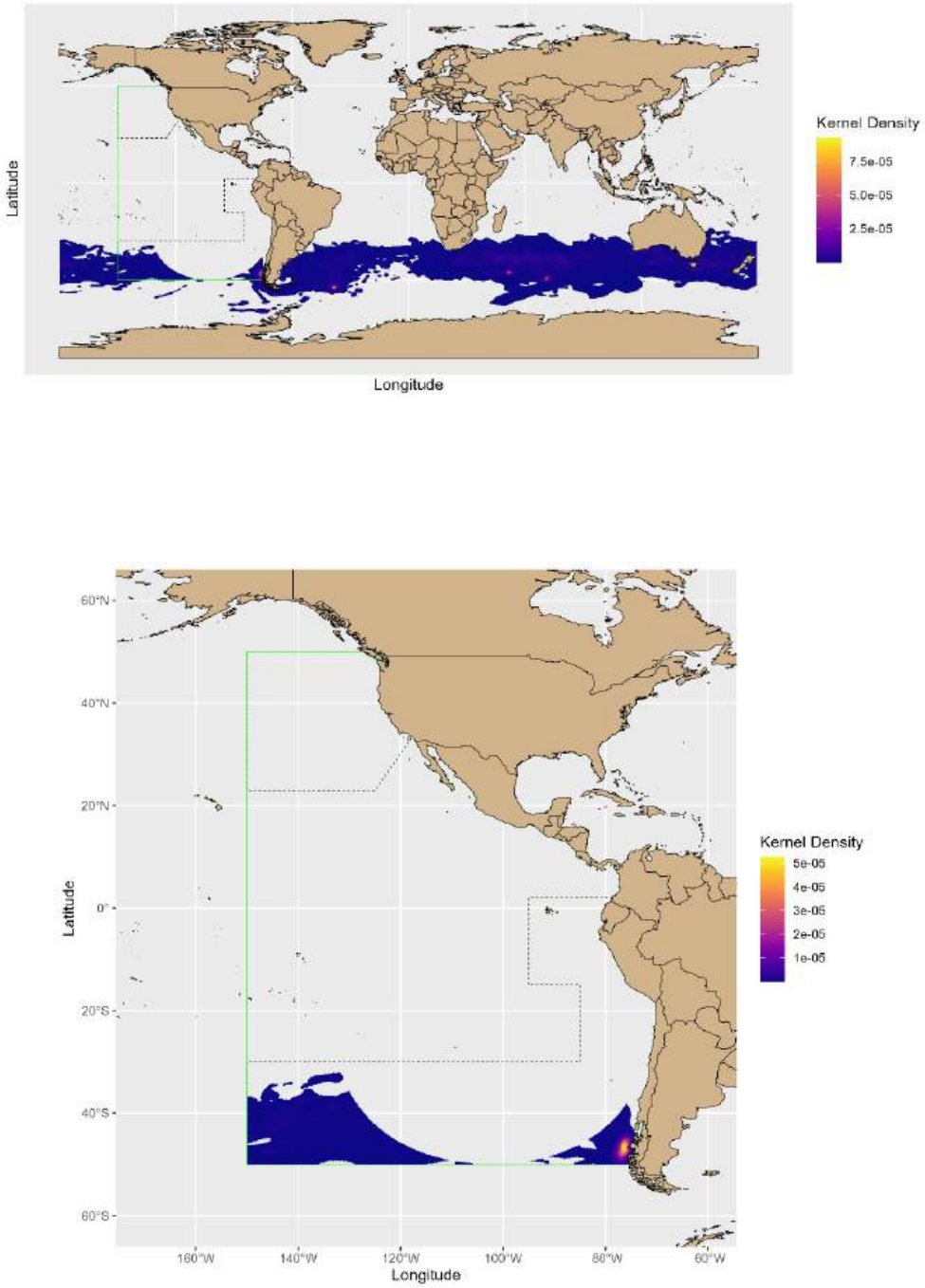


Annex 1 Figure 11. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the juvenile Northern Giant Petrel (*Macronectes halli*) based on GPS/PTT tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.

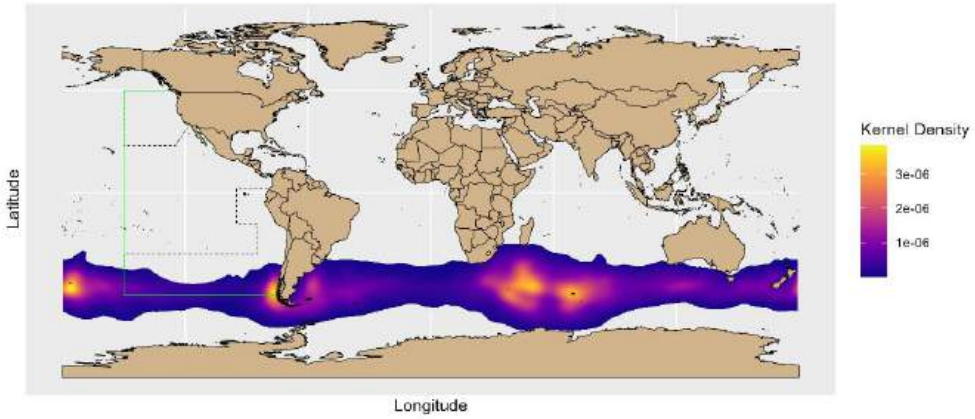


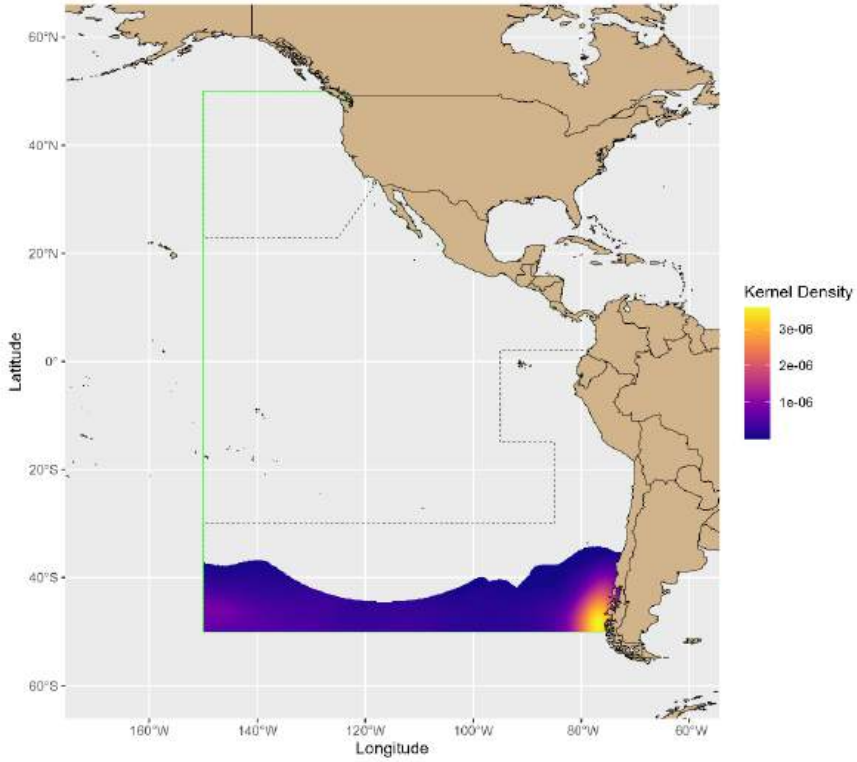


Annex 1 Figure 12. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the adult non-breeding Salvin's Albatross (*Thalassarche salvini*) based on GLS tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.

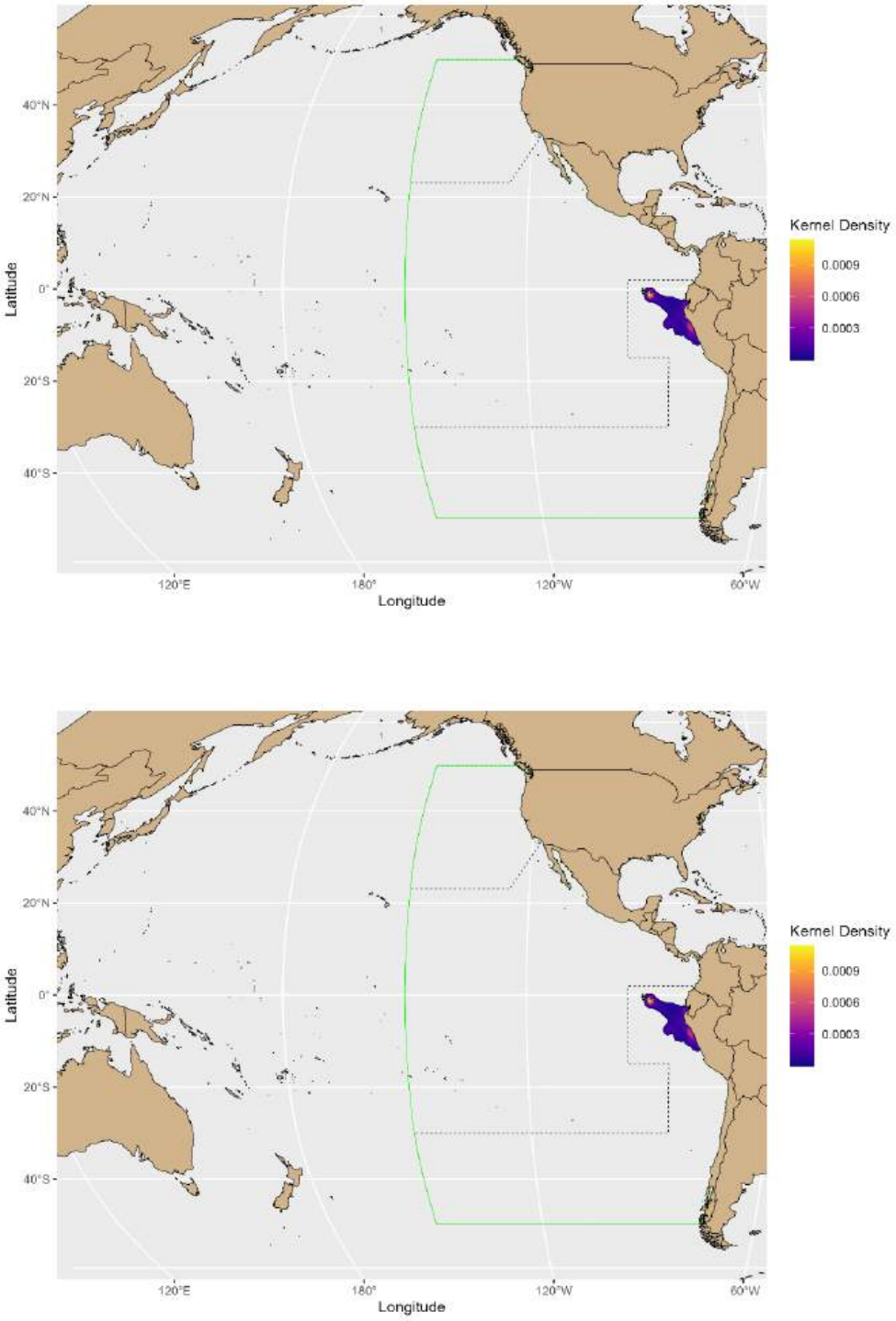


Annex 1 Figure 13. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the juvenile Wandering Albatross (*Diomedea exulans*) based on GPS/PTT tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.

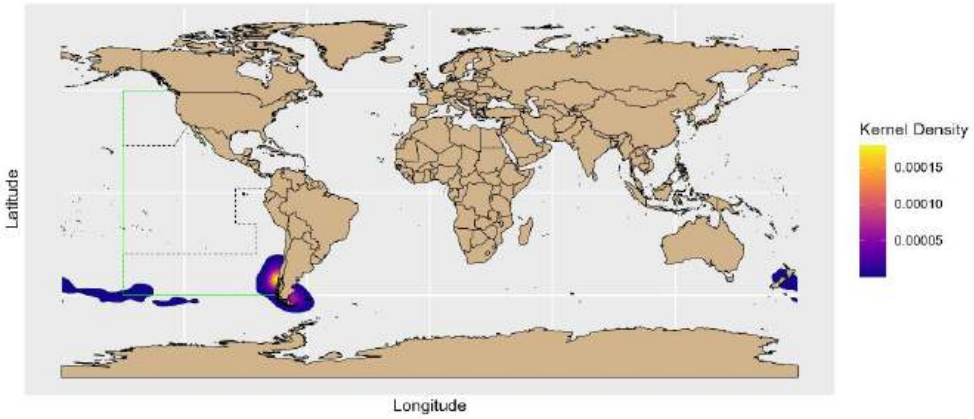


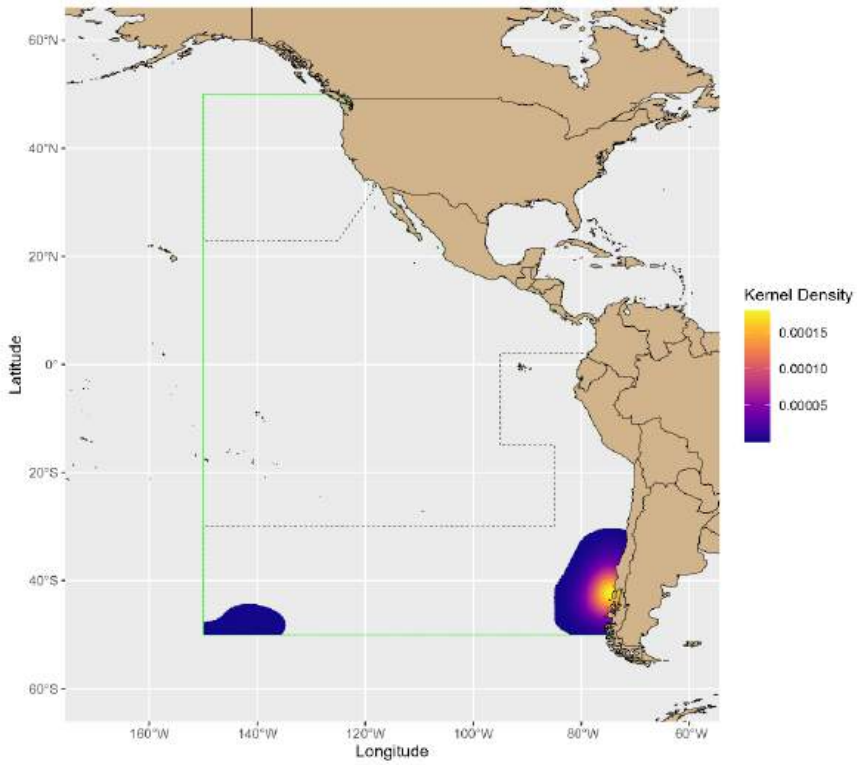


Annex 1 Figure 14. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the adult non-breeding Wandering Albatross (*Diomedea exulans*) based on GLS tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.

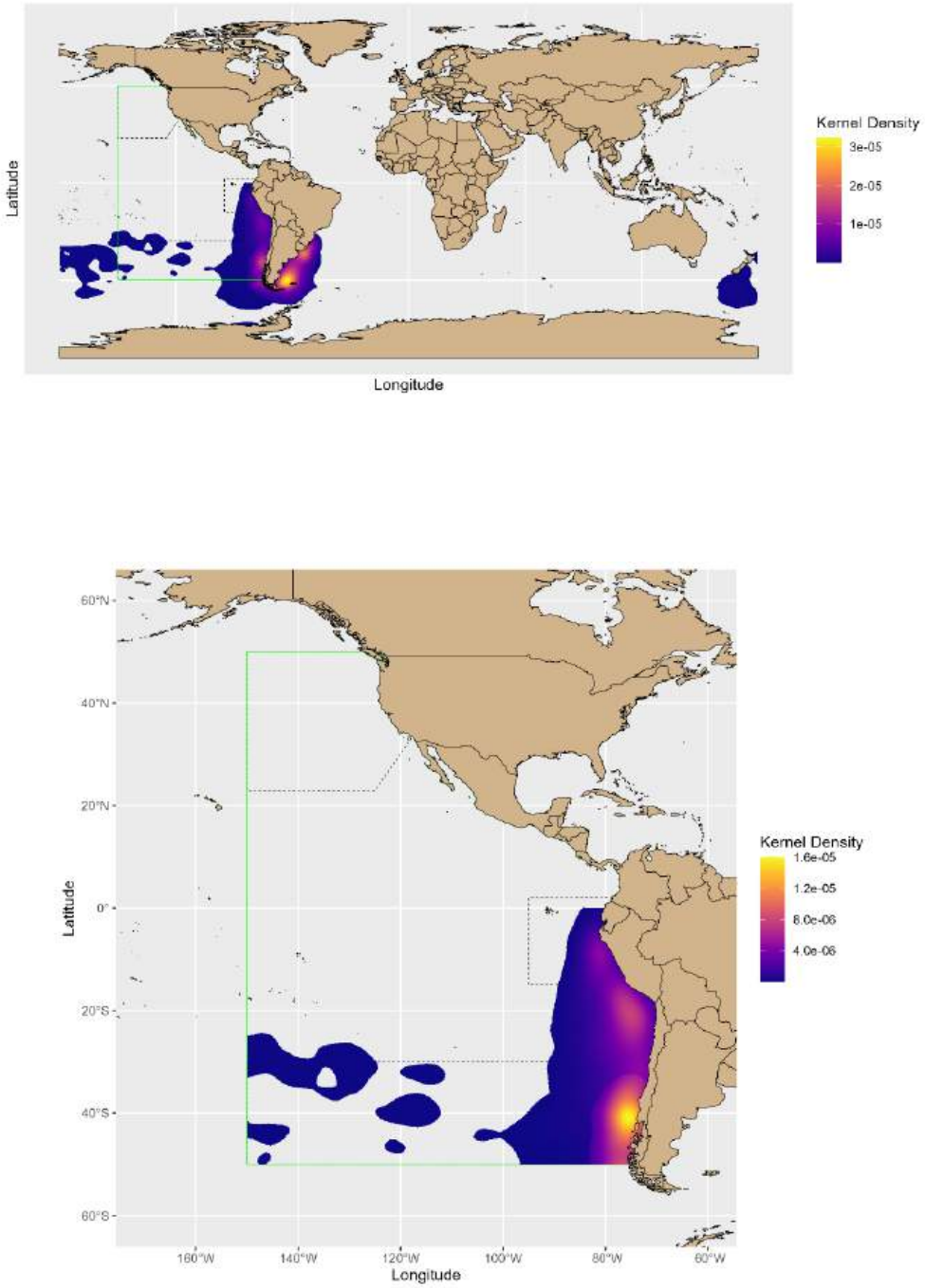


Annex 1 Figure 15. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the breeding Waved Albatross (*Phoebastria irrorata*) based on GPS/PTT tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



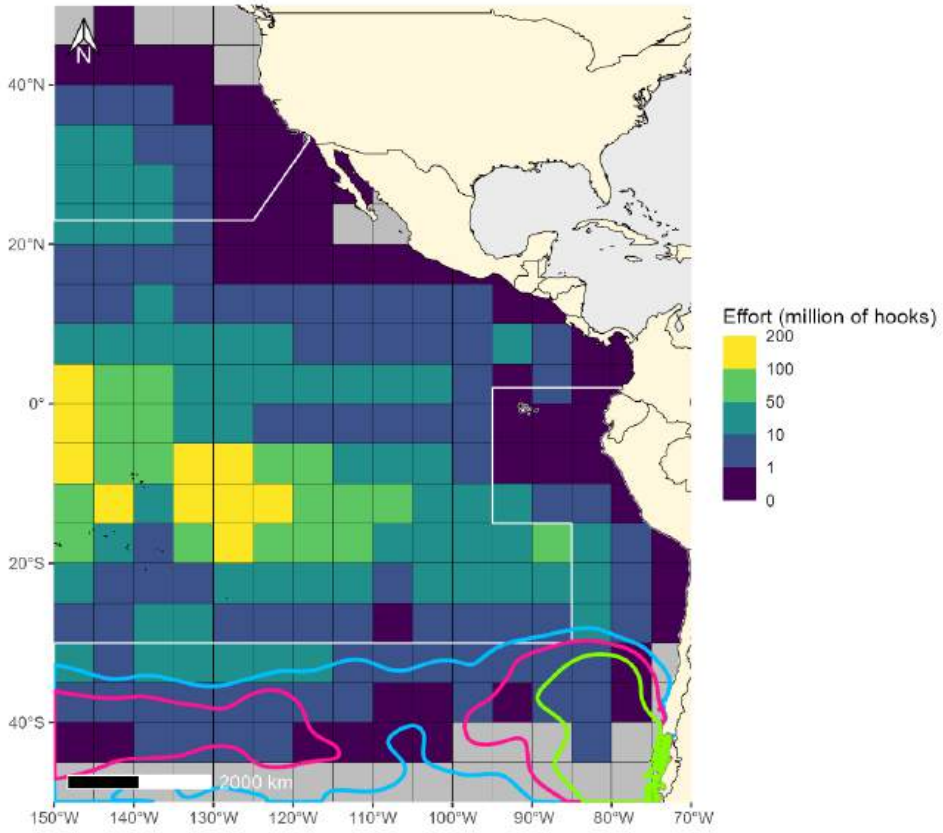


Annex 1 Figure 16. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the adult non-breeding Westland Petrel (*Phoebastria irrorata*) based on GLS tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



Annex 1 Figure 17. Global (top map) and cropped (bottom map) utilization distributions (UDs) for the adult non-breeding White-chinned Petrel (*Procellaria aequinoctialis*) based on GLS tracks. Green line outlines the IATTC Convention Area, while the areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.

9. ANNEX 2



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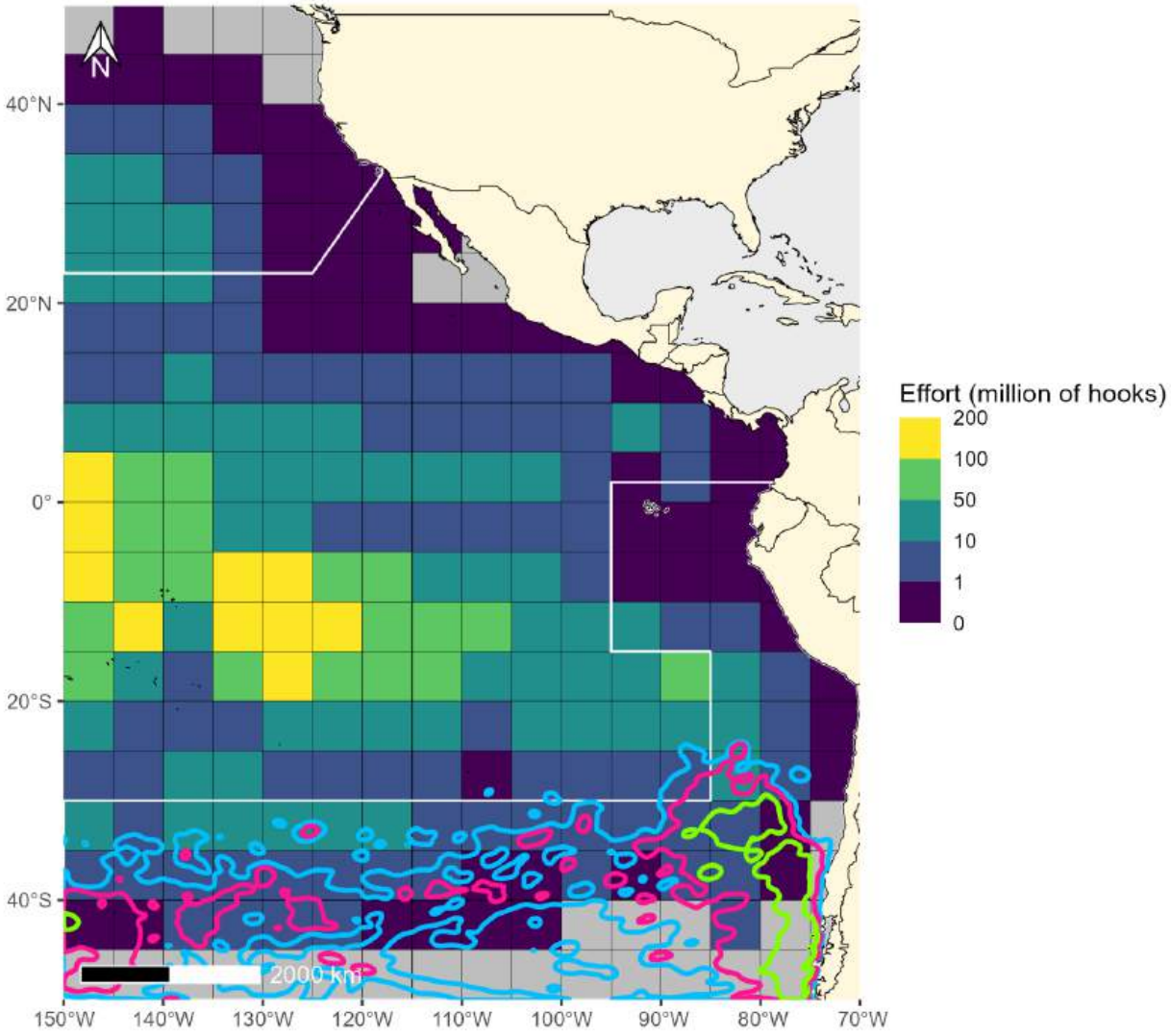

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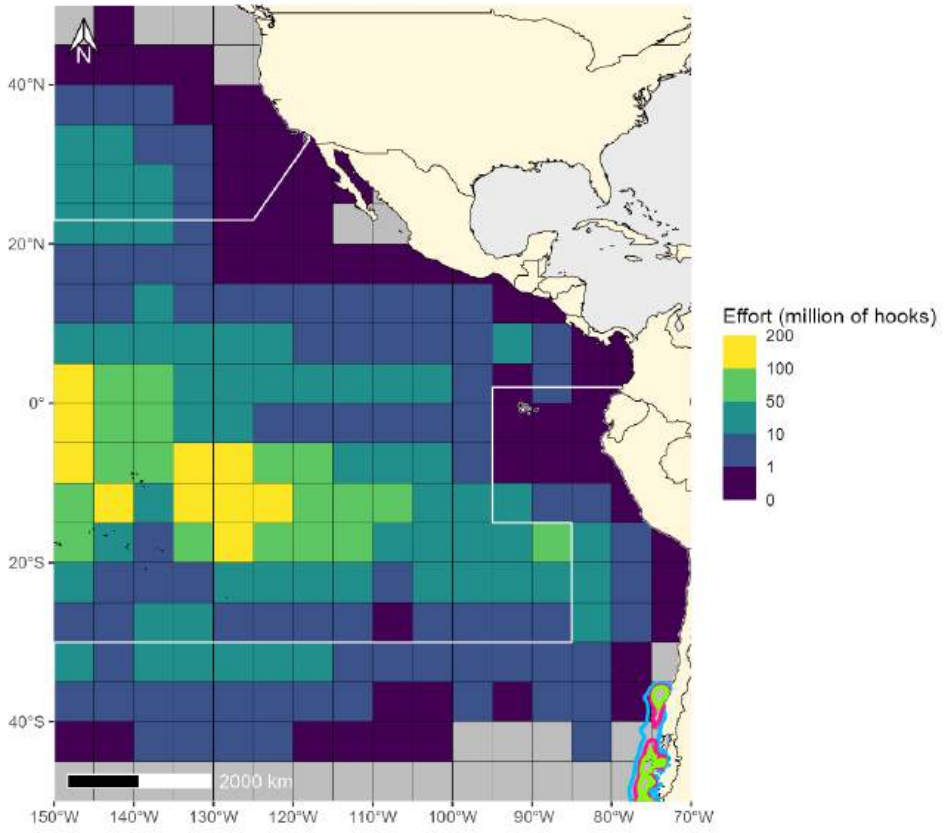

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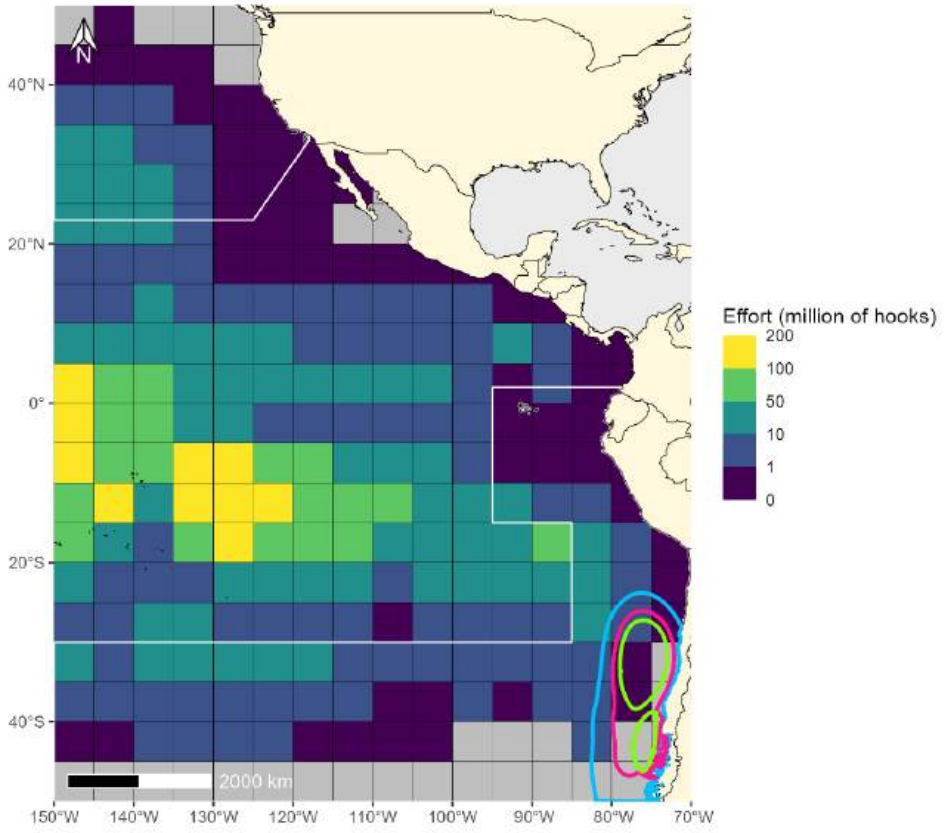

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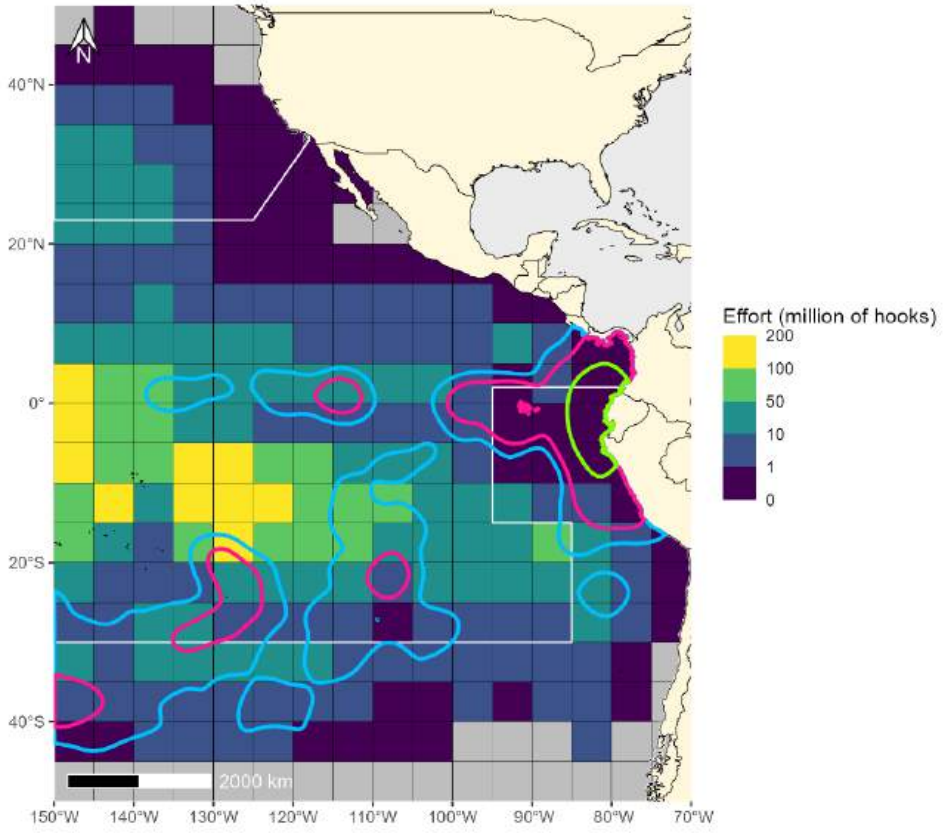

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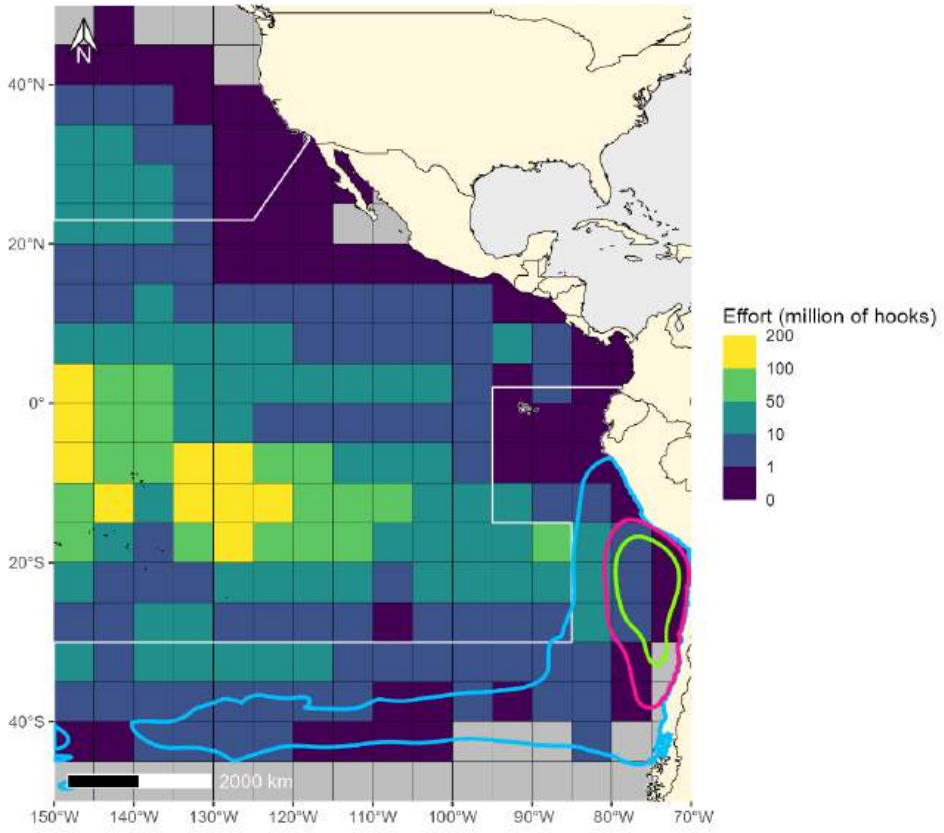

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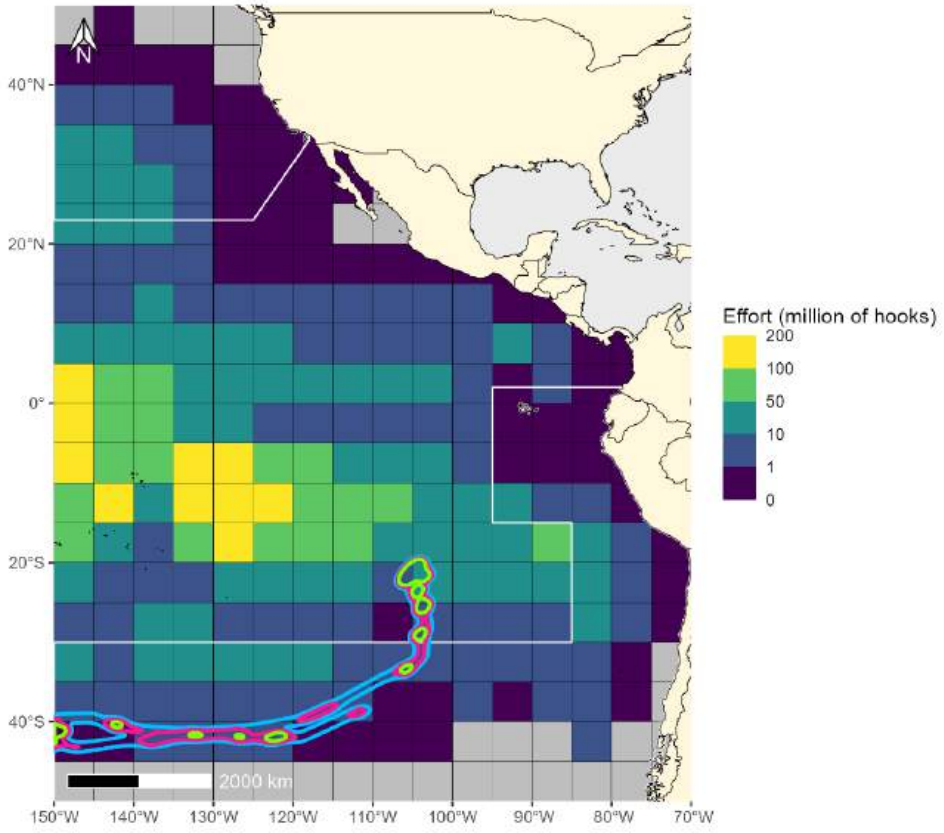

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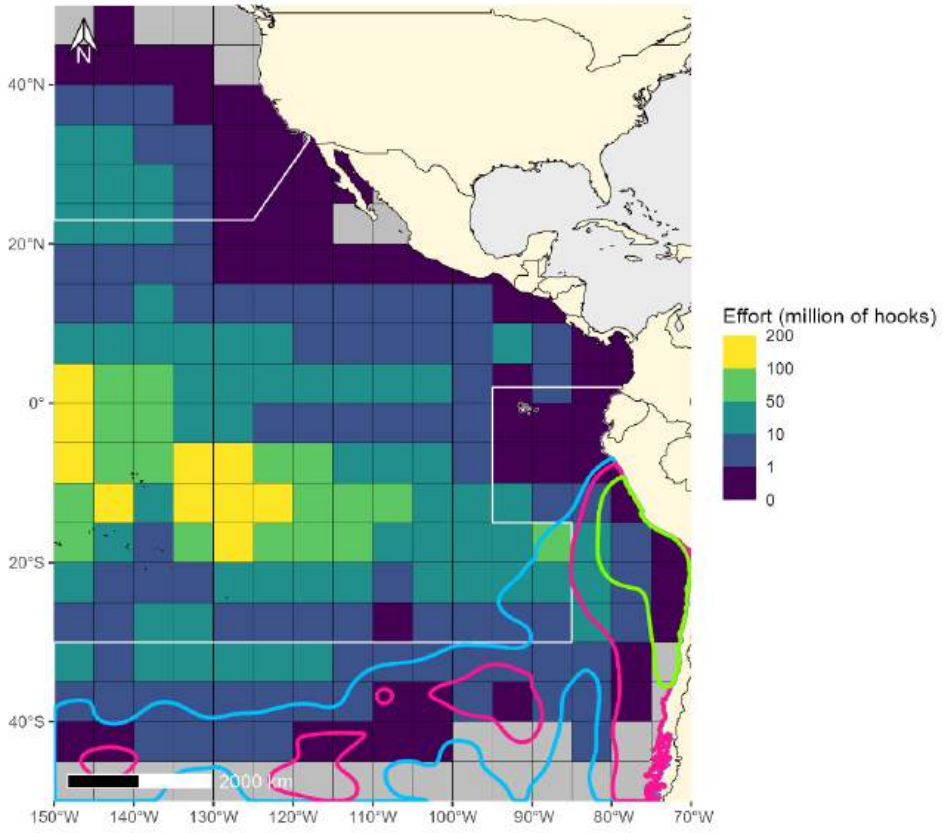

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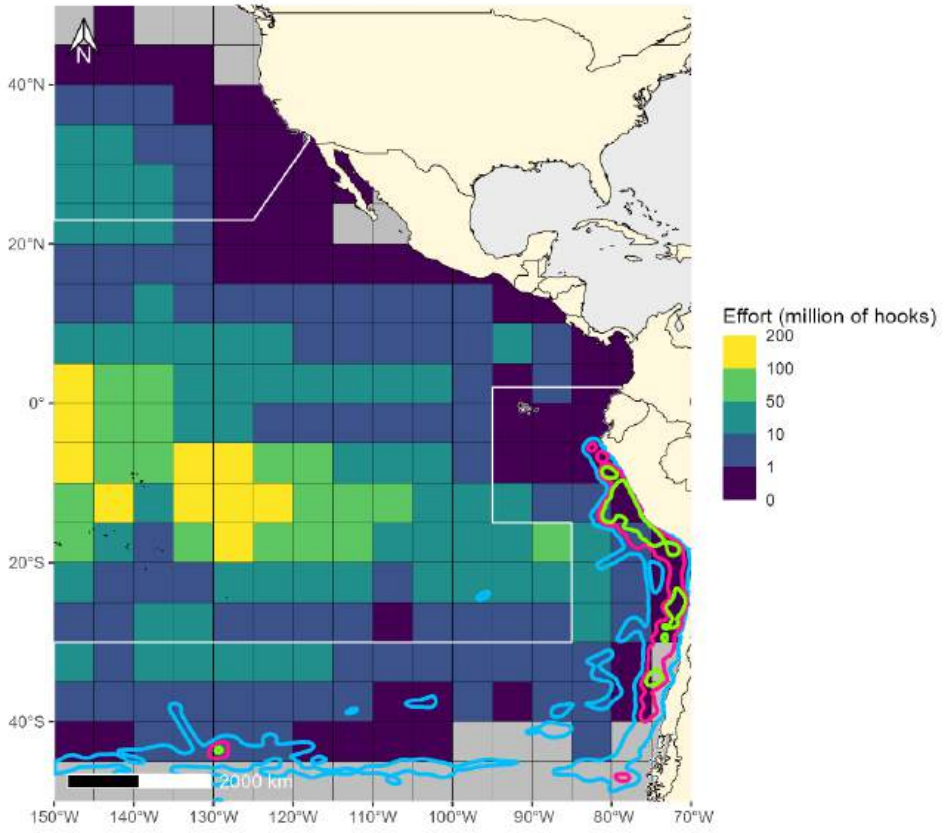

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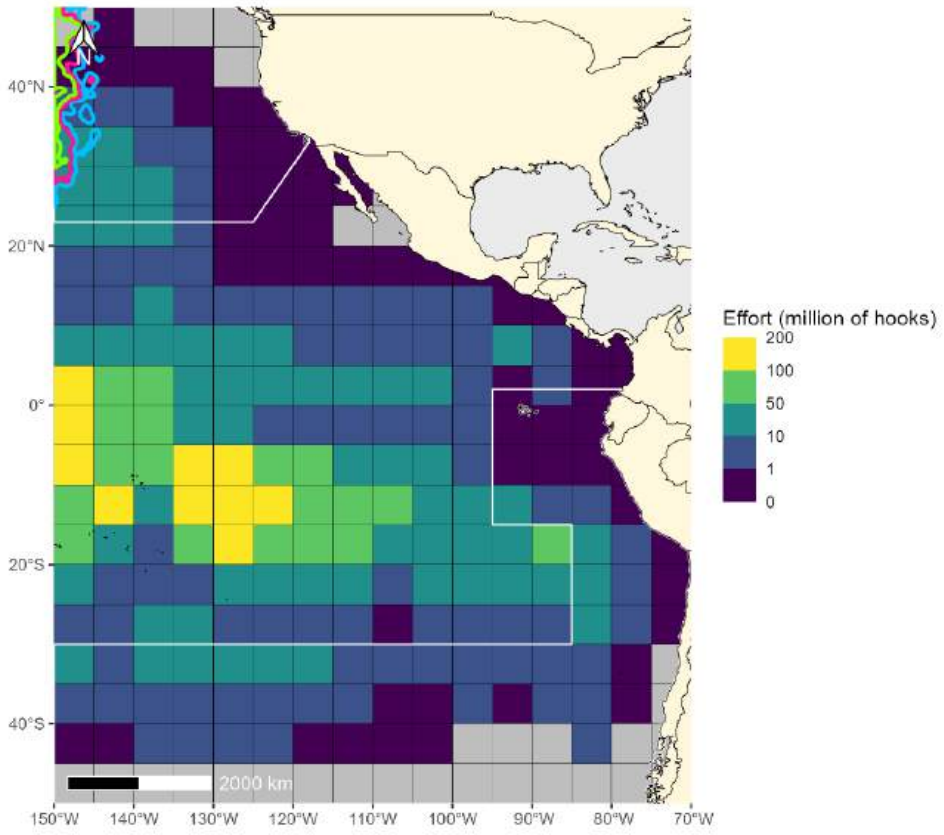
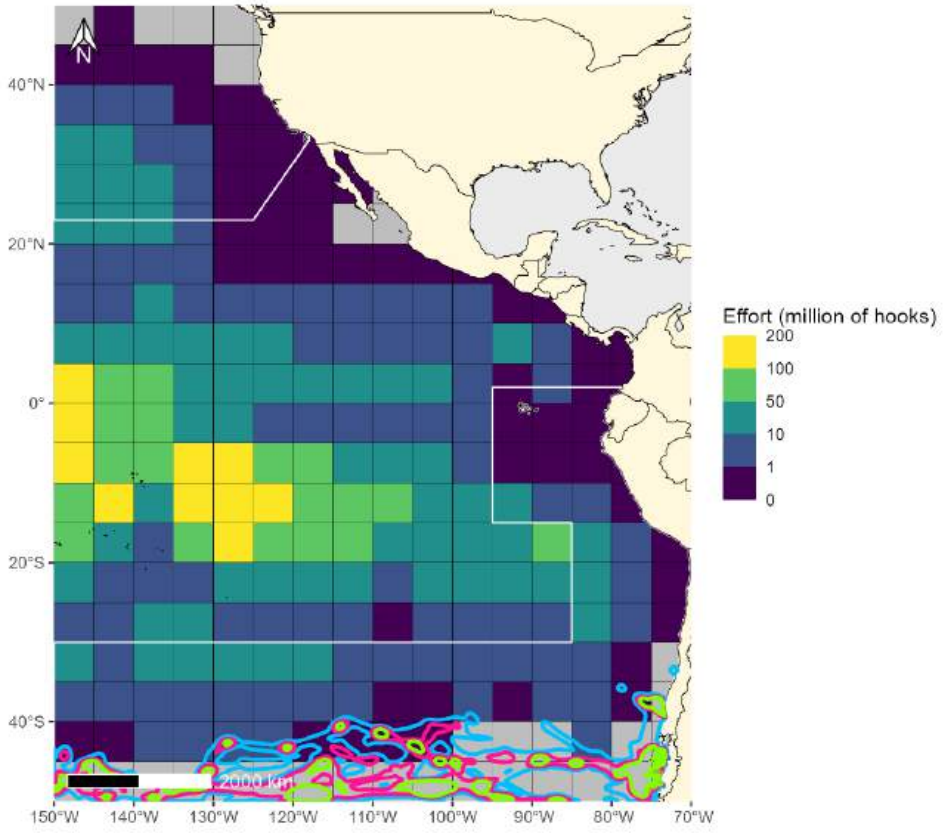
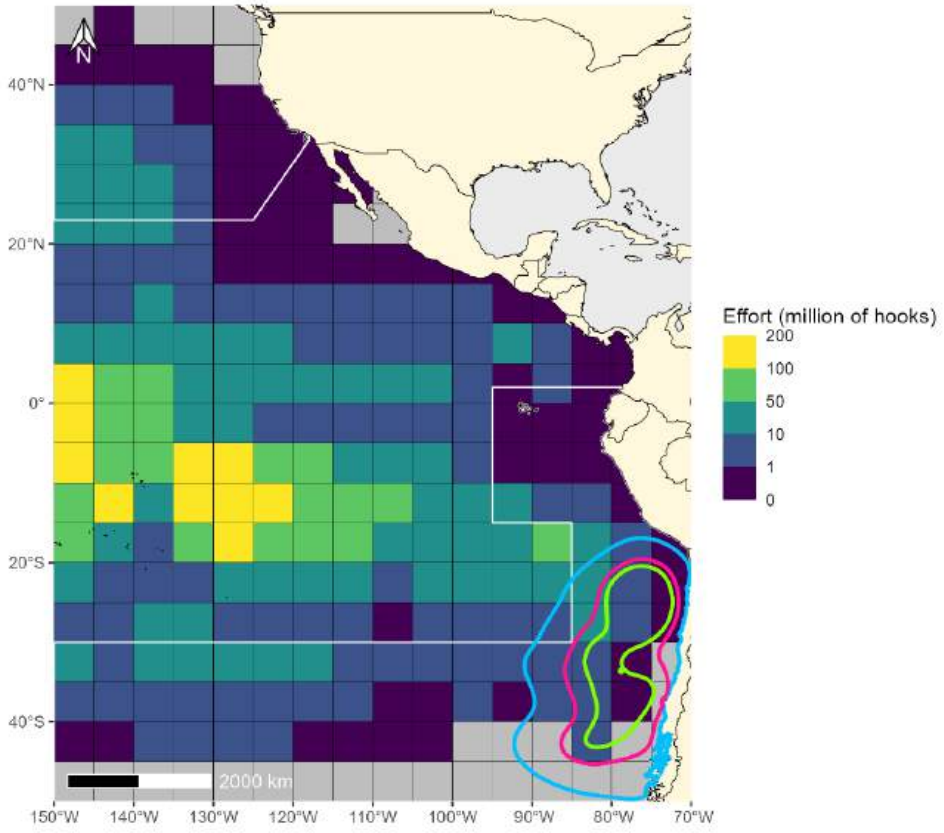


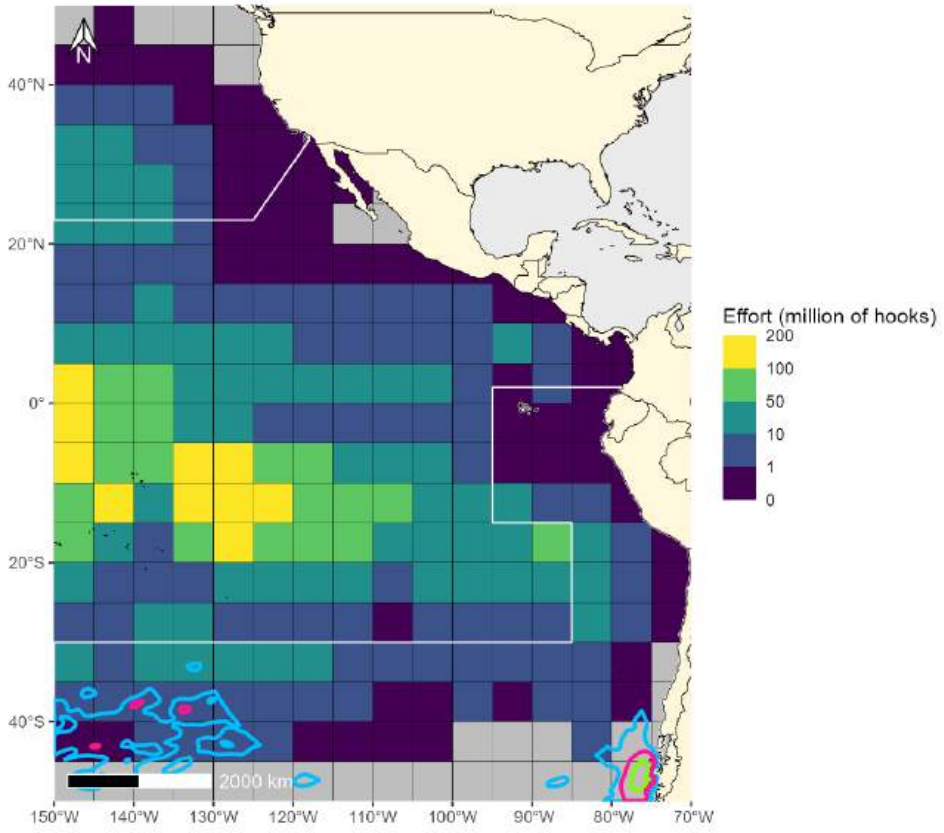
Annex 2 Figure 10. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of adult breeding Laysan Albatross (*Phoebastria immutabilis*) based on GPS/PTT tracks with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000-2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.



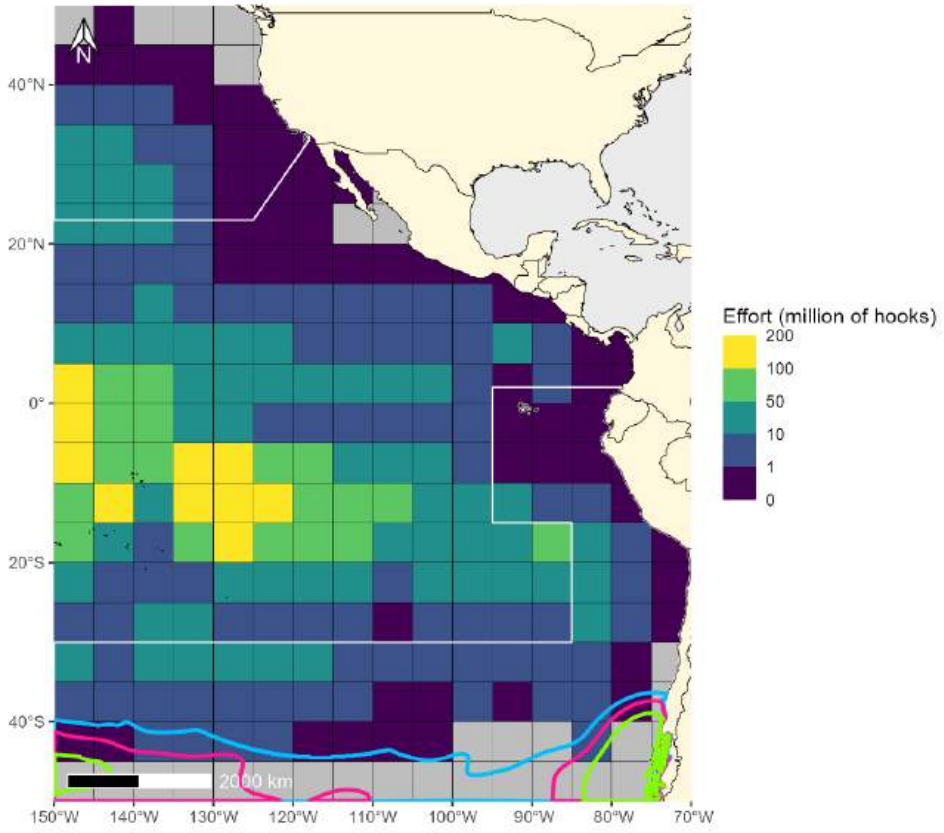
Annex 2 Figure 11. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of juvenile Northern Giant Petrel (*Macronectes halli*) based on GLS tracks with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000-2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.



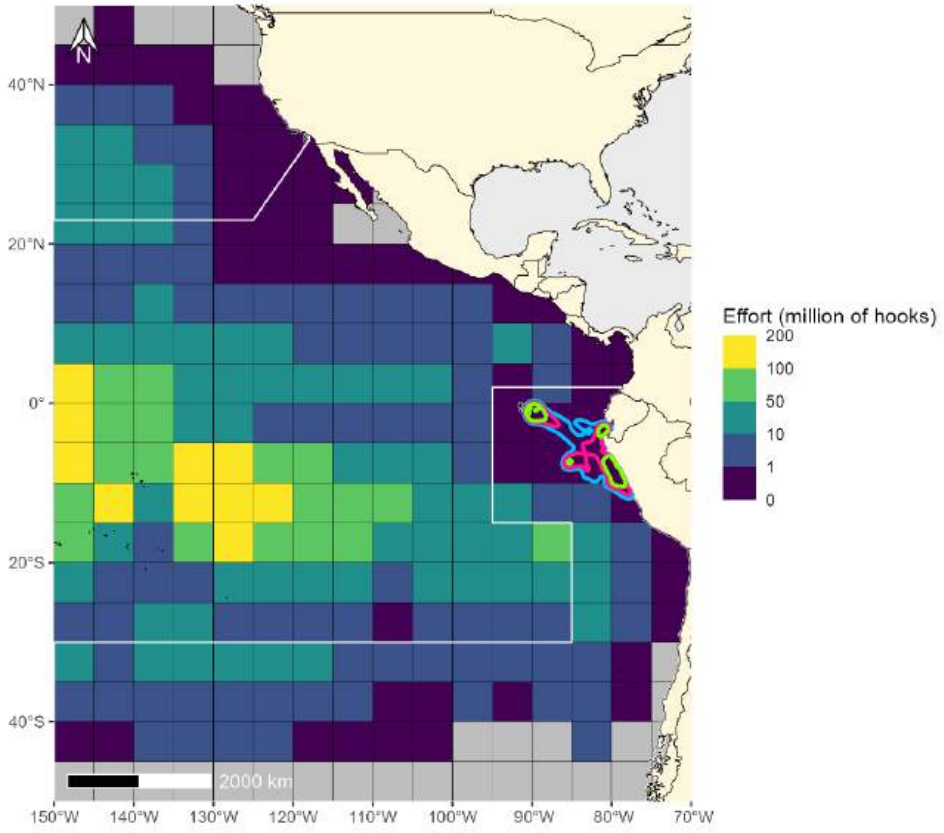
Annex 2 Figure 12. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of adult non-breeding Salvin's Albatross (*Thalassarche salvini*) based on GLS tracks with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000-2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.



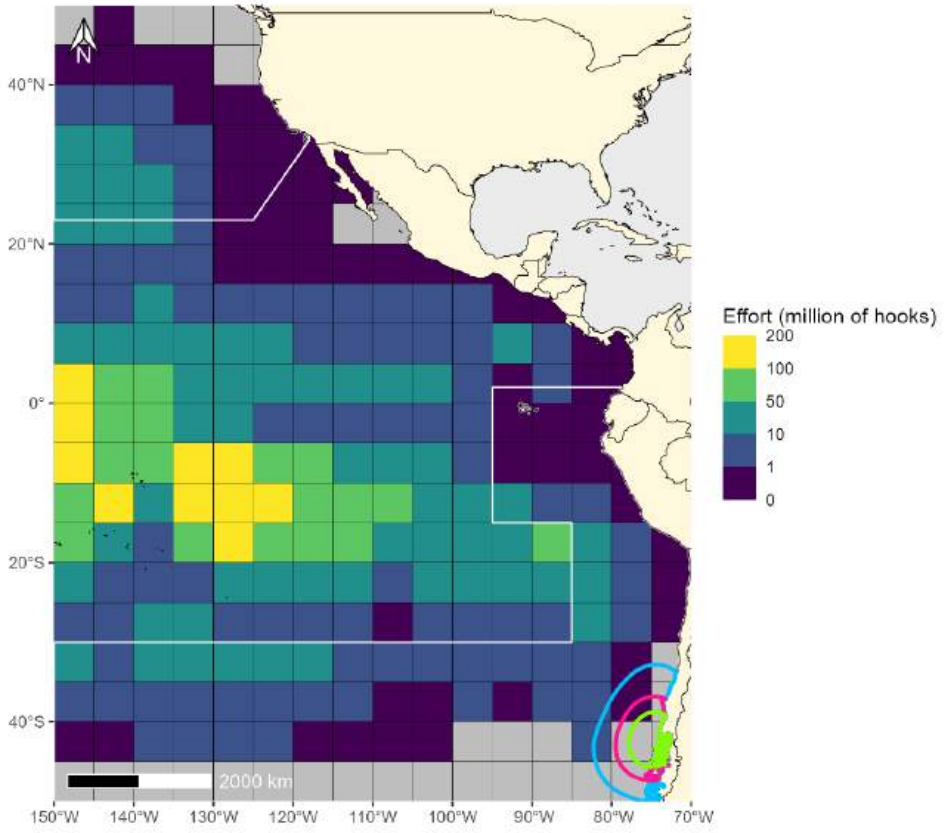
Annex 2 Figure 13. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of juvenile Wandering Albatross (*Diomedea exulans*) based on GPS/PTT tracks with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000-2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.



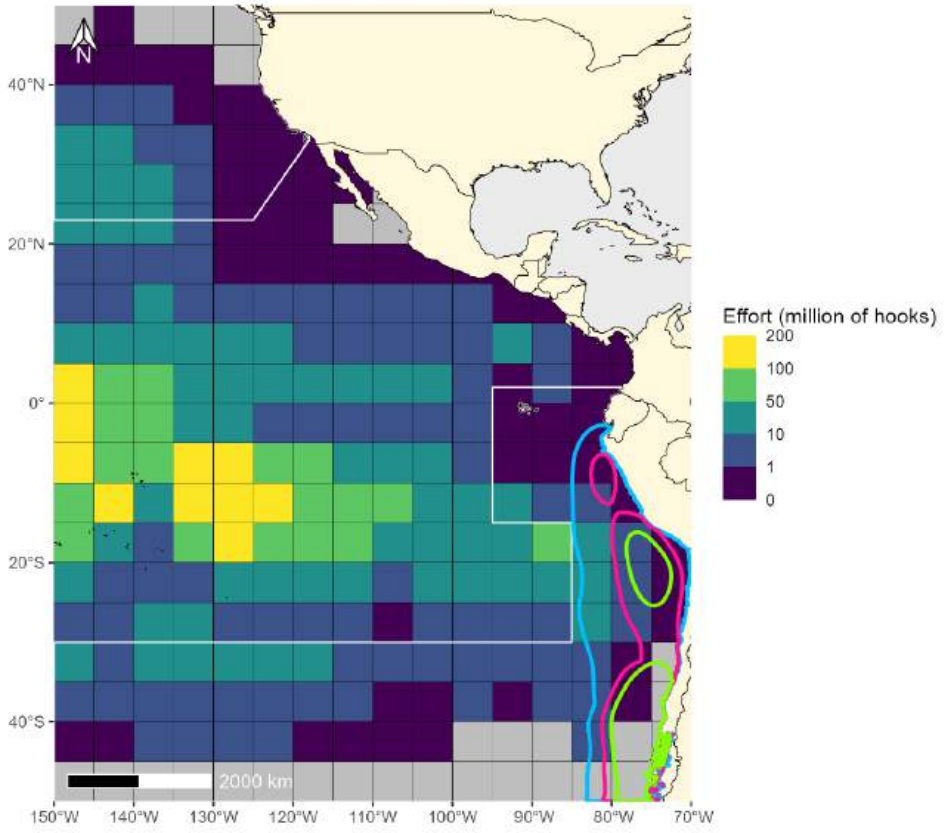
Annex 2 Figure 14. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of adult non-breeding Wandering Albatross (*Diomedea exulans*) based on GLS tracks with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000-2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.



Annex 2 Figure 15. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of adult breeding Waved Albatross (*Phoebastria irrorata*) based on GPS/PTT tracks with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000-2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.

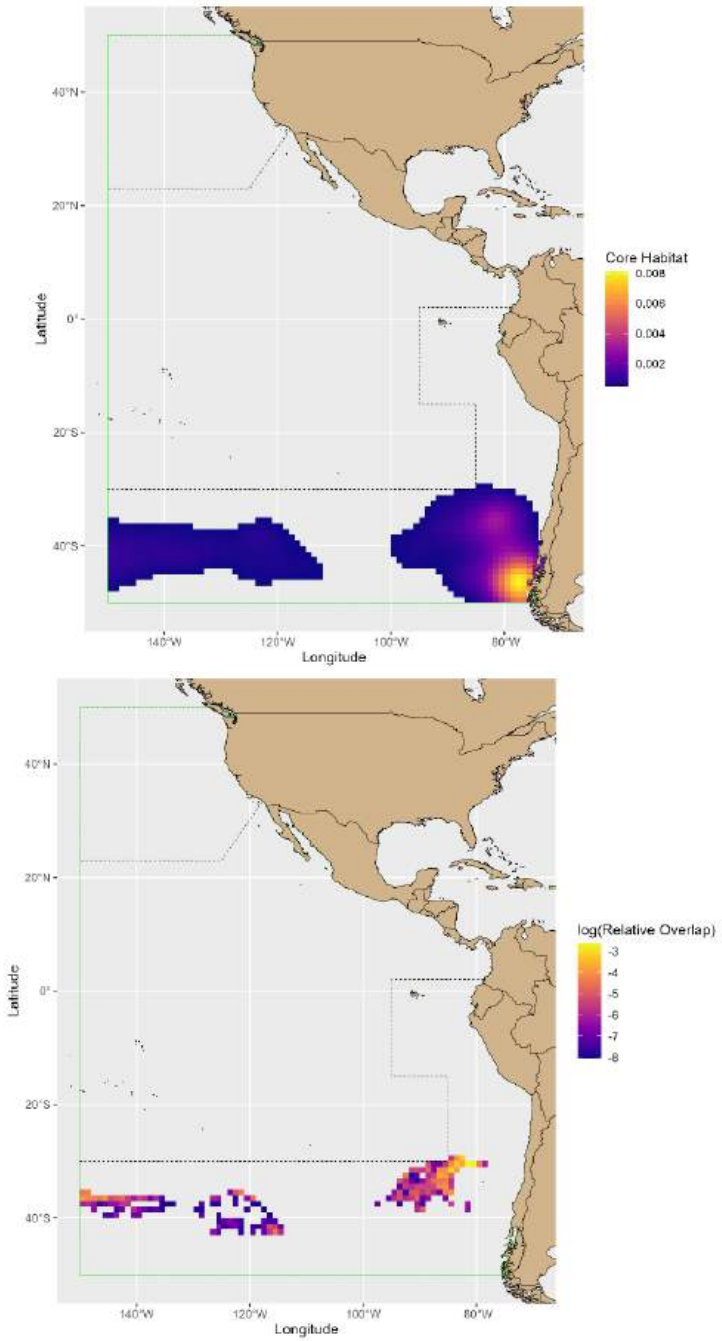


Annex 2 Figure 16. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of adult non-breeding Westland Petrel (*Procellaria westlandica*) based on GLS tracks with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000-2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.

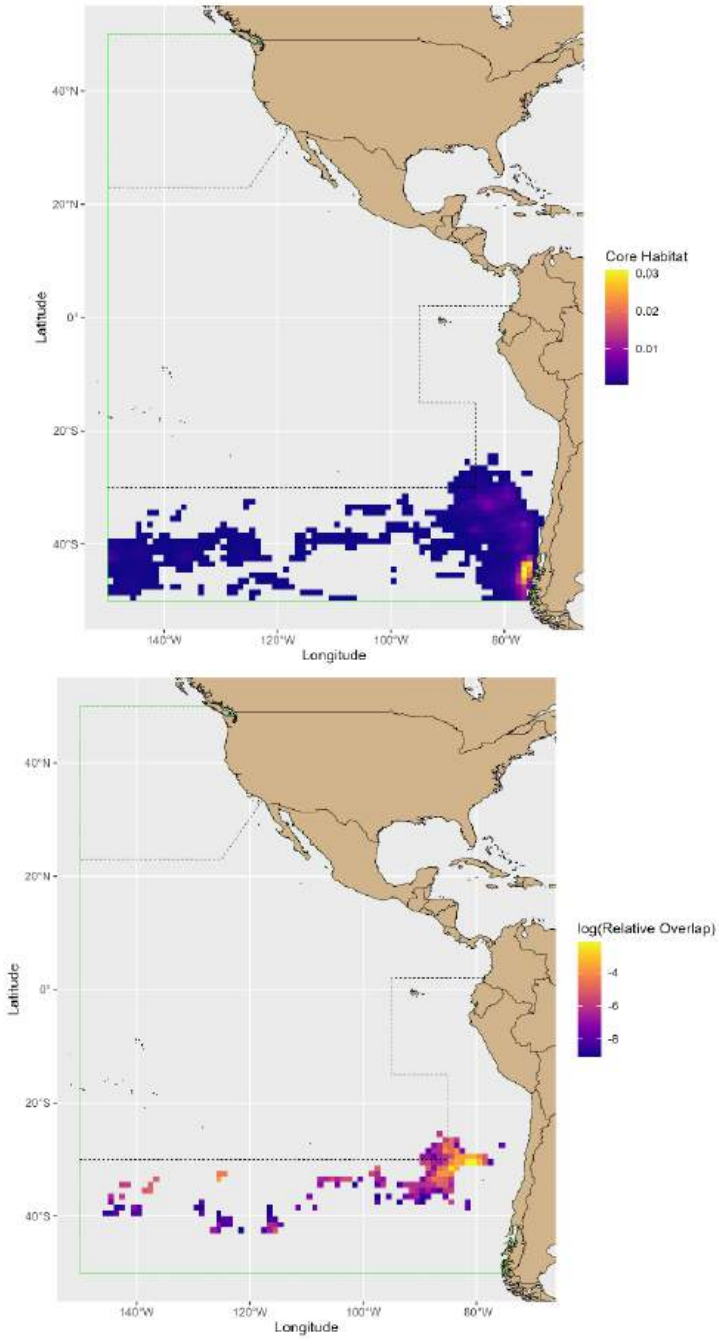


Annex 2 Figure 17. Overlapping 95% (blue line), 75% (pink line), and 50% (light green line) isopleths of adult non-breeding White-chinned Petrel (*Procellaria aequinoctialis*) based on GLS tracks with longline fishing effort data (in number of hooks) from logbooks reported in 5°x5° grid cells by CPCs from 2000-2023. The areas north of the northern white line and south of the southern white line represent where two mitigation measures are required under C-11-02.

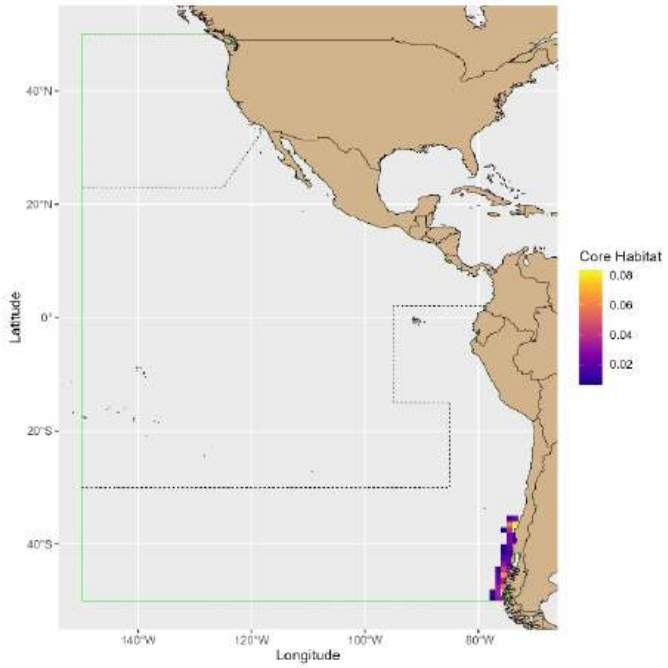
10. ANNEX 3



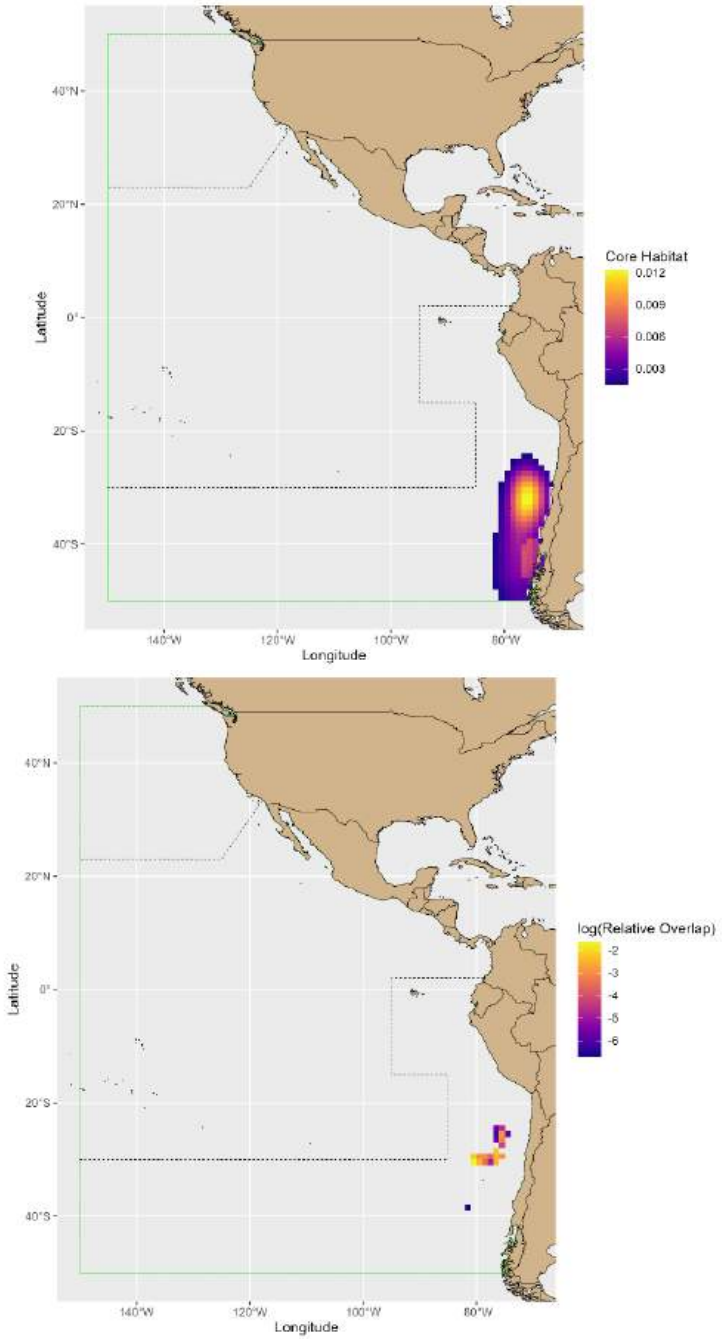
Annex 3 Figure 1. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for adult non-breeding Antipodean Albatross (*Diomedea antipodensis*) from GLS tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



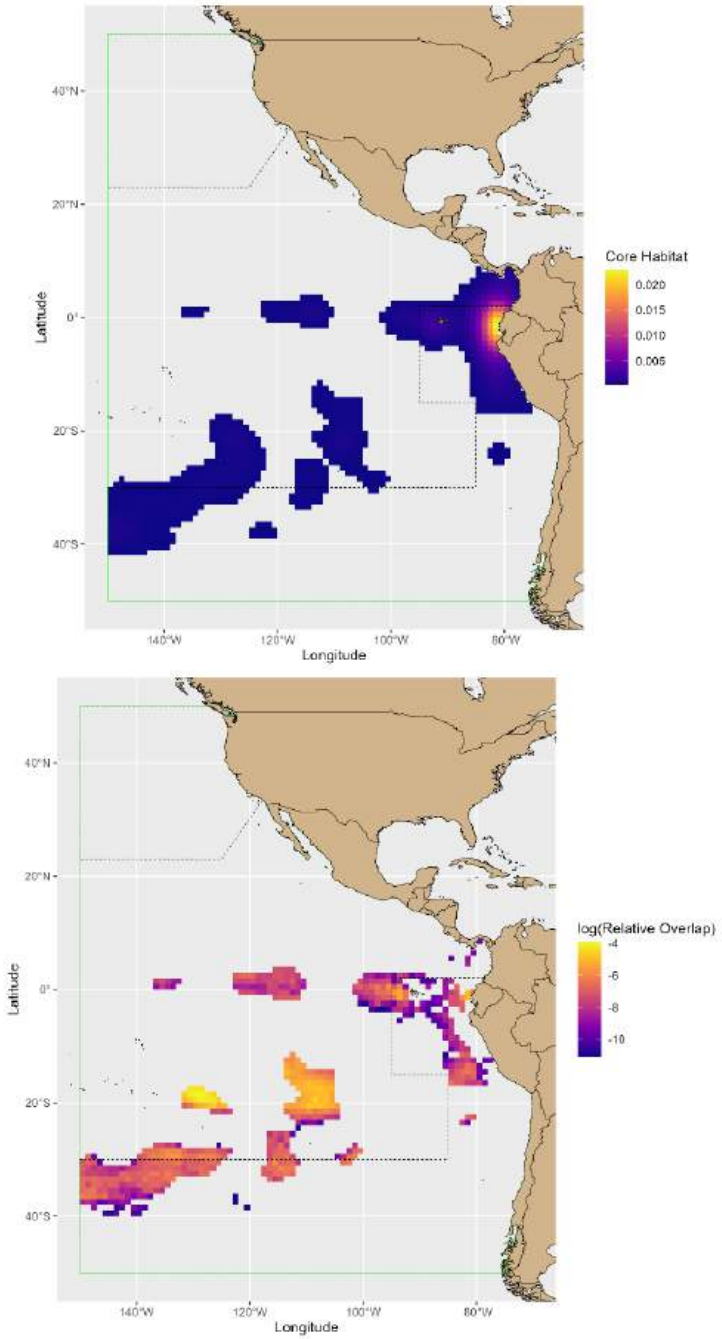
Annex 3 Figure 2. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for adult non-breeding Antipodean Albatross (*Diomedea antipodensis*) from GPS/PTT tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



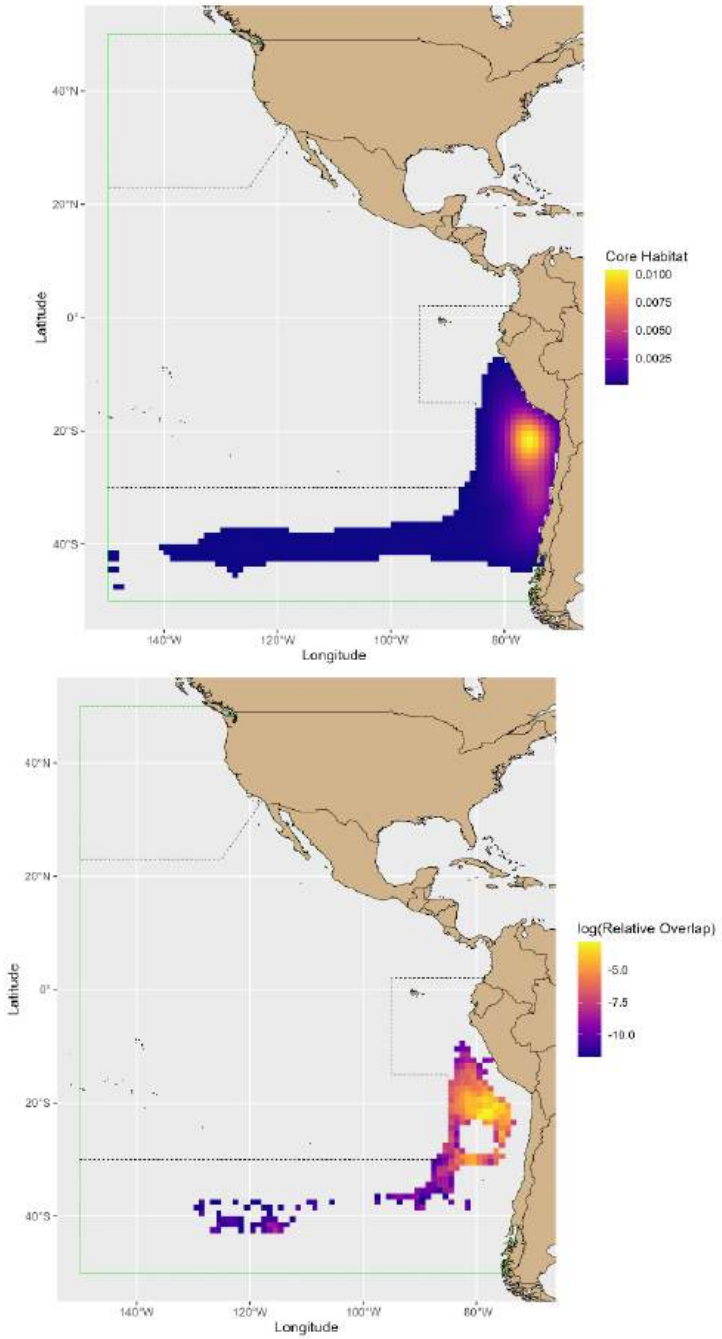
Annex 3 Figure 3. Core habitat extracted from the utilization distribution for adult breeding Black-browed Albatross (*Thalassarche melanophris*) from GPS/PTT tracks. There is no overlap between core habitat and GFW estimated longline fishing effort. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



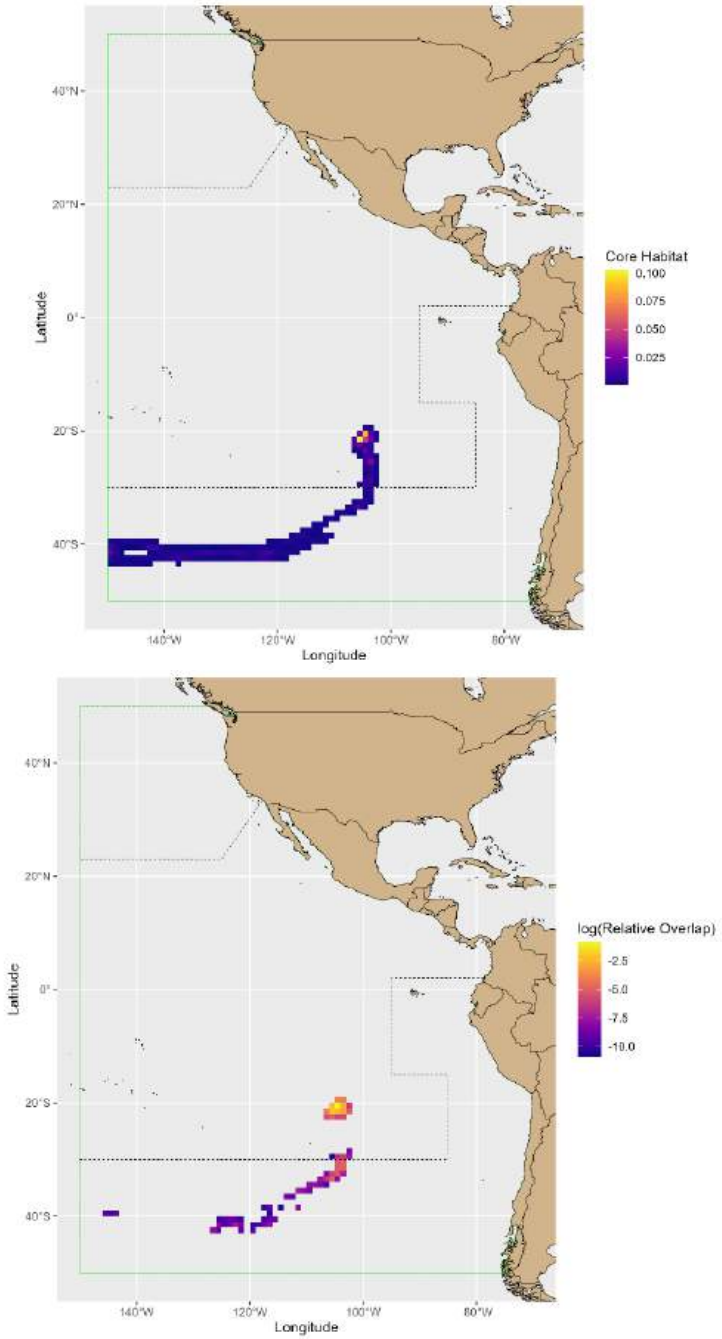
Annex 3 Figure 4. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for adult non-breeding Black-browed Albatross (*Thalassarche melanophris*) from GLS tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



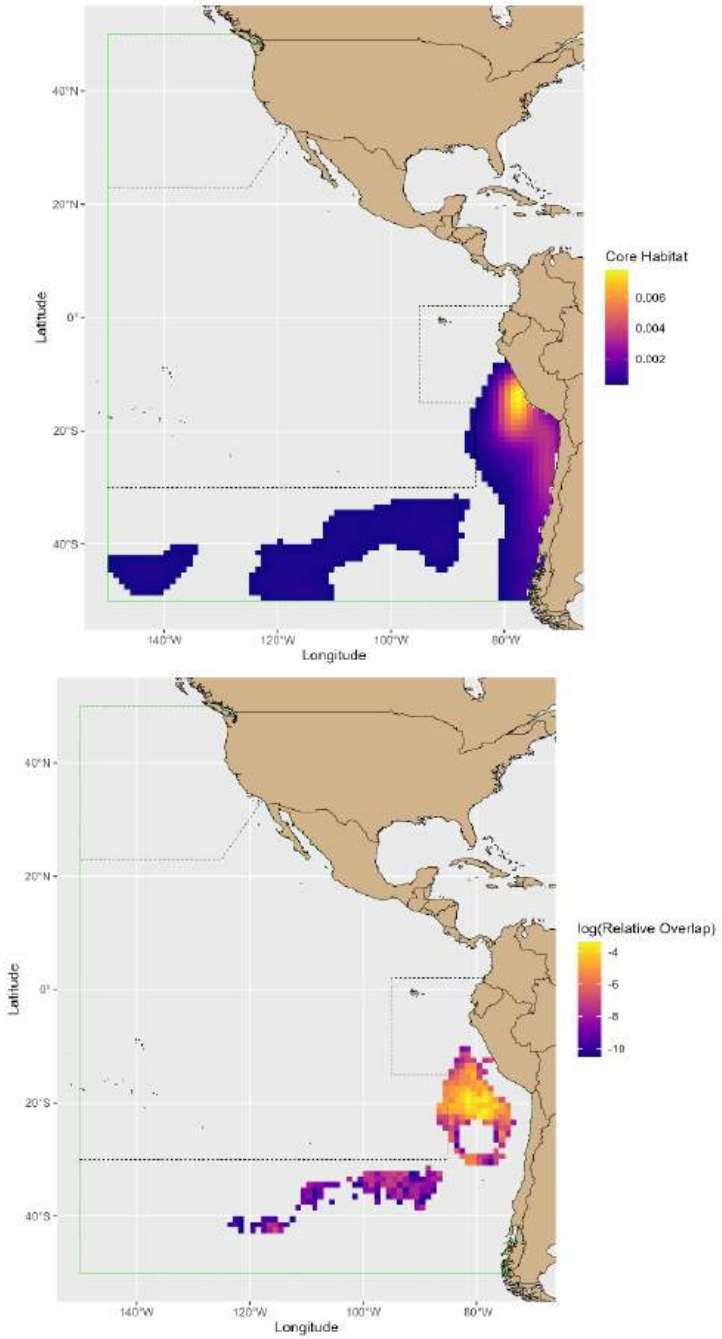
Annex 3 Figure 5. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for adult non-breeding Black Petrel (*Procellaria parkinsoni*) from GLS tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



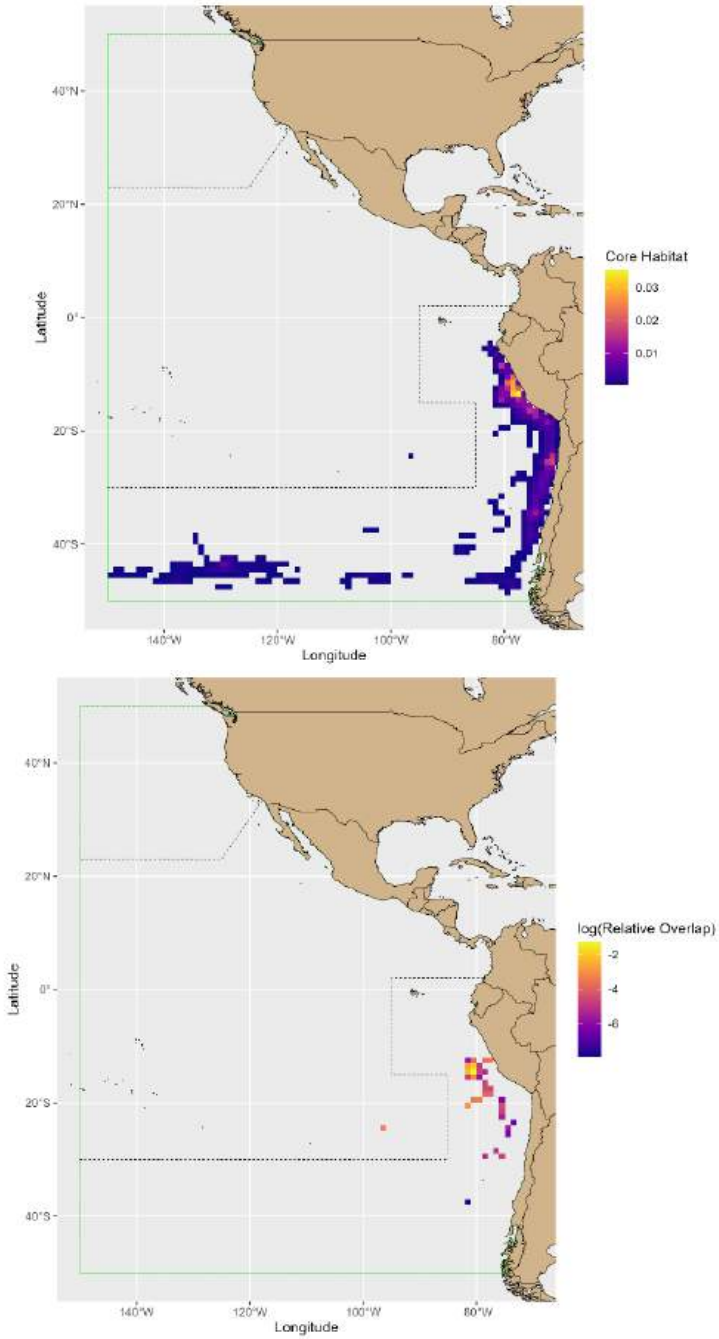
Annex 3 Figure 6. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for adult non-breeding Buller's Albatross (*Thalassarche bulleri*) from GLS tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



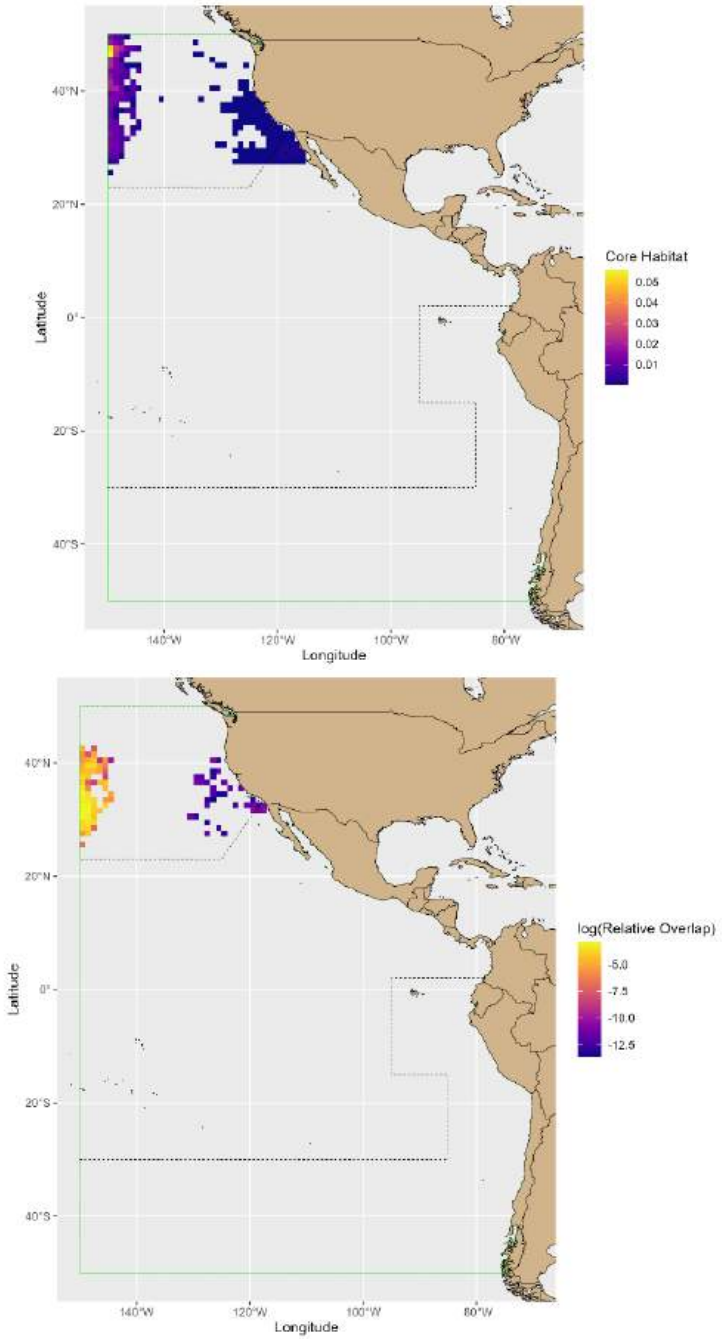
Annex 3 Figure 7. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for adult non-breeding Buller's Albatross (*Thalassarche bulleri*) from GPS/PTT tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



Annex 3 Figure 8. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for adult non-breeding Chatham Albatross (*Thalassarche eremita*) from GLS tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



Annex 3 Figure 9. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for adult non-breeding Chatham Albatross (*Thalassarche eremita*) from GPS/PTT tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



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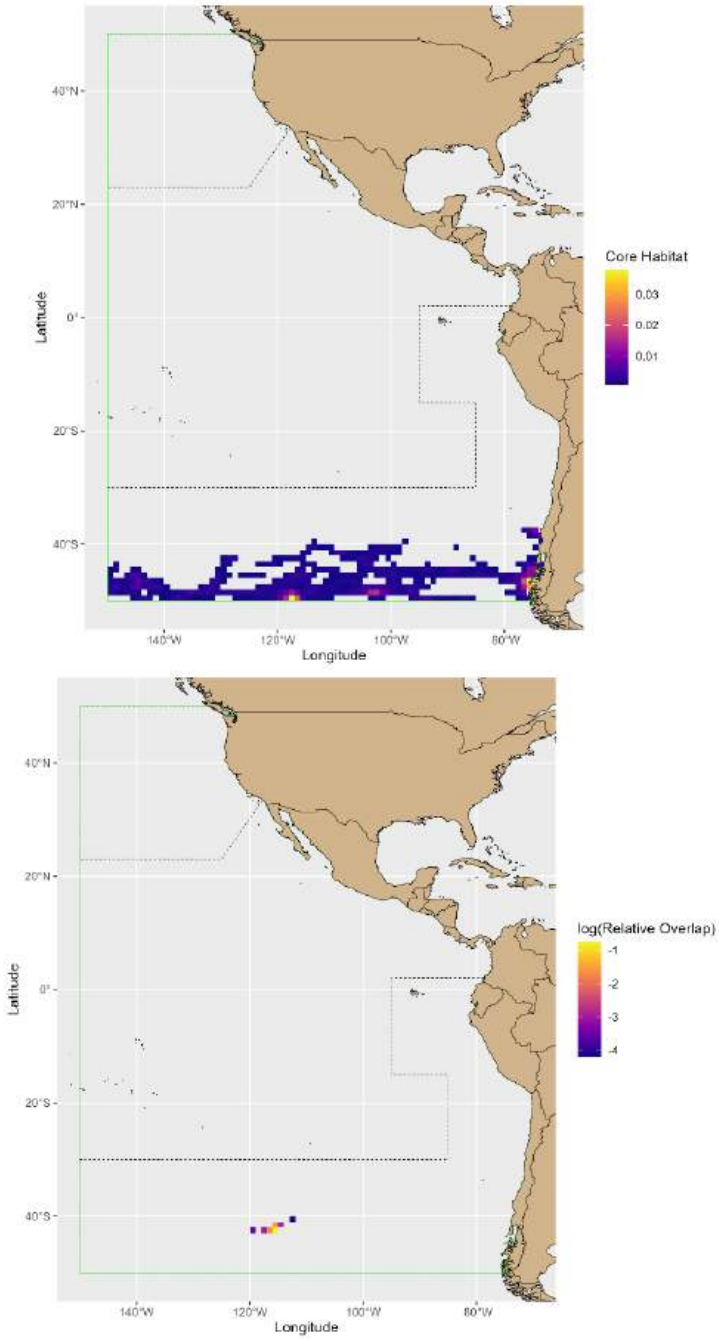
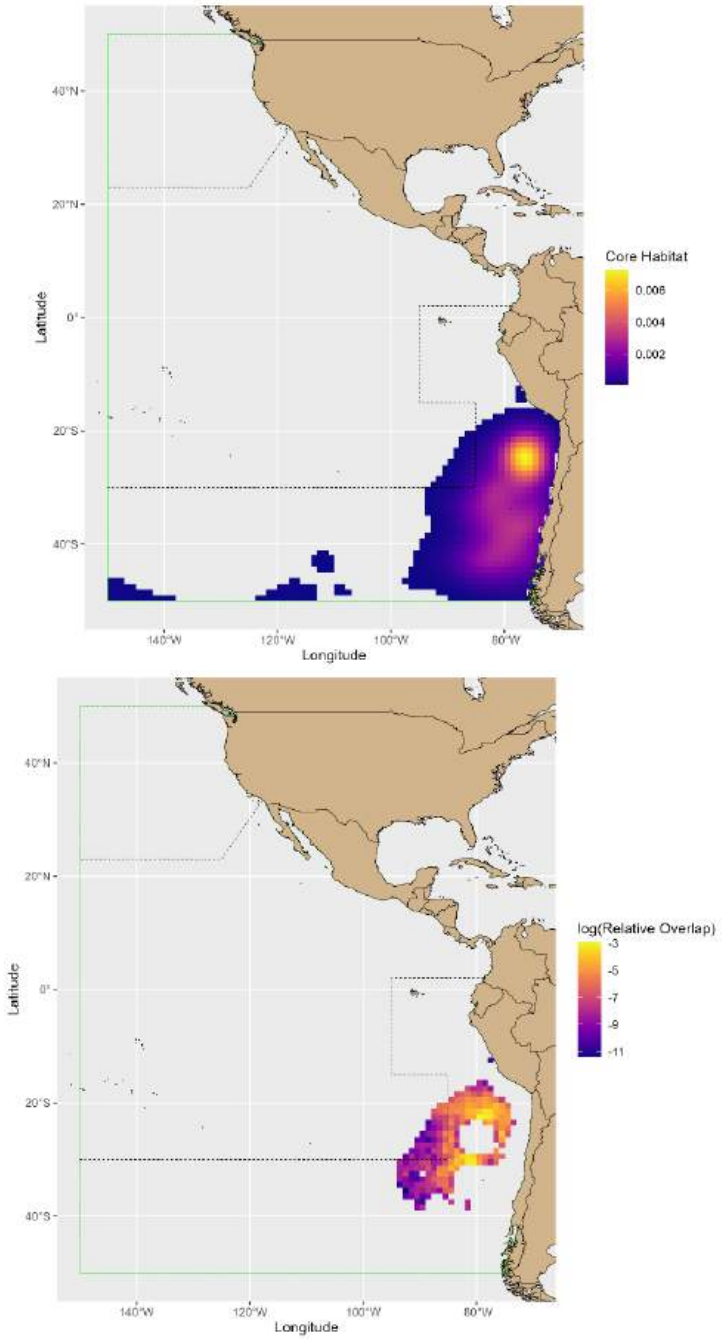


Annex 3 Figure 11. Core habitat (top map) extracted from the utilization distribution and associated relative overlap (bottom map) with GFW estimated longline fishing effort for juvenile Northern Giant Petrel (*Macronectes halli*) from GPS/PTT tracks. The highest relative overlap are areas in yellow. The areas north of the northern black dashed line and south of the southern black dashed line represent where two mitigation measures are required under C-11-02.



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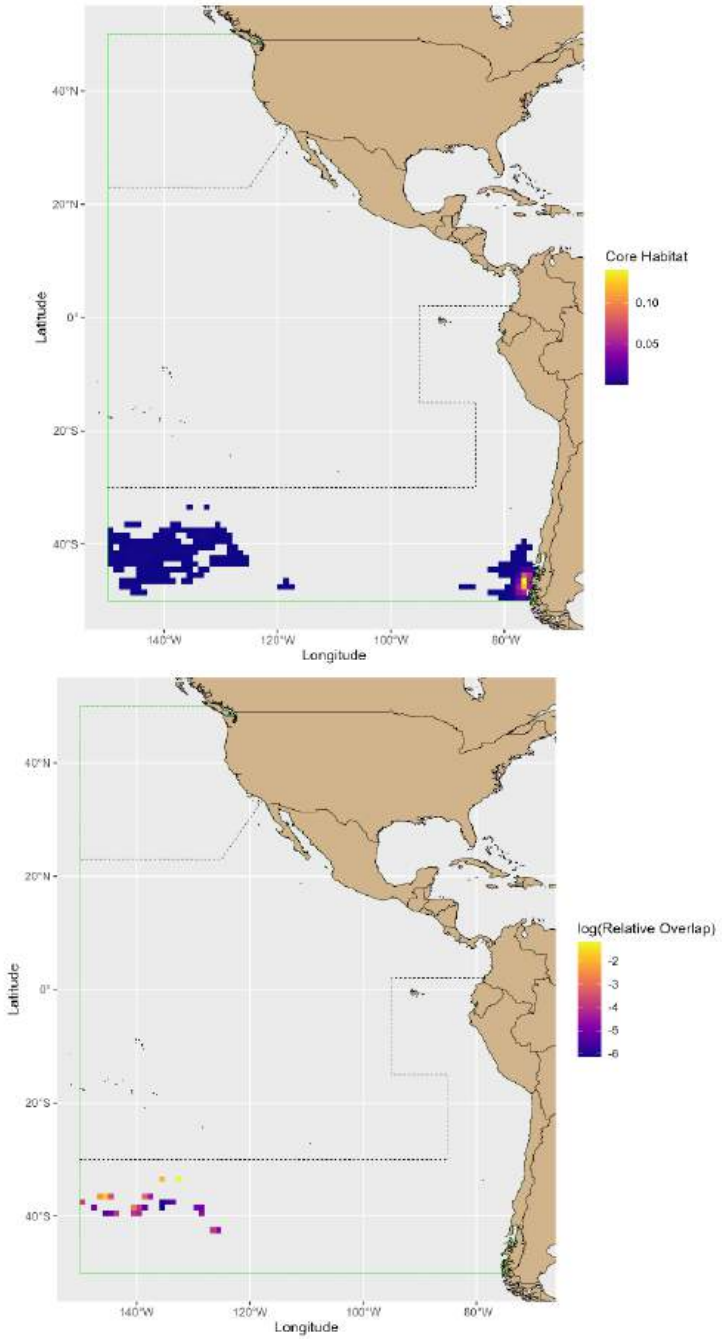

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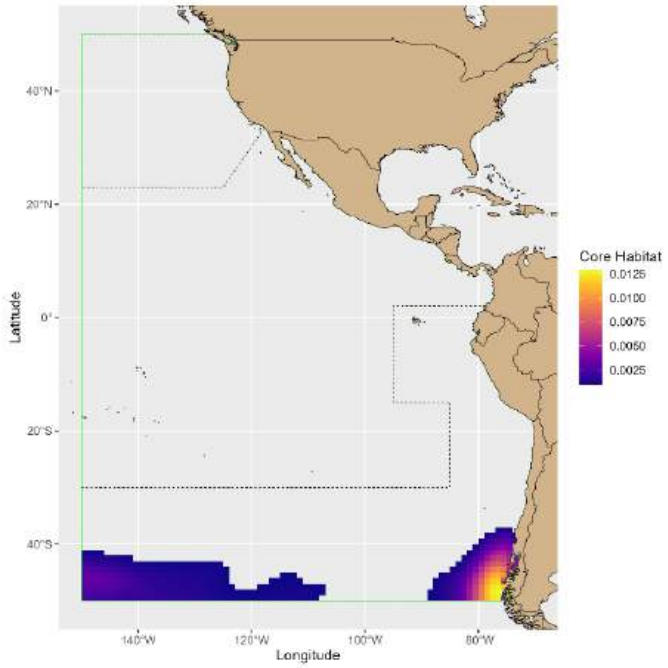

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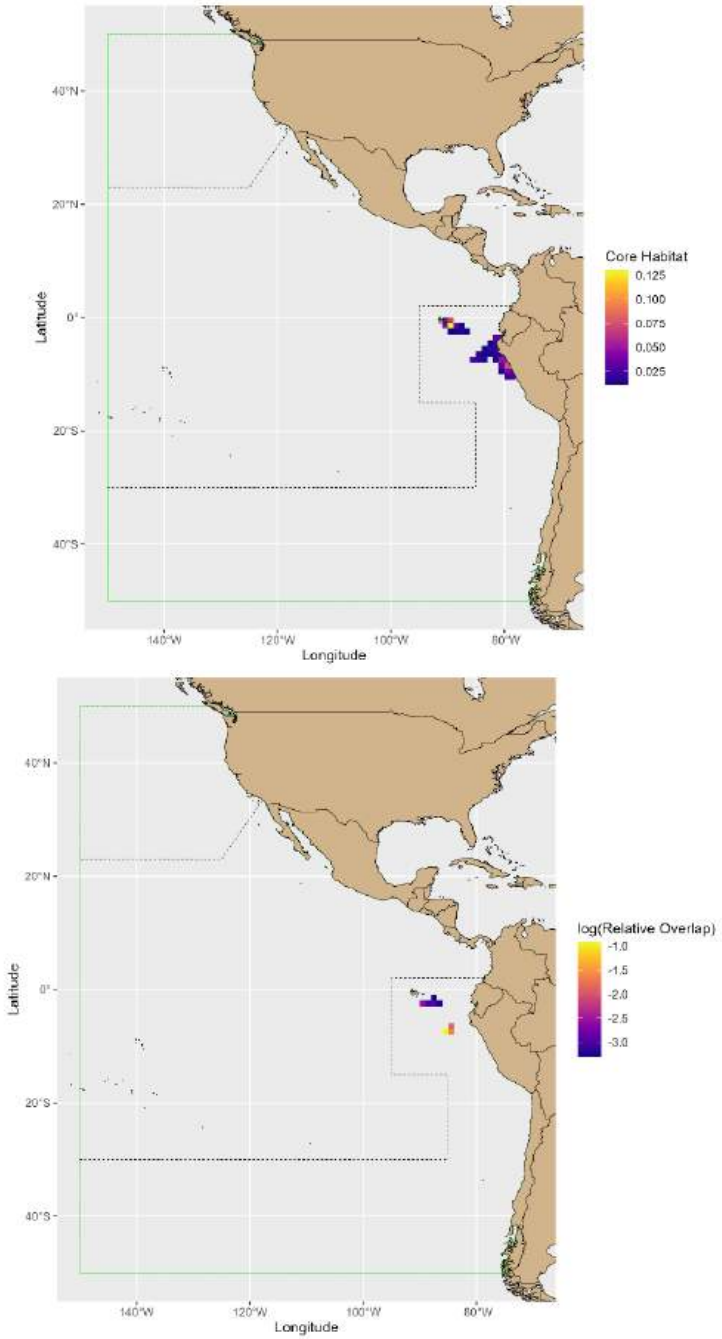

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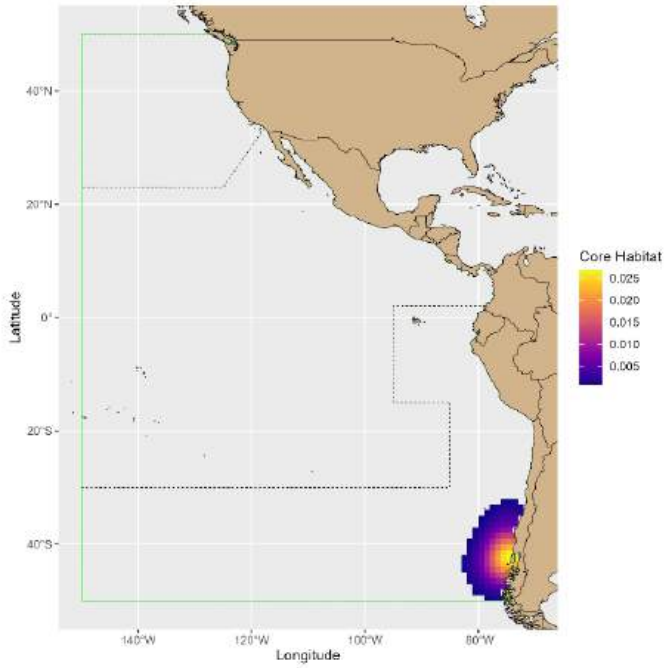

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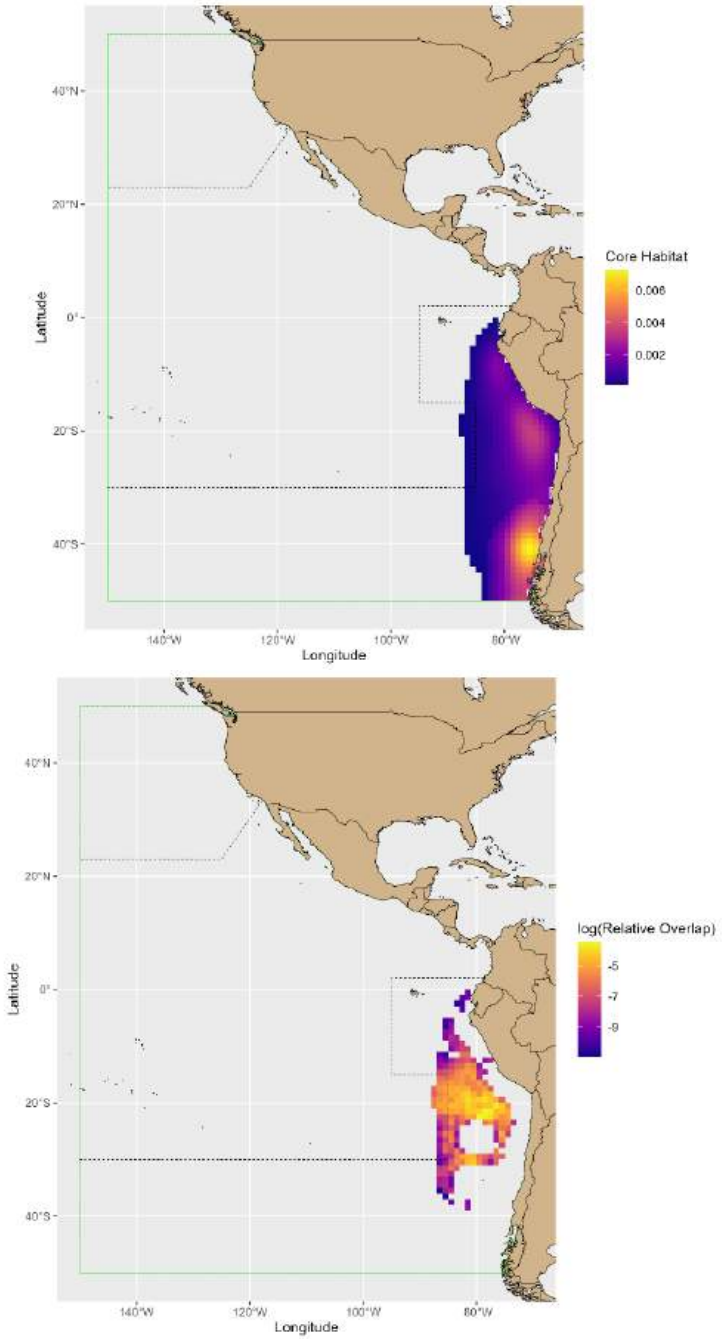

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