

Notes

Flesh-footed Shearwaters (*Puffinus carneipes*) in the Northeastern Pacific Ocean: Summary and Synthesis of Records from Canada and Alaska

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Flesh-footed Shearwaters (*Puffinus carneipes*) breed in Australia and New Zealand, but spend the non-breeding season in the north Pacific Ocean. They are rare compared with most non-breeding pelagic seabirds that occur in the northeastern Pacific. Recent surveys at breeding colonies have indicated a significant population decline since the 1970s. We compiled records of Flesh-footed Shearwaters off the Pacific coast of Canada and Alaska from 1937 to 2013. Flesh-footed Shearwaters were recorded from May to October, with most sightings in August and September. Flocks of more than 20 birds have not been recorded since the 1940s, and most sightings have been of single birds, although some key areas (e.g., Goose Island Bank) have not been surveyed in recent years and previous surveys are confounded by fishing activity. Given the significant population declines at breeding colonies, the conservation status of Flesh-footed Shearwaters should be revisited.

Key Words: Flesh-footed Shearwater; *Puffinus carneipes*; British Columbia; Alaska; range limit; non-breeding season; seabird

Introduction

Flesh-footed Shearwaters (*Puffinus carneipes*) are transequatorial migrants that breed in the south Pacific and Indian Oceans from September to May, and raise a single chick each year (Marchant and Higgins 1990). Breeding colonies are located on North Island, New Zealand (Waugh *et al.* 2013), Lord Howe Island, Australia (Reid, Hindell *et al.* 2013), and around 40 islands in South and Western Australia (Lavers 2015). In addition, a small number breed on Île Saint-Paul in the Indian Ocean (Duriez and Delord 2012). Estimates of the global breeding population have ranged from 220 000 to 420 000 pairs (Marchant and Higgins 1990), but a recent reassessment and critical evaluation of historic data suggests that it may be closer to 74 000 pairs (Lavers 2015). Serious reductions in the number of breeding pairs have been reported across most of the species' range with breeding abandoned on at least six islands in New Zealand and Western Australia (Reid, Hindell *et al.* 2013; Waugh *et al.* 2013; Lavers 2015). Breeding populations are threatened by climate change (Bond and Lavers 2014), fisheries bycatch (Baker and Wise 2005; Reid *et al.* 2012), ingestion of plastic (Lavers *et al.* 2014), introduced predators (Priddel *et al.* 2006), contaminants (Bond and Lavers 2011; Lavers *et al.* 2014), and various other anthropogenic activities (Lavers 2015).

A variety of shearwaters occur off the northern Pacific coast of North America, including small numbers of Flesh-footed Shearwaters (Martin 1942; Kenyon *et al.*

2009). In light of observed population declines at breeding sites and revised global population estimates, our goal was to summarize the occurrence of Flesh-footed Shearwaters in Alaskan and Canadian waters of the Pacific Ocean using published and unpublished records.

Methods

We compiled records of Flesh-footed Shearwaters in Alaskan and Canadian waters from published sources and from researchers or pelagic tour boat operators in British Columbia and Alaska. We also obtained records from eBird, an online citizen-science repository for bird sightings (eBird 2014). We included records that were in Canadian waters or farther north (Figure 1) and contained a date and specific location. Records were screened to eliminate duplicates appearing in multiple sources or from multiple observers. For multiple records from the same location on the same day, we used the maximum count.

Results

We found 182 records of Flesh-footed Shearwaters, comprising 531 individuals, in Canada and Alaska from 1937 to 2013 (Table 1). Shearwaters were recorded between 2 May 1970 (Campbell and Shepard 1971) and 16 October 1992 (eBird 2014) with most sightings in August and September (Figure 2). Of the 182 records, 171 (94%) also included data on the number of birds seen. Of these, 101 (59%) records were of single birds, 32 (19%) were of two birds together, and the remainder

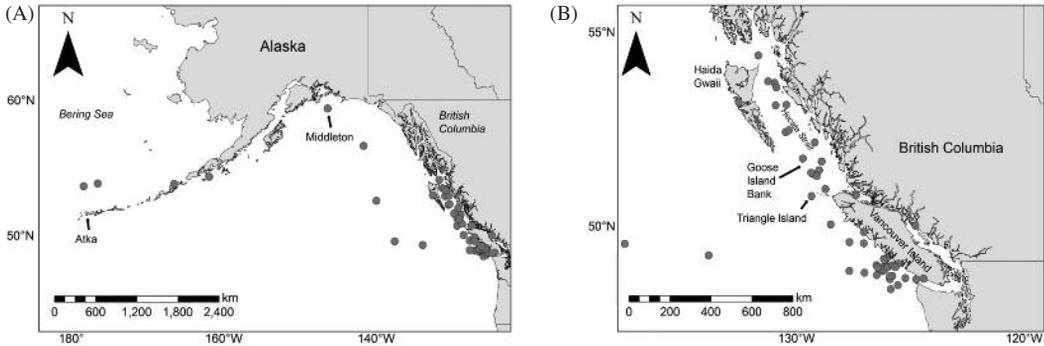


FIGURE 1. Flesh-footed Shearwaters (*Puffinus carneipes*) occur off the coast of British Columbia, and Alaska (A), particularly on the Goose Island Bank (B). Records indicated by grey circles (some records overlap or consist of multiple individuals).

TABLE 1. Summary of records of Flesh-footed Shearwaters (*Puffinus carneipes*) in Alaska and British Columbia from 1937 to 2013 by month.*

Month	Alaska		British Columbia	
	No. of records	No. of birds	No. of records	No. of birds
May			14	16
June	2	2	20	109
July	1	1	18	76
August	18	68	37	60
September	31	114	32	56
October	1	1	7	10
Unknown			1	18
Total	53	186	129	345

*Data sources: Martin (1942); Mills (1960); Martin and Myres (1969); Crowell and Nehls (1970); Campbell and Shepard (1971, 1972); Hatler *et al.* (1978); Guzman and Myres (1983); Campbell *et al.* (1990); Morgan *et al.* (1991); Cecile (2004); Kenyon *et al.* (2009); eBird (2014); North Pacific Pelagic Seabird Database (2014); various authors' unpublished data. See complete dataset for details (see *Data Availability* section).

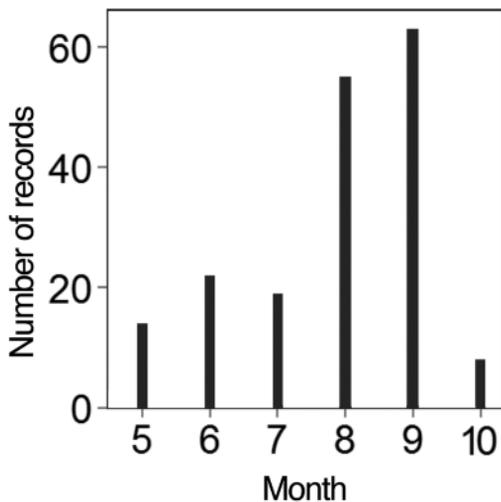


FIGURE 2. Flesh-footed Shearwaters (*Puffinus carneipes*) occur in Canadian waters between May and October, with a peak in August and September. Data are presented as the number of records (regardless of the number of birds observed) by month of record ($n = 182$).

were 4–60 birds, although only 11 (6%) were records of more than 10 individuals (Figure 3).

Discussion

Flesh-footed Shearwaters occur in the northeastern Pacific Ocean during the non-breeding season (May–October) and are less abundant than other shearwater species off the coast of British Columbia and Alaska (Kenyon *et al.* 2009). This made it simple to examine changes in abundance over time because, as a rare species, any records were notable and likely to be recorded.

Flesh-footed Shearwaters are well-known ship followers and highly gregarious at sea (Bartle 1974; Wahl and Heinemann 1979; Wood 1990; Freeman 1992; Baker and Wise 2005). Earlier surveys were conducted from fishing vessels (Martin and Myres 1969), which artificially inflated flock size. More recent at-sea surveys were typically carried out during oceanographic cruises, which are along established transects. Hence, time trends are difficult to assess based on current at-sea data.

Our results for Alaska are of particular interest, as Flesh-footed Shearwaters have been considered hypo-

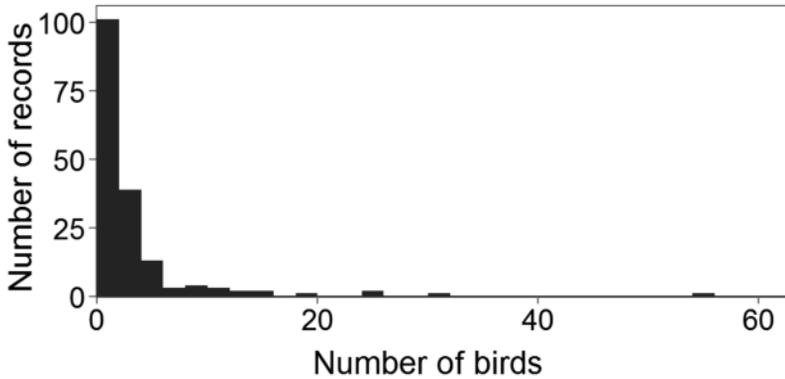


FIGURE 3. Most of the 182 records of Flesh-footed Shearwaters (*Puffinus carneipes*) in Canada have been of one or two birds (mean: 3, median: 1).

thetical in that state (Kessel and Gibson 1978; Gibson and Byrd 2007). Specifically, two records from the Bering Sea, north of Atka Island, are exceptional, and represent the most northerly records in North America. Large numbers of shearwaters spend the austral winter in the north Pacific Ocean and Bering Sea (Onley and Scofield 2007); thus, Flesh-footed Shearwaters could be easily overlooked. Current standardized surveys and databases (e.g., North Pacific Pelagic Seabird Database 2014) will be useful in documenting any northerly shift in the range of Flesh-footed Shearwaters (Hazen *et al.* 2013).

There is little evidence that direct mortality occurs in Canadian and Alaskan waters (e.g., one report of five birds taken as bycatch in experimental fisheries in the central North Pacific in the early 1990s; Elliott 2005), and no Flesh-footed Shearwaters have been recorded on beached bird surveys in British Columbia (K. Barry, personal communication), although the vast majority of birds that perish at sea never appear as beached birds (Haney *et al.* 2014). Current evidence suggests that most birds spend the non-breeding season in the western Pacific off Japan and Korea (Rayner *et al.* 2011; Reid, Tuck *et al.* 2013) or in the northern Indian Ocean (Wijesinghe 1985; Palot 2008; Powell 2009; Lavers *et al.*, unpublished data), so the North American non-breeding population represents a small, but unknown proportion of breeding birds.

Using biogeochemical markers, Lavers *et al.* (2013) predicted that most Flesh-footed Shearwaters collected off British Columbia and Washington originated from Western and South Australia and smaller numbers from New Zealand. Population estimates from Western and South Australia in the 1970s and 1980s (more than 350 000 pairs) are erroneous, and recent more rigorous surveys suggest a much smaller population (less than 36 000 pairs); therefore, the actual population trend is difficult to ascertain given the vast overestimates in the 1970s and 1980s (Lavers 2015).

An important caveat to our analysis is that we did not account for survey effort. Important areas for Flesh-

footed Shearwaters, such as the Goose Island Bank, have not been surveyed in recent years (the last survey was in 1970), and most pelagic surveys take place on vessels of opportunity (Kenyon *et al.* 2009). Furthermore, we did not account for differences in the shearwaters' at-sea distribution over time, which is expected to change with oceanographic and climatic conditions (Hazen *et al.* 2013).

At-sea observations can closely mirror population trends at breeding colonies (Clarke *et al.* 2003); thus, significant population declines at Australasian breeding sites suggest that the overall abundance of this species in Canadian and Alaskan waters could have decreased. Additional surveys in key areas, such as the Goose Island Bank, are required to establish the status of Flesh-footed Shearwaters in the northeastern Pacific Ocean.

Data Availability

The complete dataset of Flesh-footed Shearwater sightings is available on figshare at <http://dx.doi.org/10.6084/m9.figshare.1233374>.

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