

Short communication

Revised population estimate and trends for the Endangered Northern Rockhopper Penguin *Eudyptes moseleyi* at Tristan da Cunha

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Abstract

Around 80% of the world population of Northern Rockhopper Penguin *Eudyptes moseleyi* is found at Tristan da Cunha and Gough Island in the South Atlantic Ocean, where populations appear to be declining. However, numbers of birds at Middle Island, a small satellite island of Nightingale Island at Tristan da Cunha, have not been counted since 1973 when an estimated 100,000 pairs were recorded. Updated population counts were obtained for all four islands at Tristan da Cunha (Tristan, Inaccessible, Nightingale and Middle islands) in 2009 providing a census of the whole island group and the first repeat count of Middle Island. Estimated breeding numbers at these four islands were Tristan 6,700 pairs, Inaccessible 54,000 pairs, Nightingale 25,000 pairs and 83,000 pairs at Middle Island. These counts confirm that Tristan da Cunha is a vitally important site for this 'Endangered' species holding over 65% of the global population and that breeding number have been relatively stable over the last 30 years.

Introduction

The Northern Rockhopper Penguin *Eudyptes moseleyi* is listed as globally 'Endangered' by IUCN/Birdlife International, due to large-scale (> 90%) decreases in numbers over the last century and more recent population decreases in the last 30 years (Cuthbert *et al.* 2009). Over 80% of the global population of Northern Rockhopper Penguins are found at Tristan da Cunha and Gough Island in the central south Atlantic (Cuthbert *et al.* 2009), with remaining populations occurring at Amsterdam and St Paul Islands in the Indian Ocean (Guinard *et al.* 1998). Population trends over the last 30 years for the Atlantic populations indicate that numbers have decreased at Gough Island, with more modest declines at Inaccessible and Nightingale Islands (both part of the Tristan da Cunha group of islands) and relatively stable numbers at the main island of Tristan (Cuthbert *et al.* 2009). Best estimates of numbers up to 2004–2007 are of around 32,000–65,000 pairs at Gough, 18,000–27,000 at Inaccessible, 19,500 at Nightingale, and 3,200–4,500 at Tristan. However, and crucially, numbers and population trends of birds breeding at Middle Island (Tristan da Cunha) are unknown, despite the fact that this site may hold as many birds as all other islands at Tristan da Cunha and Gough combined. Middle Island supported an estimated 100,000 pairs in 1973 (Richardson 1984) and recent observations suggest this colony is being impacted by competition for space with recently colonising Subantarctic Fur Seals *Arctocephalus*

tropicalis (Cuthbert *et al.* 2009). An international workshop on the conservation of Rockhopper Penguins identified a census of Middle Island as the most urgent research priority for the Northern Rockhopper Penguin, followed by regular counts of breeding colonies at all of the main breeding islands in order to assess population trends (Birdlife International 2010a). In this paper we report updated population estimates for all islands within the Tristan da Cunha group, including the first repeat count of Middle Island.

Methods

Population counts of breeding penguins were made at the four main islands within the Tristan da Cunha group during the 2009 breeding season. Survey methods varied for each island due to differences in access and cover. At Tristan, all eight extant sub-colonies were counted on foot from 14 October to 1 November, during the incubation period and early chick period. At Nightingale and Middle islands, both of which are covered in dense 2-m high *Spartina arundinacea* tussock grass, penguin numbers in the largest colonies were estimated from the areas occupied by the breeding colonies (mapped on foot with a handheld GPS) and the average density of nesting pairs within these areas. Nesting densities were estimated from 60 randomly-located 5 x 5 m quadrats, which were placed within the two main sub-colonies on Middle ($n = 20$ quadrats in each) and the largest sub-colony on Nightingale ($n = 20$). Numbers of nests within small sub-colonies at Middle and Nightingale ($n = 2$ and 4, respectively) were counted on foot, apart from two inaccessible colonies on the south coast of Nightingale that were crudely estimated by scanning with binoculars from an adjacent slope in October 2007. Counts on Middle and Nightingale islands were conducted from 24 to 27 October 2009.

At Inaccessible Island, the areas of two sub-colonies (Blenden Hall and Warren's Cliff) were mapped with a handheld GPS and nesting densities were estimated from 15 and 16 randomly-located 2 x 2 m quadrats on 9 and 10 October 2009. The area occupied by nests was mapped in three other sub-colonies on Inaccessible in the first week of December. However, as chicks were in crèches at this time, the estimated size of these sub-colonies was based upon the average nesting density measured at Blenden Hall and Warren's Cliff (1.5 nests m^{-2}). Estimates of numbers at three remaining sub-colonies on Inaccessible were based upon beach counts of penguins, with the size of beach parties related to the size of the nesting population based upon five colonies where both nest counts and beach counts were made (Ryan 2005). No ground or beach party count could be made at the South Hill sub-colony on Inaccessible Island, although one scan count of the beach was possible. A total population estimate was calculated for Tristan da Cunha based upon the count data for all islands. Population trends over time are based upon the counts in this paper and the data in Table 1 of Cuthbert *et al.* (2009). However, trend data for Inaccessible Island (as

Table 1. Population estimates of nesting pairs of Northern Rockhopper Penguins and count methods at the four main islands of Tristan da Cunha. Estimates for each island are rounded to the nearest 1,000 for Middle, Inaccessible and Nightingale islands, and to the nearest 100 for Tristan. Figures in parentheses reflect the likely accuracy of the counts.

Island	Count method	Population estimate (nesting pairs)
Middle	Density and area estimates (2 main sub-colonies), ground count of nests (2 small sub-colonies)	83,000 (80,000–85,000)
Nightingale	Density and area estimates (main sub-colony), ground count of nests (4 small sub-colonies)	25,000 (22,000–28,000)
Inaccessible	Density and area estimate (2 sub-colonies), area estimates (3 sub-colonies), beach counts (4 sub-colonies)	54,000 (50,000–55,000)
Tristan	Ground count of nests (8 sub-colonies)	6,700 (6,500–7,000)
Total for Tristan da Cunha archipelago		169,000 (160,000–175,000)

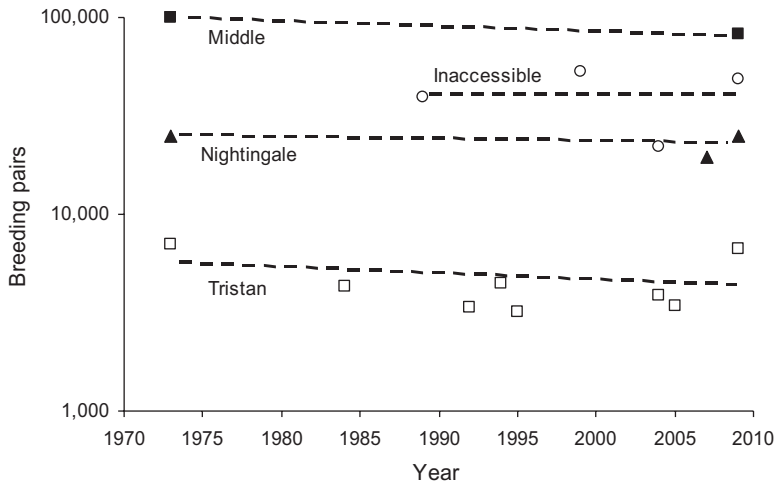


Figure 1. Population estimates of Northern Rockhopper Penguins at Tristan da Cunha for the period 1973 to 2009 for Tristan (unfilled square symbols), Nightingale (filled triangles) and Middle islands (filled squares), and 1989 to 2009 for Inaccessible Island (unfilled circles). Dashed lines are the linear best-fit lines.

plotted in Figure 1) are based on density and area estimates of sub-colonies (when available), with beach counts of penguins estimated to represent 6% of the breeding population in all years, compared with a conversion factor of 15% for beach parties and colony sizes used in previous years (Ryan *et al.* 1990 and see results below). Additionally, Table 1 of Cuthbert *et al.* (2009) incorrectly reports 19,500 pairs from Nightingale in 2005, when the count took place in 2007 as is plotted in Figure 1.

Results and Discussion

Counts of Northern Rockhopper Penguin nests at Middle Island indicated that this site held around 80,000–85,000 breeding pairs in 2009 (Table 1). Given differences in count techniques, some caution is required in comparing this figure with the earlier estimate of 100,000 pairs in 1973 (Richardson 1984). Nonetheless, it suggests that numbers have remained broadly similar over the last 36 years at this island, which remains the most populous site for the species. Richardson's 1973 estimate was based upon a very short visit to the island and he reported a lower nesting density (0.5 pairs m^{-2}) and greater area of occupancy (c.20 ha) versus the current estimates (1.19–1.95 pairs m^{-2} and 4.45 ha; Table 1). While these differences are puzzling, it is worth noting that previous estimates of Richardson's for numbers of nesting seabirds at Gough Island, which were again based on very brief visits to the island, provided similar estimates to more recent counts based upon more extensive survey methods (Cuthbert and Sommer 2004).

Counts in 2009 of numbers of penguins at Inaccessible Island indicate around 50,000–55,000 pairs. This figure is considerably higher than previous counts for Inaccessible, where 24,000–30,000 pairs were estimated in 1989 and 1999, and 16,000–20,000 pairs in 2004 (Ryan 2005). Previous totals for Inaccessible Island were based on an assumption that numbers of birds at beach parties during the early chick stage correspond to roughly 15% of the estimated number of breeding pairs (Ryan *et al.* 1990). In 2009, counts of beach parties at five sub-colonies, where estimates of areas occupied by breeding birds and densities of nests were available for two sub-colonies, indicated a linear relationship between the size of beach parties and the size of the sub-colony (breeding pairs in sub-colony = 19.0* birds in breeding colony, $R^2 = 0.92$, $n = 5$ sub-colonies), with the beach party counts holding around 6% of the total number of breeding pairs.

This value of 6% suggests that the correction of 15% may have underestimated breeding numbers on previous occasions. An alternative explanation is that breeding densities and breeding numbers were lower in previous surveys, and consequently beach party numbers were genuinely lower in previous years. Average counts of beach parties at Inaccessible in all four years from the same eight sites (all beaches except South Hill) support this, with broadly similar totals (2,380, 3,210 and 2,935 birds) in 1989, 1999 and 2009, but substantially smaller numbers in 2004 (1,315 birds). When population sizes from the four survey years at Inaccessible were adjusted with the new 6% conversion factor, population estimates were broadly similar across most years but still lowest in 2004 (Fig. 1). Estimates from the other main islands at Tristan da Cunha indicate around 22,000–28,000 pairs on Nightingale, and 6,500–7,000 pairs on Tristan, which with the estimates for Middle and Inaccessible islands suggests a total population of around 160,000–175,000 pairs at Tristan da Cunha. If numbers of breeding pairs have remained similar at Amsterdam and St Paul in the Indian Ocean where 25,000 and 9,000 pairs, respectively, were recorded in 1993 (Guinard *et al.* 1998), and with 48,500 pairs at Gough Island (based on the average of counts in 2004 and 2006; Cuthbert *et al.* 2009), then the total population of Northern Rockhopper Penguins is estimated to be around 250,000 pairs. This total confirms the global significance of the Tristan da Cunha group of islands with over 65% of the population found at this location.

Comparison of population trends at the four main islands in the Tristan da Cunha group for the 36-year period from 1973 to 2009 for Tristan, Nightingale and Middle islands and for the 20-year period from 1989 to 2009 for Inaccessible indicate no significant trend in breeding numbers and stable populations at all islands, although with relatively high inter-annual variability in breeding numbers (Figure 1). Previous estimates of trends of Northern Rockhopper Penguins at islands in Tristan da Cunha concluded that there may have been declines at these islands, as the most recent counts of pairs at Tristan (in 2004 and 2006) and Nightingale (2007) were both lower than the estimates from the early 1970s (Cuthbert *et al.* 2009) and the last count from Inaccessible Island (in 2004) also was lower than counts at this island in the late 1980s and late 1990s (Ryan 2005). The stable numbers at Tristan da Cunha, as revealed by the 2009 survey, contrasts with the situation at Gough Island, where counts from 2004 and 2006 suggest that the population had declined at a rate of 3–4% a year from an estimated 110,000 pairs on Gough in the early 1980s (Cuthbert *et al.* 2009). Similarly, for populations of Northern Rockhopper Penguins in the Indian Ocean, despite contrasting trends at Amsterdam and St Paul (Guinard *et al.* 1998), the overall trend suggests a decline of around 2% a year for the period 1971–1993 (Cuthbert 2009). If, as the latest counts in this study indicates, number of breeding pairs have remained stable at Tristan da Cunha, which supports over 65% of the total population, in the last 20–36 years, then the overall rate of decrease is lower than previously estimated.

Given a relatively stable population of around 168,000–170,000 pairs at Tristan da Cunha, the total population is estimated to have declined by around 33% over the last 30 years. Based on this rate of decrease the population of Northern Rockhopper Penguins should be classified as globally 'Vulnerable' instead of its current status of 'Endangered', on the basis of the decreases exceeding 30% in three generations (30 years for a *Eudyptes* penguin; Birdlife International 2010a,b). While this presents a more optimistic scenario than previously thought, these more modest declines need to be placed in context against the historical size of the population at both Gough and Tristan da Cunha, where in the past century (and until the 1950s on Gough; Swales 1965) millions of pairs were likely to have been present (Cuthbert *et al.* 2009). Knowledge of the factors driving population declines of Northern Rockhopper Penguins at Gough Island and Southern Rockhopper Penguins *Eudyptes chrysocome* at other islands in the Southern Oceans is currently low, although changes in at-sea factors are considered the most likely drivers behind the observed large-scale changes (Cunningham and Moors 1994; Guinard *et al.* 1998; Hilton *et al.* 2006; Birdlife International 2010a). Consequently, concurrent studies of the at-sea ecology and foraging ecology of Northern Rockhopper Penguins at both Tristan da Cunha and Gough Island may be useful in suggesting differences in these populations that are contributing to their different population trends, as well as factors that influence the relatively high inter-annual variation in breeding

numbers. Repeat monitoring of numbers of breeding pairs at all of the main islands is also essential to determine accurately the population trends and conservation status of this species.

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