Dispersal of colour marked fledgling black-browed albatross from the Falkland Islands.

COLOUR MARKING OF FLEDGLING BLACK-BROWED ALBATROSS ON STEEPLE JASON ISLAND

This project was run jointly between Falklands Conservation Seabirds at-Sea Team (Ben Sullivan and Tim Reid), Nic Huin (Science Officer, FC), Tatiana Neves (Projeto Albatroz, Brazil), Roberto Warlich (CTTMar - Universidade do Vale do Itajaí, Brazil) and with the support of the Wildlife Conservation Society.

Project Objective

To collect at-sea sightings of colour marked fledgling black-browed albatross to determine their dispersal pattern and level of interaction with longliners and potentially other vessels, such as trawlers. The long-term project objective is to help target future research into seabird mortality on the Patagonian Shelf, including:

- where do juvenile black-browed albatross disperse in relation to adult birds?
- how important is juvenile mortality in the decline of black-browed albatross in the Falkland Islands?
- do adults and juveniles have comparable by-catch rates?

Project Rationale

The Falkland Islands contain around 85% of the world's breeding population of black-browed albatross (*Thalassarche melanophris*) (Gales 1998), and breeding grounds and foraging waters for a range of seabirds vulnerable to fisheries related mortality. However, subsequent census results have identified a dramatic decline in the number of breeding pairs compared to a census of Beauchêne Island conducted in 1980 and various censuses conducted on different islands throughout the last 20 years. Based on extrapolated population estimates for 1995, the 2000/01 census identified an estimated reduction of 87 500 breeding pairs over a five year period. This includes serious declines at the three largest colonies (Steeple Jason -47 300, Grand Jason -10 100 and Beauchêne -27 500) (Huin 2001).

Monitoring the movements (by satellite tracking and geolocators) of adult breeding FI black-browed albatrosses has shown that they feed in different regions of the Patagonian Shelf throughout the year, depending on the stage of their breeding cycle (Grémillet 2000, Huin 2002). There is considerable evidence that these birds suffer high levels of longliner mortality

(Brothers 1995, Schiavini *et al*.1998, Stagi et al 1998, Neves & Olmos 1998, Stagi and Vaz-Ferreira 2000, Favero *et al.* 2003, Olmos *et al*. 2000), which is most likely the primary cause of the recently identified decline in the Falkland Island population. It is difficult to accurately assess the role of longlining in the Falkland Island waters in this decline because prior to May 2001 there was no designated seabird observer program, and hence it is difficult to assess the historical rate of seabird by-catch in the fishery. However, as recently as the mid 1990's, the level of seabird by-catch in waters around the Falkland Islands has been very high including 4.3 birds/line during the summer of 1995 (Brothers 1995), with recorded events of up to 90 black-browed albatrosses killed in a single day (Brothers 1996). The introduction, under licensing, of mandatory mitigation measures over the last few years has resulted in a greatly reduced mortality rate in Falkland Islands waters. In 2001/02 longline mortality was estimated to be 0.016 birds/1,000 hooks (0.009-0.023), predominantly adult black-browed albatross.

Longlining over the extent of the Patagonian Shelf and into the waters of northern Argentina, Uruguay and Brazil is directly relevant to the conservation of black-browed albatross from the Falkland Islands. Over 25 million hooks were set by Argentine demersal longliners on the Patagonian Shelf from 1993-95 but only anecdotal estimates of seabird by-catch exists. Therefore, a range of by-catch estimates from CCAMLR waters was applied (0.19-0.67 birds/1000 hooks) to derive an implied mortality of between 3,852-13,514 individuals for the Patagonian Shelf during an 18-month period (Schiavini *et al.* 1998). Subsequent data collected by longline observers in Argentinean waters (1999-2001) showed that of an estimated by-catch rate of 0.18 birds/1000 hook, black-browed albatross comprised 53% of recorded mortalities (Favero *et al.* 2001).

Black-browed albatross was also the most common species killed by pelagic and demersal longliners in Uruguayan waters in 1993/94. In the pelagic fishery the estimated by-catch rate for albatross was 4.7 /1000 hooks (black-browed albatross comprised 120 of 123 albatrosses observed to be caught), and in the smaller demersal fishery 78 black-browed albatross deaths were recorded in a single trip (Stagi *et al*. 1998). More recent by-catch estimates from Uruguay suggest that in 1999 between 666 and 2,345 birds were killed by pelagic longliners, and between 533-1,876 of these were black-browed albatross (Stagi and Vaz-Ferreira 2000). In 1998, 35 demersal longliners operated in southern Brazil, with an estimated seabird by-catch of 2,201 to 6,226 birds, including 127 - 587 black-browed albatross. In the same year 22 pelagic tuna longliners caught between 348 and 7,105 seabirds, including 140-2,842 black-browed albatross (Olmos *et al*. 2000).

There are currently few data on the movements of dispersing juvenile black-browed albatross, sub-adults and non-breeding birds from the Falkland Islands and how they are affected by fishing activities. The very low ratio of juvenile birds to adult birds recorded by SAST during at-sea surveys since 1998 (White *et al.* 2002), and the fact that no juvenile mortalities have been recorded by SAST or FIFD seabird observers on longliners or trawlers operating in local waters since 2001 suggests that the issue needs to be addressed over the full extent of the Patagonian Shelf and north into Uruguay and southern Brazil. In addition, the high levels of juvenile mortality recorded in Brazilian waters where adult breeding birds do not occur, suggests that dispersing juveniles generally travel greater distances than adult breeding males and females.

It is important to gain a thorough understanding of the movements and fate of juvenile birds in order to understand the current decline, which has three possible causes: (1) an increase in adult mortality, (2) a decrease in recruitment into the breeding population (i.e. increased mortality of birds aged between 1 and 7-10 years) and, (3) a combination of (1) and (2) (Huin 2001). The best way to gain such an understanding would be to conduct a long-term demographic study, ringing individual birds and following their life history. Although such studies will commence in the Falkland Islands within the next few years, due to low fecundity, delayed maturity and extreme longevity it will be many years before meaningful demographic data is collected. In addition, the recovery of ringed birds outside their breeding grounds is notoriously low and slow in terms of receiving recovery data, the majority of which consist of birds found washed up dead or exhausted on beaches, or as a result of fishing activities (e.g. South Georgia studies, Prince et al 1998: 26,000 black-browed albatross ringed since 1959, 281 recovered; Saunders Island ringing, Huin 1999: 2,000 birds ringed in 1998, no recoveries to date). At the start of the ringing program in South Georgia an attempt was made to compare dispersion of birds from there and from the Falklands where nearly 9 000 birds (mainly juveniles) were ringed over a period of 5 years (Tickell 1967). During the first five years after ringing a total of 66 juveniles rings were recovered (0.75%), of which 0.49% were recovered in the first year along the east coast of South America from Argentina up to central Brazil and a further 0.08% recovered in South Africa.

Methods

Colour marking of albatrosses has been used to identify individual birds (Thomas *et al.* 1983) and the movement/dispersal of birds from specific breeding colonies (Tickell and Gibson 1968, Brothers *et al.* 1997, Waugh 1998). The British Antarctic Survey (BAS) has also used the method extensively at South Georgia since the mid 1970's both to study individual birds on land and to research dispersion at sea of birds from known colonies (Bird Island Monitoring Programme, BAS, *unpubl. data*). One advantage of colour marking birds is the cost effectiveness compared to satellite tracking and geolocators, particularly for juveniles which do not return to breed for up to 7 years. The easy identification of marked birds also greatly increases the potential number of records (sightings) in the short-term, compared with ringing.

The initial plan was to colour mark around 10 000 black-browed-albatross fledglings on the breast and rump. The size and easy access of the breeding population on Steeple Jason Island made it the most suitable site for colour marking birds. The trip to Steeple Jason was timed (1 -11 April 2002) to coincide with a decrease in adult black-browed albatross chick provisioning in the colony and to mark birds just prior to them fledging when they had completed moulting their down feathers. The mean fledging date is 22 April, ranging from 13 April until 3 May (Huin 1999). Once in the colony we realised that marking the birds on the rump would require handling each bird, so in order to minimise stress on birds and maximise the number marked, paint was applied only to the breast. This is not expected to significantly reduce the detectability of birds at sea and was considered necessary to reduce disturbance within the colony. Each bird was marked by leaning down toward the breast of the bird with the spray can and applying the paint and did not involve any handling of the chicks. It was expected that the paint would remain visible for up to 4 months (*cf*: Brothers *et al*. 1997).

The breeding success of black-browed albatross has been shown to be lower on the fringe of colonies so in order to maximise the potential for successful fledging of marked birds we concentrated our effort in the core of the colony. On Steeple Jason the risk of predation by striated caracara (*Phalcoboenus australis*) is likely to be higher for more accessible birds located on the fringe of the colony, so a band of around 10 nests deep around the fringe of the colony were left unpainted. Similarly, injured chicks, those born late in the season that had considerable down left on their chest and those in the process of being fed or with a parent in attendance were not marked.

On two occasions we suspended work in the colony because our presence was considered to be causing significant disturbance due to strong winds. The usual response of birds to our presence was to stand on their nest and bill clap as a defensive display, many birds also stepped back on their nest and used their wings for balance. However, when winds were particularly strong (around force 6 and above) many birds lost their balance and were blown off their nest as the wind caught their wings (in such case each chick was replaced on its original nest). On both days when this occurred we immediately ceased work in the colony.

No ill effects were detected after chicks were painted and on numerous occasions adults were observed feeding marked chicks, in one case a chick was fed within 1 minute of being painted.

In total, we marked 16 537 birds (Figure 1 & 2 Table 1), this increased sample size (from the planned 10 000, due to paint saved by not painting rumps) will obviously greatly increase the chance of at-sea sightings. Based on a maximum breeding success of around 60% (Huin 1999) this figure represents around 7.2% of the expected fledgling population from the Falkland Islands in 2002, and around 17.8 % of the Steeple Jason population. From known chick mortality rate, we expected 95-99% of marked chicks to fledge successfully (Huin *unpubl. data*).

Table 1 Number of birds marked.

Date (days of April)	1	5	6	7	8	9	**Total**
No.birds	3,547	5,283	1,743*	12*	4,228	1,744	**16,537**

*On the afternoon of 6 April and for most of the 7 April wind conditions prevented birds from being marked.

Observer Coverage

After discussions held with Tatiana Neves (Projeto Albatroz, Brazil) at a workshop on the South American Strategy for the Conservation of Albatross and Petrels. (Uruguay, September 2001) planning commenced to co-ordinate observers around South America to record marked juvenile black-browed albatross form the Falkland Islands. It was thought that the level of at-sea observer coverage both in Falkland Island waters and along the extent of the Patagonian Shelf and into Brazilian waters afforded an excellent opportunity to form a collaborative project to help identify the movement of dispersing juvenile black-browed albatross and potentially identify one of the primary causes of their decline.

All project participants were provided with a colour flier with a picture of a marked bird and data collection forms. Data required included the date, location (latitude/longitude), number of birds recorded and any additional notes on their behaviour and/or association with fishing vessels.

Figure 1. Painted chicks on nests

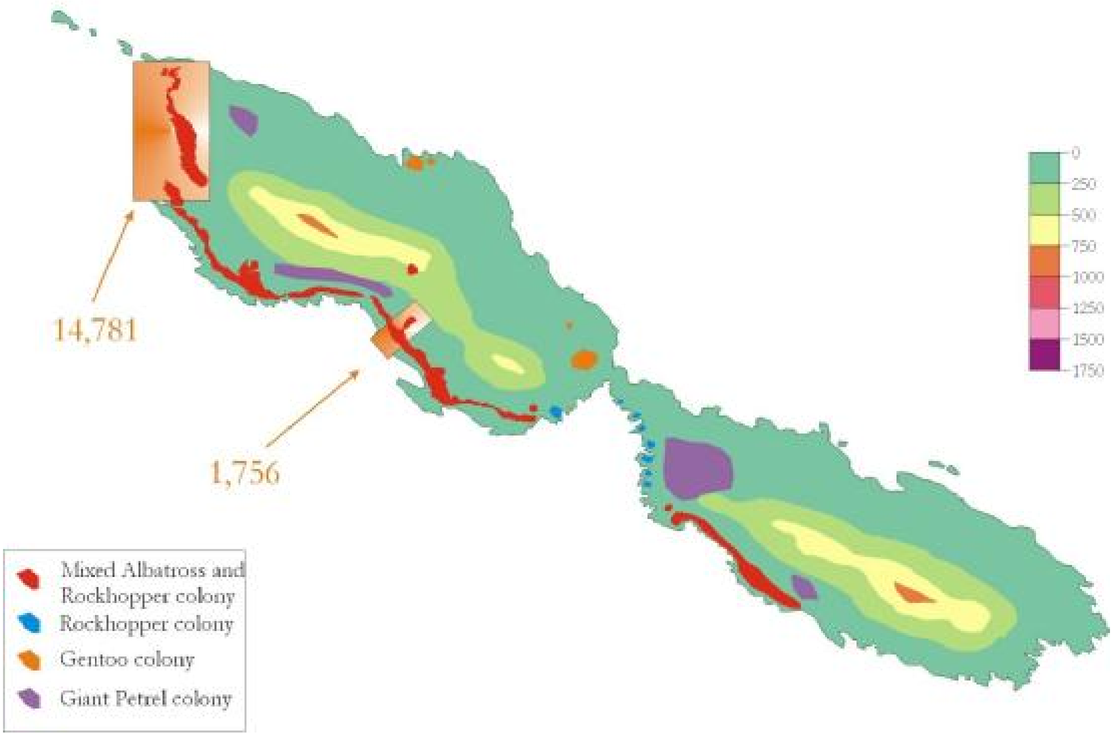

Figure 2. Location of seabird breeding colonies on Steeple Jason. Orange indicate areas were juveniles were marked.

Falkland Islands

Seabird Observers

From mid April until the end of August 2002, dedicated seabird observers conducted 201 days of coverage. This included two trips conducted by SAST observers using standard at-sea survey methods (see Tasker *et al*.1984, Webb and Durinck 1992, White *et al*. 2002).

- Ten day at-sea trip on the FPV Dorada (May 2002)
- Nine days onboard the *HMS Leeds Castle* on a return voyage from the Falkland Islands to Montevideo, Uruguay (27 May – 11 June)

The remainder of the coverage was collected by Patagonian toothfish (*Dissostichus elegenoides*) longliner observers. Longliner observers conducted hourly counts within a 500 x 500m sampling area in Falkland Island waters and anecdotal observations during all daylight hours when observers were on-deck monitoring line hauling.

- One SAST observer (April 17 days) and two FIFD observers (April 10 days, May 31 days, June 54 days, July 30 days and August 40 days)

Anecdotal observers

- FIFD observers (five fisheries observers working on trawlers and jiggers)
- Crew and officers of Byron Marine crewed vessels, *FPV Sigma* and *Dorada* and the *Tamar*
- Fishery Officers (five officers, two at-sea during all *FPV* cruises)
- Spanish versions of the project flier were given to the Captains and officers of 12 *Loligo* trawlers and approximately six finfish trawlers operating in Falkland Island waters from April-May 2002 as part of their licensing packages
- Local media coverage (Penguin News and Falkland Island Broadcasting Station) to notify the public of the project and sighting information required**.**

Brazil

Given the records of juvenile black-browed-albatross mortality in Brazilian longline fisheries, SAST worked closely with Tatiana Neves (Projeto Albatroz, Brazil) and funded the deployment of four months of observer coverage on longliners on the south and southeast coast of Brazil between 23ºS and 35ºS. Projeto Albatroz staff conducted 10 cruises during this period, representing a survey effort of 208 days at sea. SAST funding paid for four of these cruises. In addition, Projeto Albatroz co-ordinated a public awareness campaign aimed at providing information to merchant mariners, fishers and sailors. This resulted in Dr. Roberto

Wahrlich instructing at-sea observers from the Brazilian Observers Program to record sightings of marked birds between April and August 2002 (*Method 3* see below). This provided an additional 2353 days of anecdotal coverage in Brazilian waters. (The Brazilian Observer Program is coordinated by the Departamento de Pesca e Aquicultrura of the Agriculture Ministry in a partnership with the Universidade do Vale do Itajaí – UNIVALI). (See Appendix for a summary of Brazilian observer effort).

Three methods were used by Projeto Albatroz and Brazilian Observer Program observers and other at-sea observers in Brazil:

Method 1: Continuous ten-minute counts were conducted hourly using the same method as that used by SAST when conducting at-sea surveys (*sensu* Tasker *et al.* 1984, White *et al.* 2002). These counts were conducted during all daylight periods when the vessel was steaming. As fishing vessels attract seabirds which then associate with the vessel, several steps were taken to minimise recording ship associates.

Method 2: All seabirds present were counted at specific intervals during longline hauling (i.e. when each of the six radio beacons was hauled onboard).

Method 3: Anecdotal observations recorded during daylight periods when observers were on-deck.

<u>South America</u>

Colleagues in Argentina and Uruguay involved with observer programmes also assisted in the project by distributing information and data collection forms to at-sea observers and fishing companies. It is difficult to determine the level of coverage in these areas, but it is known that the seabird observer program in Uruguay was not in operation at the time of the project. In Argentina members of Foundacion Patagonia Naturale (FNP, Guillermo Harris, Esteban Frere, Patricia Gandini and Guillermo Caille) assisted by providing information to a range of observers and fishing companies, and Aves Argentina personnel (Fabian Rabuffetti, Buenos Aires) also informed pelagic observers and fishermen. In Chile, Carlos Moreno provided fliers to fisheries/seabird observers working between the Magellan Straits and Valdivia between April-July 2003.

<u>Southern Hemisphere (General)</u>

Up to of 41 CCAMLR observers were informed of the project, plus biologists onboard British Antarctic Survey ships conducting passages to and from British Antarctic Territory and South Georgia and either the Falkland Islands or mainland South America. Colleagues, pelagic tour operators, and tour ships in South Africa (including the Tristan da Cunha group), New Zealand and Australia were notified and information was posted on several seabird list servers. Merchant mariners were targeted by flier that was included with the mail-out of the *Marine Observer*, a quarterly journal published by the British Meteorological Office, which is distributed to over 1 200 merchant vessels worldwide. It is estimated that 60 of these vessels have regular trade routes from the UK to South America (via Atlantic coast), Australia (via cape Horn) and South Africa (via Atlantic coast) and up to half of these would be expected to be in the Southern Hemisphere at any one time. In addition, up to 130 vessels in Australia and New Zealand received information (J. Massey *pers. comm.*).

Results

In total, 70 sightings of marked albatross were received (Table 2, Figures 3 & 4). Fifty-eight of these sightings were made by observers in Brazil (23 by Projeto Albatroz observers and 34 by Brazilian Observer Program observers), six by a SAST observer south of Mar del Plata on a return trip from the Falkland Islands to Montevideo (Uruguay), three birds were sighted around the Mar del Plata region by an Aves Argentinas observer (Figure 3) and a fourth was sighted in this area from the coast. A single bird was also recorded by a BAS observer in oceanic waters to the north-east of the Falkland Islands (Figure 4). One bird was seen in South African waters, about 200km south of Cape Agulhas. The majority of sightings were associated with the shelf break, however, this may be a reflection of fishing effort, and therefore the extent of observer coverage. Despite the relatively high level of survey effort in Falkland Island waters not a single marked bird was recorded locally. In addition, no sightings were recorded in the southern Patagonian Shelf or in the Indian or Pacific oceans.

Seventy records out of a total of 16 537 marked birds equates to a sighting rate of 0.42%. Considering the enormous area of the Patagonian Shelf and shelf waters of northern Argentina/Uruguay and into Brazil, which totals to around 1.2 million km^2. The sighting rate was considered relatively high.

For each observation of an orange albatross, the distance from its colony of departure was calculated. The closest observation (and first) was more than 700 km away, whilst the furthest was 6,500 km away, with an average distance of 2,400 km from Steeple Jason. Using the average fledging date of 22 April (or the earliest fledging date of 13 April for earliest records), an estimate of the birds' speed was calculated. This ranged from 147 down to 26 km per day with an average speed of 58.7 km per day (adult average travelling speed is 20 km per day). These flying speeds are comparable to those obtained from satellite tracking adult black-browed albatross, which suggest that juvenile albatross acquire the flying capabilities of adults soon after fledging.

Figure 3. A colour marked bird sighted around Mar del Plata (Photo courtesy of Fabian Rabuffetti, Aves Argentinas)

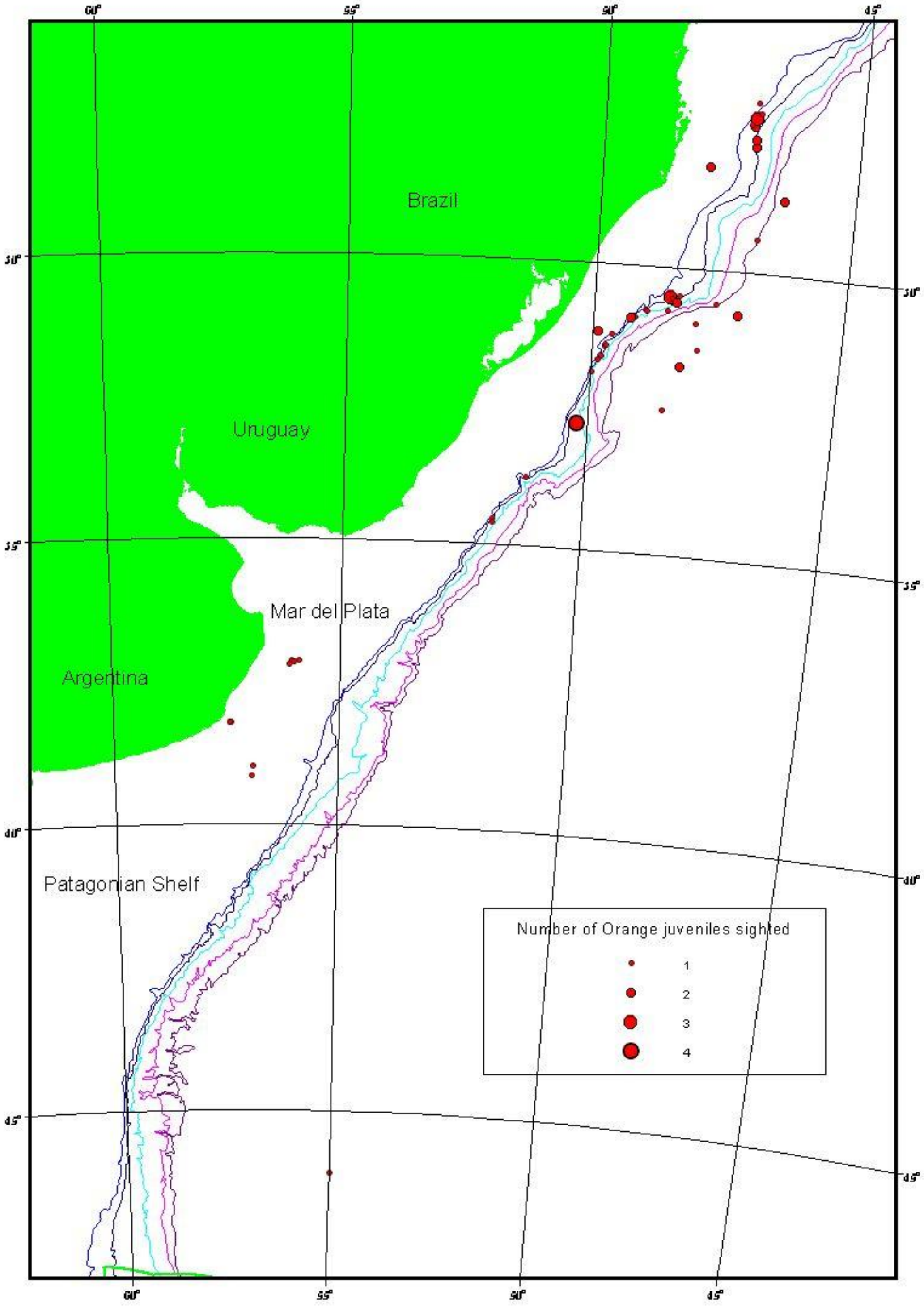

Figure 4. Location of recorded sightings in the South American region

Discussion

Colour marking has several advantages and disadvantages over traditional methods of determining seabird distribution, such as satellite tracking, ringing and more recently geolocators. Colour marking is relatively cheap compared to the purchase of satellite tracking equipment and satellite access. This affords the opportunity to mark and potentially track a larger sample size, which means that rather than relying on a few individuals with electronic tracking equipment a more representative picture of a population's movements can be obtained. However, unlike satellite tracking and geolocators, the level of sightings of marked birds is highly dependent on the level and extent of post-marking observer effort. In addition, because of potential biases introduced by repeated sightings, records can at best reflect the number of sightings, rather then the number of individual birds. Compared to ringing, which is also relatively cheap and can return long-term data, colour marking is a short-term option (i.e. the life span of the paint used) but one that due to the highly visible nature of the paint affords the opportunity for any at-sea, or even coastal observers, to record sightings. With these advantages and disadvantages in mind, our results can cautiously be interpreted.

Our sighting rate of 0.42% compares favourably with other colour marking projects conducted on black-browed albatross from Campbell Island in New Zealand in 1995, 1 000 black-browed albatross (*Thalassarche melanophris impavida*) were marked with Picric acid and 700 grey-headed albatross (*Thalassarche chrystomata*) were marked with Rhodamine B. In 1996, an additional 200 birds of each species were marked with Picric acid. The proportion of dyed black-browed albatross sighted were 0.042% in 1995/96 and 0.015% in 1996/97. Only a single grey-headed albatross was sighted in 1995 (Waugh 1998).

Movements of Falkland Island breeding adult black-browed albatross (as determined by satellite tracking and geolocators) has shown that they feed in different regions of the Patagonian Shelf throughout the year depending on the stage of their breeding cycle. During the incubation period birds forage predominantly in the northern reaches of the Patagonian Shelf, up to 41°S, while during chick rearing, birds forage locally in areas adjacent to breeding sites (Grémillet *et al.* 2000, Huin 2002). During both of these periods, no difference was detected in foraging range between males and females.

Geolocators provided insight in the winter distribution of adult birds. Unlike the breeding season, males and females foraged in different areas. Males extended their range north up to 37°S, but still remained on the Patagonian Shelf, whilst females went as far north as the Plata estuary at 33°S. At the same time females exhibited a proclivity to disperse loosely over open deep waters (as far as half-way to South Africa) or to switch to the Humboldt current (west of Chile). Detailed comparisons showed that throughout the winter period females and males foraged in different areas (Figure 5). It is assumed this is due to males and females separating their distribution based on competition for food resources.

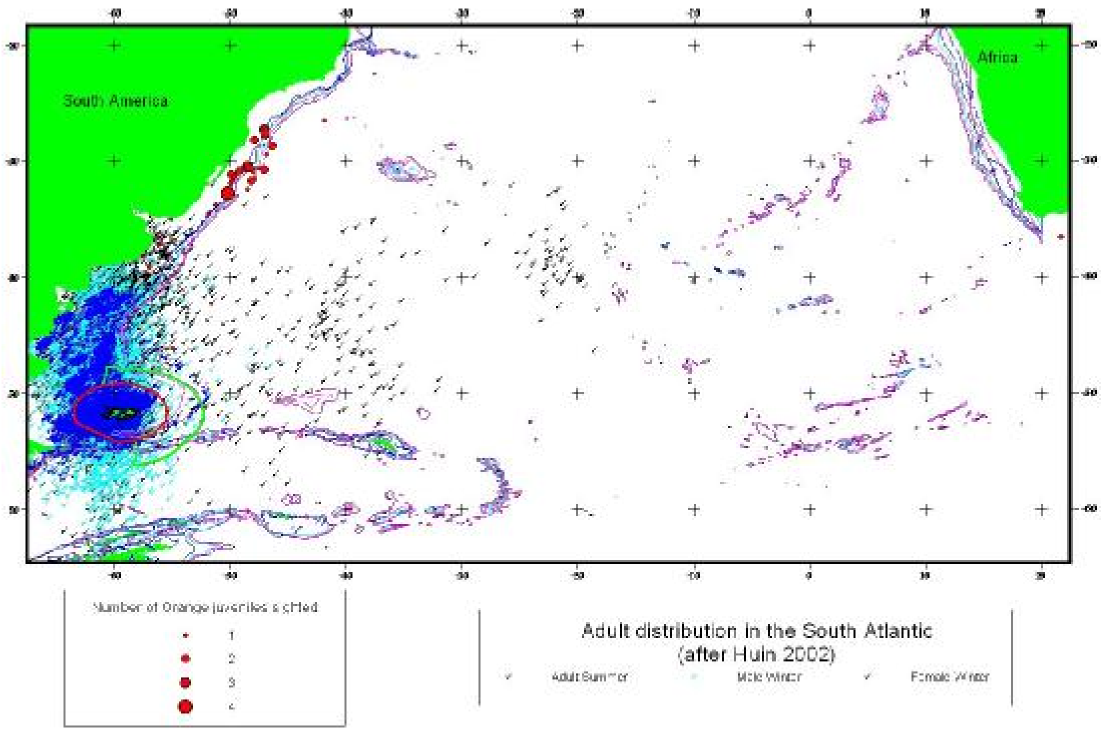

Figure 5. All recorded sightings (NB: South Africa) and the summer and winter distribution of adult breeding birds.

While the average distance travelled and flight speed provide an interesting insight into the flight capabilities of black-browed albatross, the results should be treated with caution as the calculations are based on the assumption that all birds fledged on a similar date and that birds are sighted when they first arrive in an area. Another problem arising from calculating the straight distance between two fixed points is that birds rarely fly in a straight line. Such error can be corrected with data obtained from satellite-tracked adults for whom the ratio of total distance travelled to maximum radius from the colony can be calculated. Unlike breeding adult birds which return the their nests during the breeding season, chicks do not return for several years so we estimated such a ratio for a one-way trip at 2.36. This means that all birds observed (between end of April and mid-August) already travelled between 1,700 and 15,200km, with an average of 5,600 km. These figures are almost certainly an underestimate, particularly for the latter sightings (end of June onwards).

In this study all sightings of juvenile black-browed albatross were outside and predominantly north of the distribution of adults during the breeding season, and outside the distribution of adult males throughout the year. Eleven sightings (16%) of juveniles occurred where a relatively high abundance of adult females were recorded in the winter and a total of 18 (26%) were seen within the overall adult female range in winter. However, based on geolocator data, 16 of these 18 sightings of juveniles occurred at a time of year when adult females do not use the area. The remaining 74% of sightings occurred north of the year-round range of all adults. The record from South Africa is twice as far east as any recorded adult movement. This is supported by the results of one trip in Brazilian waters (22 June to 15 August 2002) when a total of approximately 2,500 black-browed albatross were recorded, only one of which was an adult. On the four days aboard the *HMS Leeds Castle* outside local waters (north to Montevideo), a total of 506 black-browed albatross were recorded, of which 476 were adults and 30 juveniles. The vastly different proportion of adults:juveniles in Brazilian and Argentinean waters is further evidence to support the satellite tracking and geolocator data (Huin 2002, *unpubl. data*) As previously discussed, this is also reflected by the fact that 97% of longline black-browed albatross mortality recorded in Brazilian waters are juveniles (Neves & Olmos 1998, Olmos *et al*. 2000).

Geolocator data shows that adult females not only forage further north than males, but a small proportion of females (around 10%) move to oceanic waters to the east of the Patagonian Shelf. The 1:2.9 ratio of juvenile male to female black-browed albatross mortality in the pelagic tuna fishery in Brazilian waters (Neves and Olmos 1998), suggest that like adult black-browed albatross, the foraging distribution of juveniles may also be segregated based on sex. The one sighting of a juvenile in oceanic waters to the north east of the Falkland Islands and the one record from South Africa, suggest that a proportion of juveniles also disperse into deeper oceanic waters to forage. Given the low observer coverage on the high seas it is not surprising that only two colour-marked birds were sighted. As previously discussed colour marked birds only provide potential sightings for a short period of time, so while they can provide information on the initial dispersal pattern of fledglings it provides no insight into where birds forage in the 4-6 year period prior to returning to the islands to breed.

The lack of recorded sightings from Falkland Island waters, despite the high level of observer effort, suggests that juvenile birds travel north out of local waters immediately after fledging. This is further supported by results of at-sea surveys conducted in local waters since 1998, which have recorded very few juvenile black-browed albatross (White *et al.* 2002). Due to biases introduced to the data set by the concentration of survey effort in Brazilian waters and to a lesser extent Falkland Island waters, it is more difficult to interpret the significance of the lack of sightings from the southern Patagonian Shelf. The recorded sightings further north in Argentinean waters (around Mar del Plata) in late May and early June suggests that juveniles do not simply pass through the northern reaches of the Patagonian Shelf on their way further north but a proportion of them, at least, use these areas as foraging grounds. Possibly, juveniles pass through the southern reaches of the Patagonian Shelf relatively quickly on their passage north, or pass over the shelf break and oceanic waters further to the east. The single record on the high seas north-east of Falkland Island waters is insufficient to support this argument, but it does pose the question as to whether the lack of records in the southern reaches of the Patagonian Shelf is due to juveniles avoiding competition with foraging adult males and females not only by foraging further north, but also by reaching those areas by travelling north by east at a great travelling speed.

Our results further emphasise the importance of Brazilian waters and the northern reaches of the Patagonian Shelf for juvenile black-browed albatross. Although no longline mortalities of marked birds were recorded the prevalence of juvenile birds in Brazilian waters in combination with their relatively high levels of mortality in this area clearly exhibit the importance of the region for the conservation of the Falkland Islands black-browed albatross population, at least, the high proportion breeding in the Jason Islands The fact that only 0.06% (14 juveniles) of band recoveries of birds from South Georgia were recovered in the South Atlantic is further evidence that the juvenile black-browed albatross killed in Brazilian waters are most likely to be Falkland Island bred birds (see also Tickell 1967 for separation between South Georgia and Falklands birds). While it is still uncertain what relative importance the mortality of juvenile black-browed albatross has in the currently high level of their population decline it is certain that reducing juvenile mortality in Brazilian waters will significantly increase the number of new birds recruited into the adult breeding population. Declines in recruitment into the breeding population have been shown to be critical factors in the decline of black-browed albatross populations in both South Georgia (Croxall et al. 1998) and the Crozet Islands (Weimerskirch and Jouventin 1998).

Acknowledgements

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Brazil

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