

An unusual influx of Short-tailed Shearwaters into nearshore waters of southern British Columbia in 2021

Anthony J Gaston¹, Jared R. Towers², Mark Maftai³, Sonya Pastran⁴, Yousif Attia⁵, Gordon Curry⁶

¹Tony Gaston Consulting, 174 Dufferin Road, Ottawa, ON K1M2A6; email: tonygastonconsult@gmail.com

²Bay Cetology, 257 Fir Street, Alert Bay, BC, V0N 1A0 email: jrtowers@gmail.com

³Raincoast Education Society, P.O. Box 815, Tofino, BC, V0R 2Z0; email: mark@raincoasteducation.org

⁴3268 Haida Drive, Victoria, BC. V9C2M7; email: sonya.pastran@gmail.com

⁵Birds Canada, 115 Front Road, PO Box 160, Port Rowan, ON N0E 1M0; email: yattia@birdscanada.org

⁶P.O. Box 336, Sointula, B.C. V0N 3E0; email: gordon.curry@gmail.com

Abstract: An unusual influx of Short-tailed Shearwaters *Ardenna tenuirostris* occurred in British Columbia marine waters in 2021 with concentrations of thousands of birds in the Blackfish Sound region of eastern Queen Charlotte Strait and hundreds, possibly thousands, in the northern Salish Sea. Birds began to arrive in mid-August, built to a peak in mid-September and were mostly gone by early November. Most records were very close to shore and there is a strong likelihood that birds moved to the Salish Sea from Queen Charlotte Strait via Discovery Passage—an unusual route for an otherwise pelagic seabird. We make some tentative comments on possible causes of the influx.

Key words: Short-tailed Shearwater *Ardenna tenuirostris*, Sooty Shearwater *Ardenna grisea*, invasion, inshore observations, timing of arrival

Gaston, A.J., J.R. Towers, M. Maftai, S. Pastran, Y. Attia, and G. Curry. 2022. An unusual influx of Short-tailed Shearwaters into nearshore waters of southern British Columbia in 2021. *British Columbia Birds* 33:7–13. First published online June 2022.

Introduction

The Short-tailed Shearwater *Ardenna tenuirostris* is a transhemispheric migratory seabird breeding on islands off Australia in the Austral summer and moving to the North Pacific during the non-breeding period (Campbell *et al.* 1991). It occurs from Japan to California and as far north as the Chukchi and Beaufort seas (Nishizawa *et al.* 2017; Carboneras *et al.* 2020). It principally occurs in British Columbia during May–September (Guzman and Myres 1983; Morgan *et al.* 1991; Burger 2003; Cannings *et al.* 2016). It can be difficult to distinguish from the closely related Sooty Shearwater *Ardenna grisea*, with which it is often seen. Most previous records of Short-tailed Shearwaters in B.C. suggest that Sooty Shearwaters typically outnumber them by approximately 10:1 (Guzman and Myres 1983; Vermeer *et al.* 1989; Burger *et al.* 2002), although Vermeer *et al.* (1989) suggested 3:1 off the southwest coast of Vancouver Island during September–December.

In 2021, unprecedented numbers of Short-tailed Shearwaters were reported from the Salish Sea, greatly outnumbering

Sooty Shearwaters in inner coast waters. This article summarizes the influx of birds as documented by eBird records and by transect surveys carried out in eastern Queen Charlotte Strait and associated waterways (see inset map B, Figure 1) in 2020 and 2021. To place the 2021 sightings in historical context, a contrast is drawn with eBird records from the period 2011–2020. Emphasis has been placed on eBird records because they provide a standardized source of data that should be broadly comparable over the past decade. Historical data (such as those provided by Campbell *et al.* (1991), while often supported by specimens and therefore providing definite evidence of species identification, seldom provide any evidence of effort or geographical scale.

eBird records of Short-tailed Shearwater from 2011–2020

The following account is based on eBird records downloaded on 2 December 2021 (eBird 2020: eBird Basic Dataset. Version: EBD_reOct-2021) from which duplicate records (those with the same group identifier, or with identical times and locations) were eliminated (see Sullivan *et al.* 2009 for further details of eBird). Numbers of eBird lists that in-



Figure 1. Map showing the position of district boundaries along the B.C. coast (terrestrial boundaries are not exact). Inset A shows detail of the northern Salish Sea. Inset B shows the area covered by boat transect surveys during 12–15 September, 28–30 September and 12–15 October 2021. The coloured polygons define the zones for which numbers of birds were estimated separately: Central Queen Charlotte Strait (grey), Eastern Queen Charlotte Strait (pink), Cormorant Channel (green) and Johnstone Strait including Blackfish Sound (yellow). Almost all shearwater sightings on the systematic surveys were in the Johnstone Strait and Eastern Queen Charlotte Strait zones. Large numbers were also seen in eastern Cormorant Channel (GC pers. obs.).

cluded Short-tailed Shearwaters in B.C. waters during 2011–2020 varied from 1 in 2020 to 25 in 2019 (Figure 2), with the majority in the Skeena-Queen Charlottes (33%) and Alberni-Clayoquot (29%) districts (District boundaries are shown in Figure 1). Prior to 2021 there were no eBird records of Short-tailed Shearwaters in Vancouver district, only one to the north of Denman Island in Comox-Strath-

cona District (in 2019) and only two reported from Nanaimo district (in 2018). In B.C. waters the species showed two peaks of occurrence during 2011–2020, in May (21% of records) and September (30%; Figure 3). Very few sightings (7) were reported outside May–October.

The highest numbers of Short-tailed Shearwaters reported on eBird before 2021 were all in the Skeena-Queen Charlottes district, either in Hecate Strait or Dixon Entrance, with a peak of 700 reported on 2014 October 30. Elsewhere, the highest count on eBird was of 45 off Tofino on 1994 April 17. Few records before 2021 exceeded ten birds. Higher counts were reported by Campbell *et al.* (1991), including a record by P.W. Martin (in Guzman and Myres 1983) of “hundreds of thousands” over Swiftsure Bank, off the mouth of Juan de Fuca Strait, in May 1972. Clearly, Short-tailed Shearwaters may be very abundant in B.C. waters in some years.

eBird Records in 2021

Apart from one record of ten birds off Solander Island on July 20 and one of 100 birds off Cape Scott (northern Vancouver Island) on July 22, the first records of Short-

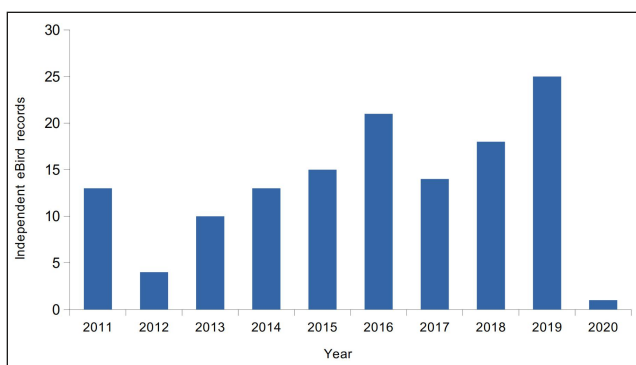


Figure 2. Number of eBird records for Short-tailed Shearwaters in B.C. waters during 2011–2020.

Table 1. Independent eBird records for Short-tailed Shearwaters by district and month, mean number of records annually during 2011–2020 and the ratio of records in 2021 to the mean for the preceding ten years.

	Kitimat-Stikine	Skeena-Queen Charlottes	Central Coast	Capital	Comox-Strathcona ¹	Alberni-Clayoquot	Mount Waddington	Nanaimo	Vancouver
July						1	1		
August	1			3	20	8	29	55	
September		3	2	17	53	1	51	26	14
October				8	3	1	3	14	
Total 2021	1	3	2	28	76	11	84	95	14
Mean/yr 2011–2020	0.6	4.4	1.8	0.8	0.1	3.9	1	0.2	0
2021 vs 2011–2020	1.7	0.7	1.1	35.0	760.0	2.8	84.0	475.0	

¹Excluding the portion of this region on the west coast of Vancouver Island

tailed Shearwaters in B.C. in 2021 were from the Mount Waddington district early in the second week of August, with numbers of birds rising rapidly until the middle of the month (JT pers. obs.). Most other August eBird records were from the Blackfish Sound-Johnstone Strait area (Mt. Waddington district) and from the Campbell River area (Table 1). They were first reported in Blackfish Sound on August 09, off Tofino on August 14, near Nanaimo on August 18, off the Central Coast and the Victoria area on August 30 and not until early September elsewhere. The first Vancouver district record was reported on September 04. Numbers generally decreased after mid-September, with the last definite identification in the Mount Waddington district on October 27 (GC, pers. obs.), although a few shearwaters observed in early November could have included this species.

Numbers of records of Short-tailed Shearwaters reported on eBird for the northern coast in 2021 were typical of earlier years: Skeena-Queen Charlottes, 3 records; Kitimat-Stikine, 1 record and Central Coast, 2 records. These three districts produced the highest number of records in earlier years (Table 1). The number of records in the Alberni-Clayoquot district were approximately three times the annual mean for the previous decade, and in all other regions the records reported in 2021 exceeded those reported from 2011–2020 by a large margin. In particular, Short-tailed Shearwaters had not been recorded in the Blackfish Sound area prior to 2021 despite many days of observations over the previous decades (JT, pers. obs.). Prior to 2021 there were only three eBird records of Short-tailed Shearwater in the Salish Sea compared with 185 in 2021 (Table 1). However, we must keep in mind that, once the presence of the relatively rare Short-tailed Shearwater in the Salish Sea was known, many birders may have been inspired to spend time looking for them. Consequently, numbers of Short-tailed Shearwater records may well be exaggerated compared with what might have been recorded by normal birding activity for the same district and season.

Surveys in eastern Queen Charlotte Strait and adjacent waters, 2020 and 2021

In 2020, a series of replicate seabird surveys were conducted from a small boat in eastern Queen Charlotte Strait, Blackfish Sound, Cormorant Channel and the west entrance to Johnstone Strait (Gaston *et al.* 2020; inset B, Figure 1, Figure 4). Transects running from north to south were evenly spaced and run at a constant speed of ~26 km/h with birds being counted within a 100 m strip on either side of the boat's course. Birds sitting on the water and birds flying were recorded separately. Four surveys were carried out during alternate weeks between mid-August and the end of September. The surveys of mid-September and end of September were repeated in 2021, with an additional survey in mid-October. For analysis, we divided the survey area into four blocks (inset B, Figure 1). Although there are many records of seabirds from this area reported on eBird in both years, the surveys, through use of standardized methods, allow a more accurate comparison of records.

In 2020, we saw no Short-tailed Shearwaters on any survey, but we recorded more than 500 Sooty Shearwaters on the mid-September survey, mostly in Blackfish

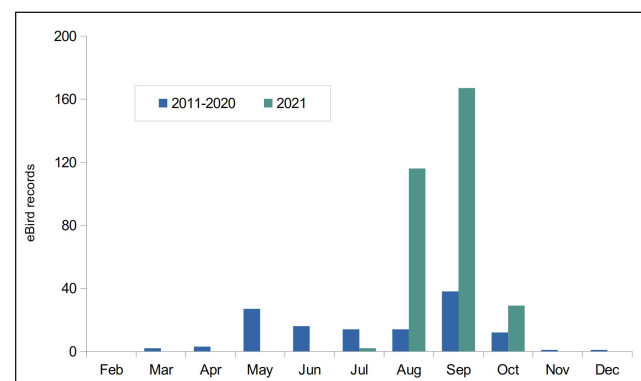


Figure 3. eBird records of Short-tailed Shearwaters in B.C. waters by month: 2011–2020 (combined) and 2021.

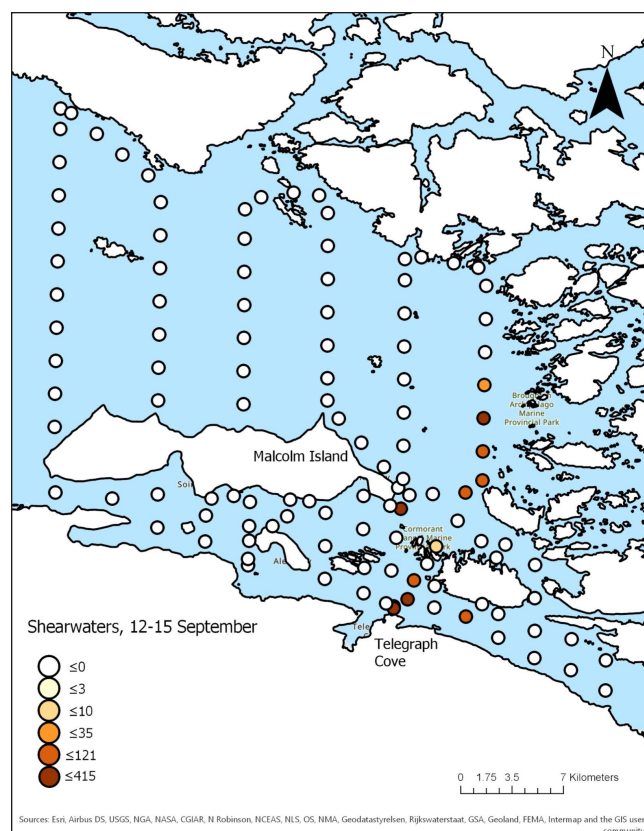


Figure 4. Distribution of Short-tailed Shearwaters (definite and presumed) counted on surveys of eastern Queen Charlotte Strait and adjacent waters during 12–15 September 2021. Circles represent 5-minute survey segments, equivalent to approximately 1 km² of area surveyed.

Sound. The possibility that a few Short-tailed Shearwaters were present in 2020 cannot be discounted. In 2021 we recorded high numbers of predominantly Short-tailed Shearwaters, with just under 2,000 counted on the water on transects during September 12–15 (100/km²). A few Sooty Shearwaters accompanied the flocks of Short-tailed Shearwaters at that date, representing ~3–5% of the total number of birds. An estimate for the entire area of our Johnstone Strait zone (including Blackfish Sound), based on the transect densities (129/km²), estimated 8,900 birds, with a further 5,800 in our Eastern Queen Charlotte Strait zone (density 26/km²). Because the birds were mostly aggregated into flocks of hundreds which moved about frequently and rapidly the precision of these estimates is probably very low, but it seems likely that at least 5,000 were present in the whole survey area during September 12–15. The total counts on later surveys were 968 on September 28–30 and 341 on October 13–15.

Our numbers are similar to those provided by eBird records for the same area, where observers reported thousands of Short-tailed Shearwaters with the highest estimates of 2,000 on August 20, 2,700 and 2,250 on August 23 (independent estimates), and 1,500 on September 11

and 16. On September 05, GC estimated a total of 3,800 shearwaters in the Blackfish Sound-Cormorant Channel area (eBird checklist S94313533), of which 15% were judged, on the basis of a critical review of numerous photographs, to be Sooty and the remainder Short-tailed. None of the eBird records were from waters north or west of Foster Island in eastern Queen Charlotte Strait. Hence the main concentration area for Short-tailed Shearwaters appears to have remained consistent throughout the period of their residency.

South of the Mount Waddington district, numbers were generally lower but many observers estimated >200 birds in the Comox area, with the highest counts 350 on September 06, 280 on September 03 and 250 on September 08. At Hornby Island, 270 were reported on October 10, one of only three October records for the region. In Nanaimo district, the highest counts were from Columbia Beach: 401 and 331 on August 31 (half an hour apart, hence probably mostly the same birds) and 189 on October 10. At Deep Bay, 224 were reported on September 01. Peak counts in other regions did not exceed 100 birds.

eBird records of Sooty and Manx Shearwaters in 2021

eBird records of Sooty Shearwater for 2021 (325 records) do not suggest that they were seen more often than in earlier years (average records, 2016–2020 = 330), although records reported from the Salish Sea (38 in the Comox area, 19 off Nanaimo) were much higher than usual. In fact, this species had been recorded only rarely from the northern Salish Sea prior to 2021 (Campbell *et al.* 1991) and only two pre-2021 eBird records exist for Nanaimo. Many eBird observers made direct comparisons with nearby Short-tailed Shearwaters in their notes, so it seems very unlikely that many records involved misidentification. While the two species are often confounded, the occurrence of unusually high numbers of both species in the Salish Sea in 2021 appears certain.

Records of Manx Shearwater *Puffinus puffinus* in B.C. in 2021 mirrored those of Short-tailed Shearwater, but on a smaller scale. This species was first confirmed in the province in recent decades (Force *et al.* 2006) and is still a review species for the B.C. Bird Records Committee. In 2021, Manx Shearwaters were recorded in the Mount Waddington district, mostly with Short-tailed Shearwaters in the Blackfish Sound area, on one occasion in July, on four occasions in August, and once in September (GC and JT, pers. obs.). Multiple birds were seen together on several occasions with a minimum of four individuals together on August 23 (GC pers. obs.). Like Short-tailed Shearwater, 2021 was the first year Manx Shearwater had been recorded in this area.

Potential origin and causes of the invasion

The distribution and timing of arrival of the Short-tailed Shearwaters in 2021 may give some clue about how they arrived in the area. Large numbers appeared in Blackfish Sound, Cormorant Channel and outer Johnstone Strait in mid-August. Shortly thereafter small numbers appeared off Campbell River and south to Deep Bay in the Nanaimo region, building to hundreds by the end of the month. Conversely, the first records for the Victoria area did not occur until August 30 and never exceeded 19 birds. Consequently, it seems highly unlikely that the shearwaters entered the Salish Sea via the Strait of Juan da Fuca and much more probable that they moved directly south from Queen Charlotte Strait via Johnstone Strait and Discovery Passage to enter the Salish Sea from the north. Assuming that the shearwaters did not fly over land—an unlikely scenario—and given that the passage is less than 1 km wide in places, this is a rather extraordinary excursion into inshore waters for a procellariiform seabird.

One area where the invasion might have originated would be the Gulf of Alaska, where Short-tailed Shearwaters are common in summer (Nishizawa *et al.* 2017, Carboneras *et al.* 2020). However, although abundant there in 2021, they were less numerous than in some earlier years (J. Piatt, K. Kuletz, M. Arimitsu, pers comm.). Interestingly, dramatically higher-than-normal numbers were recorded in Cook Inlet, Alaska in 2017 (J. Piatt, pers. comm.), and major die-offs of Short-tailed Shearwaters in the southeastern Bering Sea in 2019 (K. Kuletz, pers com), were correlated with abnormally high water temperatures (Van Hemert *et al.* 2021), yet no large influx was reported in B.C., according to eBird records.

The scarcity of records from the north and central coasts of B.C. in 2021 does not support the idea that birds arrived down the coast from the Gulf of Alaska. Rather, it seems more likely the birds that arrived in B.C. waters in August 2021 came from further west, perhaps from the southeastern Bering Sea where large numbers occur in August in some years (Hunt *et al.* 2002, Jahncke *et al.* 2005). In the first two weeks of August 2021 the weather over the Gulf of Alaska was dominated by a ridge of high-pressure extending eastwards from about 180°W longitude accompanied by predominantly west and northwest winds. There were no major storms during the period, but the weather patterns would have been conducive for eastward movement of birds in the central North Pacific.

Feeding Short-tailed Shearwaters will exploit different areas depending on prey availability (Jahncke *et al.* 2005; Kuletz *et al.* 2020) and episodes of abnormally high sea surface temperatures in the Bering Sea in recent decades have been associated with major die-offs (Baduini *et al.* 2001; Van Hemert *et al.* 2021) and reduced breeding success for those returning to their breeding colonies (Glencross *et al.* 2021). There was no evidence

of unusual die-offs of Short-tailed Shearwaters in Alaska during 2021, with the exception of relatively high mortality in the Bering Strait region (COASST, <http://3.223.50.225:3838/Explore-data/>; J. Piatt, K. Kuletz, M. Arimitsu, pers comm.). However, it is possible that some birds were responding to recent ocean warming in the North Pacific by seeking out new feeding areas. The persistence of thousands of Short-tailed Shearwaters in the Blackfish Sound area for more than a month, where they were observed feeding on Pacific Herring *Clupea pallasii* and zooplankton (JT, pers. obs.) suggests that conditions there were congenial to them. This is not surprising because Short-tailed Shearwaters require highly productive feeding areas (Baduini *et al.* 2006) and the Blackfish Sound area is well known for aggregations of feeding seabirds and marine mammals in late summer (McMillan *et al.* 2018; Gaston *et al.* 2020).

Conclusions

In a typical year, only small numbers of Short-tailed Shearwaters are recorded in B.C. waters, mostly off the north coast and the west coast of Vancouver Island (Guzman and Myres 1983; Kenyon *et al.* 2009). Although these observations may be a poor reflection of numbers that migrate through British Columbian waters each year, the exceptional number of records in 2021 in eastern Queen Charlotte Strait and associated waterways, and the northern Salish Sea can reasonably be described as an 'invasion' because these are areas where seabird observations, both from shore and from boats, have been numerous for many years.

A legitimate question arising from the unusual shearwater observations in 2021 is whether high numbers of Short-tailed Shearwaters may have occurred in past years but were mistaken for Sooty Shearwaters. If that were the case, then we might expect an unusually high number of Sooty Shearwater records in 2021 in the areas where Short-tailed Shearwaters occurred in abundance. As we report, there was no overall increase in Sooty Shearwater sightings in B.C. waters in 2021, yet the records of Short-tailed Shearwaters in Mount Waddington and Comox-Strathcona districts were unprecedented. Nevertheless, such invasions might be a regular but infrequent phenomenon that has previously gone undetected due to the Short-tailed Shearwaters remaining offshore. It is possible that Short-tailed Shearwaters move into B.C. waters periodically in response to shifts in oceanic or atmospheric conditions that occur many years apart, making 2021 the first year in which this phenomenon was detected, principally because the birds appeared in areas close to shore and frequented by numerous birders.

The invasion of thousands of Short-tailed Shearwaters in B.C. waters in 2021 was striking but it must be

noted that approximately 30 million Short-tailed Shearwaters spend the non-breeding season in the North Pacific (Hunt *et al.* 2000). The peak of 5,000–10,000 birds in the Mount Waddington district and perhaps several thousand more in the northern part of the Salish Sea in late August and early September constitutes a very small proportion of the total population of the North Pacific. Hence, although the event was dramatic at the local scale it may have been a relatively trivial one at the scale of the species' population.

Acknowledgements

We thank all those who contributed eBird records of shearwaters in B.C. waters over the past decade. John Piatt, Kathy Kuletz and Mayumi Arimitsu kindly responded to requests for information on observations in Alaska. Assistance with the surveys in 2020 was provided by Iwan Lewylle, Graham Sorensen and Ken Wright and in 2021 by Artie Ahier, Carissa Arnett, Marla Barker and Kai Bosch. Funding was provided by the Anne-Marie Gaston Memorial Trust and administration was managed by the Raincoast Education Society.

Literature Cited

- Baduini, C.L., G.L. Hunt Jr., A.I. Pinchuk, and K.O. Coyle. 2006. Patterns in diet reveal foraging site fidelity of short-tailed shearwaters in the southeastern Bering Sea. *Marine Ecology Progress Series* 320:279–292.
- Baduini, C.L., K.D. Hyrenbach, K.O. Coyle, A. Pinchuk, V. Mendenhall, and G.L. Hunt Jr. 2001. Mass mortality of short-tailed shearwaters in the south-eastern Bering Sea during summer 1997. *Fisheries Oceanography* 10:117–130.
- Burger, A.E. 2003. Effects of the Juan de Fuca Eddy and upwelling on densities and distributions of seabirds off southwest Vancouver Island, British Columbia. *Marine Ornithology* 31:113–122.
- Burger, A.E., A.D. Lawrence, and E.A. Stewart. 2002. Seasonal and spatial variations in densities and composition of seabird communities off southwest Vancouver Island, 1993–1995. In: Burger, A.E. (editor). 2002. *Distribution and abundance of seabirds off southwest Vancouver Island: a year-round study in relation to the risks of oil spills*. Report to Nestucca Trust Fund and B.C. Ministry of Water, Land, and Air Protection, Victoria, B.C.
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser and M.C.E. McNall. 1991. *The Birds of British Columbia*, Vol. 1. Royal British Columbia Museum, Victoria, B.C.
- Cannings, R., T. Aversa and H. Opperman. 2016. *Birds of British Columbia and the Pacific Northwest*. Heritage House Publishing, Vancouver, B.C.
- Carboneras, C., F. Jutglar, and G.M. Kirwan. 2020. Short-tailed Shearwater (*Ardenna tenuirostris*), version 1.0. In *Birds of the World* (J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, and E. de Juana, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA.
- eBird. 2020. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: <http://www.ebird.org>. (Accessed: 2 December 2020).
- Force, M., K. Morgan, and J. Jantunen. 2006. Manx Shearwater in British Columbia: comments on a pioneering seabird. *Wildlife Afield* 3:5–11.
- Gaston, A.J., M. Maftei, S. Pastran, K. Wright, G. Sorensen, and I. Lewylle. 2020. *Marine bird surveys in Queen Charlotte Strait and adjacent channels, August–September 2020*. Ms. Report, Raincoast Education Society, Tofino, B.C.
- Glencross, J.S., J.L. Lavers, and E.J. Woehler. 2021. Breeding success of short-tailed shearwaters following extreme environmental conditions. *Marine Ecology Progress Series* 672:193–203.
- Guzman, J.R., and M.T. Myres. 1983. The occurrence of shearwaters (*Puffinus* spp.) off the west coast of Canada. *Canadian Journal of Zoology* 61:2064–2077.
- Hunt, G.L. Jr., H. Kato, and S.M. McKinnell. 2000. *Predation by marine birds and mammals in the Subarctic North Pacific*. PICES Scientific Report No. 14. North Pacific Marine Science Organization, Sidney, B.C.
- Hunt, G.L., C. Baduini, and J. Jahncke. 2002. Diets of short-tailed shearwaters in the southeastern Bering Sea. *Deep-Sea Research II* 49: 6147–6156. [https://doi.org/10.1016/S0967-0645\(02\)00338-7](https://doi.org/10.1016/S0967-0645(02)00338-7)
- Jahncke, J., K.O. Coyle, S.I. Zeeman, N.B. Kachel, and G.L. Hunt Jr. 2005. Distribution of foraging shearwaters relative to inner front of SE Bering Sea. *Marine Ecology Progress Series* 305:219–233.
- Kenyon, J.K., K.H. Morgan, M.D. Bentley, L.A. McFarlane Tranquilla, and K.E. Moore. 2009. *Atlas of Pelagic Seabirds off the west coast of Canada and adjacent areas*. Technical Report Series 499: 1–309. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.
- Kuletz, K., D. Cushing, and E. Labunski. 2020. Distributional shifts among seabird communities of the Northern Bering and Chukchi seas in response to ocean warming during 2017–2019. *Deep-Sea Research Part II* 181–182:104913.
- McMillan, C.J., J.R. Towers, and J. Hildering. 2018. The innovation and diffusion of “trap-feeding”, a novel

- humpback whale foraging strategy. *Marine Mammal Science* 35:779–796.
- Morgan, K.H., K. Vermeer and R.W. McKelvey. 1991. *Atlas of pelagic birds of western Canada*. Canadian Wildlife Service Occasional Paper 72:1–72.
- Nishizawa, B., K. Matsuno, E.A. Labunski, K.J. Kuletz, A. Yamaguchi, and Y. Watanuki. 2017. Seasonal distribution of short-tailed shearwaters and their prey in the Bering and Chukchi seas. *Biogeosciences* 14: 203–214, doi:10.5194/bg-14-203-2017.
- Sullivan, B.L., C.L. Wood, M.J. Iliff, R.E. Bonney, D. Fink, and S. Kelling. 2009. eBird: a citizen-based bird observation network in the biological sciences. *Biological Conservation* 142:2282–2292.
- Van Hemert, C., R.J. Dusek, M.M. Smith, R. Kaler, G. Sheffield, L.M. Divine, K.J. Kuletz, S. Knowles, J.S. Lankton, D.R. Hardison, R.W. Litaker, T. Jones, H.K. Burgess, and J.K. Parrish. 2021. Investigation of Algal Toxins in a Multispecies Seabird Die-off in the Bering and Chukchi Seas. *Journal of Wildlife Diseases* 57:399–407.
- Vermeer, K., K.H. Morgan, G.E.J. Smith, and R. Hay. 1989. Fall distribution of pelagic birds over the shelf off SW Vancouver Island. *Colonial Waterbirds* 12:207–214.

