MACQUARIE ISLAND NON TARGET BIRD MORTALITY, SPECIFICALLY IN RELATION TO GIANT PETRELS - INTERIM REPORT

Biodiversity Monitoring Section, Resource Management and Conservation Division, DPIPWE

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1. BACKGROUND

1.1 Status of Giant Petrels on Macquarie Island

Macquarie Island is a haven for seabirds, with millions of individuals comprising 23 species breeding on the island. Despite the abundance of some species, particularly penguins, thirteen of these bird species are listed as threatened species under Tasmanian Threatened Species Protection Act 1995, including the two species of giant petrel, Northern (*Macronectes halli*) and Southern (*M. giganteus*). Both Northern and Southern giant petrels are also listed as threatened species under the EPBC, and the National Recovery Plan for Albatrosses and Giant Petrels (http://www.environment.gov.au/biodiversity/threatened/publications/recovery/albatross/foraging.html) has recently been revised (pending approval). Both species have a circumpolar distribution, and in Australian territories, Northern giant petrels breed on Macquarie Island, whilst Southern giant petrels breed on both Macquarie and Heard Islands.

Common name	Species Name	TSPA status	EPBC Status	IUCN status	Population on Macq Isl. (annual breeding pairs)	Population trend	Global population (% Macq Is. population)
Northern giant petrel	*M. halli*	Rare	Vu	LC	1829 (2010/11)	increasing	11,800 (15.5%)
Southern giant petrel	*M.giganteus*	Vu	En	LC	2534 (2009/10)	stable	50, 170 (5.0%)

A recent global assessment of the speciation and phylogeography of giant petrels, including birds from Macquarie Island confirmed the presence of subpopulation structuring in both species (Techow. M., C. O'Ryan; R.A. Phillips, R. Gales; M. Marin; D. Patterson-Fraser; F. Quintana; M.S Ritz; D.R Thompson; R.M Wanless; H. Weimerskirch; P.G Ryan (2009) Speciation and phylogeography of giant petrels Macronectes. Molecular Phylogenetics and Evolution.doi:10.1016 /j.ympev.

2009.09.005). Southern giant petrels from Macquarie Island clustered with populations from South Georgia and the Indian Ocean, whilst Northern giant petrels were most similar to populations from Crozet and Prince Edward islands.

Both species of giant petrels are also listed in Annex 1 of the Agreement on the Conservation of Albatrosses and Petrels (ACAP). ACAP is a multilateral agreement which seeks to conserve albatrosses and petrels by coordinating international activity to mitigate known threats to albatross and petrel populations. ACAP came into force in February 2004 and currently has 13 member countries and covers 29 species of albatrosses and petrels. The ACAP Secretariat is based in Hobart, and DPIPWE's Rosemary Gales is the Convenor of the ACAP Status and Trends Working Group which coordinates global assessments of the conservation status of these species.

Under the Australian Antarctic Program, the Biodiversity Monitoring Section of DPIPWE has monitored the conservation and population status of albatrosses and giant petrels on Macquarie Island annually since 1994 (Chief Investigator: Dr Rosemary Gales (DPIPWE), Co-investigators: Rachael Alderman (DPIPWE), Dr Geoff Tuck (CSIRO), Dr Richard Phillips (British Antarctic Survey)). This ongoing monitoring program has provided long term and robust data relating to the population status of these species. For the giant petrels, this monitoring program includes reliable counts of annual breeding pairs, as well as estimates of breeding success. These data are provided to DEWHA annually as well as to ACAP (Agreement on the Conservation of Albatrosses and Petrels (www.acap.aq) global albatross and petrel database. Satellite tracking has provided information on the at-sea distribution of these birds (Trebilco, R., Gales, R., Baker, G.B., Terauds, A., and M.D. Sumner. (2008) At-sea movement of Macquarie Island giant petrels: relationships with marine Protected Areas and Regional Fisheries Management Organisations. Biological Conservation 141: 2942-2958.). Banding of chicks has also provided information on pelagic distribution, as well as providing a population of known-age individuals. Importantly, this program provides the ability to measure the impacts of anthropogenic activities.

Fisheries bycatch is widely recognised as a major source of mortality of albatrosses and petrels globally. Demersal longline fishing for Patagonian toothfish is undertaken in commonwealth waters adjacent to Macquarie Island. Recognising the vulnerability of Macquarie Island seabirds to interactions with this fishery, AFMA requires that a raft of mitigation measures are implemented. Included in these are seabird bycatch limits. In the case of Northern and Southern giant petrels, if two birds are killed as a result of interactions with fishing gear, then longline fishing ceases for the remainder of the season.

1.2 Macquarie Island Pest Eradication Plan (MIPEP)

The Macquarie Island Pest Eradication Plan (MIPEP) aims to eradicate rabbits, rats and mice from the island. The operation involves aerial broadcast of an anti-coagulant poison, brodifacoum, followed by 3-5 years of hunting. The nature of the bait results in the potential for both primary and secondary poisoning of non-target species, and in relation to Macquarie island fauna, these species are most likely seabirds that remain resident on the island during the winter months. In order to minimise the environmental impacts of the program, the aerial baiting operation was scheduled for winter months when most wildlife is absent from the island. The Environmental Impact Statement prepared by PWS assessed the risk of primary and secondary poisoning of these species and concluded that impacts of the baiting operations were unlikely to be significant.

Aerial broadcast of 8% of baits in coastal areas occurred on 5 occasions between 5th and 29th June 2010. Comprehensive island baiting was not completed due to persistent inclement weather. After the baiting operations ad hoc searches discovered dead birds which upon necropsy were confirmed to have died as a result of poisoning. This then lead to more intensive searches of coastal areas. When BCB was informed of the extent of the bycatch, specific requests for additional information were forwarded to the MIPEP program manager. These included request for tissue samples for determination of gender (and potentially species), GPS coordinates of carcase location, and information on carcase condition. By 21 September 2010, a total of 736 birds had been recovered dead, 275 (37 %) of which were reported to be northern giant petrels.

Table 1: Summary of bird species found dead following bait drop

Common name	**Species Name**	**Population on Macquarie Island (annual breeding pairs)**	**Population size accuracy**	**Number carcases found (% of total)**
Northern Giant petrel		1829 (2010/11)	High	275 (37.4%)
Southern Giant petrel		2534 (2009/10)	High	10 (1.4%)
Kelp gull		"hundreds"	Low	354 (48.1%)
Subantarctic skua		1030 (a)	Medium	78 (10.6%)
Mallard		??		1 (0.1%)
Black duck		??		18 (2.4%)
Total				**736**

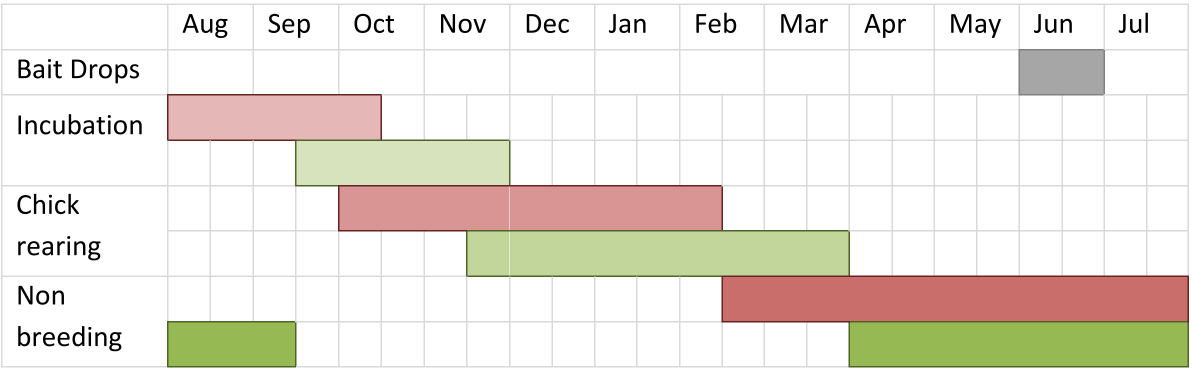
(a) 2009/10 survey of 30% of the island documented 0.08 nests/hectare (total island area 12875 ha)

2. OBJECTIVES OF REPORT

The objectives of this report are to provide a context to the incidence of non target mortality, particularly with respect to the impact on giant petrels. The information that is available from the nature and extent of the poisoning of non target species is synthesised with information that has been obtained from the long-term DPIPWE seabird population programs that have been conducted on Macquarie Island since 1994. This will enable the extent of the mortality to be more accurately assessed, to better identify the level of risk posed by the full implementation of the eradication program, and inform consideration of appropriate potential mitigation options, and to provide advice on issues for consideration in subsequent eradication efforts.

3. STATUS AND TRENDS OF MACQUARIE ISLAND GIANT PETRELS

Figure 1: Approximate Breeding Chronology of Giant Petrels on Macquarie Island.



(Red = NGP, Green = SGP)

3.1.1 Southern Giant petrels

Size dimorphism is pronounced; morphometrically males are up to 15% larger and can weigh up to 40% more than females.

Although *SGPs* breeds annually in loose colonies, breeding activities are interspersed with "sabbatical" periods; non-breeding periods lasted on average 1.4 years and occurred approximately every 1.7 years at Ile de la Possession. In one year, some 15-40% of breeders were deemed to be on sabbatical. Whilst birds may attend the colony all year most birds arrive at colonies from July – August through to September, depending on latitude and location. At the Antarctic sites, eggs are generally laid in mid-October to mid-November, over approximately a 21 day period. Laying tends to be earlier at lower latitudes, starting in late August on Gough Island, and late September on Marion Island, Macquarie Island and Iles Crozet. On average, eggs are incubated for *c*. 60 days, hatching late October to late January; egg losses tend to be noticeably higher than chick losses. Young chicks are brooded and guarded for 24-26 days until they attain thermal independence. Males deliver food to the chicks more frequently than do females; male chicks fledge later and with a higher body mass than females. Chicks fledge from March to late May, generally *c*. 100–130 days after hatching. In Patagonia, the fledging period lasts from late March to late April after only 86-125 days in the nest.

Failed breeders do not lay a replacement egg but tend to remain in the colony for up to nine days after loss of the egg. Although young birds may return earlier to the colony, (earliest return recorded at 2.5 years), age of first breeding is around 5-6 years, with a peak at 7-8 years on South Georgia , and 9-11 years on Macquarie Island.

Although *SGPs* exhibited a high degree of fidelity to their breeding island, the location of their actual nest sites appeared rather “unstable” as nests were rarely used in two consecutive years, instead, colonies moved to another area in the general vicinity of the previous location.

Adult survival rates are generally high, with 84% and 91.7% being recorded at Prince Edward islands and South Georgia respectively. There are no data for adult or juvenile survival rates at Macquarie Island. Between 1996 and 2007, breeding success at Macquarie Island has averaged 45.6% (+/-7.5%).

SGP’s primarily nest in colonies around the coastal flats of Macquarie Island, Figure 2. A few birds nest singly, and there are a small number of nesting sites on the plateaux. Colonies range in size from one to over 100 breeding pairs. SGPs are frequently found nesting in close association with NGPs. In 1994/95 a breeding success area in the south of the island was established, these being censused in late October and again in March. Whole island censuses have been conducted in most years since then, resulting in annual estimates of breeding effort and success.

Globally populations of SGPs are showing different trajectories, some populations increasing and others decreasing. A recent assessment of global trends indicated that the declines do not approach the threshold for classification as Vulnerable, and the species has been down listed by the IUCN from Near Threatened to Least concern.

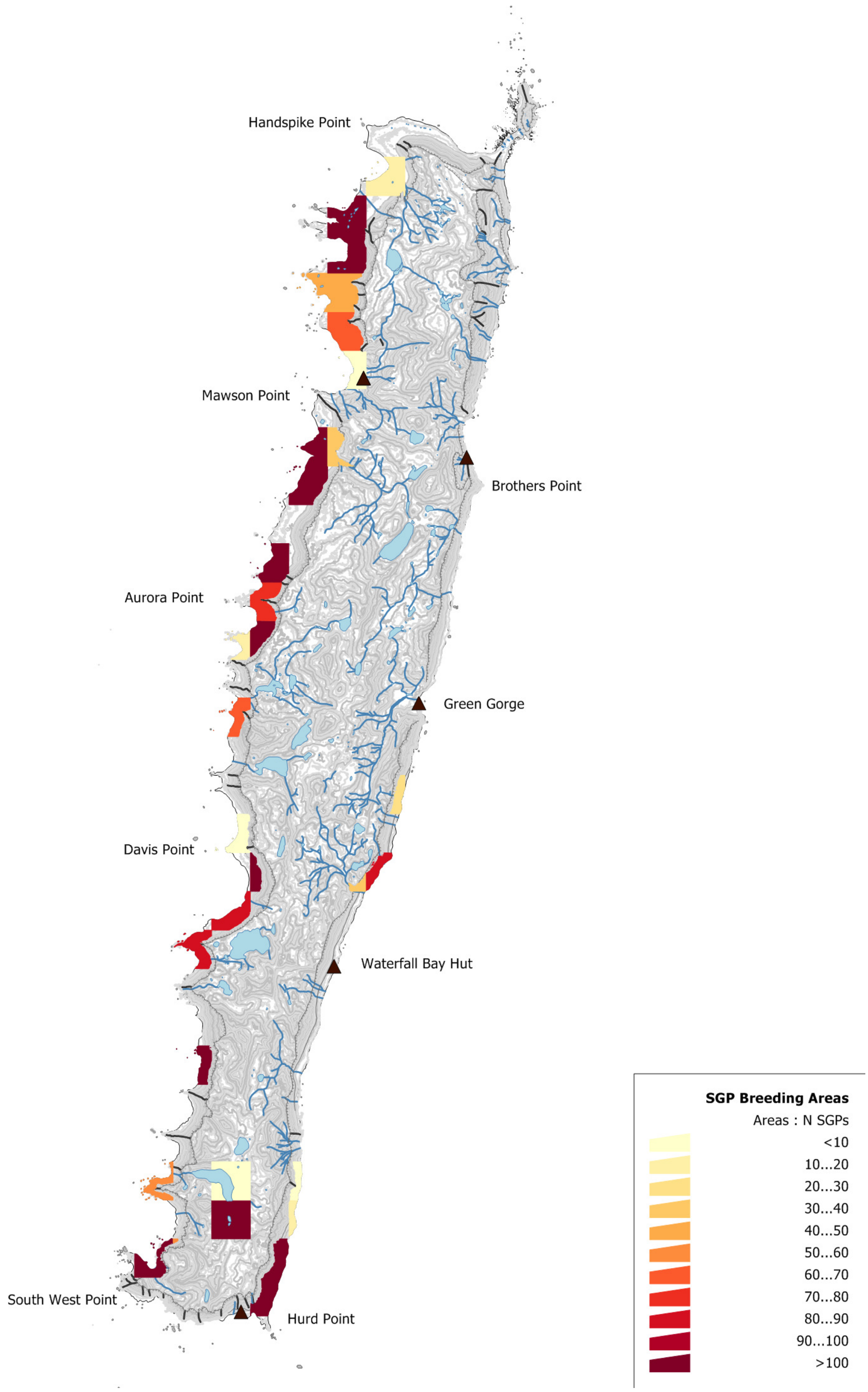


Figure 2: Breeding location and density of SGP's on Macquarie Island.

On Macquarie Island counts of the breeding population have been conducted on 13 occasions between 1995 and 2009. The annual population size has varied between 1969 and 2588 pairs each year, the most recent assessment of 2534 pairs being obtained for the 2009/10 breeding season. Overall the population trend for this population is **stable** (TRIM result: 0.85%, not significant).

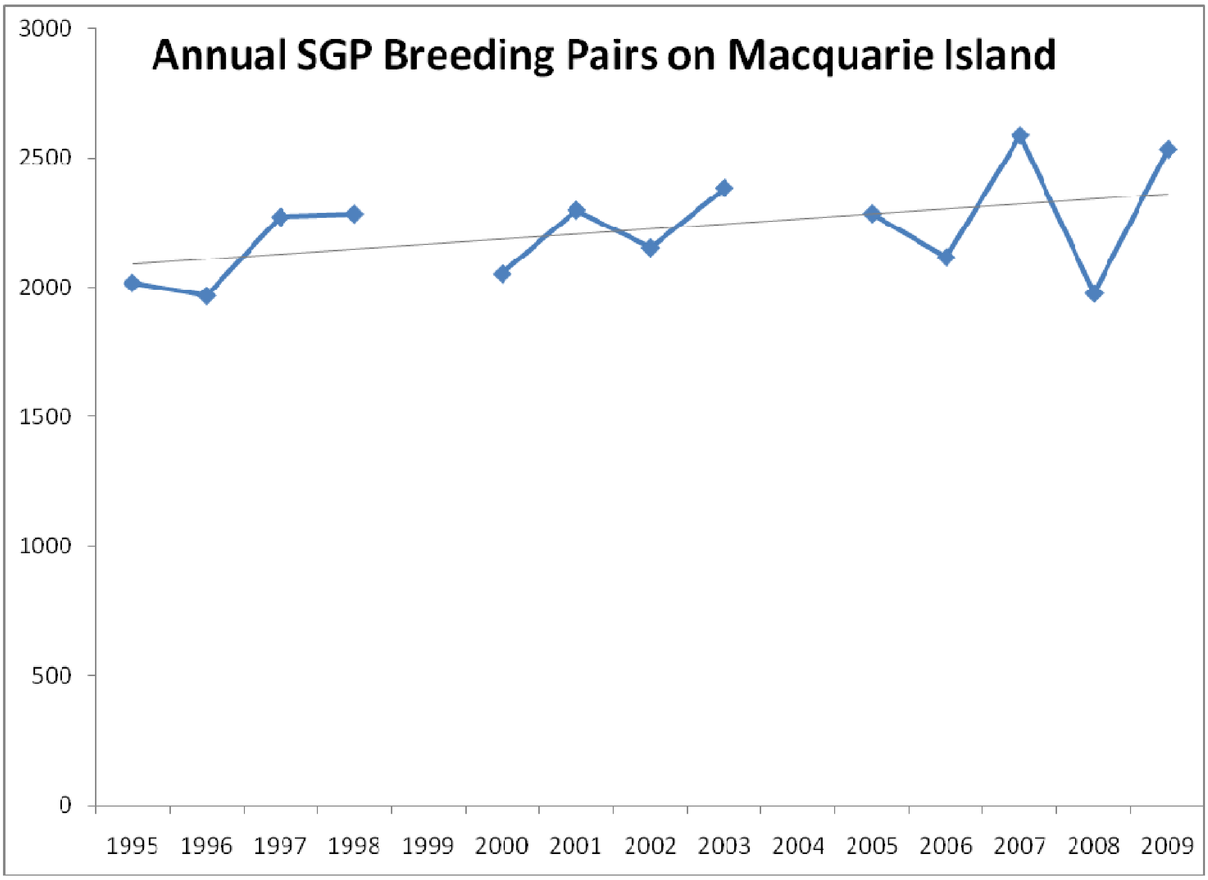


Figure 3: Estimated annual breeding pairs of SGPs on Macquarie Island.

3.1.2 Northern Giant Petrels

NGPs are surface-nesting colonial or solitary annual breeders. This species exhibits strong fidelity to their breeding islands and also strong pair bonds, generally mating for life. No differences in seasonal or gender plumages exist, but males are larger with heavier bills. In locations where both giant petrel species breed, *SGPs* begin egg laying about six weeks after *NGPs*, which reduces competition given the similarity in diets and foraging range. While some birds are present at colonies over winter, the breeding season generally begins in August when birds arrive at the colonies and lay a single egg between August and early October. Both sexes share incubation (59-60 d) and food provisioning duties. Males spent a significantly greater proportion of time incubating on South Georgia whereas females took a greater proportion of incubation shifts on Marion Island. Chick rearing period on Marion Island was 120.1 d ± 4.0 d for male chicks and 114.3 d ± 2.5 d for female chicks; female chicks weighed 82% of male chick mass prior to fledging. On South Georgia, female chicks also took 114.3 ±2.8 d but males took only 109.8 ± 2.1 d to fledge. Age of first breeding is at least 4-11 years; sabbaticals, or non-breeding periods, are common and were recorded at Île de la Possession, Crozet archipelago for 15-40% of adults each year (source: ACAP species assessment).

Adult survival rates are generally high, with 88-93% recorded at South Georgia and 92.3% being recorded at Iles Crozet. There are no data for adult or juvenile survival rates at Macquarie Island. Breeding success at Macquarie Island has averaged 66%, ranging between 53 and 72% pa.

Northern giant petrels breed around most of Macquarie Island's coastal flats (see Figure). In 1994/95 a study area in the NW of the island was established to document breeding effort and success. Whole island surveys have also been undertaken in some years, in order to estimate the entire island population. As this species was identified as potentially being at risk of poisoning, the whole island surveys were conducted most recently in 2007/08 and 2010/11.

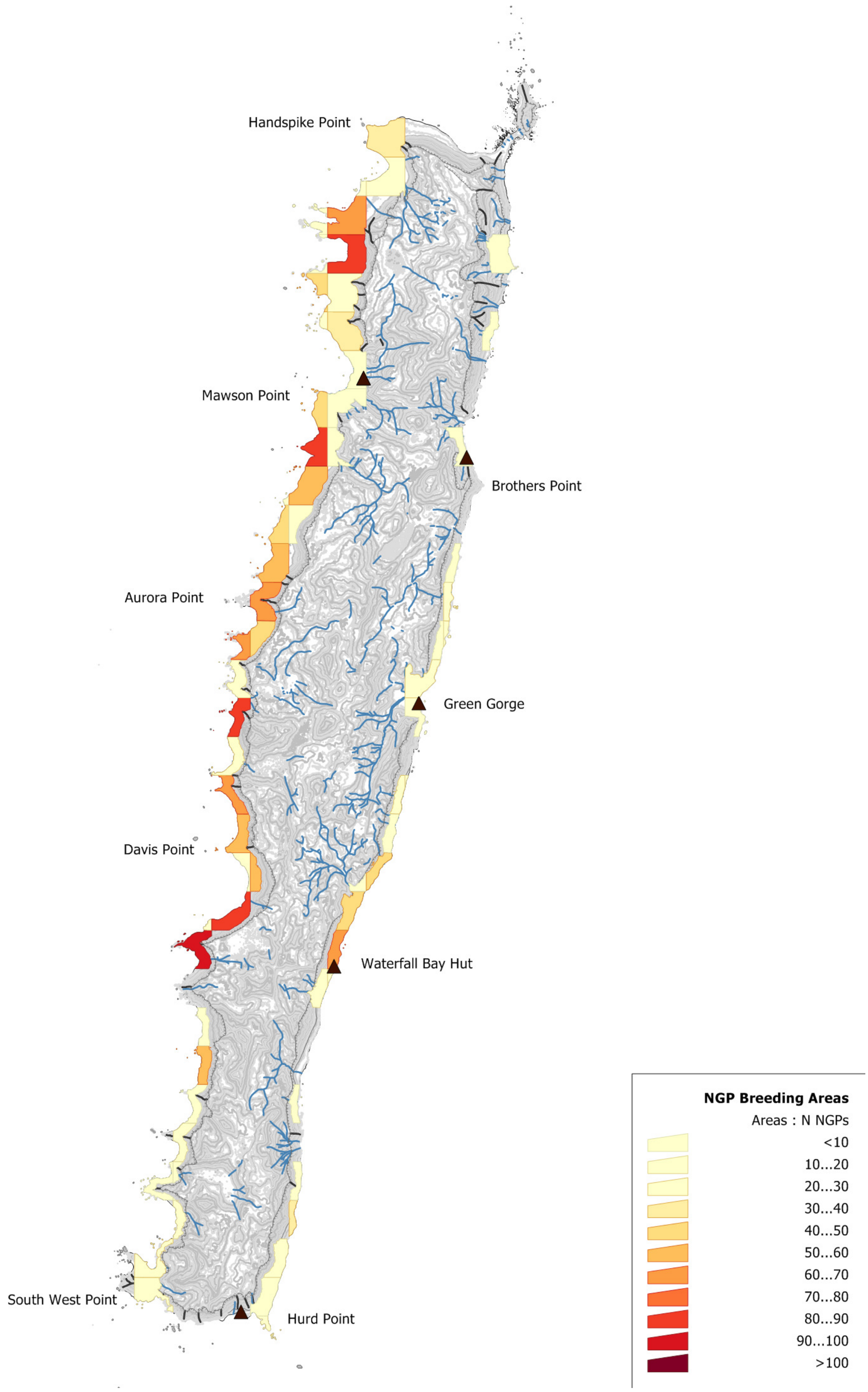


Figure 4: Breeding location and density of NGPs

Across their range, NGP populations have shown both decreases (as a result of bycatch associated with longline and trawl fishing operations) and increases (as a result of increased food availability resulting from increasing seal and penguin populations and increased offal discharge from fishing vessels). In 2009 IUCN down listed NGPs from Near Threatened to Least Concern as predicted declines in the global population did not eventuate.

On Macquarie Island, based upon the NW study colony which comprises 26% of the total population, the population has been undergoing a moderate **increase** at a rate of 2.3% p.a. (1996-2010 data, TRIM analyses). A whole island census in 2007/08 reported a total population of 1840 breeding pairs, very similar to the count of 1829 pairs counted in September 2010. Breeding effort in the NW study area in 2009/10 was 479, compared to 495 in the 2010/11 season.

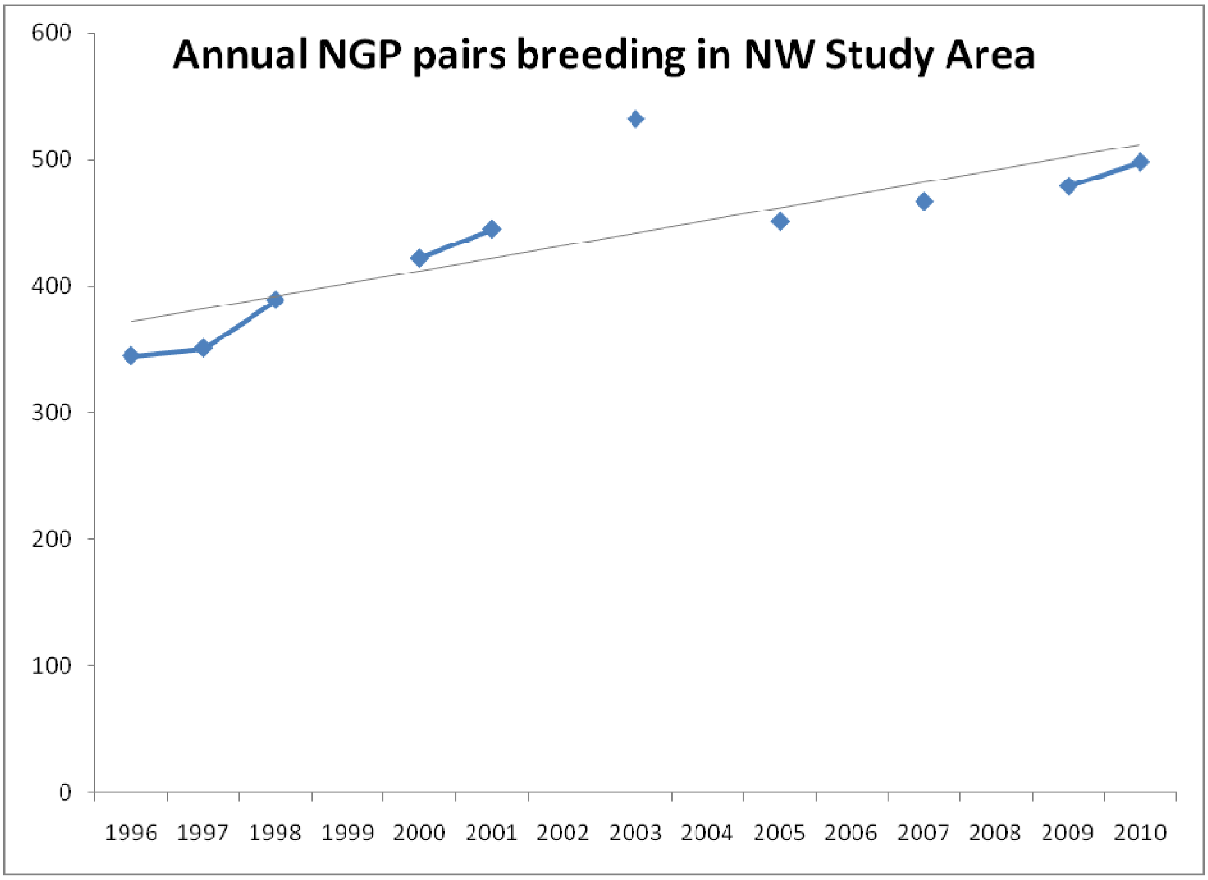


Figure 5: Estimated annual breeding pairs in the NW “Featherbed” study area (approximately 25% of total island population).

3.1.2 Skua population trend

The total number of skua breeding pairs within a defined census area, representing approximately 30% of the total area of Macquarie Island, has been counted in 1974, 1983, 2004, 2008 and 2009. TRIM analysis of this data shows the population is **stable** (a non significant average increase of 1.1% per annum over the time period).

4. SEASONAL ABUNDANCE OF IMPACTED SPECIES

In order to minimise impacts on non-target species the bait drops were scheduled for the winter months when most species are absent from the island. Some species however are known to remain on the island over winter, and so may be vulnerable to impacts from MIPEP. To determine temporal variation in the numbers of these species during the year, BCB and PWS have coordinated monthly counts along four transects covering both coastal and plateau landscapes. These counts have occurred each month since May 2007. Most species were found to be in low numbers during the winter months, except kelp gulls and giant petrels which were still recorded in large numbers in some months.

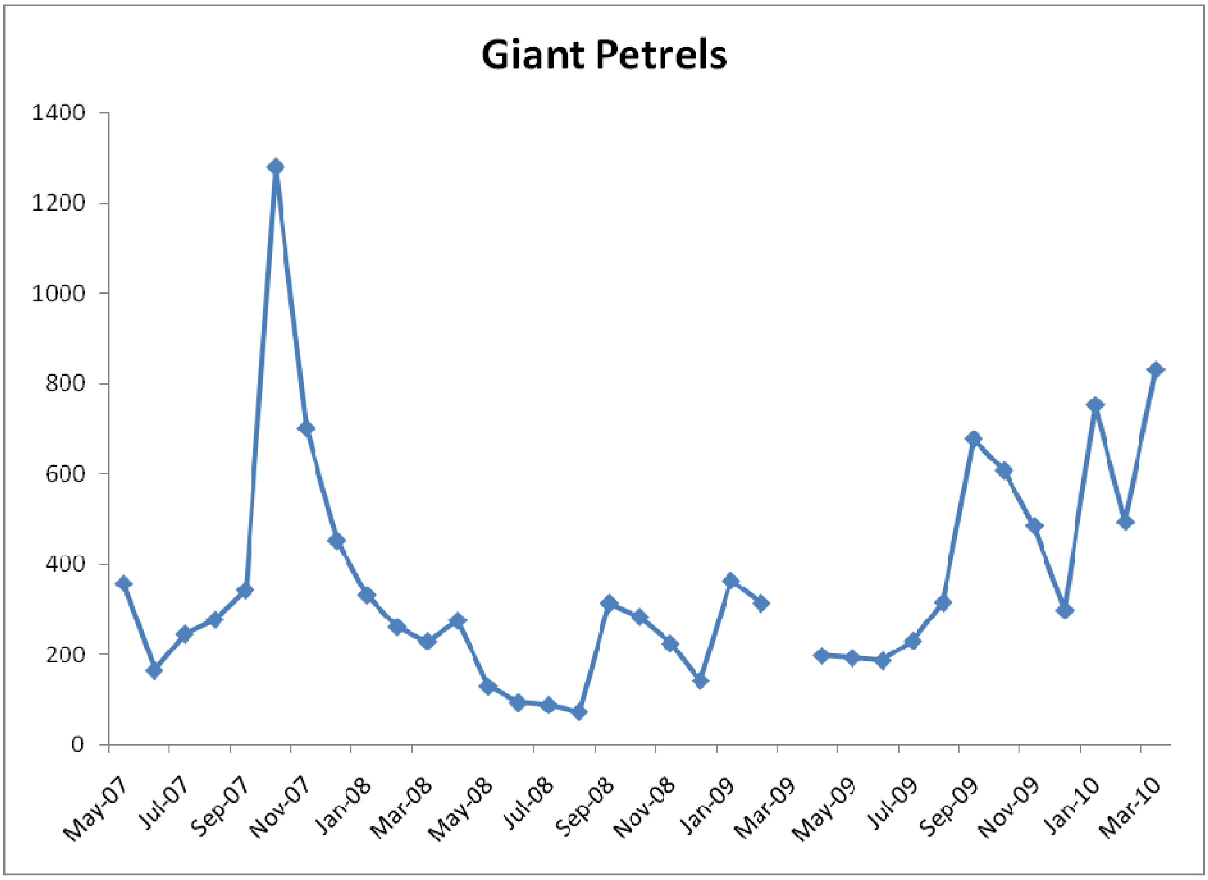


Figure 6: Seasonal abundance of Giant Petrels (species not distinguished) from Monthly counts

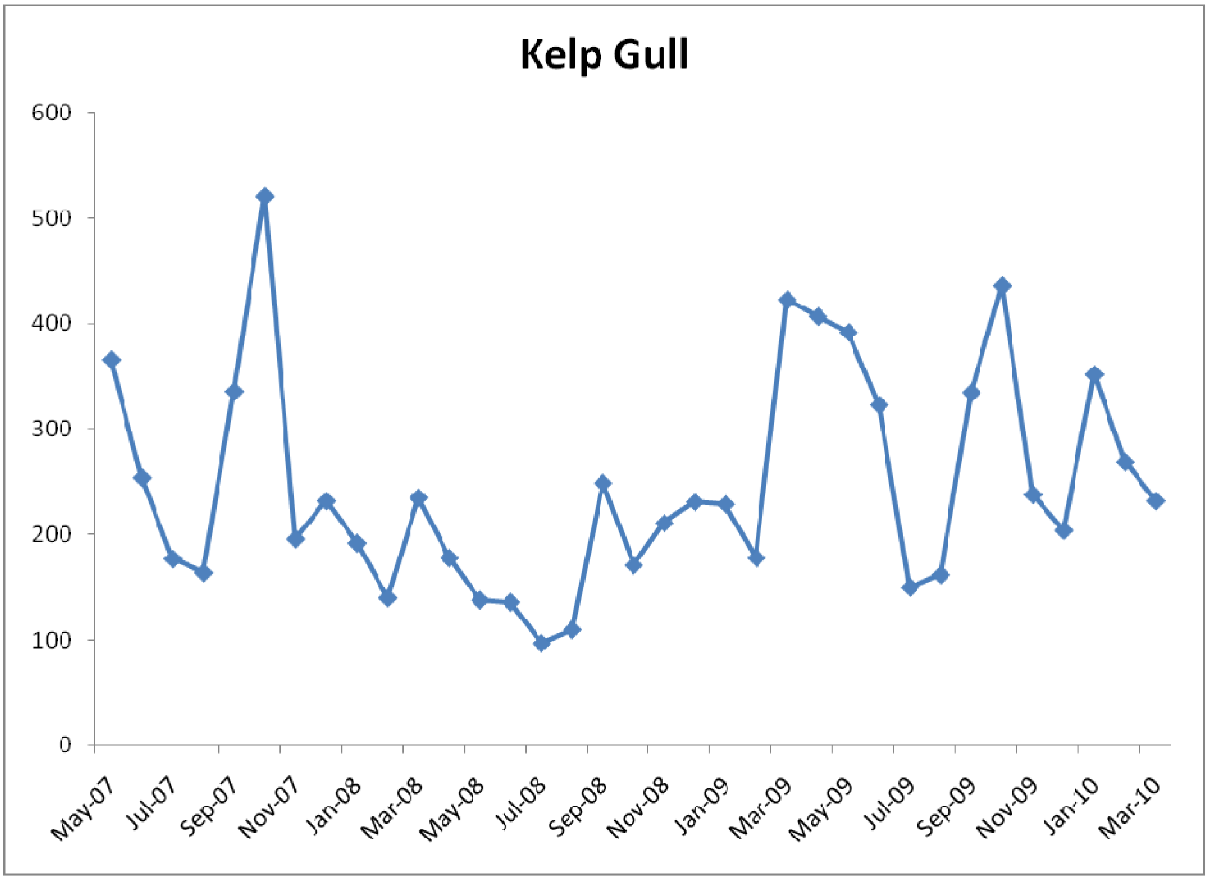


Figure 7: Seasonal abundance of kelp gulls from monthly counts

The time series depict the abundance of giant petrels (species not discriminated in counts), kelp gulls and skuas which together comprised over 95% of the non-target mortality. Giant petrel abundance varies of the year, with fewest birds being observed in June in all years. However there is marked annual variation in abundance and this, together with the persistence of these species on the island over winter makes scheduling baiting operations to coincide with limited bird abundance challenging. Similarly kelp gulls remained in high numbers throughout the year. Skuas however were rarely observed on the transects between May and August, after which they return to the island in large numbers in September at the beginning of the breeding season (note: aggregations of skuas have been observed during August elsewhere on the island).

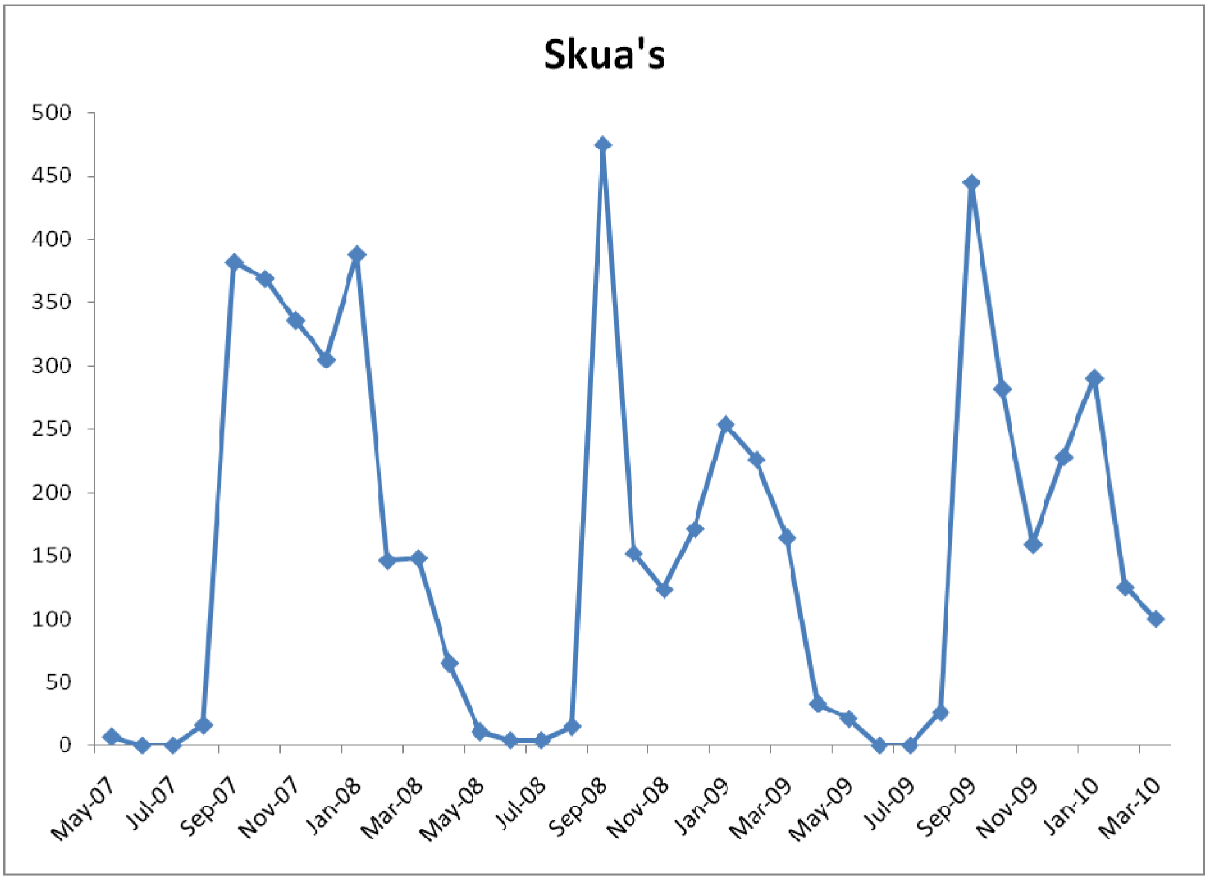


Figure 8: Seasonal abundance of Skua's from monthly counts.

5. CHRONOLOGY OF BAITING AND IMPACT

Eight percent of the poison was broadcast on five occasions on Macquarie Island between 5th and 29th June 2010. Aerial baiting of North Head occurred from the station on 5th June, and the coastal areas at the south of the island were baited on four occasions (19th, 21st, 27th, and 29th June 2010), The following map shows the areas that were baited during this period.

Figure 9: Locations of bait broadcast: June 2010.

Following the discovery of non-target wildlife, ad hoc searches were undertaken in an effort to understand the extent of the impact. The following graphs illustrate the timing of detection of dead seabirds. It is important to note that the searches were not conducted systematically and so the temporal patterns should not be over-analysed, i.e. periods where dead birds are absent likely reflects limited search effort rather than no mortality. The red diamonds indicate the timing of the baiting operations. With respect to the skuas the recent increase in numbers of dead birds reflects their return to the island and scavenging of dead rabbits and birds, see Figure 12. During the September NGP survey, debilitated skuas were also observed showing symptoms of poisoning, and so the number of skuas affected will likely increase. Many of the carcases of gulls and giant petrels that were detected in September had been dead for several weeks, with only small numbers being classified as "freshly dead". Data on the condition of carcases found, including indication of scavenging and time since death, were not routinely collected. Bait was still evident on the ground in September, but the toxicity at this time is unknown. Whilst some birds continue to be impacted via secondary poisoning (three months after the baiting operations) it is expected that these numbers will continue to decrease as the baits decay and as alternate food sources on the island increase (with the return of elephant seals and penguins to the island).

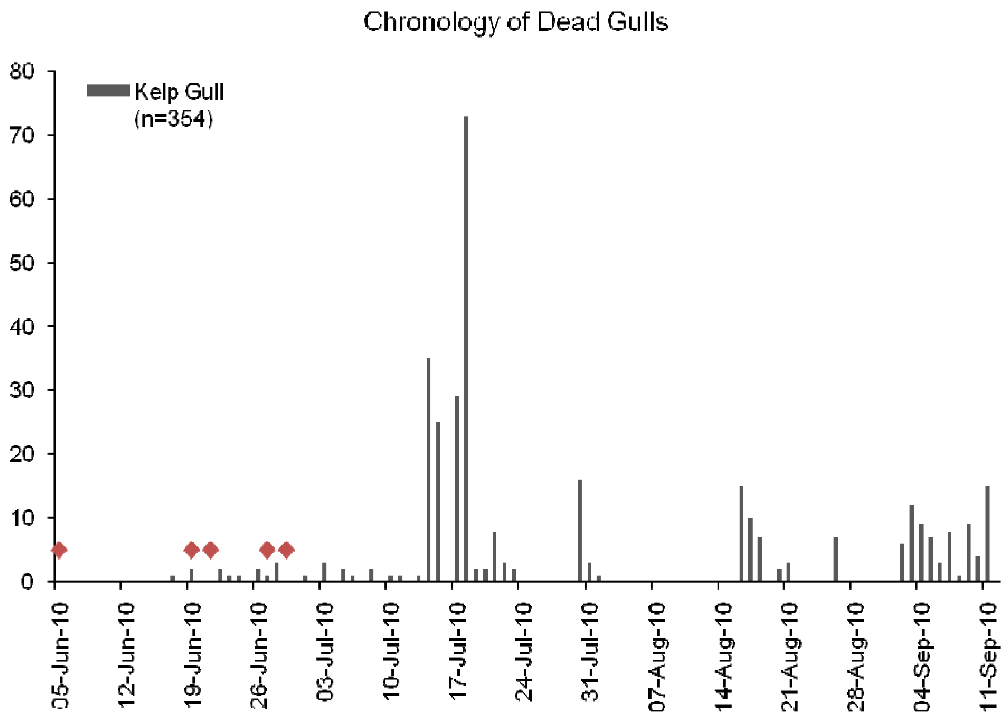


Figure 10: Dates of detection of dead kelp gulls (n=grey bars) following baiting (red diamonds)

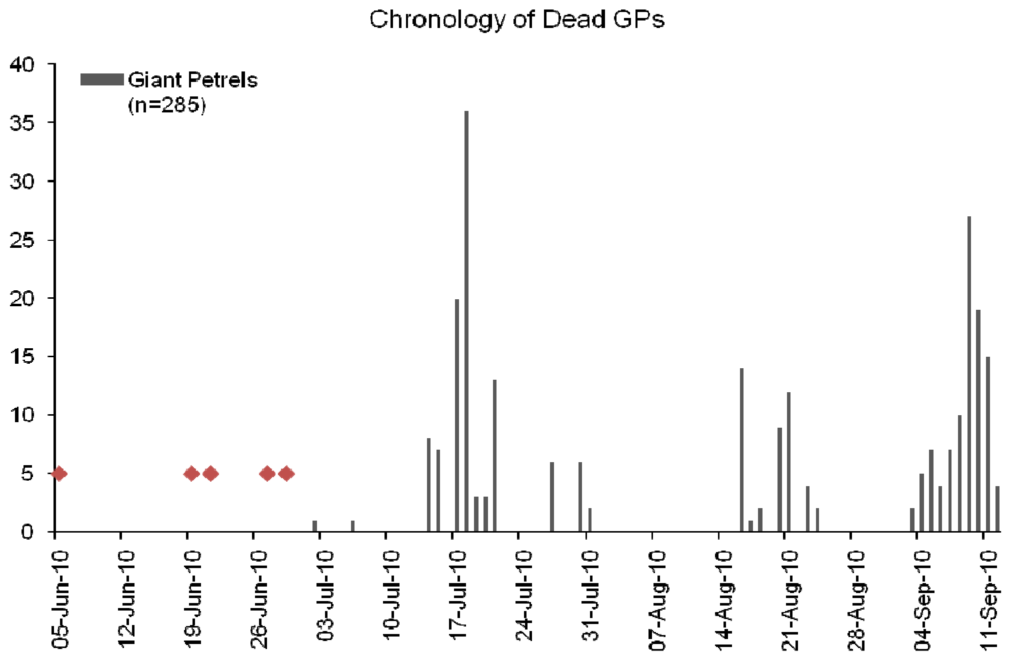


Figure 11: Dates of detection of dead giant petrels (n=grey bars) following baiting (red diamonds)

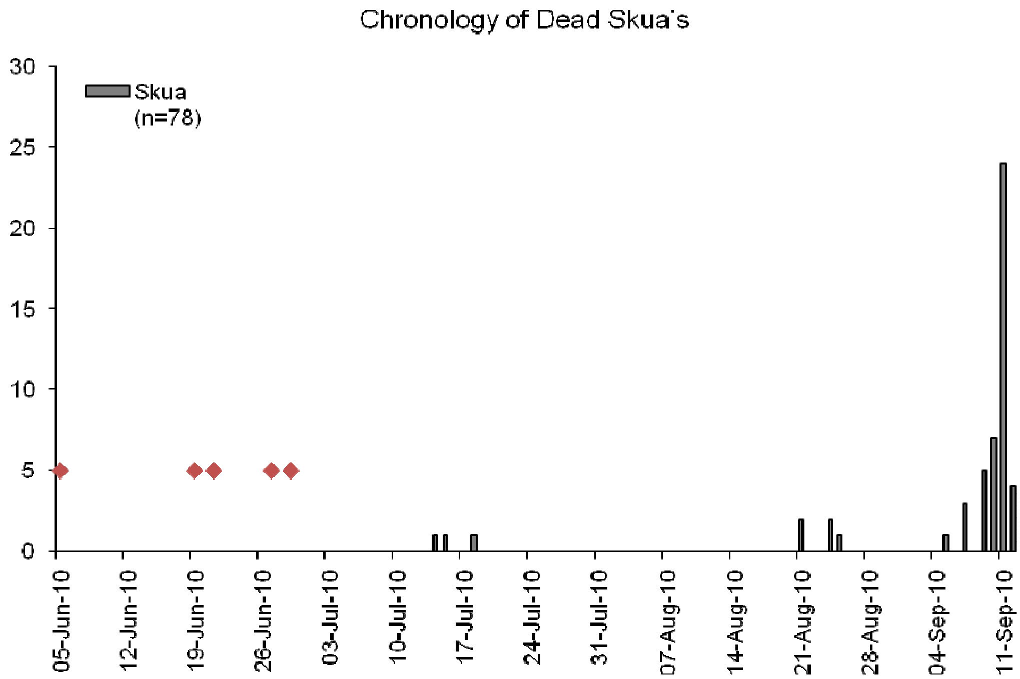


Figure 12: Dates of detection of dead skua's (n=grey bars) following baiting (red diamonds)

6. DETAILS OF DEAD BIRD RECOVERIES

Despite the baiting operations being restricted to North head and the south of the island, giant petrel carcases were found widely distributed on both the west and east coasts of the island.

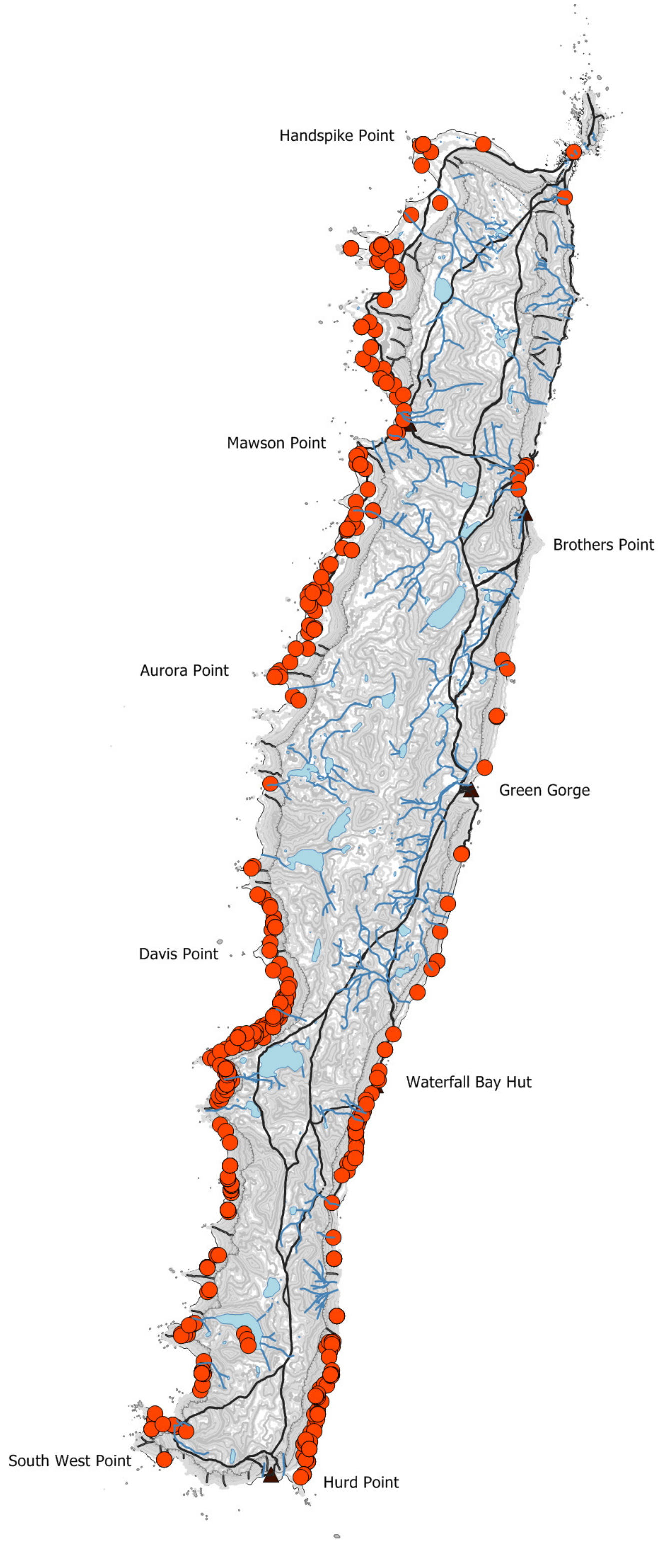


Figure 13: Location of dead giant petrels (both species combined).

Observations of wildlife rangers indicate that giant petrels were impacts via secondary poisoning following scavenging of rabbits, and some cannibalism. Similarly skuas were also impacted by secondary poisoning following scavenging. Whilst kelp gulls were also observed scavenging poisoned carcases, they were also likely impacted by primary ingestion of bait pellets.

6.1 Northern giant petrel sex ratio

Northern giant petrels show marked sex-related differences in their foraging behaviours. Adult males and females at South Georgia and Marion Island were observed to show segregation in foraging behaviour, likely to reduce intraspecific competition. Males tended to show more flexible foraging between coastal and pelagic habitats, probably taking advantage of seal carrion availability, whereas females were consistently more pelagic. Interspecific competition with *SGPs* resulting from similar diets is reduced by the six week difference in breeding phenology and some spatial segregation in foraging area. *NGP* breeding appears to be timed to take advantage of abundant carrion from the seal pupping season, an important food source during chick brooding. However, in sympatric areas, there is competition at carcasses

Consistent with these observations the sex ratio of NGPs was strongly male biased with nine of ten samples that underwent molecular analyses, confirming a strong male bias (further samples have been collected and shall be analysed when they RTA). An additional five banded NGPs and one banded SGP were also confirmed as being males on the basis of morphometric measurements made at the time of banding. This male bias will likely be important in assessments of impact.

6.2 Recovery of banded birds

Some ad hoc banding of chicks both giant petrel species has been undertaken since the 1960s. Since the inception of the DPIPWE/BCB long term monitoring program in 1994, 25% of NGP chicks and between 30 and 100% of SGP chicks banded each year since 1995 (excluding 2004).

Forty seven giant petrels found were banded and therefore known aged individuals: 43 out of 275 (16%) of NGPs were banded and 4 out of 10 (40%) SGPs. The age distribution of the banded individuals is shown in the Figure below.

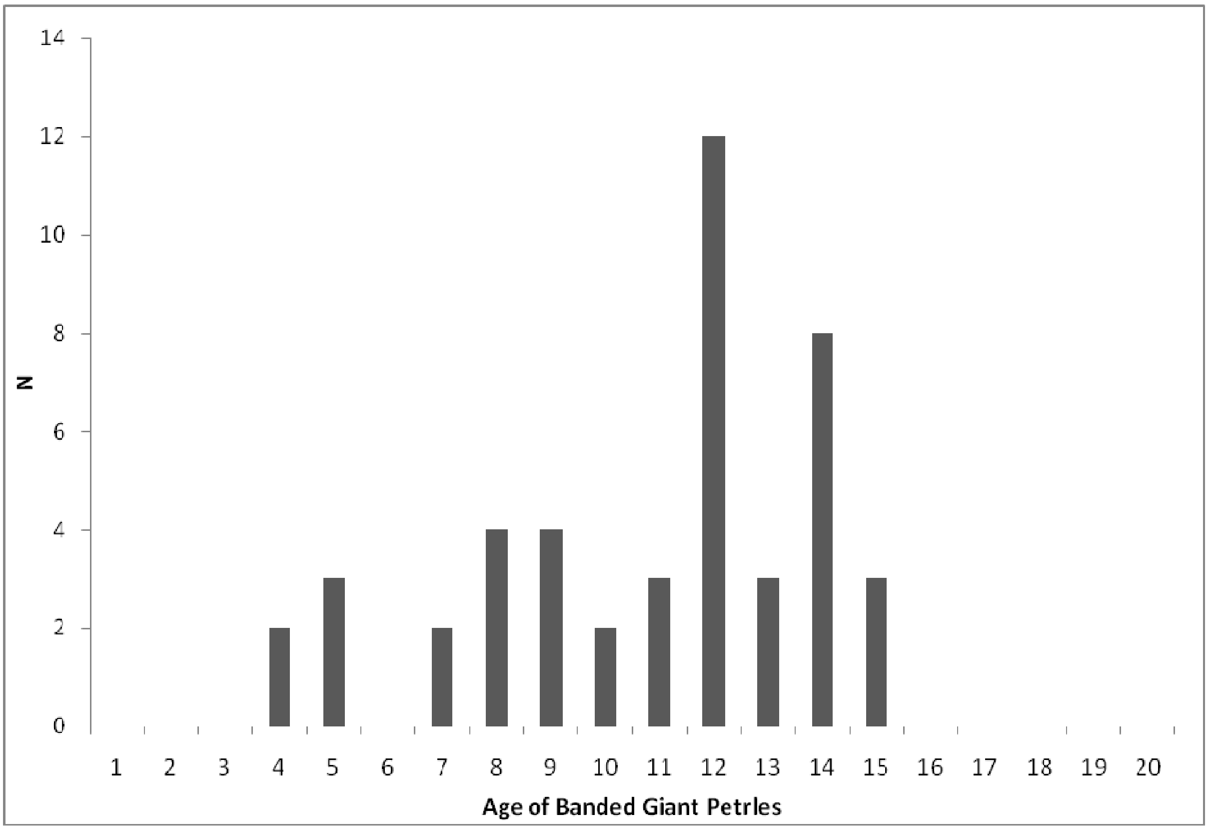


Figure 14: Age distribution of banded giant petrels

These results indicate that birds were all adults (only two pre-breeders) and mostly of breeding age. Analysis of the banding data also revealed that two of the banded SGPs were mis-classified as NGPs. **An unknown proportion of the un-banded NGPs are likely to be misidentified**. There were no cases of NGPs being misidentified as SGPs and this is unlikely to have occurred because of the way species are identified in the field. Bill tip colouration is the key character used to identify species (it is green in SGP and red in NGP). As carcases age, the green in the SGP tip fades to become more uniformly red/pink in colour and this would lead to misclassification. In addition, there are patterns in plumage colouration that definitively identify SGP but none for NGP (i.e NGPs do not have unique colour morphs, but SGPs do).

The bias in the banded to un-banded ratio for both species supports the idea that SGPs are under-represented in the totals.

7. EXTENT OF IMPACT

It is important to note that current figures relate only to birds found dead on the island – initial searches were limited to incidental discoveries by PWS rangers. Additional information was then requested to better assess the extent of mortality included tissue for gender determination, exact location of carcase and carcase condition to enable assessment of time of death.

Interpretation of 2010 census results in terms of extent of mortality is limited at this stage, particularly in light of the skewed sex bias. It will be important to continue to accurately monitor breeding success and breeding effort in 2010/11 and beyond. If 90% of the 275 dead NGPs were male (n=275), this would represent ca: 13% of the number of breeding males (based on an annual breeding population of 1829 pairs). Clearly more detailed assessments of impact are required.

It is important to note the like history characteristics of petrels (and albatrosses) makes them vulnerable to only small changes to levels of adult survival (compared to other families of birds, including gulls and skuas).

8. POTENTIAL MITIGATION OPTIONS

A range of mitigation options require consideration prior to application of baits on Macquarie Island. Observations of wildlife rangers indicate that giant petrels were impacts via secondary poisoning following scavenging of rabbits, and some cannibalism. Similarly skuas were also impacted by secondary poisoning following scavenging. Whilst kelp gulls were also observed scavenging poisoned carcases, they were also likely impacted by primary ingestion of bait pellets. Primary poisoning shall be difficult, if not impossible to mitigate against, whilst secondary poisoning presents more options for mitigation.

8.1 Mitigation – limit access to carcases

One straight forward mitigation option is to minimise/limit access to poisoned carcases by extensive efforts to discover and bury carcases following the bait drops. This would require significant effort by additional personnel and detection dogs. Potentially this could be achieved if the full complement of hunters and the dogs were deployed at the beginning of the operation in order to undertake these tasks in a dedicated manner. The full team could also assist on non-flying days between bait applications. The search efforts (in time and space) should be strategic, rather than ad hoc. Should focus attention in aggregation areas, but the effort would also need to be extensive (in light of the distribution of carcases to date). This option would require additional resources in terms of personnel dedicated to this task. Given that the current experience shows that birds are being impacted by secondary poisoning three months after the application of baits, these efforts would have to be sustained over a significant period.

8.2 Mitigation – feeding stations

The provision of strategically placed feeding stations could assist in distracting giant petrels from scavenging on poisoned carcases. Giant petrels are voracious scavengers and this foraging behaviour could be exploited to decrease the consumption of poisoned carcases. Pre-feeding prior to the bait drops could habituate the birds to feeding stations, further assisting in reducing the level of non target mortality. This option should be further considered and developed in consultation with others with relevant experience.

8.3 Mitigation – Non-target wildlife program

The non-target wildlife program would benefit from management by an appropriately experienced person with responsibility for the program. The non-target program should be managed by a person with extensive knowledge of the seabird populations being impacted. Appropriate adaptive management is going to be fundamental to the success of efforts to mitigate further mortalities. Robust collection of information, documentation and communication shall be essential. This will assist in enabling real time responses to (predicted and unpredicted) bycatch outcomes. This could be facilitated by dedicated seabird bycatch officer who could assimilate results and coordinate responses. The BCB long term seabird monitoring program is well placed to assist in this regard.

8.4.1 Mitigation – consultation and communication

The outcome of the MIPEP is of global interest and relevance. Given the multi-species target and the large size of Macquarie Island, many other countries are tracking the success of MIPEP in terms of relevance to other large scale eradication programs under development (e.g. South Georgia, Gough). It would be useful to engage with relevant people to further scope mitigation options and benefit from the knowledge of those with relevant experience and expertise. Useful contacts for engagement in this issue would include:

- Dr. Richard Phillips – seabird ecologist, British Antarctic Survey; Convenor ACAP Breeding Sites Working Group.
- Dr Ben Sullivan – seabird/mitigation ecologist – Program Leader 'Albatross Taskforce" BirdLife International.
- Dr. Henri Weimerskirch – seabird ecologist - French CNRS seabird program.

9. RECOMMENDATIONS

- Update risk assessment to more accurately reflect the potential impacts to seabirds.
- Acknowledge risks and ensure robust management and mitigation.
- Dedicated non target wildlife program management to assist best practice mitigation efforts and documentation/communication of impacts. Ensure adequate collection of appropriate information in order to assess both positive and negative impacts (e.g. tissue sampling for determination of gender and species, carcase condition indices for assessment of time of death, GPS coordinates of carcases).
- Acquisition of resources to undertake mitigation that could include additional personnel (and detector dogs) tasked with detection and removal of poisoned carcases.
- Scoping of feeding station options to assist with mitigation of non-target wildlife.

- Acknowledge successes. For example the BCB King penguin – helicopter over-flight trials (2007 and 2008) enabled provision of best-practice advice and development of protocols to minimise impacts of low flying over king penguin colonies (reports available on request).

- Ensure adequate resources to enable continuation of relevant seabird monitoring programs to best inform operational and impact issues (including monthly bird counts (distinguishing between SGP and NGP), skua and gull population census, whole island NGP and SGP census and breeding success monitoring).