Agreement on the Conservation of Albatrosses and Petrels

Third Meeting of Seabird Bycatch Working Group

Mar del Plata, Argentina, 08 – 09 April 2010

Albatross and petrel distribution in the Atlantic Ocean & overlap with ICCAT longline fishing effort

Draft paper for discussion by SBWG with a view to submission by ACAP to the June 2010 meeting of the ICCAT Sub-Committee on Ecosystems

Author: BirdLife International

Albatross and petrel distribution in the Atlantic Ocean and overlap with ICCAT longline fishing effort

DRAFT FOR DISCUSSION BY ACAP SBWG

Paper prepared for ACAP by BirdLife International
to be submitted to the June 2010 meeting of the
ICCAT Sub-Committee on Ecosystems

ABSTRACT

This paper presents an analysis of the distribution of albatrosses, petrels and shearwaters in the Atlantic Ocean and their overlap with ICCAT longline fishing effort, using data from the Global *Procellariiform* Tracking Database. This database has been established through a unique collaboration between scientists from around the world. The analysis highlights the importance of the ICCAT area for Cory's shearwater, for the three albatross species breeding on Tristan da Cunha (Tristan, Atlantic yellow-nosed and sooty), and also for black-browed albatross and white-chinned petrel, the latter two species having particularly high degrees of overlap with ICCAT fishing effort during their non-breeding season (April-September) when they migrate northwards. Other species of albatross and petrel (e.g. wandering albatross) tend to be concentrated below 30-40° South. However ICCAT longline fishing effort extends into areas between 30-50° South, between April-June, particularly offshore of Uruguay and SW Brazil and south west of South Africa, resulting in overlap. Comparisons are made between the overlap calculations made here using remote tracking data, and those in a previous 'simple' analysis based on range and foraging radii. The simple approach tended to underestimate the degree of overlap between seabird distribution and ICCAT fishing effort. Many data gaps remain in terms of remote tracking data, particularly for seabird species in the Mediterranean and North Atlantic, which are under-represented in this analysis.

ACKNOWLEDGEMENTS

Albatross and petrel tracking data presented in this report are from the Global Procellariiform Tracking Database, which exists thanks to the collaboration of scientists worldwide. Data holders of those data presented in this paper are listed below. The database is managed by BirdLife International and this paper was prepared for ACAP by Orea Anderson, Cleo Small, and Phil Taylor (BirdLife International), who bear responsibility for the accuracy of information presented. The presentation of material in this report does not imply any expression of opinion on the part of BirdLife International or ACAP concerning the legal status of any country, territory or area.

Data Contributors

This analysis was made possible with the contribution of data from the following data holders:

Atlantic Yellow-nosed Albatross (Gough Island):
Richard Cuthbert, The Royal Society for the Protection of Birds, Sandy, Bedfordshire, UK

Black-browed Albatross (South Georgia):
Nic Huin, British Antarctic Survey, Cambridge, Cambridgeshire, UK

Cory's Shearwater (Azores Islands):
Jacob Gonzalez-Solis, Dept. Biologia Animal, Universitat de Barcelona, Spain
Vitor Paiva, Sociedade Portuguesa para o Estudo das Aves (SPEA), Lisbon, Portugal

Cory's Shearwater (Balearic Islands & Canary Islands):
Jacob Gonzalez-Solis, Dept. Biologia Animal, Universitat de Barcelona, Spain

Grey-headed Albatross (South Georgia):
British Antarctic Survey, Cambridge, Cambridgeshire, UK

Northern Giant Petrel (South Georgia):
British Antarctic Survey, Cambridge, Cambridgeshire, UK
Jacob Gonzalez-Solis, Dept. Biologia Animal, Universitat de Barcelona, Spain

Southern Giant Petrel (South Georgia):
British Antarctic Survey, Cambridge, Cambridgeshire, UK
Jacob Gonzalez-Solis, Dept. Biologia Animal, Universitat de Barcelona, Spain

Sooty Albatross (Gough Island):
Ross Wanless, BirdLife South Africa, Cape Town, South Africa
Richard Cuthbert, The Royal Society for the Protection of Birds, Sandy, Bedfordshire, UK

Tristan Albatross (Gough Island):
Ross Wanless, BirdLife South Africa, Cape Town, South Africa
Richard Cuthbert, The Royal Society for the Protection of Birds, Sandy, Bedfordshire, UK

Wandering Albatross (South Georgia):
British Antarctic Survey, Cambridge, Cambridgeshire, UK

White Chinned Petrel (South Georgia):
British Antarctic Survey, Cambridge, Cambridgeshire, UK

1. INTRODUCTION

Albatrosses and petrels that forage by diving are some of the most vulnerable species to bycatch in fisheries (Wooller et al. 1992, Brothers et al. 1999). Birds are attracted to baited hooks, particularly during setting, dive on the hooks, become caught and drown. These species are long-lived, have delayed sexual maturity, small clutches and long generation times, resulting in populations that are highly sensitive to changes in adult mortality. Eighteen of the world's 22 albatross species are now globally threatened with extinction (IUCN 2008), and incidental catch in fisheries, especially longline fisheries, is recognised as one of the principal threats to many of these species (Brothers 1991, Robertson & Gales 1998, Croxall et al. 1998, Baker et al. 2002).

In 2006-2009, the ICCAT Sub-Committee on Ecosystems undertook an assessment of the impact of ICCAT longline fisheries on seabirds, following a six stage methodology. Of these, Stage 3 was to analyze the spatial and temporal overlap between species distribution and ICCAT longline fishing effort, and the method selected used a combination of range data and foraging radii data in order to estimate seabird distributions for as many species as possible. However, a number of drawbacks were experienced in applying this approach, and a need was identified to undertake a fuller analysis of the remote tracking data available in the Global Procellariiform Tracking Database (Taylor et al. 2009).

This paper analyses the available albatross, petrel and shearwater remote tracking data held in the database and calculates the degree of overlap with ICCAT longline fisheries.

2. METHODS

2.1 Data availability

The Global Procellariiform Tracking Database holds data on all 7 species of albatross that breed in the Atlantic Ocean, as well as both species of giant petrel, spectacled and white-chinned petrel and Cory's shearwater (**Table 1**). Data have been made available for this analysis through agreement by the data holders, listed in the Acknowledgements.

However, tracking data are not available for all colonies of all species, and fewer data exist for adult non-breeding and juvenile distribution compared to distribution during the breeding season. For two species (light mantled albatross and spectacled petrel), data were not sufficient to enable reliable estimation of distribution or overlap with fishing effort. Care must be taken when interpreting kernel distributions where data is missing from some colonies (Table 1, and indicated on maps), and where sample sizes are small. Ideally, analysis would be based on at least 10-15 tracks for each breeding stage, and preferably each sex, before results would be considered to approach optimal reliability, though the effect of sample size varies between species and colony (BirdLife International 2004).

2.2 Data processing

The satellite tracking (PTT) data were processed using standardised methods agreed among data holders. Data points were first validated using a filter based on McConnell et al. (1992), which calculates the average velocity between the current satellite uplink and the preceding and following two uplinks. Where the velocity is over the maximum velocity *vMax* (set at 100km.hr-1 for all species), and an alternative latitude and longitude were provided, the filter substituted the alternative point. In an iterative process, the filter then removed the uplink with the highest velocity over *vMax*, although a point with high accuracy was not removed (location classes 1, 2 and 3 with accuracies of up to 1km (Argos 1989, 1996). The velocities for the four points adjacent to the removed point were then recalculated and the process repeated, until no low quality point had a velocity above *vMax*.

In order to convert the PTT tracking data into density distributions, the assumption was made that birds travelled at constant speed in a straight line between uplinks. The path of the bird was then re-sampled at hourly intervals. If the interval between two uplinks was more than 24 hours, no re-sampling was conducted between these points. Bird tracks were grouped into datasets that represented unique combinations of species/colony/breeding status/breeding stage/sex, as far as data availability allowed. Kernel density distributions were derived from these datasets using the kernel function in ArcGIS 8.2, with a smoothing (*h*) parameter of 1° and a grid size of 0.1°. (The smoothing factor of 1° was selected on the basis that this was likely to be the smallest practical unit for management on the high seas.) Data points were not separated into 'commuting' or 'foraging' points. It is thus recognised that not all areas used by the albatrosses and petrels will be areas of foraging, although these still represent areas where there is potential interaction with fisheries.

Global Positioning System (GPS) tracking data were processed in the same manner, and re-sampled at hourly intervals to make them comparable to the PTT data, although in most cases this reduced the number of points for kernel analysis. Data holders submit Geolocator (GLS) data to the Tracking Database in a processed form, since the variety of geolocators available make it unrealistic to develop a standardised validation routine for GLS data. GLS data did not require re-sampling since the locations of tracked birds are available at regular (approximately 12-hour) intervals. Kernel density distribution maps were generated as above, but with a smoothing parameter (*h*) of 2°, which approximated the nominal resolution of the GLS data, and a cell size of 0.5°.

2.3 Seasonal variation

Procellariiform distribution often varies markedly over the breeding cycle and with life history stage. During chick rearing, birds often forage closer to the breeding colony in order to provision chicks, while juveniles or non-breeding adults may be wholly pelagic in order to achieve optimal foraging efficiency. Analysis of overlap with ICCAT longline fisheries must therefore take this seasonal variation into account, particularly given that longline fishing effort also varies seasonally.

The analysis presented in this paper differs from previous analyses (e.g. BirdLife 2006) in that, rather than producing separate maps for breeding and non-breeding birds, it estimates the total distribution of each seabird species on a seasonal basis (year quarter). While there may also be variations in seabird distribution between years, studies have indicated that inter-annual differences in distribution are not as substantial as the variation between the different stages of the breeding cycle, and between breeding and non-breeding birds (Weimerskirch et al. 1993, Prince et al. 1998, Weimerskirch 2004, Phillips et al. 2004).

2.4 Calculating density distributions

Quarterly distribution maps for each species were calculated by creating density maps for each life history stage, and then by giving each of these an appropriate 'weighting' based on the duration and percent of the population involved (for further details see Appendix I). In some instances sample sizes were too small to do this for each life history stage. In these cases, surrogate data were used from other life history stages with similar distributions. For example, where no tracking data were available for the fledging period, data obtained from the incubating period was used in its place. Density distributions are represented on maps by the 25, 50, 75 and 95% Utilisation Distributions (UD), indicating the areas where 25, 50, 75 and 95% of the population's time is spent during that quarter. For full further details on derivation of density distributions, see BirdLife International (2004).

2.5 Overlap of bird distributions with ICCAT longline fishing effort

Longline fishing effort data were obtained from the ICCAT Secretariat and include the revisions presented at the March 2008 meeting of the ICCAT Sub-Committee on Ecosystems. For the purposes of this paper, the ICCAT area was defined as the 5x5° grid cells in which there was longline fishing effort reported during the years 2000-2005. Fishing effort was calculated as the average number of hooks set per grid square per year quarter during the period 2000-2005. The following overlap calculations were then made for each seabird population, based on formulas developed by the ICCAT Sub-Committee on Ecosystems:

Overlap Score 1: percent seabird population distribution within the area of ICCAT longline effort , by year quarter

Overlap Score 2: percent seabird population distribution per 5x5° grid square multiplied by the average longline hooks set within each 5x5°, per year quarter

Overlap Score 3: percent ICCAT longline effort occurring within the range of each seabird population (as represented by the 95 and 100% UD), by year quarter

3. RESULTS

Sufficient remote tracking data were available to allow the calculation of seasonal distribution and overlap with longline fishing effort for 6 species (7 populations) of albatross, both giant-petrels, white-chinned petrels from South Georgia, and for 3 populations of Cory's shearwater. Maps of distribution and overlap with ICCAT longline fishing effort are shown in **Figures 1-13**. Results of the overlap calculations are shown in **Table 2**.

Of the 10 species (13 populations) in the analysis, the three populations of Cory's shearwater, Tristan albatross and Atlantic yellow-nosed albatross all had extremely high (>=93%) overlap with the ICCAT area in all four quarters of the year (Overlap score 1 in Table 1, Figures 1-5). This was followed by sooty albatross from Gough Island, black-browed albatross from the Falkland Islands (Islas Malvinas) and black-browed albatross and white-chinned petrel from South Georgia (Georgias del Sur). The latter two species had greater seasonal variation in overlap, with most overlap occurring between April-Sept (Q2 & Q3). Wandering and grey-headed albatross and the giant-petrels had lower levels of overlap with the ICCAT area, as would be expected since they tend to forage at higher latitudes, typically below 30° South and 40° South, respectively. However, interaction between wandering albatross and ICCAT fishing effort was identified, particularly in Q2, resulting from high levels of fishing effort off the coast of Uruguay, and south west from South Africa during this period.

In terms of estimated interaction with ICCAT longline fishing effort (Overlap Score 2), Cory's shearwaters from the Balearic Islands had the highest estimated interactions with longline fishing effort, reflecting their wide distribution in the Atlantic, including across areas of intense longline fishing effort in tropical areas and in the Mediterranean. The other populations of Cory's Shearwater, plus Atlantic yellow-nosed albatross, Tristan albatross, black-browed albatross and white-chinned petrel also had high overlap with ICCAT longline fishing hooks. As shown in Table 1, Overlap 2 scores varied seasonally, reflecting seasonal shifts in bird distribution, but also in fishing effort distribution. Sooty albatross had a high overlap with the ICCAT area, but a lower overlap with ICCAT fishing effort, reflecting the fact that its distribution is concentrated in the central South Atlantic, rather than near the coasts where fishing effort is higher.

Overlap score 3 indicates that 25% or less of ICCAT longline fishing effort overlaps with albatross and petrel distribution, based on the data available for this analysis. Overlap with Cory's shearwater was much higher, reflecting the widespread distribution of this species: c.50-60% of ICCAT longline fishing effort coincided with the range of Cory's shearwater.

4. DISCUSSION

4.1 Importance of the ICCAT area for albatrosses and petrels

Of the species in this analysis, Cory's shearwater, Atlantic yellow-nosed and Tristan albatrosses were identified as having very high overlap with ICCAT longline fishing effort. Unlike the albatross and petrel populations, Cory's shearwater is not listed as threatened on the IUCN Red List, due in part to its very large population size and range. Nevertheless the population is believed to be declining (IUCN 2008). Bycatch has been recorded in ICCAT pelagic longline fisheries in the Mediterranean and North Atlantic (Dimech et al. 2008, Garcia-Barcelona et al. 2009), two of the areas highlighted as potential 'hot spots' of interaction within this analysis.

Both Atlantic yellow-nosed and Tristan albatross are endemic to Tristan da Cunha. Tracking data indicate the distribution of the Critically Endangered Tristan albatross in a belt across the South Atlantic below 30° South, although with some distribution up to 2°0 South, particularly near the coast of Namibia (Figure 5). The Tristan albatross population is in decline, with interaction with fisheries identified as a key factor (Cuthbert et al. 2005, Wanless et al. 2009). Tracking data for Atlantic yellow-nosed indicate a distribution across the South Atlantic below about 25° South, with a high concentration of distribution in the Benguela Current, corresponding to the EEZs of South Africa, Namibia and Angola, and distribution extending up to 10° South near the coast (Figure 4). For both species, overlap is higher in Q1-Q3 compared to Q4, largely as a result of seasonal variation in longline fishing effort distribution.

In relation to black-browed albatross populations, both those from the Falkland Islands (Islas Malvinas) and South Georgia (Georgias del Sur) have highest overlap with ICCAT longline fisheries in Q2 and Q3, reflecting the non-breeding periods, when birds migrate northwards to Brazil/Uruguay and South Africa, respectively, reaching up to 10° South. The non-breeding remote tracking data for the Falklands black-brows were mostly limited to birds during failed migration: further data on the non-breeding distribution of this species would be valuable, and would be likely to indicate even higher levels of overlap with ICCAT fisheries. White-chinned petrels from South Georgia also had highest levels of overlap during Q2 and Q3, corresponding to the non-breeding period where birds forage offshore from Argentina, Uruguay and Brazil. As discussed above, while wandering albatross distribution is focused south of 30° South, the analysis identified relatively high interaction with ICCAT longline fishing effort, particularly in Q2 in areas offshore from Uruguay, and southwest of South Africa.

Overlap Score 3 indicates the proportion of ICCAT longline fishing effort that overlaps with the distribution of these seabird species, and therefore the proportion of the ICCAT fleet that could be affected by management decisions to mitigate bycatch in these areas. In general, albatross and petrel populations (the species generally recognised as most vulnerable to impacts from bycatch) are distributed in the South Atlantic, affecting 25% or less (mostly <10%) of the ICCAT longline fishing effort. However, a general point from the analysis is that far fewer data were available on Mediterranean and North Atlantic species, both in terms of distribution and population status. Here, Cory's shearwater was the only species from the North Atlantic and Mediterranean that could be analysed, and this species was identified as having the highest degree of overlap with ICCAT fisheries. Additional data is urgently needed on bycatch rates and distribution of North Atlantic and Mediterranean species.

4.2 Comparison with estimates of overlap based on range and foraging radius

It is interesting to compare the overlap scores generated from the analysis of remote tracking data with the estimates of the ‘simple’ overlap approach that used range and foraging radii data (Taylor et al. 2009).

In general, the ‘simple’ approach tended to underestimate seabird overlap with the ICCAT area (Overlap score 1), particularly in the case of black-browed albatross from South Georgia (Georgias del Sur) and the Falkland Islands (Islas Malvinas), where average overlap in the ‘simple’ analysis was estimated as 11-18% and 5-11% respectively, compared to estimates of up to 74% and 41% using remote tracking data. Estimate of overlap of Tristan albatross, white-chinned petrel and even wandering albatross with the ICCAT area were also higher based on remote tracking data.

4.3 Data gaps

Remote tracking data is highly valuable in relation to providing accurate data on seabird distribution, from populations of known age and provenance. Comparison between the analysis presented here and the estimates of overlap based on range and foraging radii indicate that the two methods highlighted the same species or populations as having highest overlap with ICCAT fisheries. However, the ‘simple’ method tended to underestimate the degree of actual overlap, as demonstrated by remote tracking data. Many data gaps remain in remote tracking data, particularly for non-breeding and juvenile birds, and for species in the Mediterranean and North Atlantic. The ability to estimate seabird distribution and likely overlap with ICCAT fisheries would be greatly improved if more tracking data were available.

5. REFERENCES

Argos (1989) Guide to the Argos System. Toulouse, CLS/Service Argos.

Argos (1996) User's Manual. Toulouse, CLS/Service Argos.

Baker, G.B., Gales, R., Hamilton, S., Wilkinson, V. (2002) Albatrosses and petrels in Australia: a review of their conservation and management. Emu **102:**71-97.

BirdLife International (2004). Tracking ocean wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1–5 September, 2003, Gordon's Bay, South Africa. Cambridge, UK: BirdLife International.

Brothers, N. (1991) Albatross mortality and associated bait loss in the Japanese longline fishery in the Southern Ocean. Biological Conservation **55:**255-268.

Brothers, N. P., Cooper, J., Løkkeborg, S. (1999) The incidental catch of seabirds by longline fisheries: worldwide review and technical guidelines for mitigation. FAO Fisheries Circula No. 937, Rome.

Croxall, J.P., Prince, P.A., Rothery, P., Wood, A.G. (1998) Population changes in albatrosses at South Georgia. In: G. Robertson & R. Gales (eds.), Albatross Biology and Conservation, Australia, Surrey Beatty and Sons, pp 68-83.

Cuthbert, R., Hilton, G., Ryan, P., Tuck, G.M., 2005. At-sea distribution of breeding Tristan albatrosses Diomedea dabbenena and potential interactions with pelagic longline fishing in the South Atlantic Ocean. Biological Conservation 121: 345-355.

Dimech, M., Darmanin, M., Caruana, R., Raine, H. (2008) Preliminary data on seabird bycatch from the Maltese longline fishery (Central Mediterranean). Paper submitted to the ICCAT Standing Committee on Research and Statistics, 29 Sep-3 Oct, Madrid, Spain. SCRS/2008/027.

Garcia Barcelona, S., Ortiz de Urbina O., de la Serna, J.M., A lot, E., Macias, D. (2009) Seabird bycatch in Spanish Mediterranean large pelagic longline fisheries, 2000-2008. International Commission for the Conservation of Atlantic Tuna (ICCAT) Meeting of the Standing Committee on Research and Statistics, 5-9 October 2009, Madrid, Spain, ICCAT-SCRS-2009-136.

IUCN 2008. List of Threatened Species. A global species assessment. Available at http://www.redlist.org

McConnell, B.J., Chambers, C. and Fedak, M.A. (1992) Foraging ecology of southern elephant seals in relation to the bathymetry and productivity of the Southern Ocean. Antarctic Science **4:**393-398.

Robertson, G., Gales, R. (1998) Albatross Biology and Conservation. Surrey Beatty and Sons, NSW, Australia.

Phillips, R.A., Arata, J., Gales, R., Huin, N., Robertson, G., Terauds, A., Weimerskirch, H. (2004) Synthesis of distribution of breeding birds from different populations of selected species: Black-browed Albatross *Thalassarche melanophris*. In: BirdLife International. Tracking Ocean Wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1-5 September 2003, Gordon's Bay, South Africa. BirdLife International, Cambridge, UK, pp 24-25.

Prince, P.A., Croxall, J.P., Trathan, P.N. & Wood, A.G. (1998) The pelagic distribution of South Georgia albatrosses and their relationships with fisheries. In: Robertson, G. & Gales, R. (Eds). Albatross Biology and Conservation. Chipping Norton, Australia, Surrey Beatty & Sons, pp. 137-167.

Taylor, F., Anderson, O. & Small, C. 2009. An analysis of seabird distribution in the ICCAT area and overlap with ICCAT longline fishing effort. Paper submitted to the 2009 Inter-sessional Meeting of the Sub-Committee on Ecosystems, Recife, Brazil, 8-12 June 2009.SCRS/2009/085

Wanless, R.M., Ryan, P.G, Altwegg, R., Angel, A., Cooper, J., Cuthbert, R., Hilton, G.M.. 2009. From both sides: Dire demographic consequences of carnivorous mice and longlining for the Critically Endangered Tristan albatrosses on Gough Island. Biological Conservation 142: 1710–1718

Weimerskirch, H. (2004) Distribution of breeding birds in relation to year: Wandering Albatross *Diomedea exulans*, Crozet. In: BirdLife International, Tracking Ocean Wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1-5 September 2003, Gordon's Bay, South Africa. BirdLife International, Cambridge, UK, pp 21-23.

Weimerskirch, H., Salamolard, M., Sarrazin, F., Jouventin, P. (1993) Foraging strategy of

Wandering Albatrosses through the breeding season: A study using satellite telemetry. Auk **110:**325-342.

Wooller, R.D., Bradley, J.S., Croxall, J.P. 1992. Long-term population studies of seabirds. Trends in Ecology and Evolution **7:**111-114.

Table 1. Seabird remote tracking data held in the Global Procellariiform Tracking Database which overlap with ICCAT longline fishing effort. CR=Critically Endangered, EN=Endangered, VU=Vulnerable, NT=Near Threatened, LC=Least Concern.

Common name	Scientific name	Population	Breeding pairs	Global Pop. (%)	Threat status[2]	Data submitted: Status (No. of tracks) Tracks are PTT unless otherwise specified
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	Gough[1]	34,550	100%	EN	Breeding (74 PTT), non-breeding (25 GLS)
Black-browed Albatross	*Thalassarche melanophris*	South Georgia/Islas Georgias del Sur	74,296	12%	EN	Breeding (365 PTT), non-breeding (75 GLS)
Black-browed Albatross	*Thalassarche melanophris*	Falklands/Malvinas	399,416	67%	EN	Breeding (78 GLS), non-breeding (41 PTT & GLS)
Grey-headed Albatross	*Thalassarche chrysostoma*	South Georgia/Islas Georgias del Sur	47,674	48%	VU	Breeding (94 PTT), non-breeding (22 GLS)
Light-mantled Sooty Albatross	*Phoebetria palpebrata*	South Georgia/Islas Georgias del Sur	5,000	25%	NT	Breeding (42)
Sooty Albatross	*Phoebetria fusca*	Gough[1]	7,888	42-63%	EN	Breeding (29 GLS), non-breeding (20 GLS)
Tristan Albatross	*Diomedea dabbenena*	Gough	2,400	100%	CR	Breeding (128 PTT), non-breeding (14 GLS)
Wandering Albatross	*Diomedea exulans*	South Georgia/Islas Georgias del Sur	1,553	12%	VU	Breeding (222 PTT), non-breeding (10 GLS)
Northern Giant Petrel	*Macronectes halli*	South Georgia/Islas Georgias del Sur	4,310	38%	LC	Breeding (81 GLS), non-breeding (16 GLS)
Southern Giant Petrel	*Macronectes giganteus*	South Georgia/Islas Georgias del Sur	4,650	15%	LC	Breeding (78 GLS), non-breeding (17 GLS)
Spectacled Petrel	*Procellaria conspicillata*	At sea			VU	Non-breeding (5)
White-chinned Petrel	*Procellaria aequinoctialis*	South Georgia/Islas Georgias del Sur	2,000,000	86%	VU	Breeding (23 GLS), non-breeding (10 GLS)
Cory's Shearwater	*Calonectris diomedea*	Balearic Islands	11,000	3-4%	LC	Breeding (18 GLS), non-breeding (9 GLS)
Cory's Shearwater	*Calonectris diomedea*	Canary Islands	30,000	8-10%	LC	Breeding (26 GLS), non-breeding (8 GLS)
Cory's Shearwater	*Calonectris diomedea*	Azores	188,000	47-63%	LC	Breeding (28 GLS), non-breeding (11 GLS)

[1] Includes Tristan da Cunha population
[2] Source: IUCN (2008).

Table 2. ACAP species populations with ICCAT overlap scores calculated per quarter: Overlap Score 1: % seabird distribution within the ICCAT area ; Overlap Score 2: % seabird distribution multiplied by the average fishing effort per 5x5° grid square, 2000-2005. Overlap Score 3: % longline fishing effort within each species' range. Year quarters: Q1 (Jan-March), Q2 (April-June), Q3 (July-Sept), Q4 (Oct-Dec). UD=Utilisation Distribution.

Species	Population	Overlap Score 1 (%)				Overlap Score 2 (No Unit)				Overlap Score 3 (95% UD)				Overlap Score 3 (100% UD)			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Cory's shearwater	Balearics	100	100	100	100	9,019	11,833	46,347	11,550	28	7	13	27	52	44	47	47
Cory's shearwater	Azores	97	99	99	96	3,362	3,040	1,466	4,253	30	14	13	36	54	51	54	61
Cory's shearwater	Canaries	92	97	97	91	3,963	2,286	2,216	4,845	30	8	9	25	65	50	48	51
Atlantic yellow-nosed albatross	Gough	98	96	97	98	3,250	5,530	3,868	1,897	7	17	15	6	10	26	24	14
Tristan albatross	Gough	93	94	94	94	2,757	3,209	1,321	318	6	18	8	2	10	25	21	9
Black-browed albatross	South Georgia	20	62	74	23	521	4,091	3,553	616	3	14	10	3	7	25	18	9
White-chinned petrel	South Georgia	15	37	47	15	51	2,064	2,120	153	0	3	2	0	0	5	4	1
Black-browed albatross	Falklands/Malvinas	10	35	41	10	47	1,984	1,471	189	0	3	2	0	2	8	4	1
Sooty albatross	Gough	46	37	41	57	1,075	985	566	227	4	7	3	2	9	23	15	6
Wandering albatross	South Georgia	12	19	24	23	192	1,357	471	136	5	19	7	2	20	24	17	6
Grey-headed albatross	South Georgia	7	11	21	11	59	368	71	4	1	10	2	0	5	17	5	2
Northern giant petrel	South Georgia	8	15	13	9	68	86	233	30	0	4	2	0	2	9	5	2
Southern giant petrel	South Georgia	6	6	5	4	70	222	83	12	0	3	1	0	5	17	6	2

Figure 1. Cory's shearwater (Balearic population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

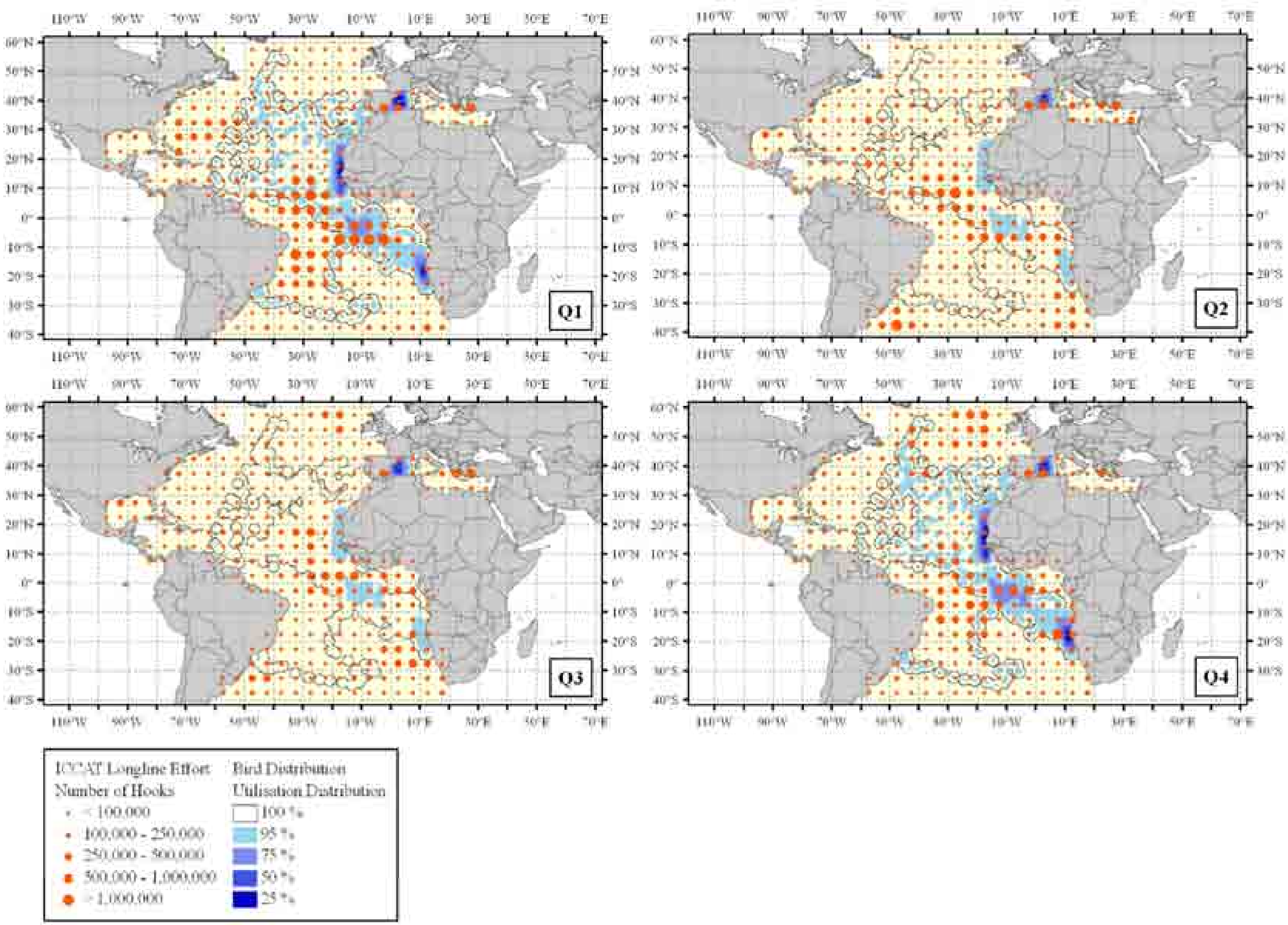

Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Figure 2. Cory's shearwater (Azores population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

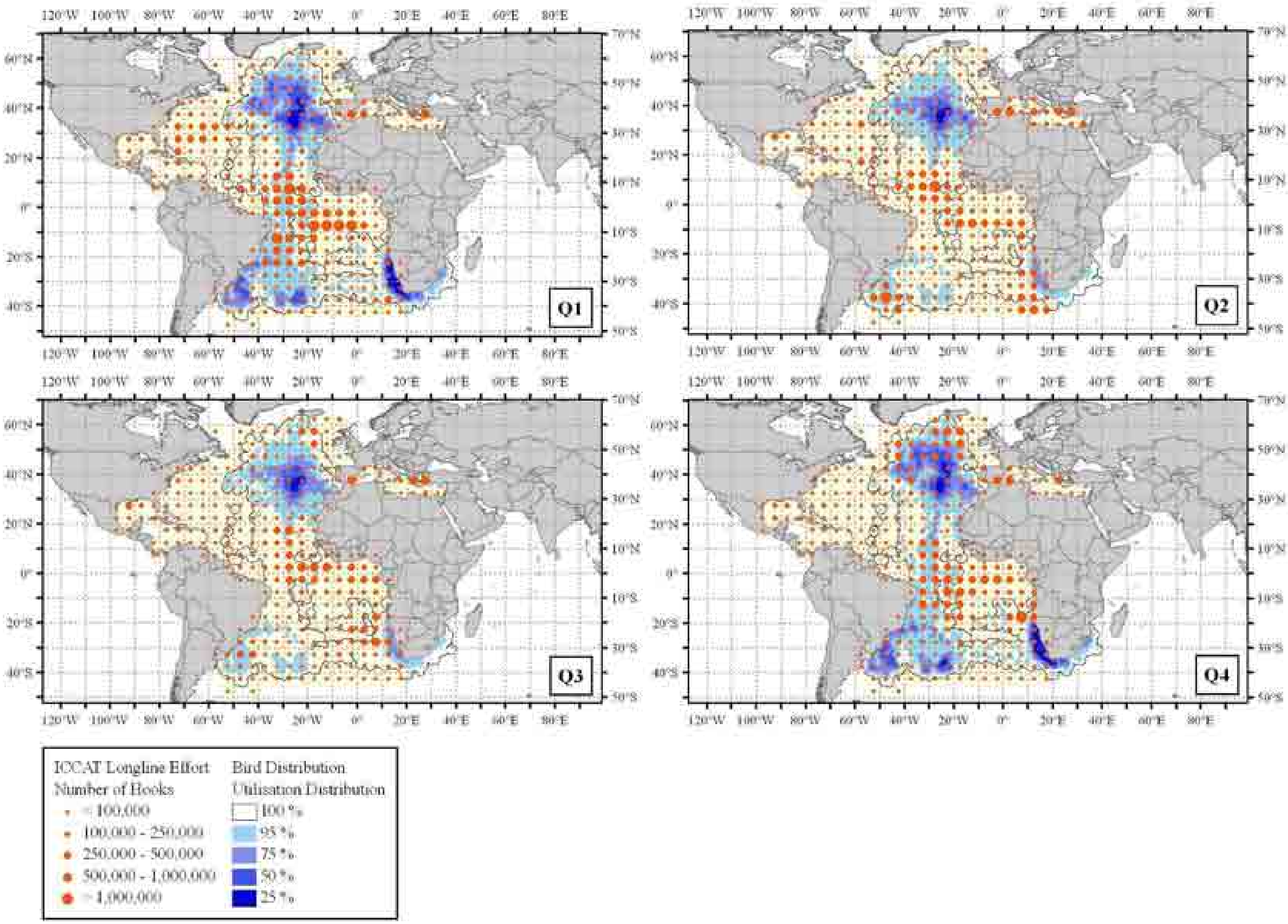

Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Figure 3. Cory's shearwater (Canaries population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

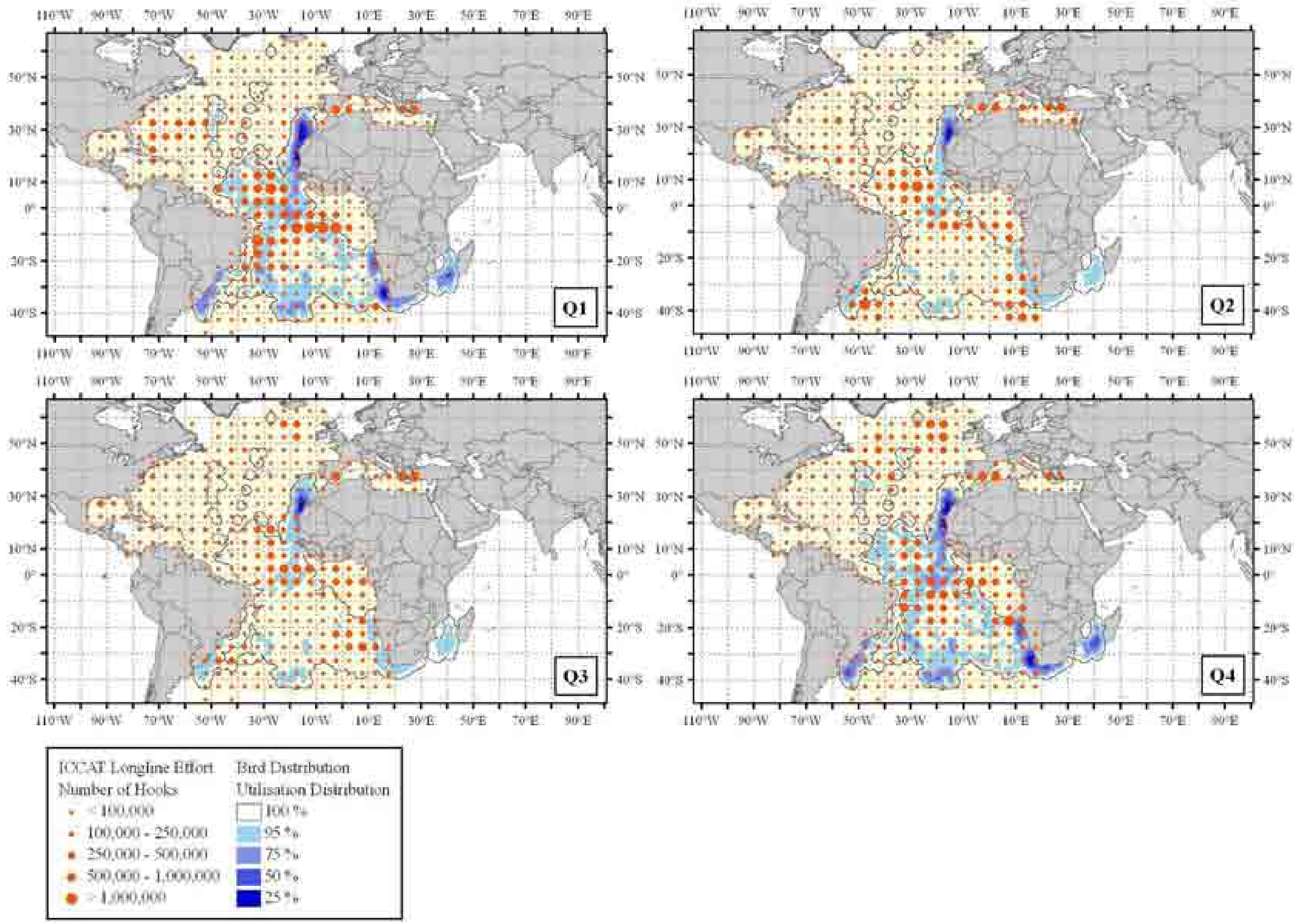

Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Figure 4. Atlantic yellow-nosed albatross (Gough population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

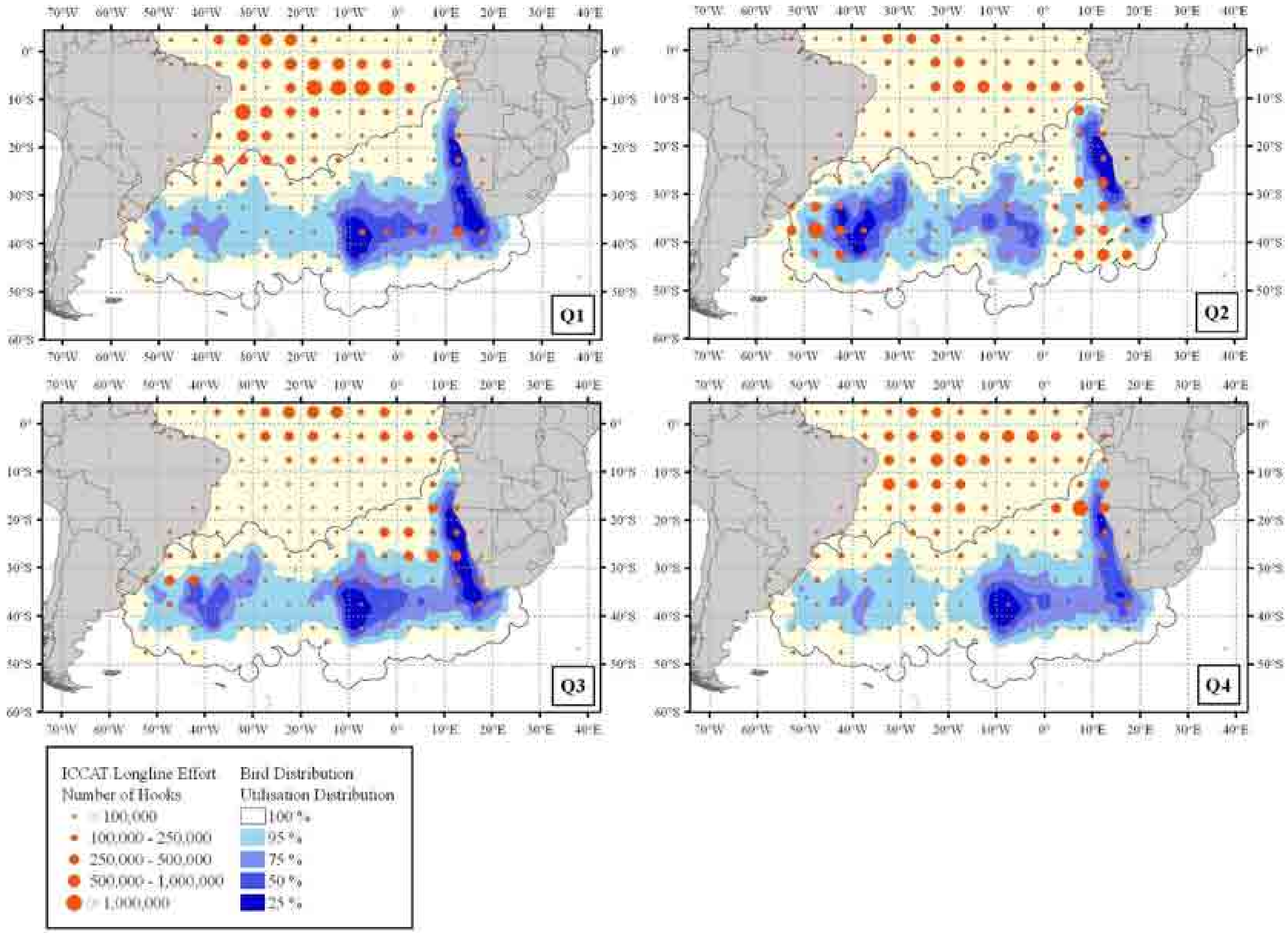

Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Figure 5. Tristan albatross (Gough Island population) distribution in the ICCAT area by year quarter Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

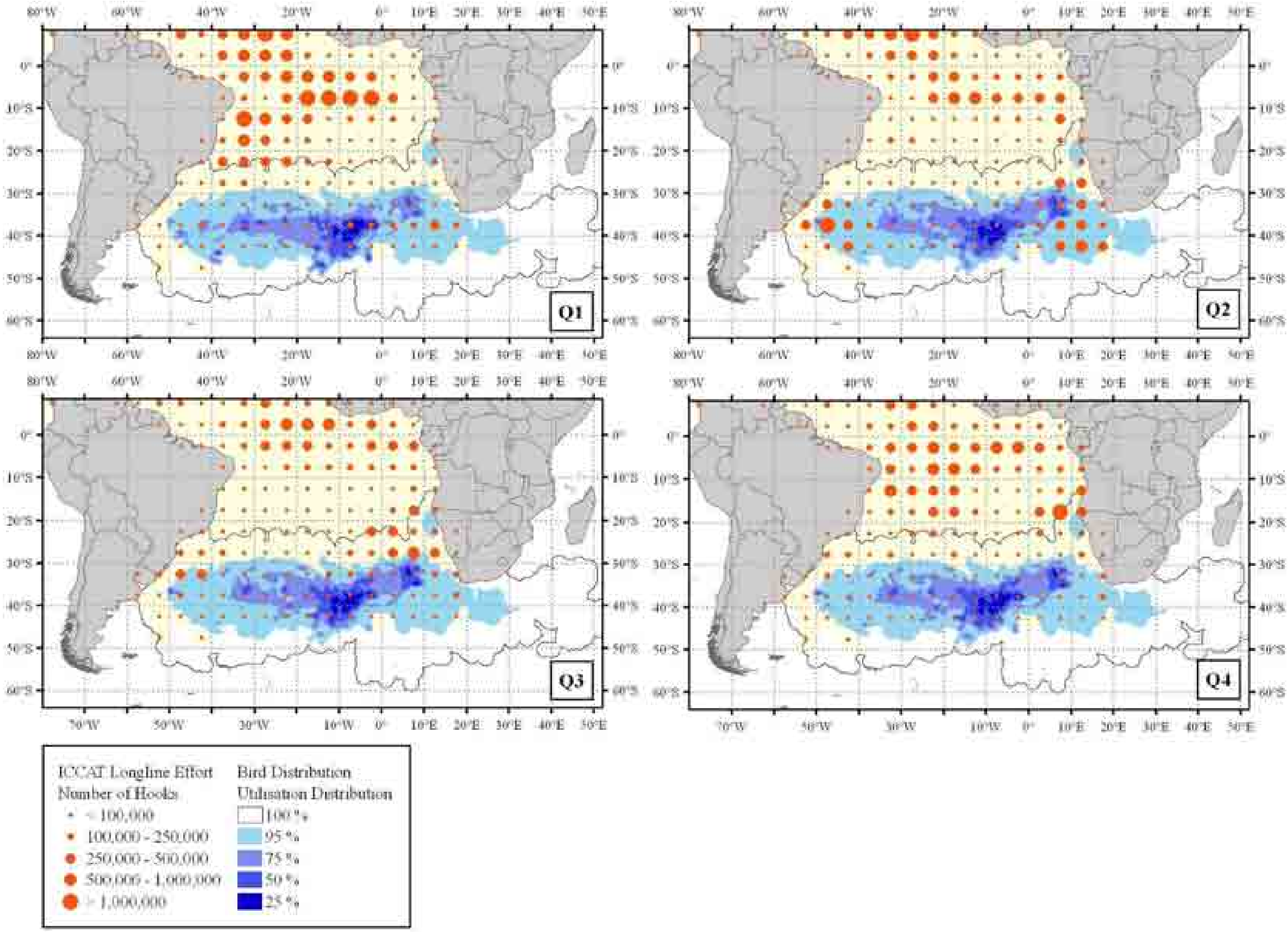

Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Figure 6. Black-browed albatross (South Georgia population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

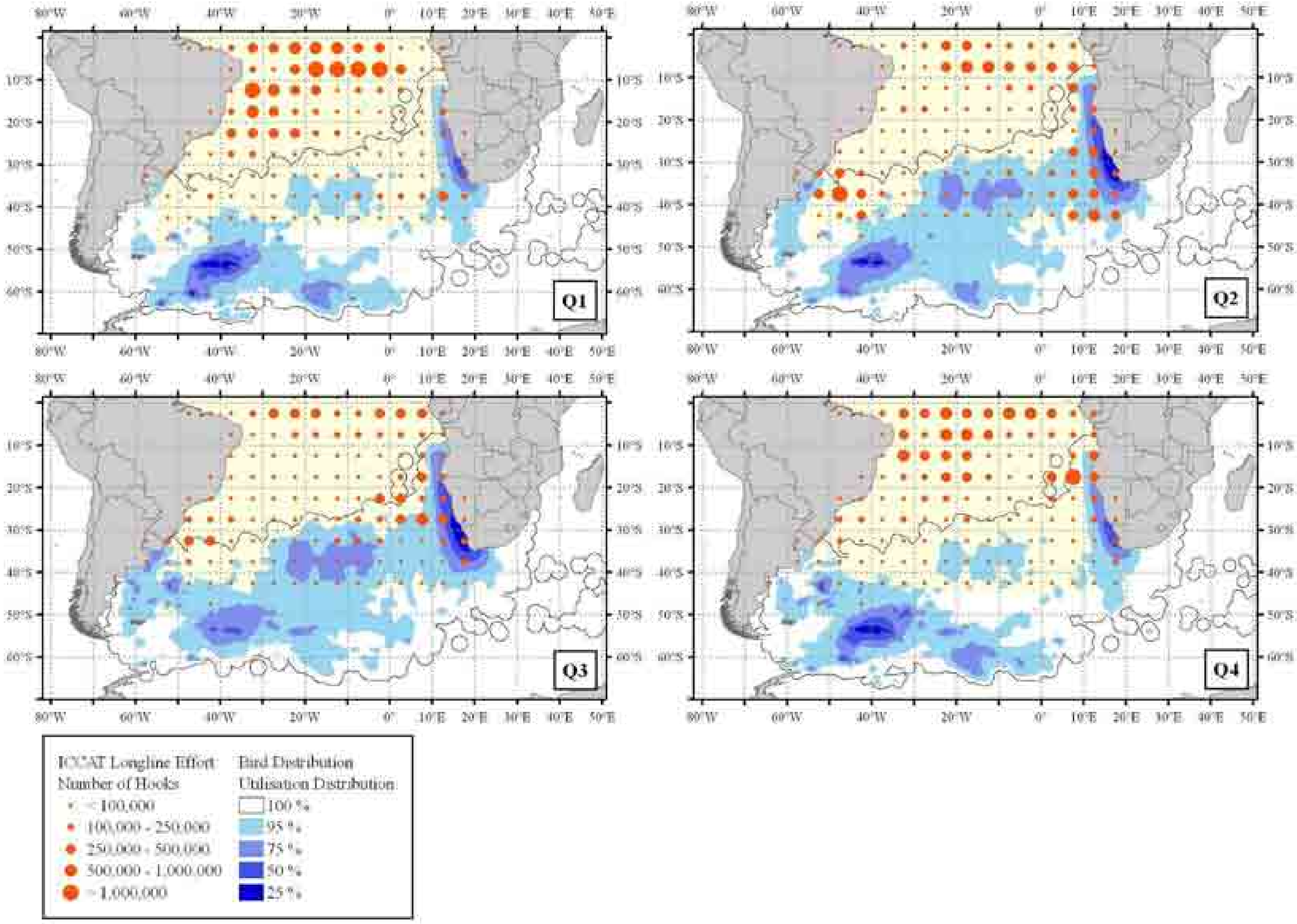


Figure 7. White-chinned petrel (South Georgia population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per

quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

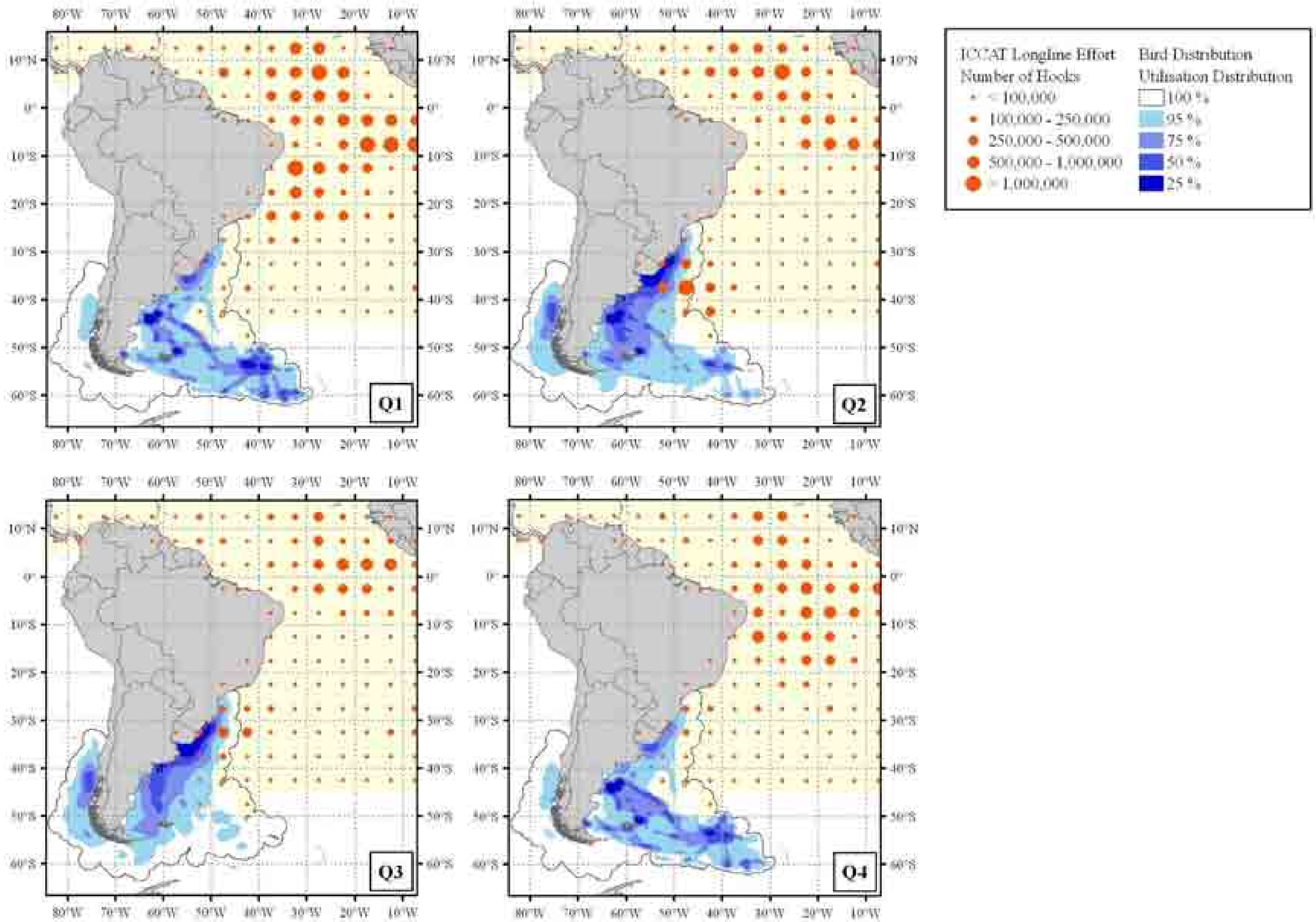

ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %
Q1
Q2
Q3
Q4

Figure 8. Black-browed albatross (Falkland Islands/Malvinas population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

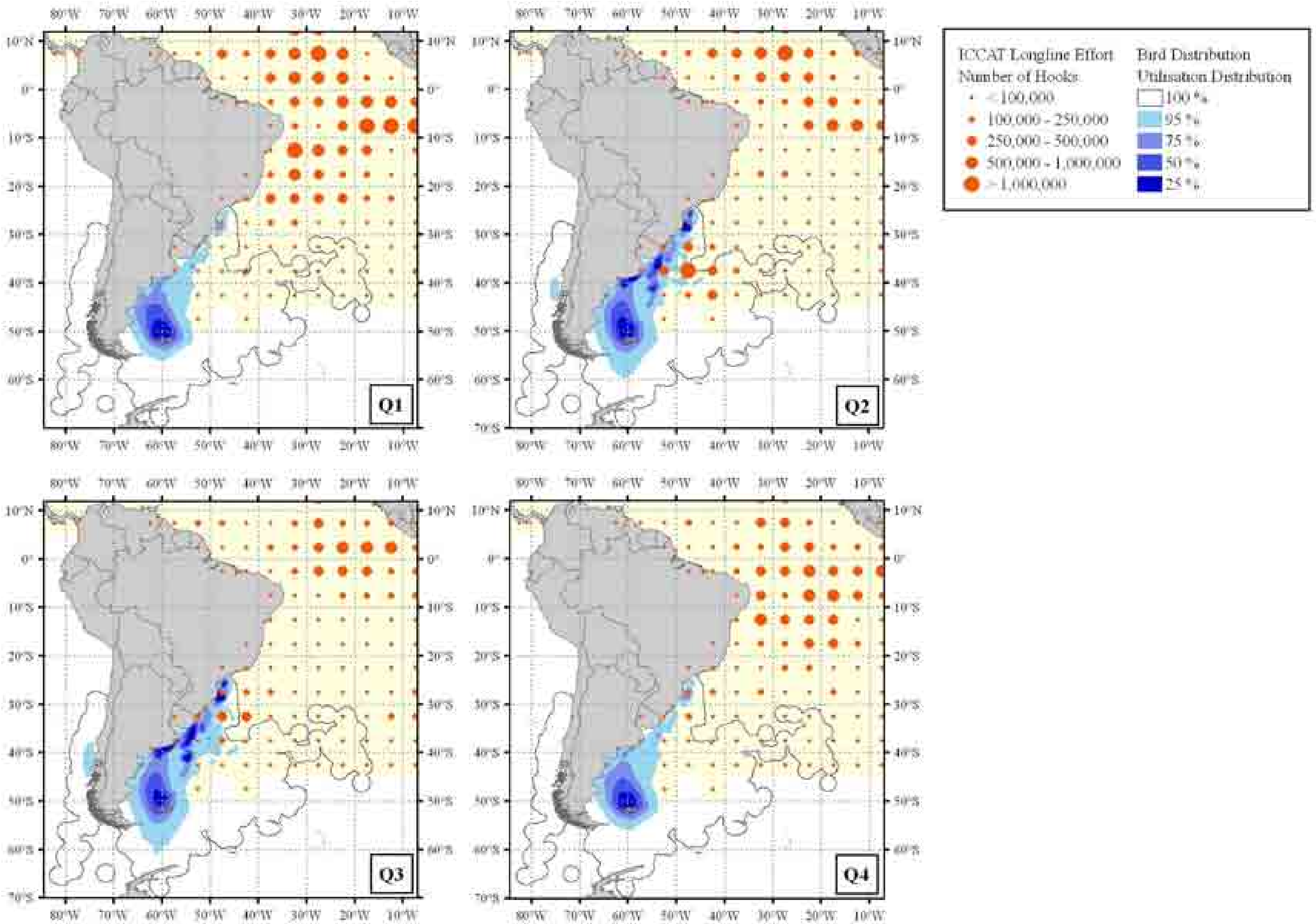

ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %
Q1
Q2
Q3
Q4

Figure 9. Sooty albatross (Gough Island population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

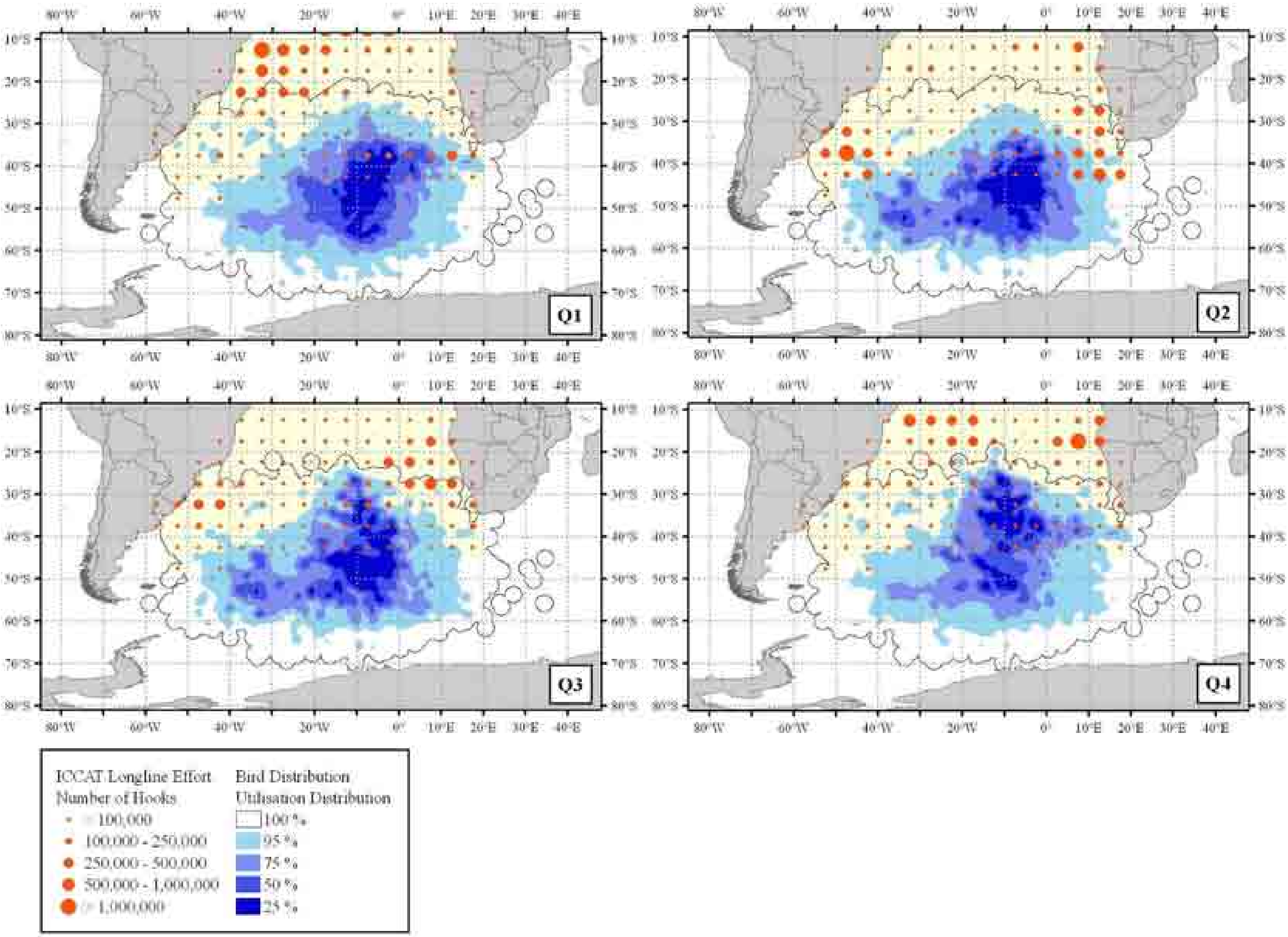

Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Figure 10. Wandering albatross (South Georgia population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

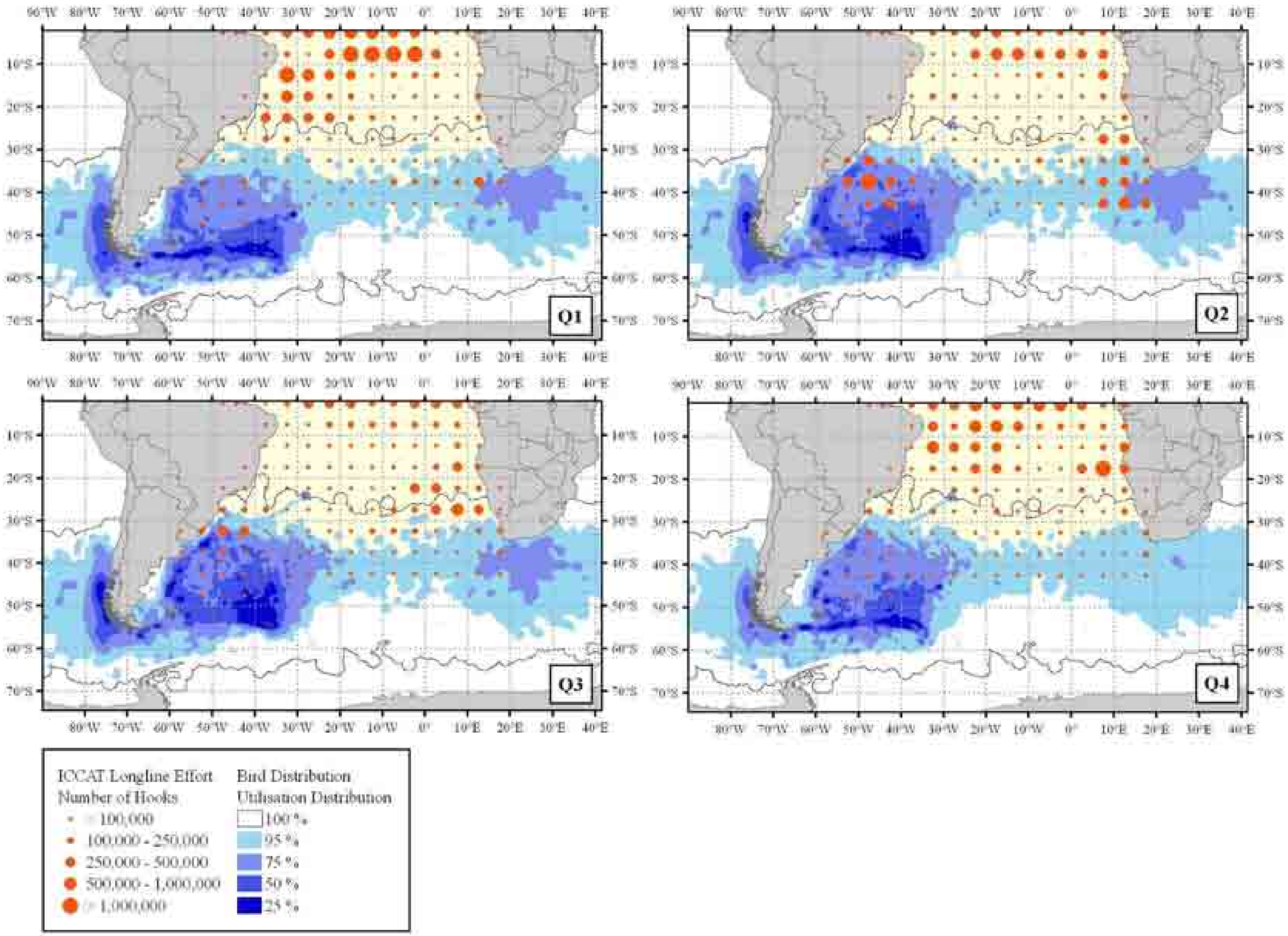

Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Figure 11. Grey-headed albatross (South Georgia population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

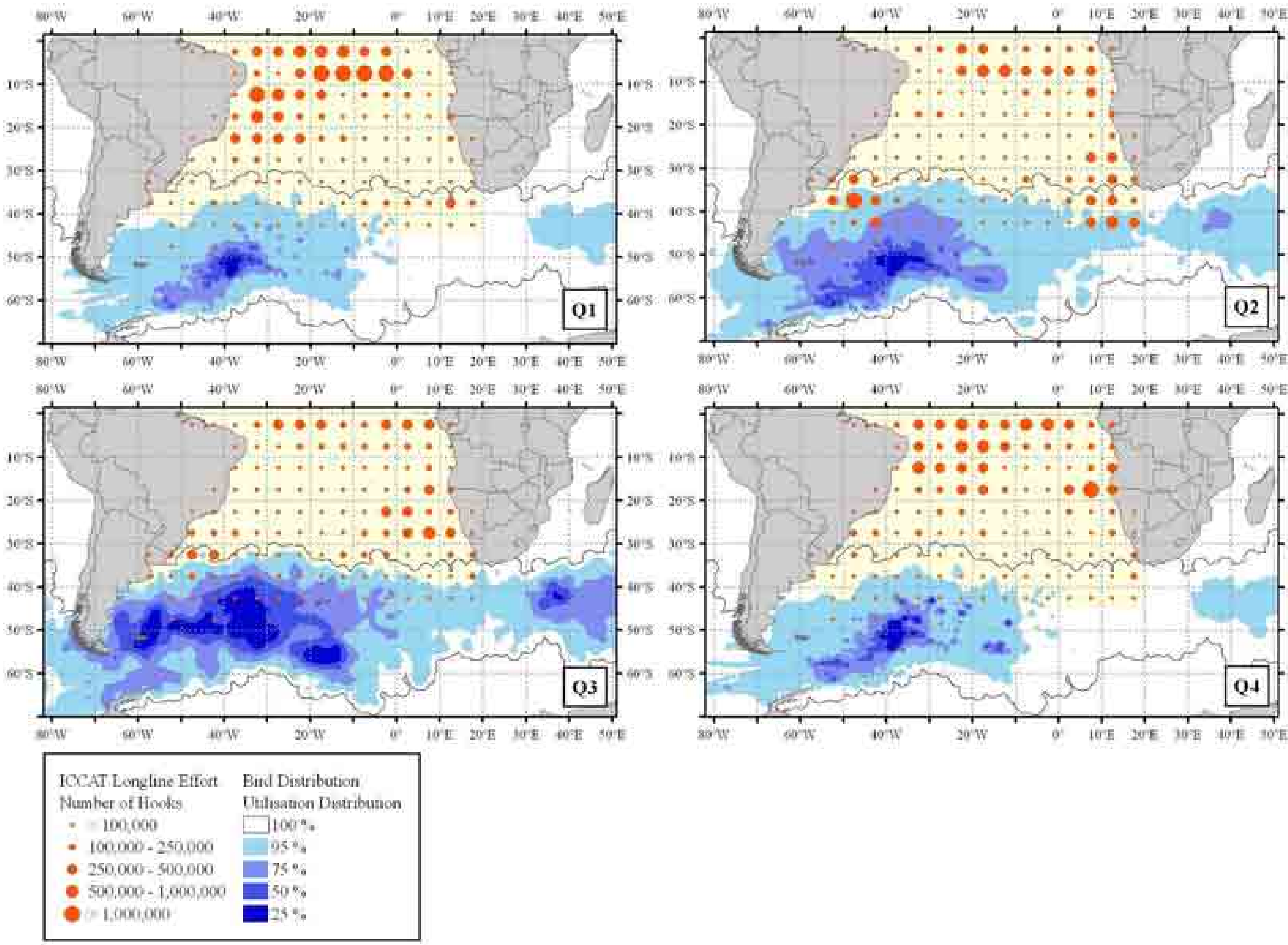

Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Figure 12. Northern giant petrel (South Georgia population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.

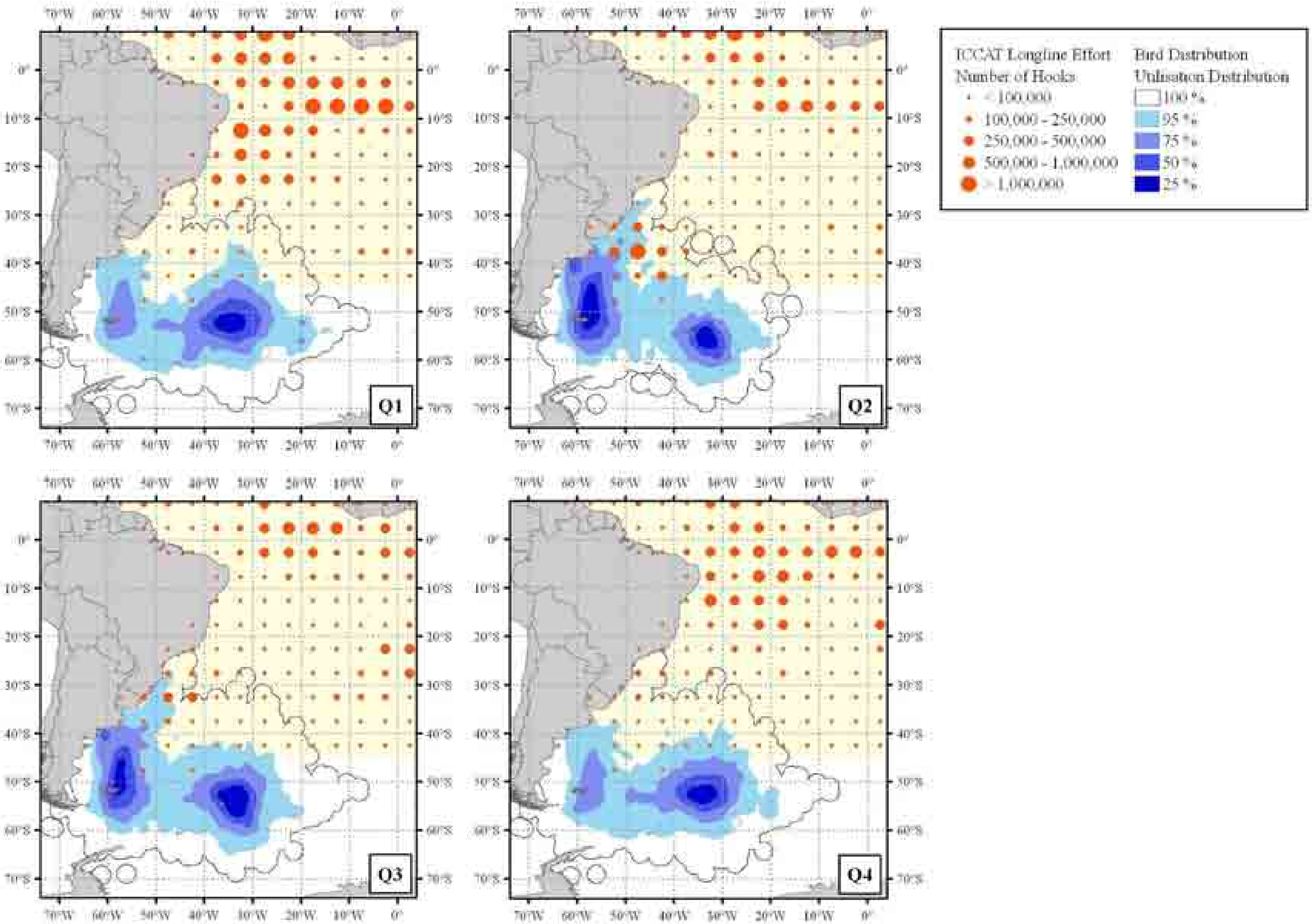
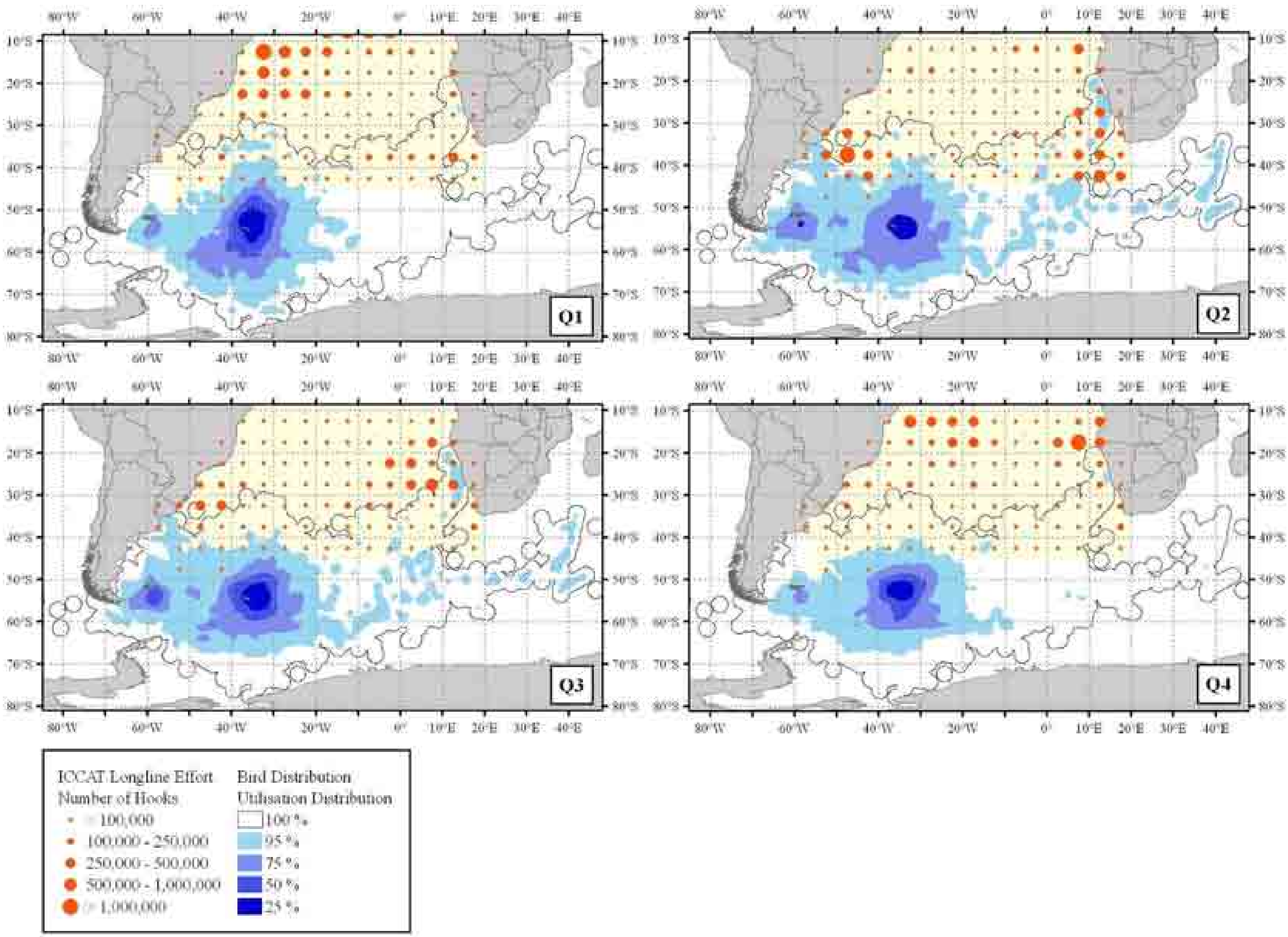

ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %
Q1
Q2
Q3
Q4

Figure 13. Southern giant petrel (South Georgia population) distribution in the ICCAT area by year quarter (Q1=Jan-Mar, Q2=Apr-Jun, Q3=July-Sep, Q4=Oct-Dec), and overlap with ICCAT longline fishing effort 2000-2005 (average number of hooks set per 5x5° grid square per quarter per year). Highest densities of bird distribution are shown in dark blue. The 100% contour indicates the full extent of the distribution of tracked birds.


Q1
Q2
Q3
Q4
ICCAT Longline Effort
Number of Hooks
< 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 1,000,000
> 1,000,000
Bird Distribution
Utilisation Distribution
100 %
95 %
75 %
50 %
25 %

Appendix I. Details on the composition of tracking data from which density distributions per quarter were comprised in the Results section above.

Atlantic Yellow-nosed Albatross	Non-breeding data was made up of Post Breeding birds and Early Failing birds during Q1 & Q2. Sabbatical range was made using sabbatical tracking data as sample size was sufficient. Small Pre-Egg sample size meant the data was lumped with Incubating and used for both.
Grey-headed Albatross	No Sabbatical data was available so an amalgam of Breeding data was used surrogately in its place. Non-breeding ranges were made using NB geolocator data from outside of the breeding period. Post-Guard and Post-Brood data were joined to make a "fledge" distribution, Brood and Brood-Guard data were joined to make a "Chick" distribution
Sooty Albatross	7 Sabbatical tracks were used to make the sabbatical range. NB distribution maps were made from tracks outside the breeding season and post breeders. Post Guard was used for Fledge and surrogately for Pre-Egg
Tristan Albatross	Post Breeding tracks were used for the Non-breeding range maps. No Sabbatical data exists therefore all breeding data was used in its place.
Wandering Albatross	Post Breeding and Non Breeding data was used for the Non-breeding distribution. 9 Sabbatical tracks were used to generate a sabbatical map. Both GLS and PTT breeding tracks were used.
White Chinned Petrel	Only Chick and Incubating data existed for the breeding season, therefore incubating had to be used surrogately for fledge and Pre-Egg. Sabbatical range was made using whatever Breeding data was available.
Giant Northern Petrel	Post Breeders outside of the breeding season were used to create the Non-breeding range. Only 2 sabbatical tracks were available so a mix of all the breeding data was used in its place.
Southern Giant Petrel	Post Breeders were used to generate the non-breeding map. Incubating was used for Pre-Egg maps.
Black-browed Albatross	Sample size was good for Non-breeding and Sabbatical data from South Georgia (both GLS). Again, however, no Pre-Egg data existed therefore Incubating was again used in its place. For the Falklands Non-Breeding data was insufficient for both GLS and PTT individually, therefore the two were combined with relative weighting and used to make the Non-breeding distribution.
Cory's Shearwater	No Sabbatical data existed for any population therefore a breeding amalgam was used instead for all 3. Pre-Egg data was used surrogately for Fledge distributions, and Post-Breeding data outside of the breeding seasons was used for Non-breeding range.