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SHORT NOTE

Changes and consistencies in marine and coastal bird numbers on Kidney Island (Falkland Islands) over half a century

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Abstract

Detecting change is necessary for effective ecosystem management, yet temporal data on key ecosystem components are lacking for many polar and subpolar regions. For example, although the Falkland Islands hosts internationally important marine and coastal bird populations, few of these were surveyed until the late twentieth century. The avifauna of one small island, Kidney Island, was surveyed between 1958 and 1963, however. This typical tussac-covered island has remained free of non-native predators, so changes in its avifauna may reflect variation in the wider marine environment. In order to obtain a rare snapshot of such changes, we re-surveyed Kidney Island's avifauna between 2017 and 2019, counting either individuals, breeding pairs or nest sites of marine and coastal waterbirds. Waterfowl, waders and cormorant populations were broadly stable, but several populations showed profound differences over the six decades between surveys. In particular, Southern Rockhopper penguins *Eudyptes chrysocome* collapsed from > 3000 to 200 pairs, while Sooty Shearwaters *Ardenna grisea* expanded by two orders of magnitude. Due to its isolation and tight fisheries management, the Falklands marine environment is assumed to be relatively pristine. Our limited results suggest that sufficient changes may nevertheless have occurred in the region's marine ecosystem to have detectable impacts on breeding seabirds.

Keywords Kelp Goose · Falkland Steamer duck · Rockhopper penguin · *Ardenna gravis* · *Haematopus ater* · Falkland Islands

Introduction

Data on long-term changes in key components of marine ecosystems are of intrinsic interest, both from historical and ecological perspectives. They are of potential relevance to the identification of ecological baselines, the understanding of ecosystem dynamics and their drivers and ultimately may help to forecast future changes.

Birds are important and highly visible constituents of many marine ecosystems. In some regions, their populations have been monitored over long periods and the drivers of their population changes are relatively well understood. However, within the Patagonian Shelf Large Marine Ecosystem and coastal areas of Southern South America, few quantitative population studies of marine and coastal birds were undertaken prior to the late twentieth century. In the Falkland Islands, long-term monitoring of seabirds began in 1997 and shorebirds in 2008 (e.g. Pistorius et al. 2010; Baylis et al. 2013; Crofts and Stanworth 2018; Poncet et al. 2018). However, no long-term monitoring is carried out of some petrels, and many shorebird and waterfowl species. In the late 1950s and early 1960s, Robin Woods surveyed bird numbers on Kidney Island, a small island with a diverse avifauna, near Stanley in the northeast of the archipelago (Fig. 1) (Woods 1970a, b). In addition, he and others made less systematic counts in the decades before and after that period (Woods 2017).

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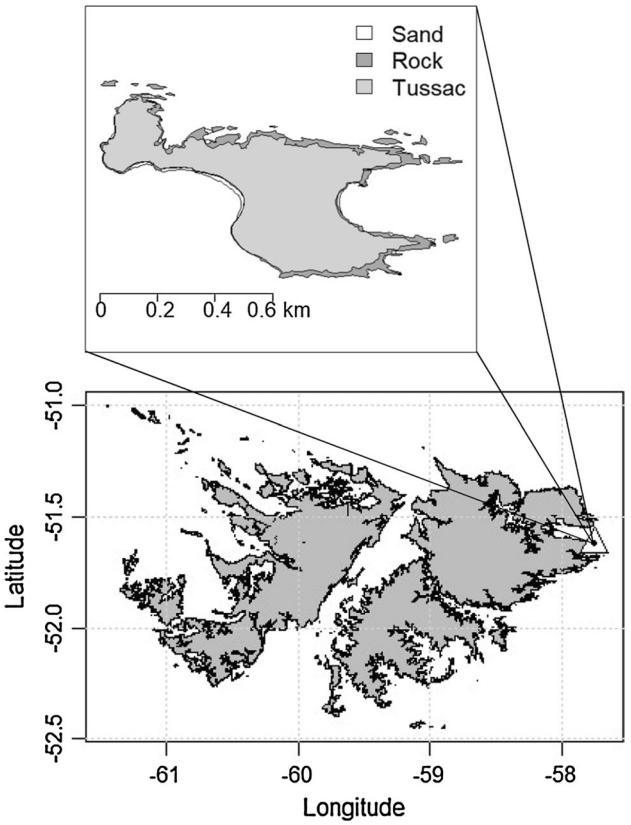

Fig. 1 Location of Kidney Island (triangle) relative to the Falkland Islands

Kidney Island has been a Nature Reserve since 1964, an Important Bird and Biodiversity Area since 2006 and a priority Key Biodiversity Area since 2016 (BirdLife International 2019). The only substantive direct impacts humans are known to have had on the island occurred before the 1960s. These included regular harvesting of tussac *Poa flabellata*, occasional fires and the collection of Southern Rockhopper penguins' *Eudyptes chrysocome* eggs (Carstairs 1995). Despite being only 0.4 km from the mainland, the island is free of introduced mammals. In the Falklands, such predator-free islands typically have twice as many coastal waterbirds as those with cats or rodents (Poncet et al. 2018). Many, like Kidney Island, also have large populations of burrowing seabirds, and the endemic Tussacbirds *Cinclodes antarcticus* and Cobb's wrens *Troglodytes cobbi* (Strange 1992; Tabak et al. 2014). The aim of the present study was to gain a snapshot of current seabird and coastal waterbird numbers on Kidney Island relative to those six decades earlier by repeating Wood's surveys of the 1950s and 1960s. Although Kidney Island harbours only a small proportion of the Falklands' bird populations, gross changes at this comparatively undisturbed site could provide valuable clues about how the region's avifauna has changed over an otherwise data deficient period.

Methods

Kidney Island (51° 38′, 57° 45′ W, area = 0.32 km^2, coastline length = 4.2 km) is located 0.4 km off East Falkland (Fig. 1). It is low-lying, with cliffs (< 20 m) dominating its north coast. The intertidal zone is generally narrow (<10 m), with a rock or boulder substrate, and small areas of sand. Extensive kelp beds, dominated by giant kelp *Macrocystis pyrifera*, surround the island and inland it is almost completely covered with dense tussac.

Woods censed or estimated numbers of birds on Kidney Island during multiple visits between 1958 and 1963. The majority of observations in the early surveys were made in December 1960 and December 1961; survey effort comprised seven weeks of camping on the island during those years (Woods 1970a, b). Occasional observations during shorter visits at other times were compiled in Woods and Woods (1997) and in Woods (2017).

Our surveys were carried out and during January 2017, November 2018 and January 2019. Between November the 17th and 19th, 2018 and January the 8th to 10th, 2019 we censused waterfowl, waders and surface-nesting seabirds by replicating the method used by Woods (1970a) in the 1960s. These birds are highly conspicuous and allow close approach by humans in the Falkland Islands. We searched the entire perimeter of the island by walking along the coastline or viewing the shoreline from the cliff top, and recorded all breeding pairs detected. We defined the presence of a breeding pair as a bird in incubating position on a nest containing eggs or chicks. In addition, we assumed that the presence of a lone male Kelp Goose *Chloephaga hybrida* or Falkland Steamer duck *Tachyeres brachypterus* displaying territorial behaviour during the breeding season indicated a breeding pair. Repeated counts in sub-sections of the coastline revealed absolute consistency in numbers. In addition, we systematically surveyed Sooty shearwaters *Ardenna grisea* across the island in January 2017 (for details, see Clark et al. 2019).

Results

Counts of Southern Rockhopper penguins and Imperial shags *Leucocarbo atriceps* made in 2017–2018 were an order of magnitude lower than those made in the late 1950s–1960s. In contrast, counts of Sooty shearwaters suggest an increase of two orders of magnitude over this period, while counts of Falkland Steamer ducks and Kelp geese were of the same order (Table 1).

Table 1 Estimated populations of marine birds on Kidney Island in the 1960s and in the early twenty-first century

	1960 (pairs)	2018 (pairs)	Notes
White-chinned Petrel *Procellaria aequinoctialis*	"Few hundred"	"Few hundred"	27 pairs in 2006, but numbers most likely were underestimated (Reid et al. 2007)
Sooty Shearwater *Ardenna grisea*	2000	140,000	Clark et al. (2019)
Great Shearwater *Ardenna gravis*	Present nesting (in 1961)	Present, probably nesting	Seen ashore in Jan 2017, Jan 2018 and Nov 2018 (see "Discussion" section)
Grey-backed Storm-petrel *Garrodia nereis*	Present nesting	Present nesting	
Southern Rockhopper Penguin *Eudyptes chrysocome*	3000+	202	25,000 eggs collected in 1914, but only 1000 in 1952 (Cawkell and Hamilton 1961)
Macaroni Penguin *Eudyptes chrysolophus*	1–2	0	
Magellanic Penguin *Spheniscus magellanicus*	Several hundred pairs	Widespread, but possibly in small numbers; tens?	
Patagonian Crested Duck *Lophonetta specularioides*	0	1	Adult plus chick in Jan 2018; one individual in Nov 2018 (nest hidden) and pair with 3 ducklings in March 2019 (Sally Poncet, pers. comm.)
Kelp Goose *Chloephaga hybrida*	14 (in 1961)	26	Despite 26 pairs in Nov 2018, only 9 males and a total of 6 broods remaining in Jan 2019
Steamer Duck *Tachyeres brachypterus*	10	7–8	7 pairs (6 with brood) and a single male in Nov 2018. Still 7 pairs in Jan 2019
Night Heron *Nycticorax nycticorax*	8	0	Still present in each recent year, no confirmed nesting; fledged juveniles seen in Jan 2018
Imperial Shag *Leucocarbo atriceps*	440	20	Similar number in 2016/2017 but large numbers (many hundred) flying past the island in all years
Rock Shag *Leucarbo magellanicus*	134	51	41 and 51 occupied nests in Nov 2018 and Jan 2019 respectively. Still occupies the same 5 subcolonies as in 1960
Black Oystercatcher *Haematopus ater*	5	4	See text for details
Falkland Skua *Stercorarius antarcticus*	1	0	No breeding in 2016 and 2018 but present in the area
Kelp Gull *Larus dominicanus*	1	0	No breeding in 2016 and 2018 but present in the area
Brown-hooded Gull *Chroicocephalus maculipennis*	20	0	2 possible nests in Jan 2017, present in the area in Nov 2018 (not nesting) when up to 6 adults seen close inshore
Dolphin Gull *Leucophaeus scoresbii*	50	0	No breeding in 2016 and 2018 but present in the area (< 10 individuals)
South American Tern *Sterna hirundinacea*	50	0	No nests in Nov 2018 or Jan 2019, but a colony with < 10 nests and ca 100–120 individuals in Jan 2017 and 105 individuals observed in Nov 2018

Unless stated otherwise, estimates from 1960 to 1961 are from Woods (1970a) and estimates from 2016 to 2019 are from this study

Discussion

The majority of the population estimates we presented are snapshots at two points in time, rather than the more extensive time series typically used to investigate population dynamics. Hence, any inferences we draw about sustained trends are necessarily tentative. Nevertheless, several of the changes are so large that they deserve highlighting.

Rockhopper penguins were estimated to have declined in the Falkland Islands by over 80% between the early 1930s and 1995s (Pütz et al. 2003). Subsequently, numbers have fluctuated (Baylis et al. 2013; Crofts and Stanworth 2018). The Kidney Island population may have been in decline prior to the 1930s as a result of intensive egg harvesting: in 1914, around 25,000 eggs were collected but by 1952 only 1000 were taken (Cawkell and Hamilton 1961). Although

egg collecting ceased in 1960 (at which time > 3000 pairs of Rockhopper penguins were estimated to breed on Kidney Island (Woods 1970a), our results suggest that the population has continued to decline. Our 2017/18 count was less than 10% of that of 1960, when the population was likely to have been already depleted. This ongoing decline may be due to changes in oceanographic conditions and, consequently, prey availability, which are thought to have driven declines in Rockhopper penguins' populations across the Southern Ocean during the twentieth century (Pütz et al. 2003; Hilton et al. 2006).

The sooty shearwater population of Kidney Island, estimated at 2000 breeding pairs in 1960 (Woods 1970a) and 140,000 breeding pairs in 2017, is by far the largest known in the Falklands (Clark et al. 2019). The species was first recorded breeding on the island in the 1930s, when "small numbers" were found in 3 discrete colonies on the slopes of the western headland (B.B. Roberts in Woods 2017). The two orders of magnitude increase over the past 80 years is in strong contrast to sharp declines in the species' core range in the South Pacific (Scott et al. 2008). Reasons for the increase on Kidney Island remain unknown but may include the recovery of tussac cover on the island after the cessation of harvesting in the 1960s (Clark et al. 2019).

The population trend for White-chinned petrels *Procellaria aequinoctialis* on Kidney Island is unknown—various past estimates reveal contradictory numbers (reviewed in Woods and Woods 1997; Woods 2017). However, this species is thought to be in decline in South Georgia (Martin et al. 2009) and elsewhere, largely due to fisheries bycatch (Barbraud et al. 2008) and is therefore classified as Vulnerable by the IUCN.

Great shearwaters *Ardenna gravis* were first recorded breeding in small numbers on Kidney Island in 1961, making this the only known colony outside the Tristan da Cunha group (Woods 1970b). The population was subsequently estimated to be 50–100 pairs (Woods and Woods 1997). We counted Great shearwaters in rafts of Sooty shearwaters that form around Kidney Island prior to the birds entering the colony each evening. These typically contained 5000–10,000 Sooty shearwaters and a mean of 12 Great shearwaters (N = 7 counts/days, range 1–29 birds). If the ratio of great shearwaters in the rafts to those attending the island is the same as for Sooty shearwaters, we speculatively estimate that approximately 168–336 Great shearwaters' pairs could breed there. It is possible that an increasing number of Great shearwaters are recruiting to the colony. Tracking data show that birds breeding on Gough Island in the Tristan group regularly forage on the Patagonian Shelf, adjacent to the Falklands (Ronconi et al. 2010).

Counts of Kelp geese in 2018–2019 were approximately twice those recorded six decades earlier. As with Sooty shearwaters, this could be due to increased tussac cover. In nearby Tierra del Fuego, Kelp geese only nest on islands free of mammalian predators, and are associated with islands with greater bush cover, perhaps because this conceals nests from predators (Liljesthröm et al. 2013). In the Falklands, the species does manage to breed in the presence of feral cats *Felis catus* and Norway rats *Rattus norvegicus* but possibly at a depressed density. It is interesting to note that the density of Kelp geese on Kidney Island is extremely high, compared to the adjacent East Falkland (pers.obs.), despite the relatively poor availability of the species' marine algae food on Kidney Island (very low surface covered by green algae such as *Ulva* or *Enteromorpha*).

Counts of Falkland Steamer ducks were approximately the same across the two recording periods. This species is resident, with pairs occupying the same coastal territories year-round (Poncet 2014), making it likely that this consistency in numbers reflects a true neutral population trend.

Counts of Rock shags breeding on Kidney Island were similar but those of Imperial shags were dramatically lower during the recent count than in the 1960s. The latter species can switch nest sites regularly. It remains very numerous in waters adjacent to Kidney Island (pers.obs.), with many hundreds regularly flying past and foraging nearby so the Kidney Island population may simply have shifted to a nearby location. There are no data on regional or overall numbers or trends of Imperial shags in the Falklands. Population trends in Argentina in recent decades have differed in sign across regions, but have remained stable overall (Frere et al. 2005; Raya Rey et al. 2014). Similarly, Rock shag numbers have fluctuated temporally and regionally in Argentina over the past 20–30 years (Frere et al. 2005; Raya Rey et al. 2014).

In late November 1936, three pairs of Blackish oystercatchers *Haematopus ater* were recorded on Kidney Island (B.B. Roberts in Woods 2014). Woods recorded five pairs in 1960 and four pairs in 1961, and seven pairs in both 1969 and 2002 (Woods 2014). We recorded four pairs in November 2018, suggesting that the population has remained small but stable over the past 82 years. Although this species is classified as Least Concern, as far as we are aware, there are no other data on its population trends.

The marked decline of Rockhopper penguins and Imperial shags on Kidney Island may have also affected birds that scavenge or predate in their colonies – for example Skuas *Stercorarius antarcticus* and Dolphin gulls *Leucophaeus scoresbii*. There is scant information on population trends of these two species in the Falklands. In Patagonia, Dolphin Gull populations appear to be broadly stable, with local increases in the past few decades (Suárez and Yorio 2005; Raya Rey et al. 2014; Pablo Yorio, pers.com.). Skuas have declined recently elsewhere in the Falklands (Catry et al. 2011), but current data are insufficient to estimate regional population trends robustly.

Brown-hooded gulls *Chroicocephalus maculipennis* and South American terns *Sterna hirundinacea* often relocate *en masse* to new breeding sites, making the differences in numbers we found difficult interpret. Both species are still present in the vicinity of Kidney Island in numbers apparently of the same order as in 1960, but few bred on the island during our visits there. Brown-hooded gulls may be increasing in South America (Burger et al. 2019), while some South American tern populations have declined in Chile, seemingly due to human disturbance (Gochfeld et al. 2019).

Kidney Island has long been afforded protection as a Nature Reserve under national legislation. Moreover, the wider Falklands marine environment is relatively pristine, due both to its isolation and relatively strict fisheries management. Our limited results suggest that despite this, some marine bird populations in the region have changed substantially over the past six decades. Future studies should seek to understand the causes of these changes, especially among Southern Rockhopper penguins and Sooty shearwaters, as well as clarify the status and trends of White-chinned petrels. Given the paucity of time series data, consideration should also be given to broadening long-term monitoring in the region to cover a wider range of marine and coastal bird species.

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Compliance with Ethical Standards

Conflict of interest The authors declared no conflicts of interest. Work on Kidney Island was approved by the Environmental Committee of the Falkland Islands Government.

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