

## COUNTS OF SURFACE-NESTING SEABIRDS BREEDING AT PRINCE EDWARD ISLAND, SUMMER 2001/02

P. G. RYAN<sup>1</sup>, J. COOPER<sup>2</sup>, B. M. DYER<sup>3</sup>, L. G. UNDERHILL<sup>2</sup>,  
R. J. M. CRAWFORD<sup>3</sup> and M. N. BESTER<sup>4</sup>

The first midsummer survey of surface-nesting seabirds at Prince Edward Island was conducted during December 2001. It was also the first census for most species since the early 1980s. Despite concerns about the impacts of longline fishing mortality on various albatrosses and giant petrels, there was no evidence that populations of these species had decreased. Indeed, the estimate of wandering albatrosses *Diomedea exulans* (Vulnerable) has increased significantly, making Prince Edward Island equal with Marion Island as supporting the largest single-island populations of this species. Species that underwent significant decreases were macaroni penguins *Eudyptes chrysolophus* (Vulnerable), Crozet shags *Phalacrocorax [atriceps] melanogenis* and Kerguelen terns *Sterna virgata* (Near-Threatened). The reasons for these decreases are unclear, but for macaroni penguins may be partly a consequence of competition for space with the burgeoning population of fur seals *Arctocephalus* spp. The 2001 survey increased the population estimates for Subantarctic skuas *Catharacta antarctica*, light-mantled sooty albatrosses *Phoebastria palpebrata* (Vulnerable) and southern giant petrels *Macronectes giganteus* (Vulnerable), mostly as a result of greater coverage than for previous counts. The 2001 survey confirms that Prince Edward Island remains a globally important breeding site for seabirds.

Key words: albatrosses, giant petrels, gull, penguins, Prince Edward Island, seabirds, shag, skuas, Subantarctic, terns

The subantarctic Prince Edward Islands are globally important breeding sites for seabirds (Williams *et al.* 1979, Cooper and Brown 1990), including eight Threatened and five Near Threatened species (BirdLife International 2000). Accordingly, the islands are recognized as an Important Bird Area (Barnes *et al.* 2001) and are afforded the highest level of conservation protection under South African law, being designated as Special Nature Reserves (Prince Edward Islands Management Plan Working Group 1996). Numbers of surface-nesting seabirds breeding at Marion Island are fairly well known (Cooper and Brown 1990, Crawford *et al.* 2003c), but there have been few counts of seabirds breeding at Prince Edward Island, which is seldom visited by people. All previous visits by ornithologists have been in early spring (August–September) or late summer–autumn (March–May; van Zinderen Bakker 1971a, Berruti *et al.* 1981, Grindley 1981, Imber 1983, Cooper and Brooke 1984, Ryan and Hunter 1985, Ryan 1987, Watkins 1987), which is too early or too late to count several of the summer-nesting seabird species. Also, there have been no dedicated counts of seabirds at the island since the early 1980s.

In order to obtain reliable population estimates for management and conservation purposes, a midsummer survey to Prince Edward Island was conducted during

December 2001. There has been concern for several albatross and petrel populations at this island, given the significant impact longline fishing mortality has had on birds breeding at Marion Island (Nel *et al.* 2002a). Six species breeding at Prince Edward Island are listed as Vulnerable and a further three as Near Threatened as a result of longline fishing mortality (BirdLife International 2000).

Of particular interest was the population of Indian yellow-nosed albatrosses *Thalassarche [chlororhynchos] carteri* (Vulnerable), because this species does not breed on Marion Island, and thus there was no information on its status at the Prince Edward Islands. It is known to be killed in significant numbers by longlines targeting both Patagonian toothfish *Dissostichus eleginoides* around the Prince Edward Islands (Nel *et al.* 2002a) and tunas *Thunnus* spp. more widely in the Southern Ocean (Ryan and Boix-Hinzen 1998, Weimerskirch and Jouventin 1998, Ryan *et al.* 2002). However, there has been no assessment of this species' population at Prince Edward Island since the early 1980s, when it was estimated that 7 000 pairs bred there (Berruti *et al.* 1981), almost 20% of the estimated global population (Tickell 2000).

There was also concern about the populations of penguins at Prince Edward Island, with both crested

<sup>1</sup> Percy FitzPatrick Institute, University of Cape Town, Rondebosch 7701, South Africa. E-mail: pryan@botzoo.uct.ac.za

<sup>2</sup> Avian Demography Unit, University of Cape Town, Rondebosch 7701, South Africa

<sup>3</sup> Marine & Coastal Management, Department of Environmental Affairs and Tourism, Private Bag X2, Rogge Bay 8012, South Africa

<sup>4</sup> Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria, Pretoria 0002, South Africa

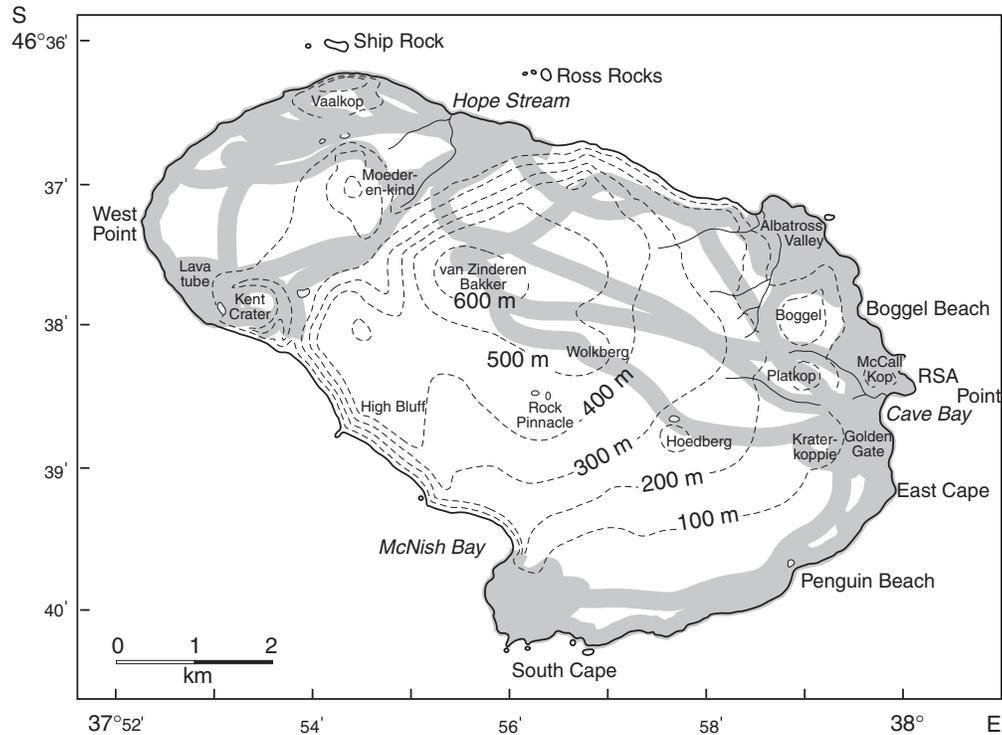


Fig. 1: Prince Edward Island, with areas covered during the seabird survey shaded. Coastal cliffs along the south and north coasts shown as not surveyed directly were scanned from adjacent headlands to estimate minimum numbers of breeding penguins and albatrosses

penguins *Eudyptes* spp. occurring listed as Vulnerable, and gentoo penguins *Pygoscelis papua* listed as Near Threatened (BirdLife International 2000). The population of eastern rockhopper penguins *E. chrysocome filholi* apparently has decreased at Marion Island (Cooper *et al.* 1997, Crawford *et al.* 2003b), and the species has experienced large decreases at several other localities (Cunningham and Moors 1994, Bingham 1998), leading to requests for South Africa to obtain a current estimate for the Prince Edward Island population (Ellis *et al.* 1998). In this paper, the first midsummer counts of surface-nesting seabirds breeding at Prince Edward Island are reported.

## MATERIAL AND METHODS

The Prince Edward Islands lie roughly 2 200 km south-east of Cape Town, South Africa in the southern

Indian Ocean. They comprise two main islands: Marion Island (290 km<sup>2</sup>; 46°52' S, 37°51' E) and Prince Edward Island (44 km<sup>2</sup>; 46°38' S, 37°57' E), 21 km apart. Marion Island has a meteorological and research station, but human activities at the near-pristine Prince Edward Island are curtailed to limit human impact (Prince Edward Islands Management Plan Working Group 1996). Prince Edward Island was visited from 17 to 22 December 2001. Teams of 2–3 observers worked systematically around the island, counting all surface-nesting birds either by entering the colonies or by scanning from outside the colonies with binoculars. Coverage included all the readily accessible coastline, as well as parts of the adjacent interior of the island (Fig. 1). Populations of penguins and albatrosses breeding on inaccessible cliff areas were estimated by scan counts from adjacent promontories or from above or below the cliffs.

Coverage of colonially nesting birds probably was adequate, especially for species confined to the coastal

Table 1: Estimates of annual-breeding populations (pairs) of seabirds at Prince Edward Island. Previous estimates are from Cooper and Brown (1990) and references therein. Estimates for 2001 are extrapolated from the actual counts, compensating for likely breeding failures prior to the census period, as well as for incomplete coverage in some species (see text for details)

Species	Past estimate	2001	
		Count	Estimate
King penguin	5 000	2 903	3 000
Gentoo penguin	650	128	475 <sup>1</sup>
Macaroni penguin	17 000	4 508	9 000 <sup>1</sup>
Rockhopper penguin	35 000	31 655	45 000
Wandering albatross	1 300	1 687	1 850
Grey-headed albatross	1 500	1 897	3 000
Indian yellow-nosed albatross	7 000	4 870	7 500 <sup>1</sup>
Dark-mantled sooty albatross	700	637	1 000
Light-mantled sooty albatross	50	92	150
Northern giant petrel	180	133	300 <sup>1</sup>
Southern giant petrel	400	567	1 000
Crozet shag	120	39	50
Subantarctic skua	60	210	250 <sup>2</sup>
Kelp gull	30	20	30
Antarctic tern	<25	0	<5
Kerguelen tern	20	2	<5

<sup>1</sup> Species that breed primarily in winter or early spring, resulting in considerable extrapolation and thus relatively low confidence in the estimated population

<sup>2</sup> Because of the highly staggered breeding season and frequent initiation of replacement clutches, this figure excludes any extrapolation for nests that failed prior to the survey

zone. However, coverage was clearly incomplete for solitary or loosely colonial species such as Subantarctic skuas *Catharacta antarctica* and northern giant petrels *Macronectes halli*, both of which also nest well inland. Crude estimates of coverage of suitable habitat for these species were used to extrapolate the likely population. Because many species were already well advanced in their breeding seasons, and some were still just starting, counts were corrected using average breeding success parameters (usually based on studies at adjacent Marion Island) to estimate the likely annual breeding populations. However, for species where it is not possible to check whether nests contain eggs or chicks (e.g. cliff-nesting albatrosses), this may lead to inflated estimates if a considerable number of nests are occupied by pre-breeding or failed pairs.

Limited time did not permit the routine multiple counting necessary to estimate census accuracy, but repeat counts were made of several key sites (e.g. cliff-nesting albatross colonies). Typically, repeat counts of small colonies varied by <5%, whereas counts of larger colonies varied by <10%. Rockhopper penguins were perhaps the hardest to count accurately, given their large numbers, the confounding effects of loafing birds and the rugged nature of much of the

coast, which was often difficult to access because of large numbers of aggressive fur seals *Arctocephalus* spp. (Bester *et al.* 2003). The count of the main wandering albatross *Diomedea exulans* concentration in Albatross Valley was validated by an independent survey recording the location of each nest (Underhill *et al.* 2003). To avoid double-counting, GPS fixes were made for most colonies or nest sites. Species distributions were plotted on a revised map of the island.

## RESULTS

No new seabird species were found at Prince Edward Island in 2001, but evidence of breeding was obtained for two burrow-nesting species not previously proven to breed at the island (Berruti *et al.* 1981, Imber 1983, Cooper and Brooke 1984). A burrow with a Kerguelen petrel *Aphrodroma brevirostris* chick was found in the valley between Boggel and Platkop, and an adult grey-backed storm petrel *Garrodia nereis* with a well-vascularized brood patch was caught when it flushed from dense *Acaena magellanica* vegetation near the base of the cliff in Albatross Valley (Fig. 1).

### Penguins

Four penguin species breed at Prince Edward Island. King penguins *Aptenodytes patagonicus* breed at three sites, all on the sheltered east coast: Boggel Beach, Cave Bay and Penguin Beach. During the 2001 census, these colonies contained 1 200, 983 and 250 incubating adults, and 78, 261 and 131 large chicks respectively, giving a total count of 2 433 incubating adults and 470 large chicks. The survey took place during the period of peak egg-laying at Marion Island (du Plessis *et al.* 1994), so the incubator count probably represents most of the 2001/02 cohort. Interpretation of the large chick count (chicks surviving from the 2000/01 cohort) is more problematic (see van Heezik *et al.* 1994, 1995). Chick counts in December represent only 10–30% of eggs laid (Weimerskirch *et al.* 1992, van Heezik *et al.* 1995), suggesting that breeding effort in 2000/01 was 2 500–5 000 pairs. However, the proportion surviving varies as a function of colony size (Hunter 1991) and between years (van Heezik *et al.* 1995). This suggests an average annual population of some 3 000 pairs (Table 1), but confidence in this estimate is low due primarily to natural variability rather than count error. There were small numbers of loafing king penguins at Hope Stream Beach on the west coast, and at the beach east of South Cape.

Gentoo penguins also breed primarily along the east coast (at least eight colonies), with only one colony

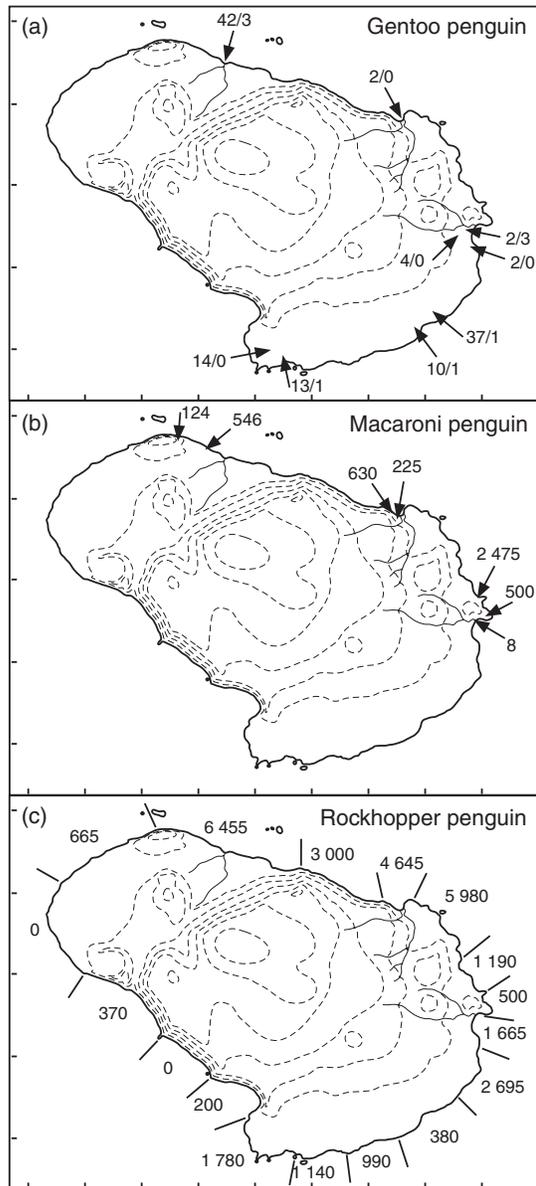


Fig. 2: Distribution of (a) gentoo penguins, (b) macaroni penguins and (c) rockhopper penguins breeding at Prince Edward Island in December 2001. For gentoo penguins, numbers of chicks and of nests with eggs are shown for each colony (depicted as chicks/nests with eggs). For macaroni and rockhopper penguins, numbers of breeding pairs at colonies or along sections of the coast respectively are indicated

on the west coast inland from Hope Stream Beach (Fig. 2a). Gentoo penguins typically breed in winter and spring at the Prince Edward Islands (Adams and Wilson 1987), so relatively few birds were breeding during the December 2001 census, and most had large chicks in crèches ( $n = 101$  chicks). However, there were nine pairs incubating eggs, and 18 pairs had 25 fairly small downy chicks still in the nest. Given that gentoo penguins rarely, if ever, rear two chicks at Marion Island (Williams 1980), this represents a minimum of 128 breeding pairs. At Marion Island in 2001, 73% of chicks had fledged by mid December. Assuming an equivalent proportion at Prince Edward Island, the population would have been about 475 pairs (Table I). However, the period of this extrapolation (four months) means that there is considerable uncertainty for this estimate.

Macaroni penguins *Eudyptes chrysolophus* were breeding at seven sites, including two colonies on the west coast between Hope Stream and Vaalkop (Fig. 2b). The largest colonies were on the slopes of McCall Kop. During the census, 4 508 pairs were counted. Most birds had small or medium-sized chicks. Based on breeding success data from Marion Island (Cooper *et al.* 1997), this represents roughly half the total breeding effort, giving an estimated 9 000 pairs at the start of the 2001/02 breeding season (Table I).

The eastern rockhopper penguin was the most abundant penguin on Prince Edward Island, occurring around most of the coastline, with the highest densities along the northern coast between Vaalkop and Boggel (Fig. 2c). Most colonies were within 100 m of the coast, but birds extended farther inland along the northern cliffs, where colonies extended up to 300 m up the cliffs. The low numbers along the west coast south of Vaalkop probably result from the largely sheer cliffs in this area. One colony among a jumbled pile of lava on top of the cliffs near West Point was more than 300 m away from the landing site, suggesting that colony sites are determined both by the need for an adequate landing site and appropriate cover for nests. A total population of 31 655 pairs was counted during December 2001. Most birds were still on eggs, with a few small chicks. Assuming a hatching success (per nest) of 70% (Cooper *et al.* 1997), the total breeding population is likely to be 45 000 pairs (Table I), but confidence in this estimate is not great because of the count difficulties for this species (see Material and Methods).

### Albatrosses

Wandering albatrosses breed on relatively open coastal plains, mostly below 150 m, on both the east and west coasts of Prince Edward Island (Fig. 3a).

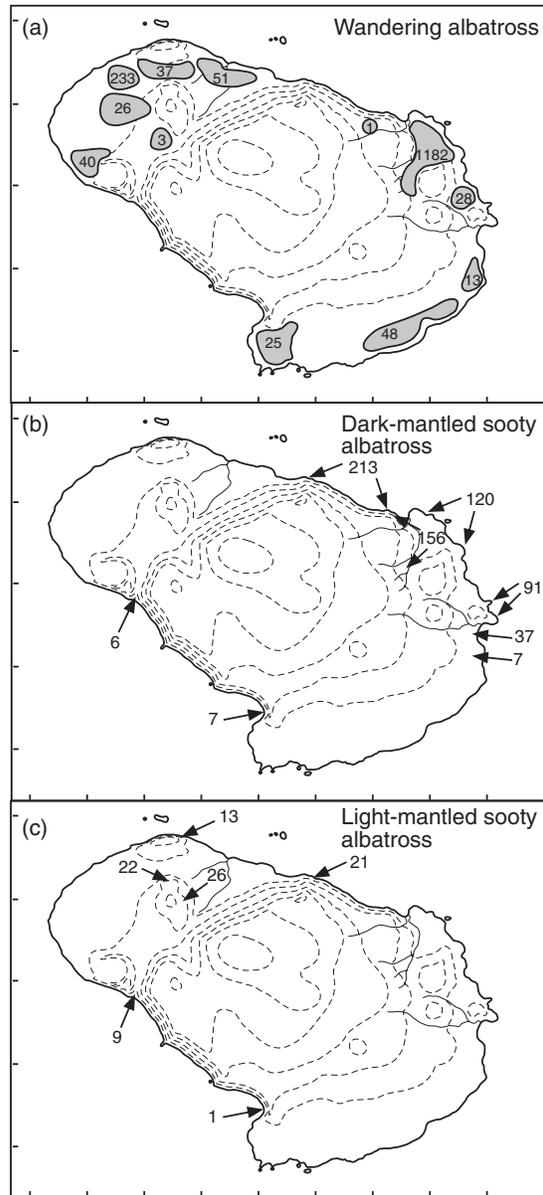


Fig. 3: Distribution of (a) wandering albatrosses, (b) dark-mantled sooty albatrosses and (c) light-mantled sooty albatrosses breeding at Prince Edward Island in December 2001. Numbers of birds at fresh nests are shown for wandering albatrosses, numbers of active nests for the other two species

However, one pair was breeding above the northern sea cliffs at more than 200 m above sea level. During the December census, most pairs were still preparing to breed, although some had already laid eggs, and a few chicks from the previous season were still present. The largest concentration was in Albatross Valley, where there were almost 1 200 pairs. The total count of birds on fresh nests was 1 687, but this is probably an underestimate of the actual breeding population. The count of three study areas on Marion Island on 23 December 2001 (immediately after the Prince Edward survey) yielded 222 fresh occupied nests, but subsequent careful checking of marked nests revealed that 251 eggs were laid, suggesting that the Prince Edward survey underestimated the actual breeding effort during 2001/02 by approximately 10%. Given that the species breeds biennially, it is estimated that the island's annual demi-population is approximately 1 850 pairs.

Grey-headed albatrosses *Thalassarche chrysostoma* only breed on the north-east- and north-facing cliffs of Albatross Valley, with a small isolated group (52 pairs) at the far western end of the cliffs opposite Ross Rocks. Within Albatross Valley, the eastern colonies consist entirely of grey-headed albatrosses, but towards the western end of the valley that species occurs in mixed colonies with Indian yellow-nosed albatrosses. There were no grey-headed albatrosses among the large yellow-nosed albatross colonies on the sea cliffs west of Albatross Valley, other than the small group at the far western end of the cliffs. During December 2001, 1 897 pairs were counted. Most were on eggs or small chicks. Assuming an average hatching success of 60% ( $n = 5$  years, unpublished data from Marion Island), this suggests that the annual demi-population is approximately 3 000 pairs (Table I).

Indian yellow-nosed albatrosses also breed on the north-east-facing cliffs of Albatross Valley, but only towards the western end of the Valley (1 300 pairs). The colonies extend from there along the sea cliffs almost to the start of the western coastal plain (opposite Ross Rocks). Accurate counts of these sea cliffs are not easy. The count using binoculars from the point north of Albatross Valley beach was 3 000 pairs; actual counts on different days by different observers were 3 007 and 2 930. From this distance it was not always possible to differentiate birds occupying nests from loafing birds. The species identity of these birds was confirmed by scanning from the top of the sea cliffs. During this exercise, some birds breeding on west-facing slopes were found that would have been invisible during the initial count (570 pairs), and were added to the total estimate. Overall, the count of 4 870 pairs is less accurate and precise than the count of grey-headed albatrosses, but it is likely to be within 10% of the actual population. The yellow-nosed albatrosses were brooding or guarding small to medium-sized

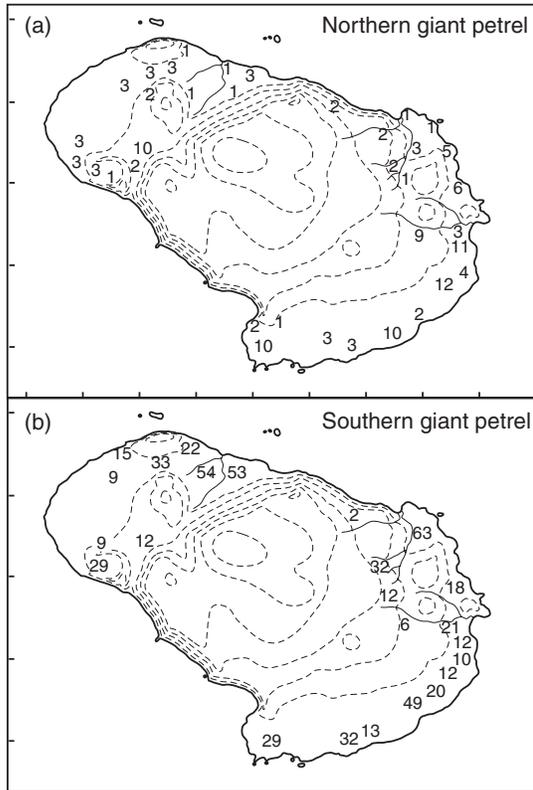


Fig. 4: Distribution of chicks of (a) northern and (b) southern giant petrels at Prince Edward Island in December 2001

chicks. Assuming a breeding success to this stage of approximately 65% (Jouventin *et al.* 1983), this suggests that the annual breeding population is approximately 7 500 pairs (Table I). In addition to the main breeding cliffs, a group of 17 loafing adults was seen on two days on the cliffs below McCall Kop.

Sooty albatrosses *Phoebastria* spp. breed on cliffs. They are difficult to count, because their dark plumage blends with the cliffs much more so than do the mollymawks *Thalassarche* spp. Counts on the inaccessible sea cliffs almost certainly underestimate the true population, especially along the south coast, where the cliffs were not scanned from above. Dark-mantled sooty albatrosses *P. fusca* occurred primarily in the northern and eastern part of the island (Fig. 3b). Unlike at Marion Island they are not confined to coastal cliffs (van Zinderen Bakker 1971b), inhabiting inland cliffs

in Albatross Valley and south of Cave Bay. There were some dense concentrations, with groups of up to 40 pairs in single-species colonies on the coastal cliffs of McCall Kop. In all, 637 pairs were counted on nests. Most were on small chicks. Assuming a mean hatching success of approximately 60% (Berruti 1979, Jouventin and Weimerskirch 1984), this suggests that the annual demi-population is at least 1 000 pairs (Table I).

Light-mantled sooty albatrosses *Phoebastria palpebrata* occurred more at the western end of the island, with the largest numbers on the inland cliffs of Moederen-kind (Fig. 3c). None was recorded on the cliffs in Albatross Valley, but there was a small group at the western end of the adjacent sea cliffs. In all, 92 pairs were counted on nests. Most were on eggs or newly hatched chicks. Assuming a hatching success of 60% (Mougin 1970, Berruti 1979), this suggests a minimum annual demi-population of 150 pairs.

#### Giant petrels

Breeding northern giant petrels are difficult to count because their nests occur singly or in loose groups up to at least 1 km inland, and are usually sheltered by rock outcrops, making detection and adequate coverage difficult. During the December 2001 survey, 133 nests with chicks were counted, 40 on the western coastal plain and 93 on the eastern coastal plain (Fig. 4a). There were quite a few nests at the periphery of colonies of southern giant petrels *Macronectes giganteus*. Assuming a breeding success of c. 55% to the large chick stage (Cooper *et al.* 2001), this suggests a minimum population of 250 pairs. However, this is almost certainly an underestimate of the island's population, because even within the areas covered during the survey, at least some nests probably were overlooked. Other nests were probably in areas not covered during the survey. It is considered that incomplete coverage of suitable habitat resulted in approximately 20% of pairs being missed. Therefore, it is estimated that the total island population is approximately 300 pairs (Table I).

Southern giant petrels typically nest in larger groups and in more open habitats than northern giant petrels. Also, their chicks have more striking white down, making colonies easier to locate. They occur widely on the island (Fig. 4b). They breed even farther inland than northern giant petrels, with colonies up to 2 km inland and more than 200 m above sea level on the eastern slopes north of Hoedberg. Assuming breeding success to the small-medium chick stage of 40% (Cooper *et al.* 2001), the count of 567 chicks in December 2001 suggests a minimum breeding population of 1 400 pairs. However, the relatively low breeding suc-

cess recorded by Cooper *et al.* (2001) at Marion Island may have been influenced by human disturbance. Southern giant petrels are renowned for being susceptible to disturbance while breeding (e.g. Chupin 1997, BirdLife International 2000). Consequently, breeding success may be higher on Prince Edward Island. Using the same success as northern giant petrels (55%), gives a total population estimate of approximately 1 000 pairs (Table I).

### Other birds

Crozet shags *Phalacrocorax [atriceps] melanogenis* were breeding at six sites, with a possible further site on Ross Rocks (Fig. 5a). All sites were on offshore stacks or inaccessible cliffs. In total, some 39 pairs were nesting during the survey, including birds on Ross Rocks that were too far away to confirm breeding. It is possible that some nests were overlooked on some of the island's sheer cliffs, but the total population is probably less than half that counted in September 1984 (Ryan and Hunter 1985), despite the fact that no colonies were found on the West Coast in 1984 (where they were almost certainly overlooked).

Subantarctic skuas were the most widespread surface-nesting seabird on the island, with a pair found breeding close to the island's peak, i.e. more than 500 m above sea level (Fig. 5a). Within surveyed areas, the dispersion of skuas was decidedly irregular, with dense concentrations in some areas (e.g. the saddle between the western scarp and Moeder-en-kind, Albatross Valley and McCall Kop). In general, nests were concentrated in areas with large numbers of burrowing petrels and were sparse on mire areas (where burrowing petrels are scarce). A total of 210 pairs was counted, but this certainly underestimates the island's population, because their solitary breeding and broad habitat tolerance means that pairs are easy to overlook, and there was incomplete survey coverage. Probably about 20% of pairs were missed, so the total island population is estimated to be 250 pairs (Table I). Breeding was staggered, with some pairs still incubating eggs, while others had almost fully feathered chicks. There were also "clubs" of non-breeding and loafing skuas scattered around the island, usually near ponds or lakes (Fig. 5b). The seven main clubs supported some 400 skuas during the December 2001 survey.

Kelp gull *Larus dominicanus* nests were scattered sparsely around the island, either singly or in small groups. Of the total of 20 nests found, 19 were along the coast, on cliff ledges, offshore stacks, in sheltered caves or in open areas on the cliff tops (Fig. 5c). One pair nested well inland at the small pond adjacent to Hoedberg. All occupied nests contained eggs, and

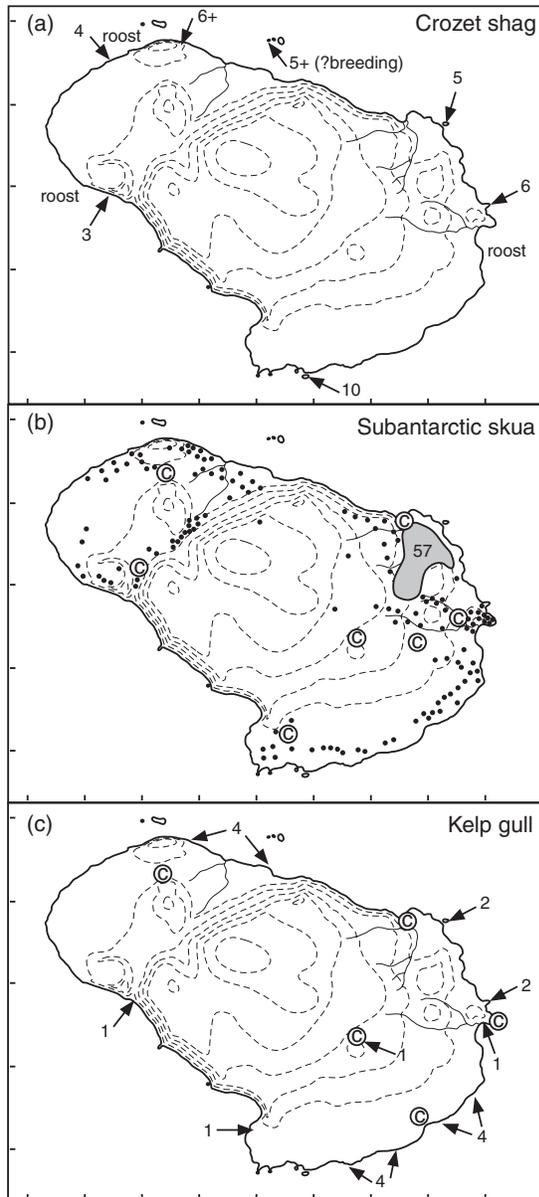


Fig. 5: Distribution of breeding pairs of (a) Crozet shags, (b) Subantarctic skuas and (c) kelp gulls at Prince Edward Island in December 2001. Location of roosts and clubs (C) of non-breeding birds are also shown

several empty nests were defended, suggesting that not all eggs had been laid yet, and others probably were overlooked. The overall breeding population was probably about 30 pairs (Table I). There were also five gull roosting "clubs" (Fig. 5c), containing some 150 birds. The largest club was at the pond north-west of Moeder-en-kind, with approximately 70 birds.

Only two pairs of Antarctic terns *Sterna vittata* were seen, in display flights over the sea west of Vaalkop. No evidence of breeding was found. Kerguelen terns *Sterna virgata* were observed along the east coast between Cave Bay and South Cape, where they were surprisingly scarce (cf. Ryan 1987). Only two pairs were found breeding: one pair had a medium-sized chick some 250 m inland in well-vegetated black lava north-east of South Cape, and another pair defended an empty scrape close to the coast between South Cape and Penguin Beach. By comparison, Kerguelen terns were highly visible along the north-east coast of Marion Island in December 2001, with several pairs feeding fledged young, and others still on eggs (pers. obs.).

## DISCUSSION

In general, the present estimates of surface-nesting seabird populations are either similar to previous estimates, or there have been increases attributable in most cases to better coverage and extrapolation for breeding failures prior to the survey (Table I). The accuracy of the estimates is compromised both by count accuracy and by the necessity to correct for breeding failure prior to the survey. The error caused by extrapolation is potentially large and is related to the time between the start of breeding and the survey. It is most problematic for winter-breeding species such as gentoo penguins, but it is also significant for early-summer breeders that already had large chicks at the time of the survey, such as macaroni penguins, yellow-nosed albatrosses and northern giant petrels. Also inter-year variation in the proportion of adults breeding cannot be addressed, which may be considerable (especially for biennially breeding species). One difficulty with assessing trends in the distributions and abundance of seabirds at Prince Edward Island based on this survey is that most previous counts were poorly documented. It is often unclear whether any attempt was made to compensate for incomplete coverage or for failed breeding attempts (e.g. Williams *et al.* 1979, Berruti *et al.* 1981). However, some clear patterns emerged from the December 2001 survey.

King penguins still breed at the same three sites where they bred in the 1970s and 1980s (Grindley 1981, Watkins 1987). Although the estimate in 2001 is smaller than previous estimates, this difference is trivial given the considerable natural variation in breeding effort shown by this species (van Heezik *et al.* 1995). Gentoo penguins also still breed at the same general sites where they were recorded in 1984 (Adams and Wilson 1987), with the exception of Boggel, where no birds were seen in 2001. The estimated population is less than that for 1984, but given the uncertainty about the extrapolation for this winter-breeding species, it is not possible to draw any firm conclusions about trends at Prince Edward Island.

Numbers of macaroni penguins appear to have decreased considerably, with the estimate in 2001 roughly half the previous estimate (Table I). This is despite the discovery of several previously undocumented colonies, including the first colonies on the west coast. Until this survey, only three colonies were known from Prince Edward Island (Watkins 1987). Most of the decrease has taken place at the large colonies on the slopes of McCall Kop. Part of this decrease might be a consequence of the burgeoning fur seal population at the island (Bester *et al.* 2003). Macaroni penguins from the southern colony at McCall Kop used to land at the northern end of Cave Bay (pers. obs.), but this area has become overrun with fur seals, forcing the penguins to land on the more exposed ledges at RSA Point. Some colonies at Marion Island also have decreased (Cooper *et al.* 1997, Crawford *et al.* 2003a), so there may be system-wide factors causing the decrease.

The distribution of rockhopper penguin colonies is little changed, at least for the eastern part of the island (Grindley 1981). The population estimate in 2001 is slightly higher than the previous best estimate (Table I), although this may represent greater coverage in this survey, as well as bias introduced by counting loafing birds as breeders in colonies observed from a distance. The stable population at Prince Edward Island contrasts with a decreasing population at Marion Island (Cooper *et al.* 1997, Crawford *et al.* 2003b), suggesting that the decrease at Marion Island may be attributable to local effects there (e.g. human disturbance) rather than system-wide changes (e.g. in foraging conditions around the islands). This inference is consistent with the limited concordance in performance of rockhopper penguin colonies at Marion Island, and contrasts with the pattern for macaroni penguins (Cooper *et al.* 1997, Crawford *et al.* 2003a).

Among albatrosses, there is little evidence that long-line fishing mortality has caused appreciable population decreases. Indeed, population estimates for all species have increased (Table I). Whether this merely re-

flects a more complete survey is uncertain, but there is little evidence of recent decreases in the populations of wandering and grey-headed albatrosses such as observed at Marion Island (Nel *et al.* 2002b). The demipopulation of wandering albatrosses estimated during this survey brings Prince Edward Island on par with Marion Island as supporting the largest single-island populations of wandering albatrosses (*sensu stricto*; Tickell 2000). The estimate of light-mantled sooty albatrosses also has increased, but this almost certainly reflects better coverage during the present survey. Perhaps the most encouraging finding of the survey was that numbers of Indian yellow-nosed albatrosses are unchanged, despite their known mortality on both toothfish and tuna longlines. This species is listed as Vulnerable (BirdLife International 2000) and has decreased by roughly one-third over the past two decades at the species' main breeding site, Amsterdam Island, apparently as a result of longline mortality (Weimerskirch and Jouventin 1998). The present survey confirms the global importance of Prince Edward Island for this species.

Estimates of both giant petrel populations have increased. Although confidence in these figures is low because of the advanced stage of breeding at the time of the survey, it is still evident that the populations are larger than previously estimated. In the case of northern giant petrels, this may be as a result of better coverage, but for southern giant petrels it is likely that the population has actually increased, contrary to the global pattern (BirdLife International 2000). Interestingly, the increase at Prince Edward Island coincides with a dramatic decrease in numbers of southern giant petrels at neighbouring Marion Island. Since the mid-1990s, the Marion breeding population has fallen from around 3 000 to only 1 500 pairs (Cooper *et al.* 2001, Nel *et al.* 2002b). This decrease is unlikely to be due entirely to mortality. Emigration to Prince Edward Island, possibly as a result of increased disturbance on Marion Island associated with the cat-eradication programme (Nel *et al.* 2002b) may be a factor. During the survey, three birds banded as chicks on Marion Island and breeding at Prince Edward Island were found, indicating that at least some Marion birds recruit to Prince Edward Island. The birds were banded in 1985, 1989 and 1990, during the period of the cat-eradication programme, which ended successfully in 1991 (Bester *et al.* 2002).

Among other species, the estimate of the kelp gull population is roughly constant, whereas that of Subantarctic skuas is considerably higher than previous estimates (Table I), perhaps because of the better coverage and accurate mapping of nests. Skuas breed farther inland and at higher elevations at Prince

Edward Island than at Marion Island (Hunter 1990), presumably on account of the much greater abundance of burrowing petrels at Prince Edward Island. The other coastal species apparently have decreased in numbers. Populations of Crozet shags and Kerguelen terns, both localized endemics to the Kerguelen Province, have decreased to less than half the numbers counted in 1984 (Ryan and Hunter 1985, Ryan 1987). In the case of the tern, this corresponds with an increase in the population on Marion Island (Ryan 1987, Crawford *et al.* 2003c), and thus there may not be cause for concern. The apparent switch to Marion Island is surprising given the importance of terrestrial invertebrates in the diet of this species (Stahl and Weimerskirch 1981) and the adverse impact that introduced house mice *Mus musculus* have had on invertebrate populations on Marion Island (Huysen *et al.* 2000). The eradication of cats from Marion Island may have been a factor.

There is greater concern about the decrease in Crozet shag numbers at Prince Edward Island, because this mirrors a marked decrease in this species at Marion Island (Crawford *et al.* 2003d). The decrease at Prince Edward Island has included the loss of at least two breeding colonies. There was no sign of breeding at the site of the largest colony on the northeast coast in 1984 (Ryan and Hunter 1985), nor on the coast between South Cape and McNish Bay. There was also no evidence of breeding at two current roost sites: birds have bred on the cliffs west of Kent Crater (JC pers. obs.) and the colony on the coast south of Cave Bay was the second largest colony in 1984 (Ryan and Hunter 1985). The reason for the decrease in Crozet shag numbers are not known, but the fact that they have occurred at Prince Edward Island as well as Marion Island suggests that the changes are probably not the result of human disturbance, but more likely due to a change in the availability of their prey (Crawford *et al.* 2003d).

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An Indian yellow-nosed albatross with chick at Prince Edward Island (photo B. M. Dyer)