

BIOLOGICAL MONITORING AT CHOWIET ISLAND, ALASKA IN 2021



Photo: Briana Bode

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Executive Order

SEMIDI ISLANDS WILD LIFE REFUGE

ALASKA

It is hereby ordered that Aghiyuk Island, Chowiet Island, Kateekuk Island, Anowik Island, Kiliktagik Island, Suklik Island, Aghik Island, Aliksemit Island, and South Island, together with all unnamed islands, rocks, and reefs, and all lands under water appurtenant thereto, lying between parallels 55° 57' and 58° 15' north latitude and meridians 156° 30' and 157° 00' longitude west of Greenwich, in the North Pacific Ocean southeast of the Alaska Peninsula, Alaska, and shown on United States Coast and Geodetic Survey Chart No. 8881, published in Washington, D.C., April, 1919, as within the Semidi Island Group, be, and the same are hereby, reserved from all forms of appropriation under the public land laws and set apart for the use of the Department of Agriculture as a refuge and breeding ground for wild birds and game and fur animals, subject to existing valid rights.

It is unlawful within this reservation (a) to hunt, trap, capture, willfully disturb, or kill any wild animal or bird of any kind whatever, to take or destroy the nests or eggs of any wild bird, to occupy or use any part of the reservation, or to enter thereon for any purpose, except under such rules and regulations as may be prescribed by the Secretary of Agriculture; (b) to cut, burn, or destroy any timber, underbrush, grass, or other natural growth; (c) willfully to leave fire or to suffer it to burn unattended near any forest, timber, or other inflammable material; (d) after building a fire in or near any forest, timber, or other inflammable material, to leave it without totally extinguishing it; and (e) willfully to injure, molest, or destroy any property of the United States.

Warning is given to all persons not to commit any of the acts herein enumerated, under the penalties prescribed by sections 106, 107, and 145 of chapter 4, title 18, United States Code (35 Stat. 1088, 1098, and 43 Stat. 98), or by section 10 of the Migratory Bird Conservation Act of February 18, 1929 (45 Stat. 1222, 1224; U. S. Code, Supp. V, title 16, sec. 71*i*).

This refuge shall be known as the Semidi Islands Wild Life Refuge.

HERBERT HOOVER

THE WHITE HOUSE,

June 17, 1932.

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INTRODUCTION

The Alaska Maritime National Wildlife Refuge (AMNWR) conducts annual ecological monitoring at eight sites throughout Alaska. The objective of this long-term monitoring program is to collect baseline status and trend information for a suite of seabird species representing piscivorous and planktivorous trophic guilds, including key species that serve as indicators of ecosystem health. Members of these guilds include surface feeders and divers feeding in both nearshore and offshore waters. By relating data to environmental conditions and information from other sites, ecosystem processes may be better understood. Data also provide a basis for directing management and research actions, and in assessing effects of management.

The Semidi Islands, off the Alaska Peninsula, were recognized for wildlife and given protective status as the Semidi Islands Wildlife Refuge in 1932 by President Hoover. With the passage of the Alaska National Interest Lands Claim Act in 1980, the Semidi Islands and many other individual reservations were brought together to create the AMNWR. The earliest descriptions of avifauna on the islands came during brief visits in 1913 (Brooks 1915) and 1940, 1945, and 1946 (Gabrielson 1959). Troyer (U.S. Fish and Wildlife Service, unpubl. data) provided the first quantitative estimates of seabird abundance in 1972. Research on seabird ecology and populations at Chowiet Island began in 1976 and continued off and on through the early 2000's (Leschner and Burrell 1977; Hatch and Hatch 1980, 1981, 1983a,b; Baggot et al. 1989; Dragoo et al. 1991a,b; Hatch unpubl. data; Nevins and Adams 1999). Since 2002, intensive season-long monitoring of seabird populations at Chowiet has been conducted every year except 2003, 2008, and 2020 (Wang 2002, Larned 2004, Larned and Sapora 2005, Fairchild et al. 2007, Helm and Zeman, Andersen et al. 2010, Shannon et al. 2011, Engstrom et al. 2011, Andersen et al. 2013, Henschen et al. 2013, Soucie et al. 2014, Pollom et al. 2015, Pollom et al. 2016, Evans et al. 2017, Higgins et al. 2018, and Mudge et al. 2019).

The specific monitoring goals in 2021 were to estimate productivity and/or population parameters for 11 indicator species representing four major feeding guilds: 1) diving fish-feeders (common and thick-billed murres [*Uria aalge* and *U. lomvia*], rhinoceros auklets [*Cerorhinca monocerata*], horned and tufted puffins [*Fratercula corniculata* and *F. cirrhata*], and red-faced and pelagic cormorants [*Urile urile* and *U. pelagicus*]), 2) surface fish-feeders (black-legged kittiwakes [*Rissa tridactyla*]), 3) diving plankton-feeders (parakeet auklets [*Aethia psittacula*]), and 4) surface plankton-feeders (northern fulmars [*Fulmarus glacialis*]). Similar data were also collected on flexible-foraging glaucous-winged gulls (*Larus glaucescens*). Additional monitoring goals include the description of breeding chronology and food habits for one or more of the above species.

Detailed results of the 2021 monitoring program are contained in these appendices and archived at the AMNWR headquarters in Homer, Alaska. Summary data will also be included in the annual Alaska seabird monitoring summary report (e.g., Dragoo et al. 2020). Due to occasional reanalysis of some data, correction of typographical errors, and efforts to standardize presentation across sites, some values used in this report have changed from previous versions. The values presented here are considered the cleanest data set available at the time this report was issued and should supersede previous reports.

STUDY AREA

Chowiet Island is located in the Semidi Islands (56°02.688' N, 156°41.857' W), which consists of nine islands located on the continental shelf approximately 80 km south of the Alaska Peninsula and 160 km southwest of Kodiak Island (see Figures 1 and 2). Local oceanography is influenced by the Alaskan Coastal Current and the Alaska Stream (Hatch and Hatch 1983a, 1989).

Shorelines are generally precipitous; the highest elevation is approximately 300 m with sheer cliffs rising more than 200 m in many areas of the islands (Hatch and Hatch 1983b). Dominant vegetation is classified as Alaskan maritime and includes umbelliferous roots, beach rye-grasses, ferns, herbs, and a few low shrubs (Hatch 1985). All islands are treeless except for Chowiet Island, which has a small number (<10) of Sitka spruce (*Picea sitchensis*), most likely introduced by fox ranchers in the early 1900s.

Fox ranching occurred on Chowiet and Aghiyuk islands from 1885 to about 1914 (Bower and Aller 1917), after which the natural die-off of the introduced arctic and red foxes (*Alopex lagopus* and *Vulpes fulva*, respectively) took place (Hatch and Hatch 1983b). The only land mammals that presently exist on the islands are Arctic ground squirrels (*Urocitellus parryii*) and they occur on all of the Semidi Islands except for South, Suklik, and Aghik (Hatch and Hatch 1983b).

Approximately 2.4 million seabirds consisting of twenty species, an estimated 25% of the total seabird biomass in the Gulf of Alaska, breed in the Semidis (Hatch and Hatch 1983a). A small population of cackling geese (*Branta hutchinsii*) breeds on Kaliktagik, Anowik (Hatch and Hatch 1983b), and Chowiet islands. The seabird population supports many avian predator species which also breed in the Semidis, including the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), glaucous-winged gull (*Larus glaucescens*), and common raven (*Corvus corax*).

METHODS

Personnel: The U.S. Fish and Wildlife Service field crew at Chowiet Island in 2021 consisted of Katie Stoner and Briana Bode (11 May to 31 August). On 25-26 June, Brie Drummond, Aaron Christ, Erin Lefkowitz, and Sarah Guitart visited the island for island familiarization; and Lauren Flynn, Spencer Atkinson (USDA Wildlife Services), and Jared Zierenberg (USDA Wildlife Services) sampled fish in the streams at camp and South Bay. On 12 August, Brie Drummond, Aaron Christ, and Nora Rojek helped the crew assess the cabin and ledgenester plots for earthquake damage. On 13-14 August, the field crew assisted Brie Drummond, Aaron Christ, Nora Rojek, Erin Lefkowitz, and Sarah Guitart in tufted puffin population sampling on nearby Suklik and Kateekuk islands and screening tufted puffin burrows for diet samples on Suklik.

Data Collection and Analysis: Crew members followed data collection and analysis methods outlined in the annual monitoring camp standardized protocols for 2021 (Alaska Maritime National Wildlife Refuge 2021) with the following exceptions:

- **Ledgenester reproductive success:** We continued to test a pilot protocol to quantify early breeding effort and success, and to obtain some absolute measures of success, in kittiwakes and murres. Within fixed-border plots and subplots, we periodically counted adults and nesting attempts (nests built for kittiwakes and eggs laid for murres) earlier in the season than usual productivity monitoring and tracked the cumulative number of nesting attempts. By using the same fixed-border plots in subsequent years, we will be able to compare absolute effort and absolute early-success measures between years, and use these values in conjunction with the ratio measures of success that we obtain from plots with non-fixed borders. At Chowiet, we implemented this new protocol in one common murre plot, one thick-billed murre plot, and one black-legged kittiwake plot beginning on 13 May. We are still analyzing these data; results will be summarized in a separate report.
- **Tufted puffin diet sampling:** Tufted puffin diet samples were collected on Suklik Island on 13 August. Two hundred and fifty-six burrows were screened and 26 bill loads were obtained. Five diet

samples were also collected opportunistically on Kateekuk on 14 August while conducting tufted puffin population transects.

- Tufted puffin genetics: We collected tissue from one dead tufted puffin chick and egg membranes from 24 tufted puffin crevices on Chowiet as part of a range-wide genetics study supported by the Pacific Seabird Group tufted puffin technical committee.
- Gull and oystercatcher genetics: Freshly-hatched eggshell membranes were collected from 36 glaucous-winged gull nests and six black oystercatcher nests for a collaborative genomics study with Environment and Climate Change Canada (ECCC).
- Marine debris: We conducted marine debris surveys monthly at Landing Cove and South Bay beaches according to NOAA's marine debris protocol for standing-stock surveys.
- Alaska Submit-A-Tick Program: We collected one tick that we found on a tufted puffin chick for the Alaska Submit-A-Tick Program.

Reproductive success and chronology data for kittiwakes, murres, parakeet auklets, and puffins were summarized using the AMNWR productivity database (except simple random standard deviation values for reproductive success parameters, which are calculated by hand). Reproductive success and chronology data for cormorants, rhinoceros auklets and gulls were summarized by hand.

Population estimates on index plots for adult northern fulmars, murres, parakeet auklets, horned puffins, and black-legged kittiwakes; and glaucous-winged gull fledgling counts; in 2014-2021 were summarized using the AMNWR population database. Population data for those species in 1976-2013 and rhinoceros auklets in all years have not yet been added to the database and have been hand-summarized (these data will be added to and summarized by the database in the future).

Diet data for species for which this information was collected were summarized for all years using the AMNWR diet database (only ongoing diet datasets are presented in this report; additional diet datasets exist [Appendices A and B]). Diet is summarized for frequency of occurrence, percent composition and percent biomass for rhinoceros auklets and puffins; frequency of occurrence, percent composition and percent volume for gulls; and frequency of occurrence and percent composition for other species. For brevity, presentation of diet data highlights only prey items that make up more than 5% of diets. A more detailed summary of Chowiet diet data is presented in a consolidated refuge-wide diet report (Drummond 2016).

Sea surface temperatures were summarized using the AMNWR sea surface temperature database.

Data for all other parameters were summarized by hand.

This report corrects the following data that were presented in previous reports:

- Standard deviations for reproductive parameters that can exceed one (mean clutch size [C/B], mean brood size [E/D], chicks per nest start [E/A], and fledglings per nest start [G/A] for black-legged kittiwakes, glaucous-winged gulls, and cormorants) were calculated with non-parametric bootstrapping.
- Some values for gull reproductive success were corrected or added for 2011, 2007, 2004, and

1998 (Figure 51 and Table 74).

INTERESTING OBSERVATIONS

- In 2021, reproductive success was below average for thick-billed murres, parakeet auklets, horned puffins, and black-legged kittiwakes. Reproductive success was slightly above average for common murres and glaucous-winged gulls, and was the highest ever recorded for tufted puffins at Chowiet.
- Reproductive success for common murres has been high since 2016 but numbers of birds on population plots remain at just about half of what they were prior to 2015. Therefore, the overall number of chicks fledged from Chowiet is assumed to be lower than it was before the 2015-2016 marine heatwave.
- Rhinoceros auklets seemed to do very well this year: plots had the second highest apparent reproductive success since data collection began in 2012, and diet samples appeared to take less effort to collect than previous years.
- Tufted puffin diet samples collected on Suklik Island were predominately small, consisting of few fish.
- Black-legged kittiwakes had a difficult year. Failures this season were near evenly split between the egg-laying and chick-rearing periods. Weather may have been a contributing factor, as a southerly storm with a 4 m spring swell during late egg-laying washed some nests off the cliff in our plots, and another storm with a 5 m spring swell during mid chick-rearing washed more nests off.
- There appeared to be an unusually low number of northern fulmar chicks present in the chute leading up from the landing site on Suklik Island (only three chicks were observed). Observations of numerous fulmar chicks at Chowiet suggested good reproductive success there.
- More Leach's storm-petrels were heard on the slopes surrounding camp and in more locations throughout the season than have been noted by previous crews. They were also heard in both crevice and fern habitat.
- After surveying all accessible coastlines and visiting all previous cormorant colonies, only a handful of cormorant nests were found (at stake 10 and one at Spruce Cove); no data was recorded for productivity.
- No Aleutian cackling goose (*Branta hutchensis leucopareia*) nests were found on Chowiet this season. However, the behavior of multiple pairs of geese at North Point suggested birds were nesting there.
- No snow buntings (*Plectrophenax nivalis*) were observed in 2021 and none have been noted since 2013. Hatch and Hatch (1979) listed snow bunting as a common breeder on Chowiet in 1976 and 1977. In 2004 snow buntings were documented breeding with broods observed at Bunting Flats and Windy Pass. Small numbers were also observed in 2002, 2005, 2007, and 2010. Future field crews should keep an observant eye out for this species.

- Three new species were added to the annotated list in 2021:
 - Pribilof rock sandpiper (*Calidris ptilocnemis ptilocnemis*)
 - Red-breasted nuthatch (*Sitta canadensis*)
 - Red crossbill (*Loxia curvirostra*)
- The mean weekly sea surface temperature in 2021 stayed true to the long-term mean throughout the season.

Earthquake report

On the evening of 28 July 2021, an 8.2 earthquake occurred 55 nautical miles SW of Chowiet. It caused numerous landslides and small mortality events among the seabirds, and moved the cabin about an inch and a half. Aftershocks strong enough to be felt lasted for several days. When crews were able to return to ledgenester plots after aftershocks ceased, it was determined that the safety of ledgenester observation stakes 6 and 9 were uncertain. Productivity of plots viewed from those stakes were able to be completed from nearby locations, but the long-term future of those plots will need to be evaluated.



Here is the first person account of the event from Briana:

We had settled in for the night, did our nightly check-in, ate dinner, dessert chocolate, and were turning in for bed. I had just arisen from my bunk to go brush my teeth, accompanied by the usual pre-day-off achy knee complaining when Katie felt something. "Is that a quake?" she asks, and I am mid-response that, no it is just me stomping towards the door, when the shaking intensifies. "Out! Out the door!" yell I as I race, toothbrush in hand, across the deck and down the steps. Katie somehow leaps from her sleeping bag, shucks the liner, and races after me in her stocking feet. By now the shaking is so intense the cabin is swaying and everything is clattering as it falls from shelves, tables, and rafters. As we emerged and turned from looking at the cabin to looking around our island we saw a large slab of rock crash into the water off nearby Kateekuk, and farther out Aghiyuk was surrounded by a halo of dust as clouds streamed from slide paths and created a surreal haze in the air. A cloud of dust filtered from over our own Windy Pass and headed our way.

I would describe the shaking as a rattling side-to-side in an east-to-west action rather than rolling, and it allowed us to keep to our feet as it went on seemingly forever. In retrospect it was probably between 30 and 45 seconds, long enough for crisis mode to kick in and planning to begin. We began assigning tasks: data, computer, satphone, inReach, shoes, and others. The shaking settled and we raced onto the deck just as a second, smaller quake started rocking, delaying us a minute. Avoiding cans rolling on the floor, pots and dishes and everything from the kitchen scattered about, we quickly grabbed gear. "Food and water" Katie reminded as we shoved cliffbars into our crevice packs, jackets, notebooks, inReach, grab the rain gear, and computer, race to the deck to fill water bottles from the tilted but still intact filter, then we were ready. As a last minute addition we grabbed the spare sleeping bags we had been using as backrests, and up the hill we climbed. All told I think it took us under two minutes.

Climbing the hill we could smell and taste dust in the air. Not wanting to be on the ridge for more aftershocks, we stopped halfway up the hill at around 300ft elevation to text we were safe and wait for news. Lisa kept us sane with her updates on the quake (8.2!) located just 55 nautical miles from us, and tsunami warning as we huddled in our sleeping bags watching the sea and the darkening sky. Sea lions were calling, peregrine fledglings yowling, and sparrows going about their nightly routines, unconcerned by the regular aftershocks we were experiencing.

Finally at 1 am in the full dark, we got the all clear and worked our way down the hill by crevice light. Door still open, the cabin was a mess. Right off we headed to the propane to turn it off in case of leaking, then stepped inside to see what had become of our home. The floor was coated in fallen cans, dishes, and spices, while gear had fallen from the shelves and empty totes fell from the rafters. Surprisingly, the only thing broken was the handle to one our coffee mugs. The cabin foundation seemed ok, with no obvious cracks or warps, and everything else seemed structurally sound. Being located in the center of a marsh may have helped in that concern, and it did not appear we had sunk any farther into the muck.

Unable to sleep with the cabin showing the chaos our hearts were in, we tidied up with an eye to potentially more shaking. GO bag packed with all the things we might need (chargers, med kit, more clothes, more water), we crawled into bed to try to sleep. Every half hour or so we would feel another shake, most tiny, but enough to get our heart rate skyrocketing and adrenaline pumping, thinking about how the first one started out so small. Very little rest was had as we waited anxiously for dawn and tried really really hard not to think about vibrations. This was further complicated by wind gusts hitting the cabin and triggering small shakes and larger moments of fear.

Dawn brought sparrowlings knocking on our windows and playing in the gutters as normal. The day continued with no further trauma, just small shivers every so often and a few larger 5.0-feeling wobbles. The wind actually helped by giving us something else to blame the shaking on and rebuild our delusions that the ground was mostly still. Counting all the wind rocking, the cabin shivered every few minutes, but obvious not-wind shakes were down to every hour or more. "Our murres!" we lamented as we sat thinking of the consequences of this night. "They were so close to fledge; think any are still there?" If we had seen everyone tomorrow as planned we would have fledge for 1/2 or more of our remaining birds. At least there were only a few eggs on the cliff because when all the birds leapt for safety those would be the first to go.

We shall have to wait and see if our chicks in crevices are still ok, though on a trip to the raft count stake to look at the island, at least one of my HOPU chicks was fine and loudly complaining from ki's nest. There is no large and apparent rockfall or slide in our local valley visible from the raft stake, but we expect some changes to have occurred up on the ledges and along our crevice routes. It was a bit eerie sitting at the stake today with the scope trying to see what had changed on the faces of our neighboring islands while

the scent of newly broken granite rode the air. If you have never experienced it, then think of something like the smell of gunpowder with rock lime, all sharp and peppery.

Feeling brave from our uneventful walk, we started our normal day-off routine and had warm showers and observed our sparrowlings act bold and curious around camp. Seems like aftershocks have picked up this evening, or we are just more attuned with the wind dying because there are little shivers every few minutes now. We are adjusting to the slight constant motion by trying to think of it like feeling the sea on the Tiglax. Heralding our chances of sleep tonight, we just had the biggest aftershock of the day with pulsing and rocking lasting 5-10 seconds. Send still thoughts.

ACKNOWLEDGEMENTS

The crew of the R/V *Tiglax* provided safe transport of crew and gear to and from Chowiet Island in 2021 as well as a mid-season resupply visit. Brendan Higgins, Jillian Soller, and Heather Renner helped orient the field crew to the island on camp drop-off day, and Heather Renner and David Martindell checked the safety of ropes leading down to ledgenester stake 3. Thanks to Lisa Spitzer on Adak for providing a crucial communication link to the outside world and for analyzing the parakeet auklet diet samples. Nora Rojek provided summaries from the AMNWR productivity and population databases and offered her availability for any needed clarification. Aaron Christ ran non-parametric bootstrapping to generate standard deviation values for several reproductive success parameters for oystercatchers, gulls, and cormorants. Rhinoceros auklet, horned puffin, and tufted diet samples were identified by the Alaska Fisheries Science Center. Finally, covid-19 restrictions made this a difficult year to safely deploy a remote field camp, and the entire Homer AMNWR office contributed logistical support to enable the field season to occur, including help with pre-season gear purchase and packing, preparing for virtual protocol and field camp training, and facilitating a strict quarantine prior to camp deployment.

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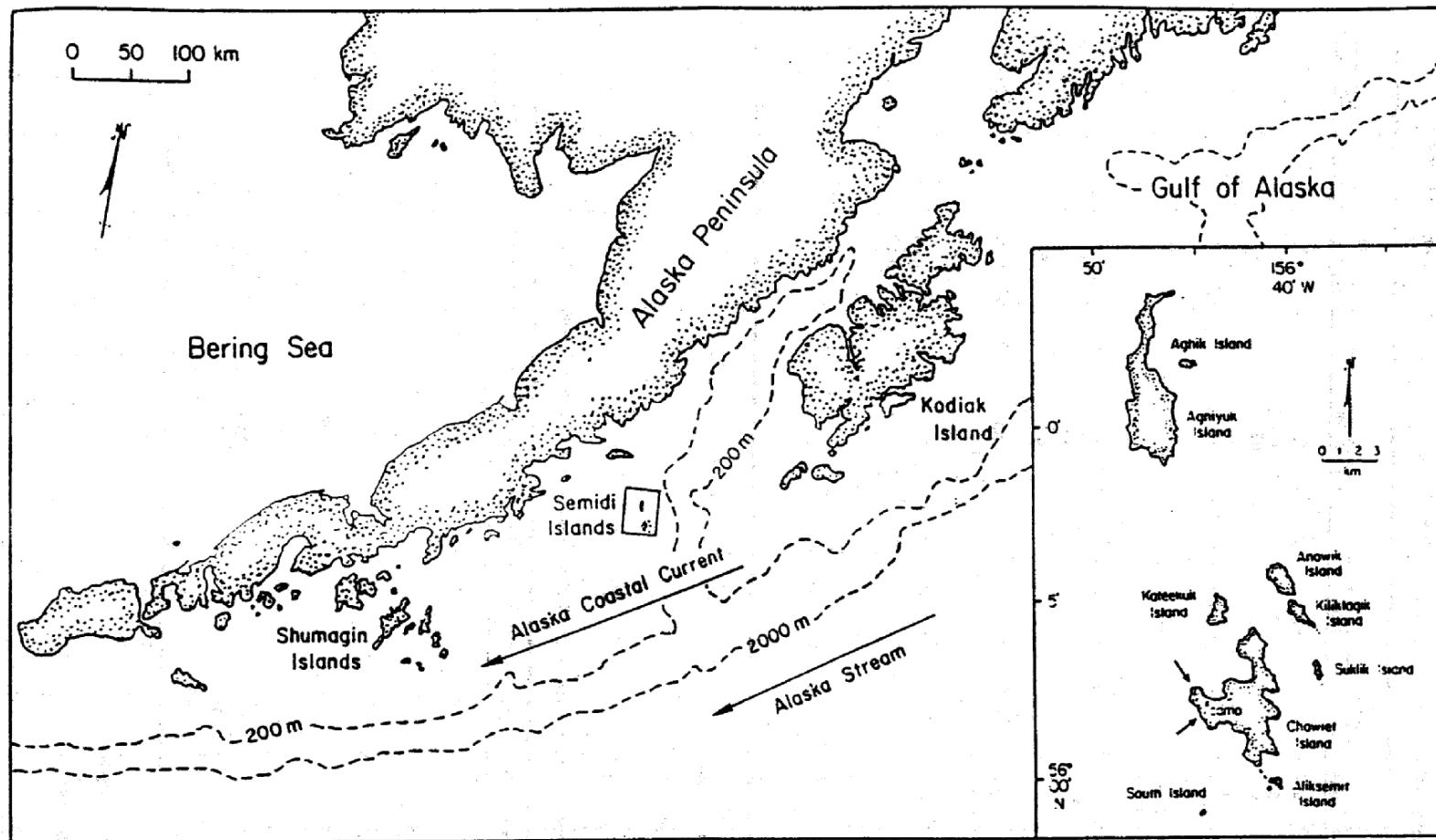


Figure 1. Location of the Semidi Islands in the western Gulf of Alaska.

- Updated 2021**
- ◆ Peregrine Falcon nest/territory
 - ✿ Bald Eagle nest
 - Common Raven nest/territory
 - Rough-legged Hawk nest/territory
 - ★ Aleutian Cackling Goose nest
 - Aleutian Cackling Goose activity
 - Steller's Sea Lion pupping and breeding colony
 - Gull colony
 - Rhinoceros Auklet colony
 - Harbor Seal haul-out and pupping area
 - Cormorant colony 2021
 - Cormorant colony previous years

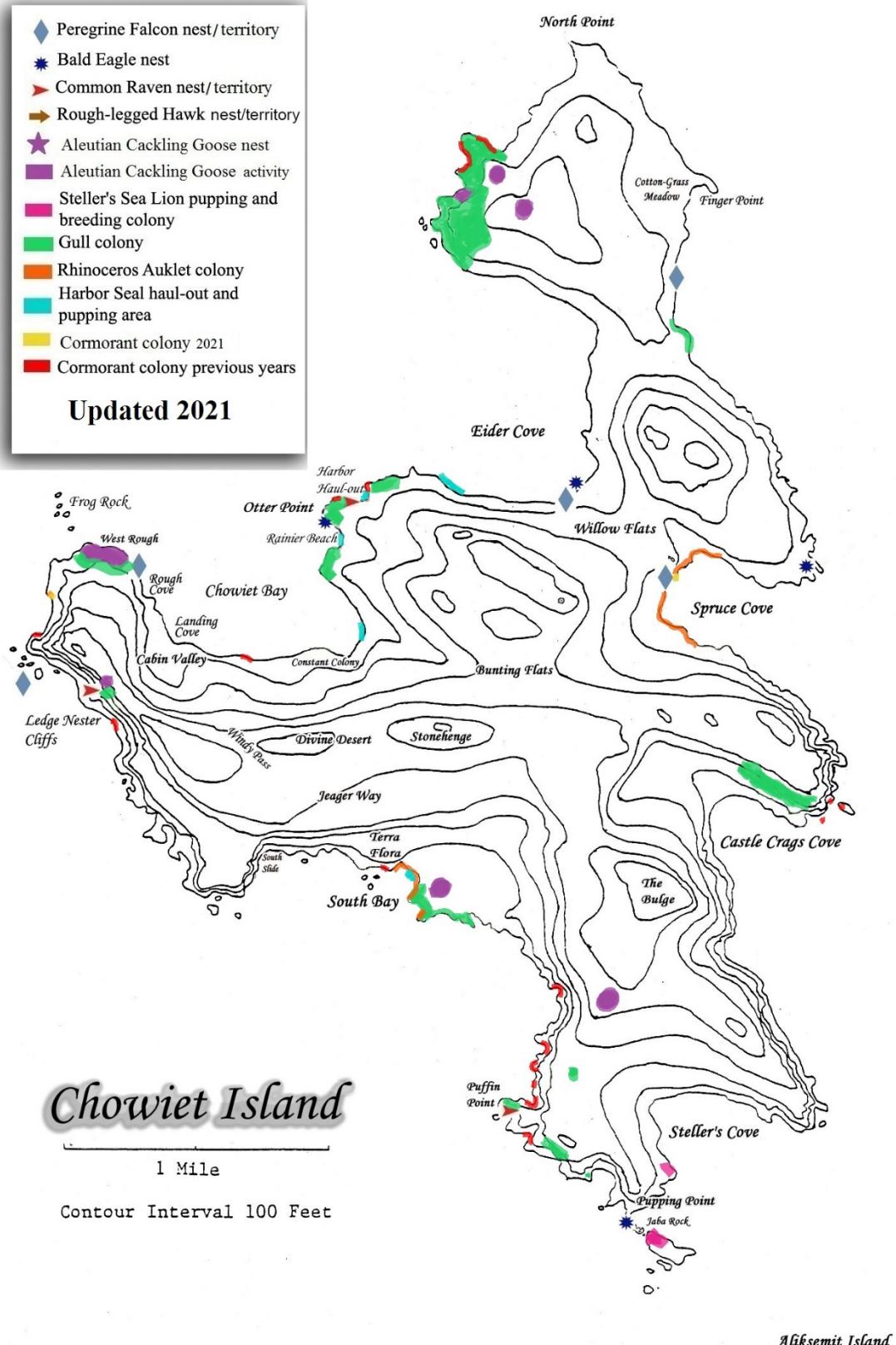


Figure 2. Map of Chowiet Island, Alaska.

FIGURES AND TABLES

Table 1. Breeding chronology of black oystercatchers at Chowiet Island, Alaska. Data represent the date of the first chick hatched in each nest. No data were collected before 2021.

Year	Mean hatch ^a	SD	n ^b	First hatch ^a	Last hatch
2021	17 Jun	7.0	6	9 Jun	26 Jun

^aIn years when chicks have already hatched at the first visit, mean hatch date is not calculated and date of first hatch is listed as < the date of first nest check.

^bSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

Table 2. Frequency distribution of hatch dates for black oystercatchers at Chowiet, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days. No data were collected before 2021.

Julian date ^a	No. nests hatching on Julian date	
	2021	
Before 1 st visit	-	-
160		1
161		-
162		-
163		1
164		-
165		1
166		-
167		1
168		-
169		-
170		-
171		-
172		-
173		-
174		-
175		-
176		1
177		1
<i>n</i>		6

^aJulian dates are adjusted by one day in leap years.

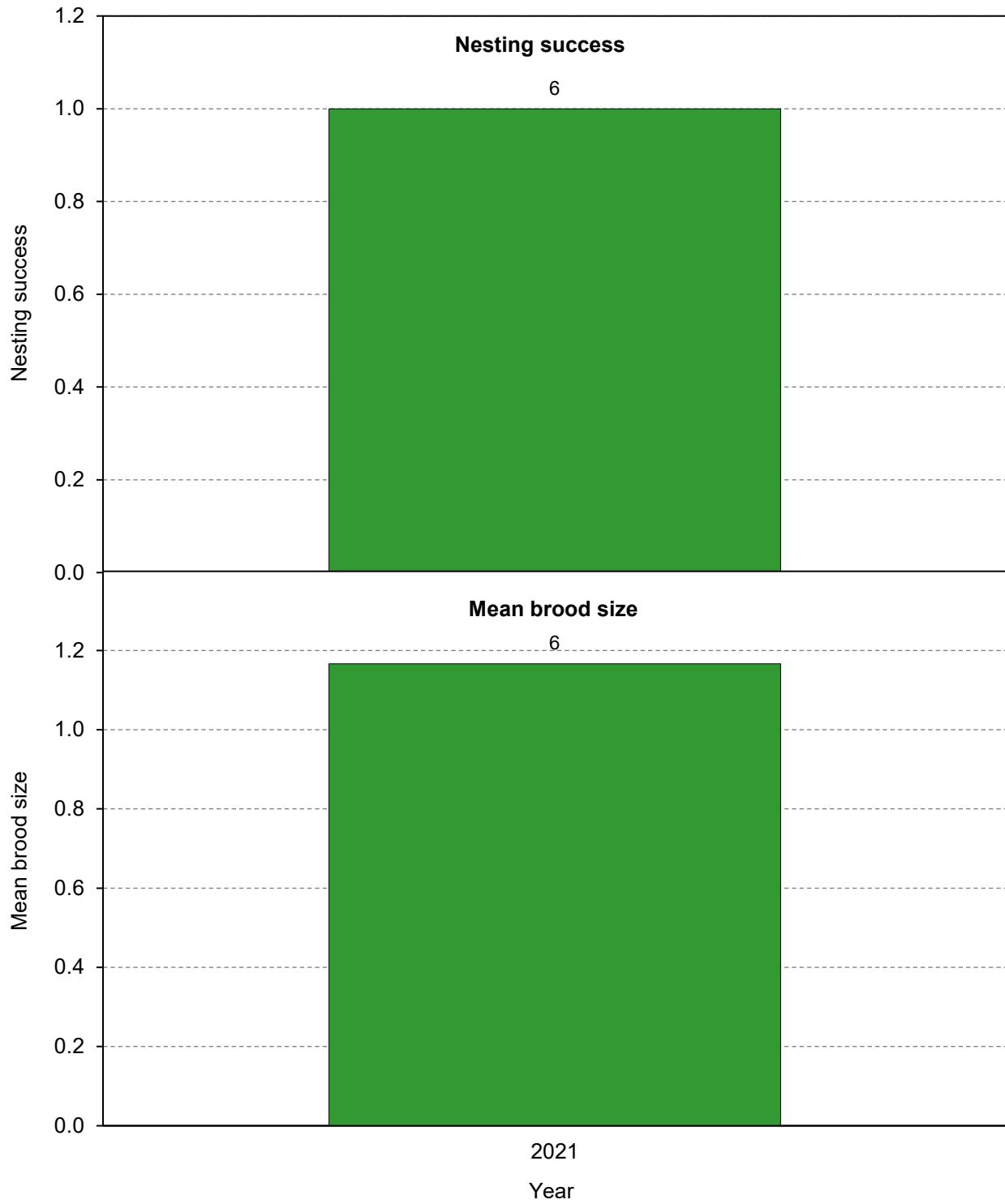


Figure 3. Reproductive performance of black oystercatchers at Chowiet Island, Alaska. Nesting success=D/B; Mean brood size=E/D; where B=nest sites with eggs, D=nest sites with chicks; E=total chicks. Numbers above columns indicate sample sizes ([B] for nesting success and [D] for brood size. No data were collected before 2021.

Table 3. Reproductive performance of black oystercatchers at Chowiet Island, Alaska. No data were collected before 2021.

Year	Nest sites w/ eggs (B)	Nest sites w/ x eggs:			Total eggs (C)	Nest sites w/ chicks (D)	Total chicks (E)	Nest sites w/ chicks fledged (F)	Total chicks fledged (G)	Mean clutch size (C/B)	Mean brood size (E/D)	Nesting success (D/B)	Hatching success (E/C)	Chick success (G/E)	Egg success (G/C)	Fledging success (F/D)	Reprod. success (F/B)
		1	2	3													
2021	7	0	4	3	17	7	16	4	5	2.4	2.3	1.00	0.94	0.31	0.29	0.57	0.57

Table 4. Standard deviation in reproductive performance parameters of black oystercatchers at Chowiet Island, Alaska. No data were collected before 2021.

Year	Total nest sites w/ eggs	Sampling design ^a	Mean clutch size ^b	Mean brood size ^b	Nesting success	Hatching success	Chick success	Egg success	Fledging success	Reprod. success
2021	6	Simple random	0.19	0.26	0.00	0.06	0.12	0.11	0.19	0.19

^aSampling for oystercatchers is based on nests as the sample unit. For simple random sampling, values are calculated using $\sqrt{\rho * (1 - \rho) / n}$, where ρ is the success rate and n is the sample size of individual nests.

^bStandard deviation values for reproductive success parameters that can exceed 1 are calculated by non-parametric bootstrapping.

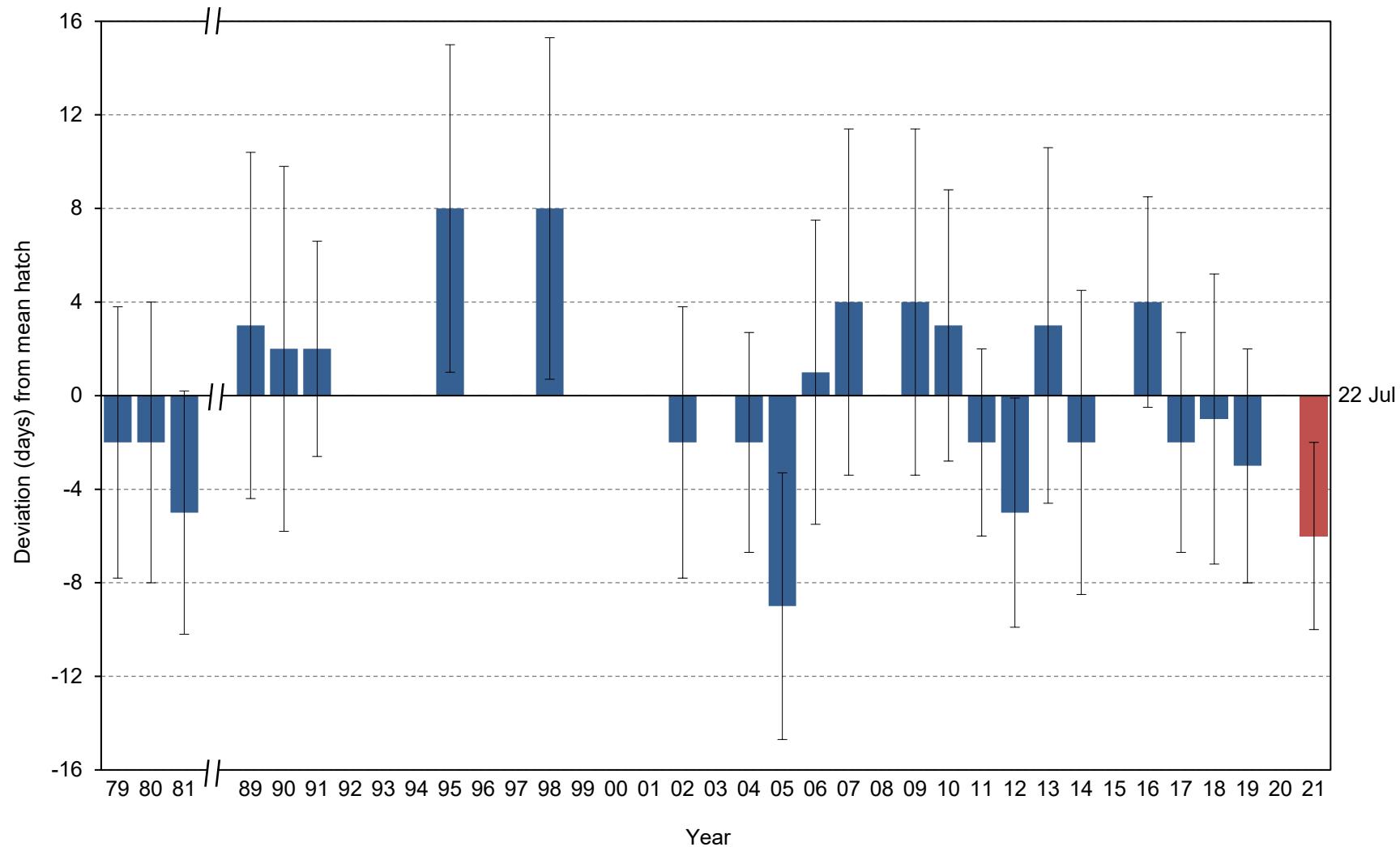


Figure 4. Yearly hatch date deviation (from the 1979-2020 average of 22 July) for common murres at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched in plots in 2015.

Table 5. Breeding chronology of common murres at Chowiet Island, Alaska. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched in plots in 2015.

Year	Mean hatch	SD	n ^a	First hatch	Last hatch	First "jump"
1979	20 Jul	5.8	37	11 Jul	6 Aug	31 Jul
1980	19 Jul	6.0	52	10 Jul	15 Aug	7 Aug
1981	17 Jul	5.2	59	8 Jul	1 Aug	24 Jul
1989	25 Jul	7.4	37	11 Jul	16 Aug	6 Aug
1990	24 Jul	7.8	91	11 Jul	22 Aug	24 Jul
1991	24 Jul	4.6	80	15 Jul	8 Aug	5 Aug
1995	30 Jul	7.0	58	22 Jun	xx ^b	10 Aug
1998	30 Jul	7.3	12	19 Jul	15 Aug	1 Aug
2002	20 Jul	5.8	135	8 Jul	11 Aug	26 Jul
2004	19 Jul	4.7	119	9 Jul	5 Aug	28 Jul
2005	13 Jul	5.7	158	29 Jun	4 Aug	23 Jul
2006	23 Jul	6.5	171	13 Jul	24 Aug	2 Aug
2007	26 Jul	7.4	127	13 Jul	30 Aug	5 Aug
2009	26 Jul	7.4	47	12 Jul	18 Aug	2 Aug
2010	25 Jul	5.8	83	13 Jul	13 Aug	7 Aug
2011	20 Jul	4.0	21	10 Jul	28 Jul	30 Jul
2012	16 Jul	4.9	90	5 Jul	1 Aug	21 Jul
2013	25 Jul	7.6	143	8 Jul	18 Aug	29 Jul
2014	20 Jul	6.5	141	8 Jul	8 Aug	30 Jul
2016	25 Jul	4.5	107	18 Jul	10 Aug	4 Aug
2017	20 Jul	4.7	124	13 Jul	12 Aug	30 Jul
2018	21 Jul	6.2	37	13 Jul	10 Aug	1 Aug
2019	19 Jul	5.0	97	13 Jul	4 Aug	3 Aug
2021	16 Jul	4.0	164	7 Jul	25 Jul	8 Aug

^aSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

^bxx indicates data potentially exist but have not yet been summarized.

Table 6. Frequency distribution of hatch dates for common murres at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched plots in 2015.

Julian date ^a	No. nests hatching on Julian date											
	79	80	81	89	90	91	95	98	02	04	05	06
180	-	-	-	-	-	-	xx ^b	-	-	-	1	-
181	-	-	-	-	-	-	xx	-	-	-	-	-
182	-	-	-	-	-	-	xx	-	-	-	-	-
183	-	-	-	-	-	-	xx	-	-	-	-	-
184	-	-	-	-	-	-	xx	-	-	-	-	-
185	-	-	-	-	-	-	xx	-	-	-	-	-
186	-	-	-	-	-	-	xx	-	-	-	16	-
187	-	-	-	-	-	-	xx	-	-	-	-	-
188	-	-	-	-	-	-	xx	-	-	-	1	-
189	-	-	1	-	-	-	xx	-	1	-	2	-
190	-	-	-	-	-	-	xx	-	-	-	29	-
191	-	-	4	-	-	-	xx	-	2	1	20	-
192	3	3	-	1	1	-	xx	-	-	3	-	-
193	-	-	5	-	-	-	xx	-	7	-	5	-
194	3	3	-	-	2	-	xx	-	-	1	5	7
195	-	-	12	-	1	-	xx	-	-	1	3	1
196	5	10	-	-	11	1	xx	-	23	15	40	2
197	-	-	11	-	-	-	xx	-	12	-	-	7
198	3	5	-	4	3	2	xx	-	1	3	1	18
199	-	-	8	4	-	1	xx	-	24	1	-	12
200	5	11	-	-	15	6	xx	1	-	40	23	10
201	-	-	6	1	-	3	xx	-	11	8	4	6
202	8	6	-	1	3	15	xx	-	-	17	-	25
203	-	-	2	2	1	2	xx	-	20	-	-	12
204	5	6	-	5	16	4	xx	1	1	10	3	6
205	-	-	5	1	1	5	xx	1	9	-	-	12
206	-	2	-	6	3	18	xx	-	1	8	1	15
207	-	-	2	-	2	-	xx	2	6	-	-	3
208	2	3	-	2	5	5	xx	-	-	2	1	1
209	-	-	-	-	1	-	xx	1	6	1	-	1
210	1	1	-	3	7	11	xx	3	-	4	-	9
211	-	-	2	-	3	1	xx	-	5	-	-	3
212	-	1	-	3	3	1	xx	-	1	-	-	2
213	-	-	1	-	3	-	xx	-	1	-	1	2
214	1	-	-	-	1	-	xx	-	-	2	1	3
215	-	-	-	1	1	-	xx	1	2	-	-	3
216	-	-	-	1	2	3	xx	-	-	-	1	5
217	-	-	-	-	-	-	xx	-	-	-	-	-
218	1	-	-	-	-	1	xx	-	-	2	-	-
219	-	-	-	-	-	-	xx	-	-	-	-	3
220	-	-	-	-	2	1	xx	-	-	-	-	-
221	-	-	-	-	-	-	xx	-	1	-	-	-
222	-	-	-	-	1	-	xx	1	-	-	-	1
223	-	-	-	-	-	-	xx	-	1	-	-	-
224	-	-	-	-	1	-	xx	-	-	-	-	-
225	-	-	-	-	-	-	xx	-	-	-	-	-
226	-	-	-	-	-	-	xx	-	-	-	-	1
227	-	-	-	1	-	-	xx	1	-	-	-	-
228	-	1	-	1	1	-	xx	-	-	-	-	-
229	-	-	-	-	-	-	xx	-	-	-	-	-
230	-	-	-	-	-	-	xx	-	-	-	-	-
231	-	-	-	-	-	-	xx	-	-	-	-	-
232	-	-	-	-	-	-	xx	-	-	-	-	-
233	-	-	-	-	-	-	xx	-	-	-	-	-
234	-	-	-	-	1	-	xx	-	-	-	-	-
235	-	-	-	-	-	-	xx	-	-	-	-	-
236	-	-	-	-	-	-	xx	-	-	-	-	1
237	-	-	-	-	-	-	xx	-	-	-	-	-
238	-	-	-	-	-	-	xx	-	-	-	-	-
239	-	-	-	-	-	-	xx	-	-	-	-	-

Table 6 (continued). Frequency distribution of hatch dates for common murres at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1982-1988. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched plots in 2015.

Julian date ^a	No. nests hatching on Julian date											
	07	09	10	11	12	13	14	16	17	18	19	21
180	-	-	-	-	-	-	-	-	-	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-
182	-	-	-	-	-	-	-	-	-	-	-	-
183	-	-	-	-	-	-	-	-	-	-	-	-
184	-	-	-	-	-	-	-	-	-	-	-	-
185	-	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	-	-	-	-	-	-	-	-	-
187	-	-	-	-	1	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	1
189	-	-	-	-	-	1	2	-	-	-	-	6
190	-	-	-	-	-	-	-	-	-	-	-	7
191	-	-	-	1	-	-	-	-	-	-	-	-
192	-	-	-	-	10	-	2	-	-	-	-	2
193	-	1	-	-	-	1	-	-	-	-	-	3
194	1	1	2	-	27	1	15	-	13	3	1	64
195	-	-	-	-	-	1	-	-	-	-	-	-
196	2	-	-	2	-	12	4	-	1	-	39	2
197	1	-	-	-	-	-	22	-	-	-	-	1
198	8	1	-	4	11	2	23	-	35	7	4	33
199	-	-	1	-	1	5	1	-	-	-	2	20
200	9	6	25	2	21	11	-	7	25	8	4	-
201	-	-	-	6	2	1	-	-	-	2	25	2
202	2	4	-	2	9	24	30	12	29	8	-	1
203	22	1	-	-	-	1	4	-	-	-	-	10
204	13	2	9	1	1	12	1	-	7	-	1	10
205	6	-	12	-	-	3	1	30	-	-	-	-
206	9	2	4	1	2	23	11	16	-	3	12	2
207	1	16	-	-	-	1	2	-	-	-	-	-
208	10	2	2	1	3	6	5	-	7	3	-	-
209	3	-	-	1	-	10	-	23	-	-	-	-
210	18	1	17	-	-	6	1	4	-	-	6	-
211	1	-	-	-	-	-	1	-	1	-	-	-
212	1	-	-	-	-	3	9	-	4	-	-	-
213	-	-	-	-	-	2	-	4	-	-	-	-
214	-	5	8	-	2	1	-	6	-	-	1	-
215	1	-	-	-	-	-	-	-	-	-	-	-
216	9	-	-	-	-	-	1	1	1	-	2	-
217	-	-	1	-	-	-	-	-	-	-	-	-
218	-	-	-	-	-	-	3	2	-	2	-	-
219	-	1	-	-	-	5	-	-	-	-	-	-
220	-	1	1	-	-	5	3	-	-	-	-	-
221	4	-	-	-	-	-	-	-	-	-	-	-
222	2	-	-	-	-	-	-	-	1	-	1	-
223	-	-	-	-	-	-	-	-	1	-	-	-
224	1	2	-	-	-	-	-	-	-	1	-	-
225	-	-	1	-	-	2	-	-	-	-	-	-
226	1	-	-	-	-	1	-	-	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	-	-	-	-	-	-	-	-
229	-	-	-	-	-	-	-	-	-	-	-	-
230	-	1	-	-	-	3	-	-	-	-	-	-
231	-	-	-	-	-	-	-	-	-	-	-	-
232	-	-	-	-	-	-	-	-	-	-	-	-
233	-	-	-	-	-	-	-	-	-	-	-	-
234	1	-	-	-	-	-	-	-	-	-	-	-
235	-	-	-	-	-	-	-	-	-	-	-	-
236	-	-	-	-	-	-	-	-	-	-	-	-
237	-	-	-	-	-	-	-	-	-	-	-	-
238	-	-	-	-	-	-	-	-	-	-	-	-
239	-	-	-	-	-	-	-	-	-	-	-	-

Table 6 (continued). Frequency distribution of hatch dates for common murres at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched plots in 2015.

Julian date ^a	No. nests hatching on Julian date											
	79	80	81	89	90	91	95	98	02	04	05	06
240	-	-	-	-	-	-	XX	-	-	-	-	-
241	-	-	-	-	-	-	XX	-	-	-	-	-
242	-	-	-	-	-	-	XX	-	-	-	-	-
<i>n</i>	37	52	59	37	91	80	xx	12	135	119	158	171

Table 6 (continued). Frequency distribution of hatch dates for common murres at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1982-1988. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched plots in 2015.

Julian date ^a	No. nests hatching on Julian date											
	07	09	10	11	12	13	14	16	17	18	19	21
240	-	-	-	-	-	-	-	-	-	-	-	-
241	-	-	-	-	-	-	-	-	-	-	-	-
242	1	-	-	-	-	-	-	-	-	-	-	-
<i>n</i>	127	47	83	21	90	143	141	107	124	37	97	164

^aIn leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

^bxx indicates data potentially exist but have not yet been summarized.

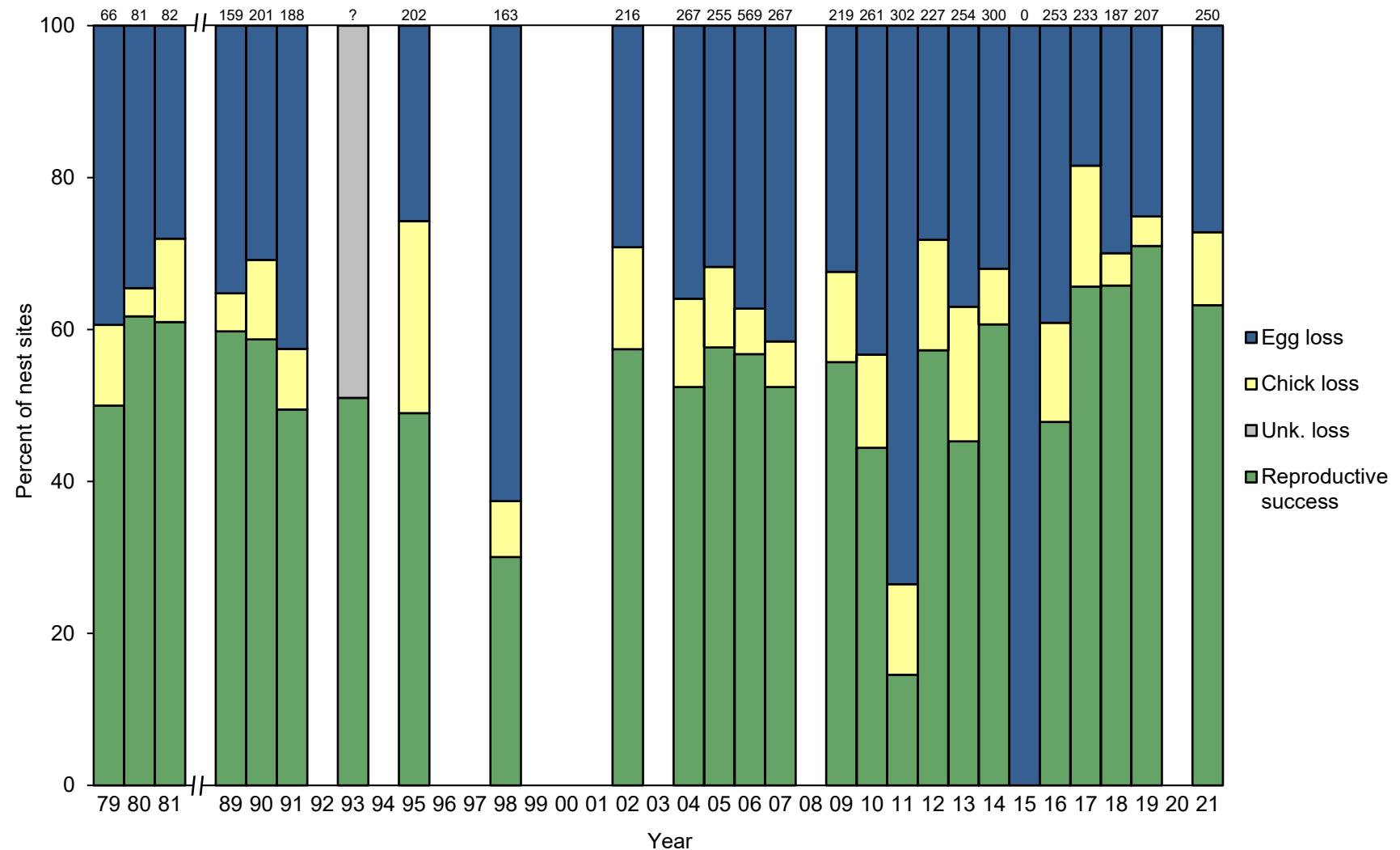


Figure 5. Reproductive performance of common murres at Chowiet Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Failure in years where no eggs were laid is considered 100% egg loss. Numbers above columns indicate sample sizes (B). No data were collected in 1982-1988, 1992, 1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; data potentially exist in 1993 but have not yet been summarized.

Table 7. Reproductive performance of common murres at Chowiet Island, Alaska. No data were collected in 1982-1988, 1992, 1994, 1996-1997, 1999-2001, 2003, 2008, or 2020.

Year	Nest sites w/ eggs	Nest sites w/ chicks	Nest sites w/ chicks fledged	Nesting success (D/B) ^a		Fledging success (F/D) ^b		Reproductive success (F/B)		No. plots ^c	Sampling design ^d
	(B)	(D)	(F)	Total	SD	Total	SD	Total	SD		
1979	66	40	33	0.61	0.10	0.83	0.04	0.50	0.09	6	Cluster by plot
1980	81	53	50	0.65	0.06	0.94	0.02	0.62	0.06	6	Cluster by plot
1981	82	59	50	0.72	0.03	0.85	0.05	0.61	0.04	6	Cluster by plot
1989	159	103	95	0.65	0.08	0.92	0.02	0.60	0.08	7	Cluster by plot
1990	201	139	118	0.69	0.04	0.85	0.04	0.59	0.04	10	Cluster by plot
1991	188	108	93	0.57	0.06	0.86	0.04	0.49	0.05	7	Cluster by plot
1993	xx ^e	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1995	202	150	99	0.74	xx	0.66	xx	0.49	xx	xx	xx
1998	163	61	49	0.37	0.09	0.80	0.06	0.30	0.08	7	Cluster by plot
2002	216	153	124	0.71	0.02	0.81	0.02	0.57	0.03	11	Cluster by plot
2004	267	171	140	0.64	0.05	0.82	0.03	0.52	0.05	10	Cluster by plot
2005	255	174	147	0.68	0.03	0.84	0.03	0.58	0.03	10	Cluster by plot
2006	569	357	323	0.63	0.02	0.90	0.02	0.57	0.02	11	Cluster by plot
2007	267	156	140	0.58	0.03	0.90	0.02	0.52	0.03	11	Cluster by plot
2009	219	148	122	0.68	0.04	0.82	0.03	0.56	0.04	10	Cluster by plot
2010	261	148	116	0.57	0.04	0.78	0.05	0.44	0.05	10	Cluster by plot
2011	302	80	44	0.26	0.05	0.55	0.07	0.15	0.02	11	Cluster by plot
2012	227	163	130	0.72	0.05	0.80	0.06	0.57	0.06	10	Cluster by plot
2013	254	160	115	0.63	0.04	0.72	0.04	0.45	0.03	9	Cluster by plot
2014	300	204	182	0.68	0.03	0.89	0.02	0.61	0.03	10	Cluster by plot
2015	0	0	0	0.00	-	0.00	-	0.00	-	11	-
2016	253	154	121	0.61	0.06	0.79	0.04	0.48	0.06	11	Cluster by plot
2017	233	190	153	0.82	0.04	0.81	0.03	0.66	0.05	11	Cluster by plot
2018	187	131	123	0.70	0.07	0.94	0.03	0.66	0.07	11	Cluster by plot
2019	207	155	147	0.75	0.05	0.95	0.02	0.71	0.06	10	Cluster by plot
2021	250	182	158	0.73	0.03	0.87	0.02	0.63	0.02	9	Cluster by plot

^aFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^bFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^cPlots that are combined for analysis are counted as a single “plot”.

^dSampling for murres is clustered by plot except when sample sizes per plot are too small or plot data are not available. For sampling clustered by plot, standard deviation values are calculated based on plot as a sample unit; for simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

^exx indicates data potentially exist but have not yet been summarized.

Table 8. Reproductive performance of common murres at Chowiet Island, Alaska in 2021.

Parameter	Plot									Total	SD ^b
	P03 M03	P03 M07	P03 M13	P03 M14	P03 M15	P03 M16	P03 MJH2/ MJH4 ^a	P09 M01	P09 M03/M04 ^a		
Nest sites w/ eggs (B)	29	31	29	30	27	32	24	24	24	250	-
Nest sites w/ chicks (D)	19	23	23	20	20	27	17	18	15	182	-
Nest sites w/ chicks fledged (F)	17	19	19	18	16	22	16	17	12	158	-
Nesting success (D/B) ^c	0.66	0.74	0.79	0.67	0.74	0.84	0.71	0.75	0.63	0.73	0.02
Fledging success (F/D) ^d	0.89	0.83	0.91	0.90	0.80	0.81	0.94	0.94	0.80	0.87	0.02
Reproductive success (F/B)	0.59	0.61	0.72	0.60	0.59	0.69	0.67	0.71	0.50	0.63	0.02

^aPlots were combined for statistical purposes.

^bStandard deviations are calculated based on plot as a sample unit.

^cFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B) equals total eggs (C), and nest sites w/ chicks (D) equals total chicks (E).

^dFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D) equals total chicks (E), and nest sites w/ chicks fledged (F) equals total chicks fledged (G)

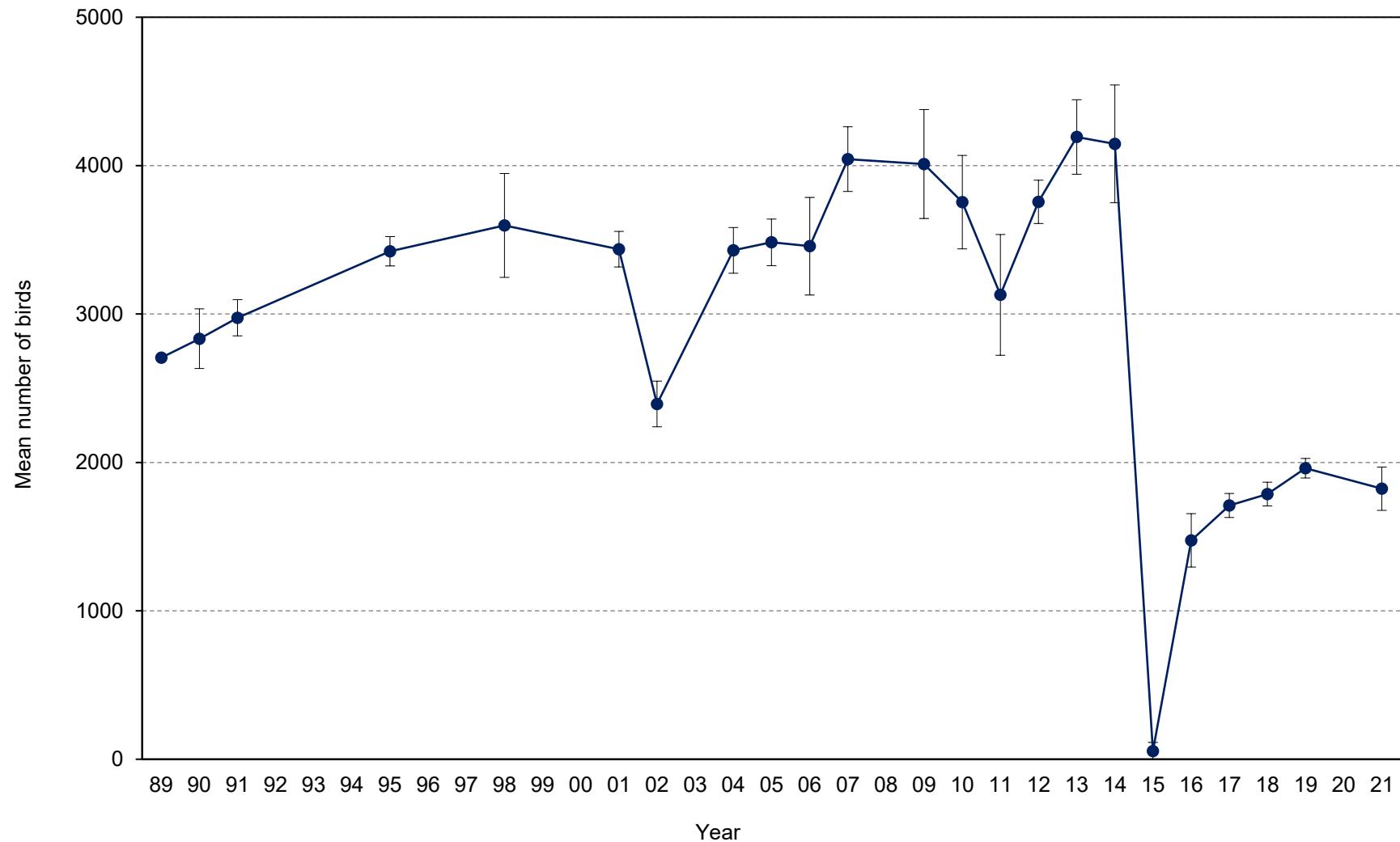


Figure 6. Mean numbers of common murres counted on index plots at Chowiet Island, Alaska. Error bars represent standard deviation. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020; data potentially exist in 1977-1981 but have not yet been summarized.

Table 9. Numbers of common murres counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	1977	1978	1979	1980	1981	1989	1990	1991	1993	1995	1998	2001	2002	2004	2005
1	xx ^a	xx	xx	xx	xx	xx	2408	2906	xx	3199	2999	3574	2448	3839	3122
2	xx	xx	xx	xx	xx	xx	2735	2714	xx	2938	3705	3386	2522	3442	3348
3	xx	xx	xx	xx	xx	xx	2658	3025	xx	3387	3818	3352	2407	3367	3428
4	xx	xx	xx	xx	xx	xx	2914	2993	xx	3561	3600	-	2125	3395	3623
5	xx	xx	xx	xx	xx	xx	2777	2850	xx	3416	3865	-	2317	3410	3568
6	xx	xx	xx	xx	xx	xx	2855	3031	xx	3328	-	-	2175	3412	3554
7	xx	xx	xx	xx	xx	xx	3071	3093	xx	-	-	-	2528	3247	3617
8	xx	xx	xx	xx	xx	xx	2888	3131	xx	-	-	-	2503	3362	3621
9	xx	xx	xx	xx	xx	xx	3051	3013	xx	-	-	-	2517	3377	3460
10	xx	xx	xx	xx	xx	xx	2991	3001	xx	-	-	-	-	3441	3484
Mean	xx	xx	xx	xx	xx	2705	2835	2976	xx	3305	3597	3437	2394	3429	3483
<i>n</i>	xx	xx	xx	xx	xx	10	10	10	xx	6	5	3	9	10	10
SD	xx	xx	xx	xx	xx	xx	201	122	xx	215	350	120	154	154	157
First count	20 Jun	22 Jun	20 Jun	20 Jun	20 Jun	21 Jun	25 Jun	28 Jun	xx	24 Jun	1 Jul	19 Jul	19 Jun	26 Jun	21 Jun
Last count	1 Aug	28 Jun	1 Aug	1 Aug	1 Aug	27 Jul	1 Aug	21 Jul	xx	28 Jul	21 Jul	23 Jul	29 Jul	19 Jul	31 Jul

Table 9 (continued). Numbers of common murres counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	2006	2007	2009	2010	2011	2012	2013	2014	2015 ^b	2016	2017	2018	2019	2021
1	3037	3875	4315	2920	2673	3919	3806	3513	133	1663	1693	1906	1865	1569
2	3708	4228	4787	3698	2566	3650	4074	3745	73	1760	1726	1687	1904	1602
3	3681	3699	4115	3973	3167	3679	4114	3890	108	1621	1630	1735	2006	1812
4	2994	3819	3914	3849	2750	3738	4267	3795	4	1605	1631	1816	2070	1822
5	3628	4248	3969	3822	3322	3679	4164	4250	3	1526	1679	1782	1867	1951
6	3671	4106	3757	3837	3339	4084	3973	4545	9	1364	1695	1919	2011	1936
7	2953	4248	3875	4098	3694	3766	4187	4583	-	1354	1752	1771	1993	1971
8	3466	4287	4210	3757	3528	3787	4744	4570	-	1304	1683	1723	1975	1872
9	3764	4098	3610	3740	3485	3588	4211	4494	-	1256	1915	1744	1963	1875
10	3672	3830	3553	3850	2761	3683	4390	4080	-	1299	1691	-	1953	-
Mean	3457	4044	4011	3754	3129	3757	4193	4147	55	1475	1710	1787	1961	1823
<i>n</i>	10	10	10	10	10	10	10	10	6	10	10	9	10	9
SD	329	218	367	315	407	146	251	397	58	180	81	80	66	146
First count	21 Jun	26 Jun	6 Jul	22 Jun	20 Jun	23 Jun	21 Jun	20 Jun	6 Jul	20 Jun	20 Jun	20 Jun	22 Jun	21 Jun
Last count	30 Jul	28 Jul	31 Jul	27 Jul	29 Jul	29 Jul	29 Jul	28 Jul	18 Jul	17 Jul	20 Jul	1 Aug	23 Jul	26 Jul

^axx indicates data potentially exist but have not yet been summarized.

^bLow counts for most replicates in 2015 due to reproductive failure; murres abandoned the cliffs, rafting offshore for a few weeks after cliff abandonment. Additionally, four replicates in June, with higher numbers, were excluded due to counts for several plots being obtained from photos.

Table 10. Numbers of common murres counted on index plots at Chowiet Island, Alaska in 2021.

Plot	Date									Mean	SD
	21 Jun	27 Jun	1 Jul	5 Jul	10 Jul	15 Jul	16 Jul	19 Jul	25 Jul		
A03M01	35	30	31	21	32	32	33	22	26	-	-
A03M02	50	46	51	46	48	47	54	46	55	-	-
A03M03	49	42	41	44	43	48	53	50	46	-	-
A03M04	106	97	108	107	115	102	118	110	115	-	-
A03M05	16	19	16	22	29	13	19	19	18	-	-
A06M01	104	119	135	123	121	128	116	134	109	-	-
A09M01	61	62	63	65	66	71	68	63	66	-	-
A09M02	348	311	316	426	422	411	391	374	383	-	-
A10M01	521	638	723	618	694	708	742	677	668	-	-
A10M02	279	238	328	350	391	376	377	377	389	-	-
Total	1569	1602	1812	1822	1951	1936	1971	1872	1875	1823	146

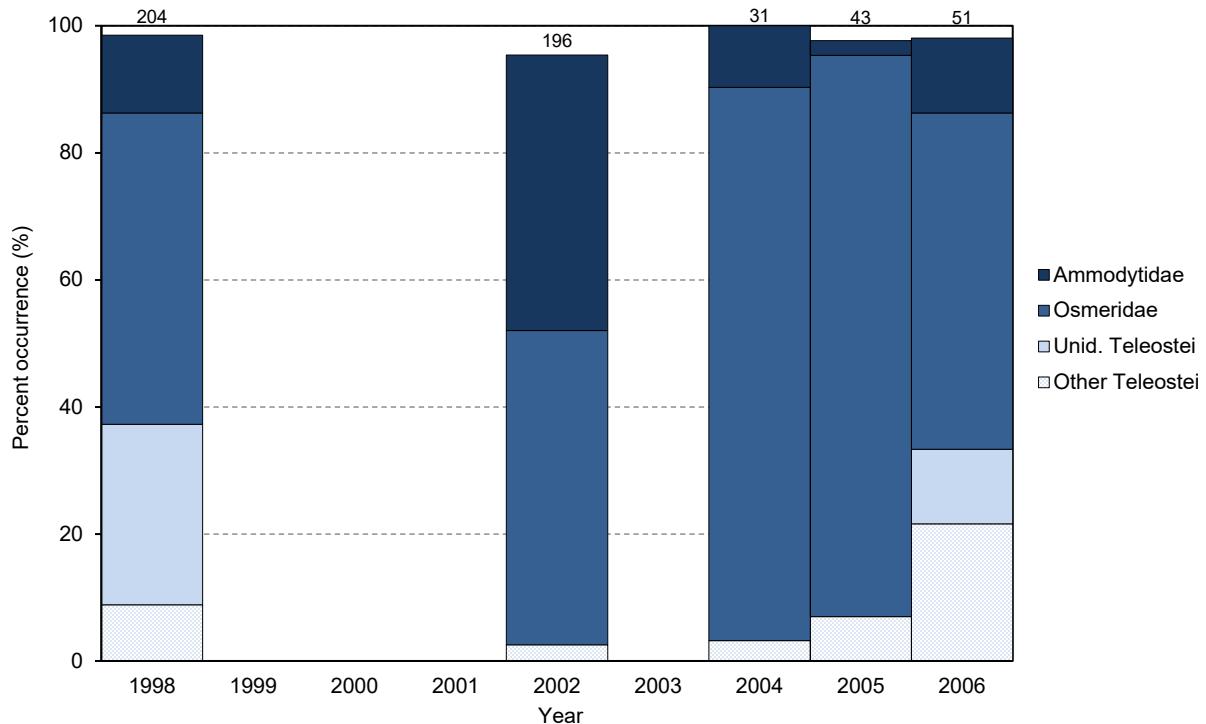


Figure 7. Frequency of occurrence of major prey items in diets of common murre chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of bill-loads observed from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1999-2001, 2003, or after 2006.

Table 11. Frequency of occurrence of major prey items in diets of common murre chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified in the field to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads observed from adults returning to the colony to feed chicks. No diet samples were collected in 1999-2001, 2003, or after 2006. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1998	2002	2004	2005	2006
No. samples	204	196	31	43	51
Invertebrates	1.0	1.5	-	2.3	2.0
Fish	98.5	95.4	100.0	97.7	98.0
Teleostei	98.5	95.4	100.0	97.7	98.0
Ammodytidae	12.3	43.4	9.7	2.3	11.8
<i>Ammodytes</i> spp.	12.3	43.4	9.7	2.3	11.8
Osmeridae	49.0	49.5	87.1	88.4	52.9
<i>Mallotus villosus</i>	46.1	43.4	71.0	83.7	45.1
<i>Thaleichthys pacificus</i>	-	1.0	12.9	2.3	7.8
Other Osmeridae	2.9	5.1	3.2	2.3	-
Unid. Teleostei	28.4	-	-	-	11.8
Other Teleostei	8.8	2.6	3.2	7.0	21.6
Other	0.5	3.1	-	-	-

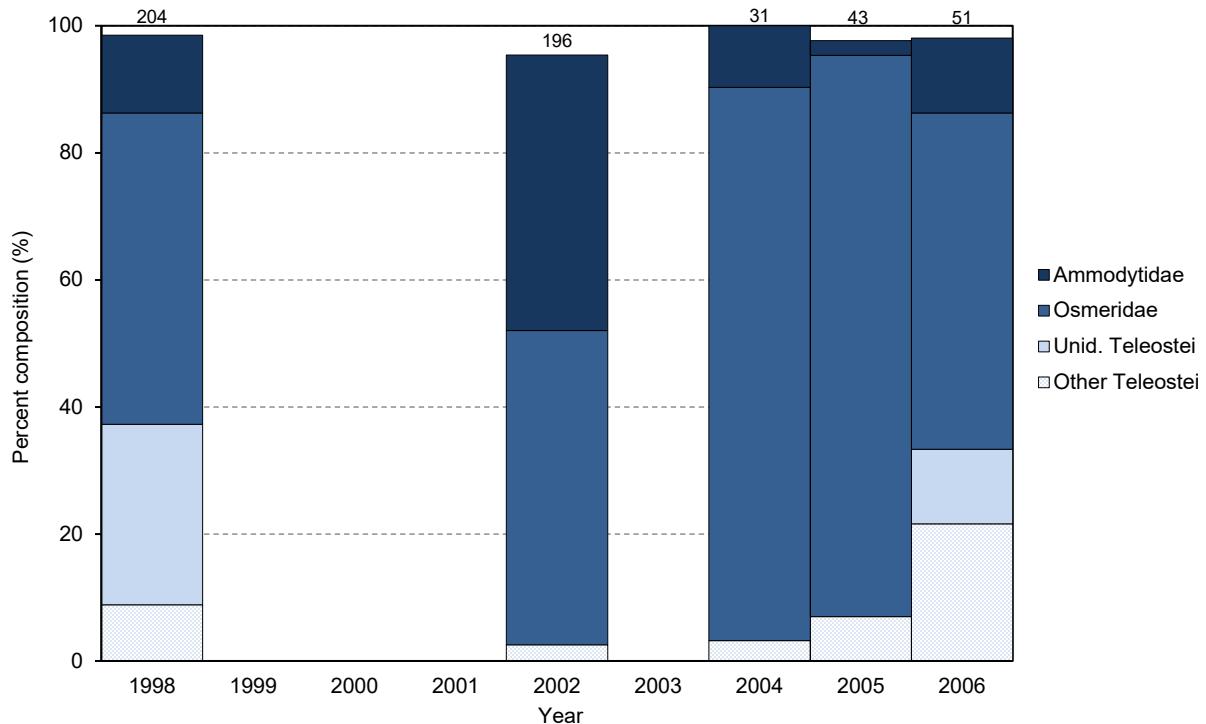


Figure 8. Percent composition of major prey items in diets of common murre chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of bill-loads observed from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1999-2001, 2003, or after 2006.

Table 12. Percent composition of major prey items in diets of common murre chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified in the field to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads observed from adults returning to the colony to feed chicks. No diet samples were collected in 1999-2001, 2003, or after 2006. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1998	2002	2004	2005	2006
No. samples	204	196	31	43	51
No. individuals	204	196	31	43	51
Invertebrates	1.0	1.5	-	2.3	2.0
Fish	98.5	95.4	100.0	97.7	98.0
Teleostei	98.5	95.4	100.0	97.7	98.0
Ammodytidae	12.3	43.4	9.7	2.3	11.8
<i>Ammodytes</i> spp.	12.3	43.4	9.7	2.3	11.8
Osmeridae	49.0	49.5	87.1	88.4	52.9
<i>Mallotus villosus</i>	46.1	43.4	71.0	83.7	45.1
<i>Thaleichthys pacificus</i>	-	1.0	12.9	2.3	7.8
Other Osmeridae	2.9	5.1	3.2	2.3	-
Unid. Teleostei	28.4	-	-	-	11.8
Other Teleostei	8.8	2.6	3.2	7.0	21.6
Other	0.5	3.1	-	-	-

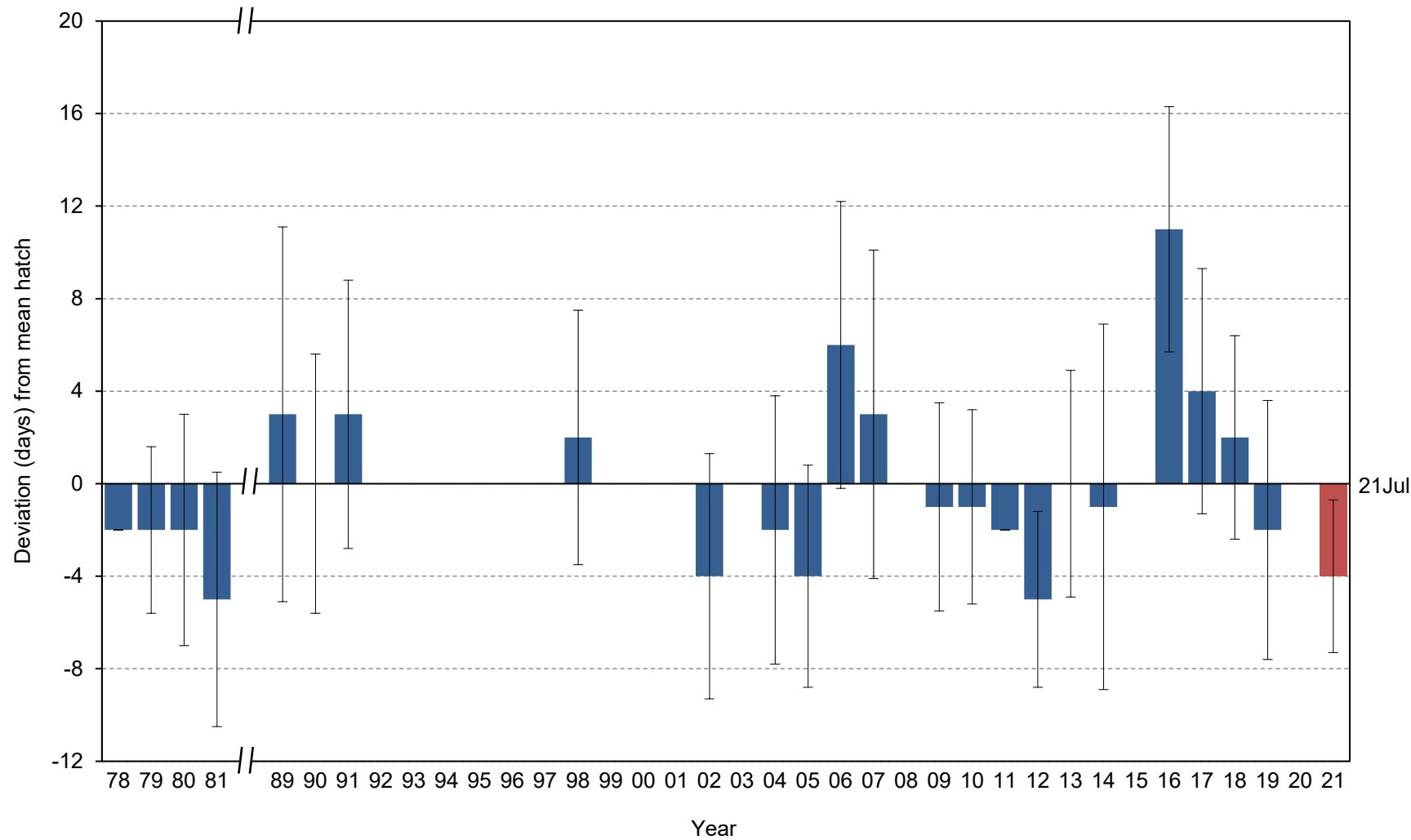


Figure 9. Yearly hatch date deviation (from the 1978-2020 average of 21 July) for thick-billed murres at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date (years without error bars have sample size of one); red highlights the current year. No data were collected in 1981-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched in plots in 2015 and data potentially exist in 1995 but have not yet been summarized.

Table 13. Breeding chronology of thick-billed murres at Chowiet Island, Alaska. No data were collected in 1981-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched in plots in 2015.

Year	Mean hatch	SD	n ^a	First hatch	Last hatch	First "jump"
1978	19 Jul ^b	-	-	-	-	-
1979	19 Jul	3.6	53	13 Jul	27 Jul	31 Jul
1980	18 Jul	5.0	58	10 Jul	1 Aug	26 Jul
1981	16 Jul	5.5	69	8 Jul	3 Aug	24 Jul
1989	24 Jul	8.1	36	11 Jul	16 Aug	28 Jul
1990	21 Jul	5.6	53	13 Jul	8 Aug	4 Aug
1991	24 Jul	5.8	83	11 Jul	18 Aug	1 Aug
1995	xx ^c	xx	xx	xx	xx	xx
1998	23 Jul	5.5	5	18 Jul	2 Aug	9 Aug
2002	17 Jul	5.3	42	8 Jul	2 Aug	26 Jul
2004	18 Jul	5.8	45	10 Jul	13 Aug	27 Jul
2005	17 Jul	4.8	73	9 Jul	29 Jul	29 Jul
2006	27 Jul	6.2	49	17 Jul	18 Aug	27 Jul
2007	24 Jul	7.1	68	13 Jul	16 Aug	2 Aug
2009	20 Jul	4.5	26	13 Jul	29 Jul	31 Jul
2010	20 Jul	4.2	45	13 Jul	2 Aug	29 Jul
2011	19 Jul	-	1	19 Jul	-	23 Jul
2012	15 Jul	3.8	43	5 Jul	26 Jul	26 Jul
2013	21 Jul	4.9	59	11 Jul	8 Aug	3 Aug
2014	20 Jul	7.9	46	3 Jul	14 Aug	30 Jul
2016	31 Jul	5.3	53	20 Jul	11 Aug	8 Aug
2017	25 Jul	5.3	59	17 Jul	12 Aug	3 Aug
2018	23 Jul	4.4	27	13 Jul	1 Aug	5 Aug
2019	19 Jul	5.6	53	8 Jul	8 Aug	24 Jul
2021	17 Jul	3.3	41	8 Jul	23 Jul	8 Aug

^aSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

^bExtrapolated from lay dates using mean incubation period.

^cxx indicates data may potentially exist but have not yet been summarized.

Table 14. Frequency distribution of hatch dates for thick-billed murres at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1981-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; data from individual nests are not available in 1978 and no eggs hatched in plots in 2015.

Julian date ^a	No. nests hatching on Julian date											
	79	80	81	89	90	91	95	98	02	04	05	06
184	-	-	-	-	-	-	xx ^b	-	-	-	-	-
185	-	-	-	-	-	-	xx	-	-	-	-	-
186	-	-	-	-	-	-	xx	-	-	-	-	-
187	-	-	-	-	-	-	xx	-	-	-	-	-
188	-	-	-	-	-	-	xx	-	-	-	-	-
189	-	-	2	-	-	-	xx	-	1	-	-	-
190	-	-	-	-	-	-	xx	-	-	-	1	-
191	-	-	8	-	-	-	xx	-	4	-	11	-
192	-	2	-	1	-	1	xx	-	-	2	-	-
193	-	-	11	1	-	-	xx	-	5	1	1	-
194	6	7	-	-	3	-	xx	-	-	3	4	-
195	-	-	15	-	-	-	xx	-	-	1	9	-
196	6	13	-	-	5	5	xx	-	9	8	11	-
197	-	-	13	-	-	-	xx	-	6	-	-	-
198	6	10	-	8	7	3	xx	-	-	5	1	1
199	-	-	6	1	2	4	xx	2	5	1	-	2
200	15	5	-	-	12	8	xx	-	-	12	20	1
201	-	-	3	3	-	5	xx	-	5	1	1	-
202	8	6	-	1	10	4	xx	-	-	5	2	9
203	-	-	2	2	-	2	xx	-	1	-	1	2
204	7	6	-	4	2	5	xx	2	-	1	5	-
205	-	-	4	2	1	3	xx	-	3	-	1	2
206	4	4	-	4	2	23	xx	-	-	-	3	3
207	-	-	-	-	-	-	xx	-	-	-	-	5
208	1	2	-	1	1	2	xx	-	-	2	-	3
209	-	-	1	-	-	-	xx	-	2	-	-	3
210	-	1	-	2	4	11	xx	-	-	1	2	3
211	-	-	3	1	-	-	xx	-	-	1	-	3
212	-	1	-	1	2	1	xx	-	-	-	-	5
213	-	-	-	-	-	2	xx	-	-	-	-	1
214	-	1	-	-	-	1	xx	1	1	-	-	1
215	-	-	1	-	-	-	xx	-	-	-	-	1
216	-	-	-	-	-	-	xx	-	-	-	-	-
217	-	-	-	-	-	-	xx	-	-	-	-	-
218	-	-	-	-	1	1	xx	-	-	-	-	1
219	-	-	-	-	-	-	xx	-	-	-	-	1
220	-	-	-	1	1	1	xx	-	-	-	-	-
221	-	-	-	-	-	-	xx	-	-	-	-	-
222	-	-	-	-	-	-	xx	-	-	-	-	1
223	-	-	-	-	2	-	xx	-	-	-	-	-
224	-	-	-	-	-	-	xx	-	-	-	-	-
225	-	-	-	-	-	-	xx	-	-	-	-	-
226	-	-	-	-	-	-	xx	-	-	1	-	-
227	-	-	-	-	-	-	xx	-	-	-	-	-
228	-	-	-	1	-	-	xx	-	-	-	-	-
229	-	-	-	-	-	-	xx	-	-	-	-	-
230	-	-	-	-	-	1	xx	-	-	-	-	1
<i>n</i>	53	58	69	36	53	83	xx	5	42	45	73	49

Table 14 (continued). Frequency distribution of hatch dates for thick-billed murres at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1981-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; data from individual nests are not available in 1978 and no eggs hatched in plots in 2015.

Julian date ^a	No. nests hatching on Julian date											
	07	09	10	11	12	13	14	16	17	18	19	21
184	-	-	-	-	-	-	1	-	-	-	-	-
185	-	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	-	-	-	-	-	-	-	-	-
187	-	-	-	-	1	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	1	1	-
190	-	-	-	-	-	-	-	-	-	2	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	7	1	-	-	-	-	1	-
193	-	-	-	-	-	1	1	-	-	-	-	-
194	3	5	4	-	8	-	5	-	-	1	-	10
195	-	-	-	-	-	-	-	-	-	-	-	-
196	2	-	3	-	-	13	-	-	-	-	19	2
197	-	-	-	-	-	-	4	-	-	-	-	2
198	8	-	2	-	18	1	17	-	3	5	1	16
199	-	-	7	-	-	2	-	-	-	-	2	2
200	6	8	11	1	3	2	-	-	1	-	-	1
201	2	-	1	-	-	-	-	-	-	-	18	-
202	3	-	-	-	5	13	1	2	22	3	-	-
203	13	-	-	-	-	-	5	-	-	7	-	6
204	8	10	8	-	-	11	-	-	4	-	-	1
205	-	-	4	-	-	5	1	4	-	-	-	-
206	4	-	3	-	-	4	4	2	-	6	6	-
207	-	-	-	-	-	1	-	-	-	-	-	-
208	4	2	-	-	1	1	3	-	21	2	-	-
209	1	-	-	-	-	-	-	10	-	-	-	-
210	3	1	1	-	-	3	-	3	-	-	1	-
211	2	-	-	-	-	-	-	1	-	2	-	-
212	1	-	-	-	-	-	-	-	2	-	-	-
213	-	-	-	-	-	-	-	7	-	1	-	-
214	2	-	1	-	-	-	-	10	2	-	-	-
215	-	-	-	-	-	-	-	-	1	-	-	-
216	1	-	-	-	-	-	1	-	1	-	1	-
217	-	-	-	-	-	-	-	-	-	-	-	-
218	1	-	-	-	-	-	1	8	-	-	-	-
219	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	1	-	-	-	-	1	-
221	1	-	-	-	-	-	-	1	-	-	-	-
222	1	-	-	-	-	-	-	4	1	-	-	-
223	-	-	-	-	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	-	1	1	-	-	-
225	-	-	-	-	-	-	-	-	-	-	-	-
226	1	-	-	-	-	-	2	-	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-
228	1	-	-	-	-	-	-	-	-	-	-	-
229	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	-	-	-	-
<i>n</i>	68	26	45	1	43	59	46	53	59	27	53	41

^aIn leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

^bxx indicates data potentially exist but have not yet been summarized.

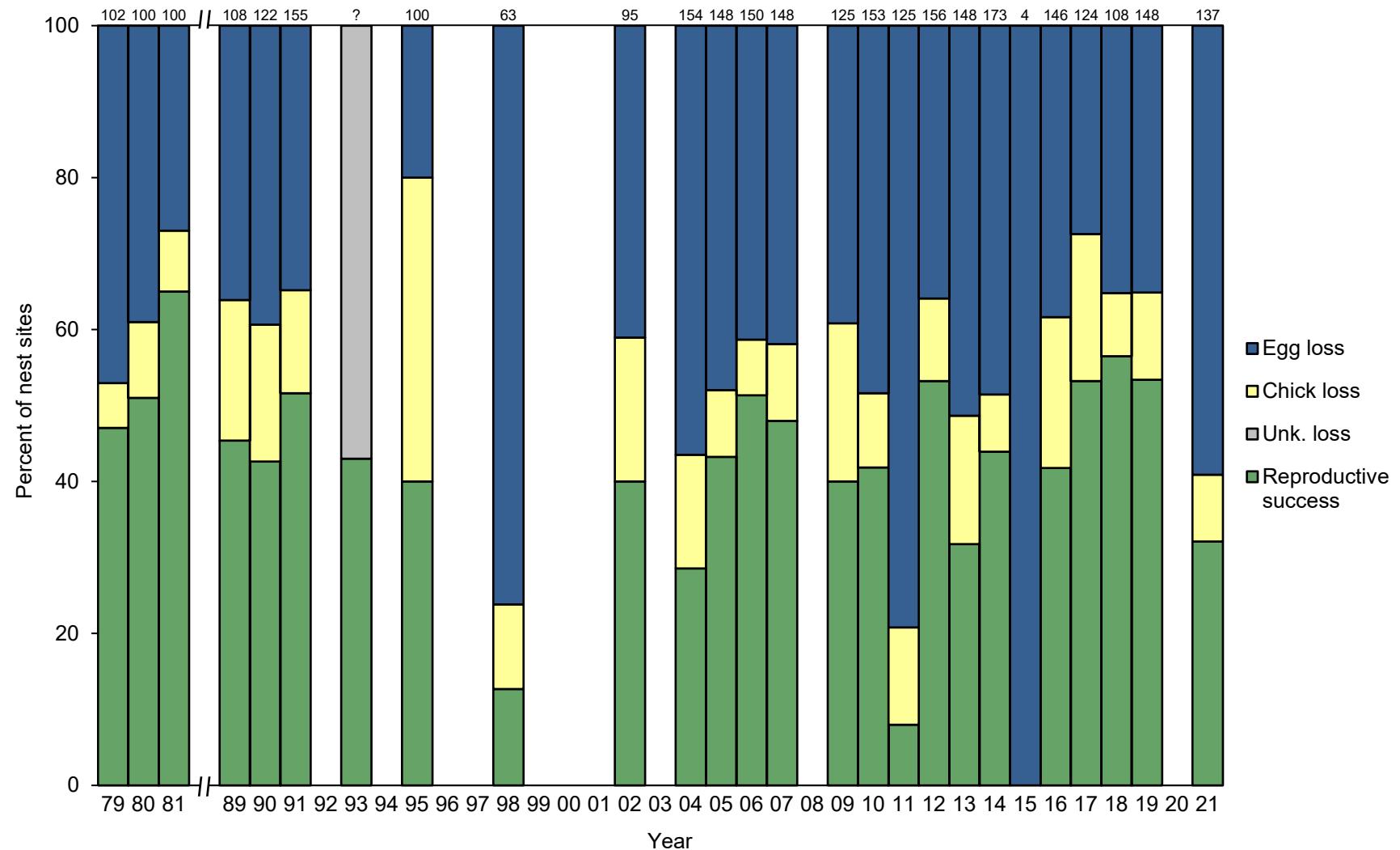


Figure 10. Reproductive performance of thick-billed murres at Chowiet Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Failure in years where no eggs were laid is considered 100% egg loss. Numbers above columns indicate sample sizes (B). No data were collected in 1982-1988, 1992, 1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; data potentially exist in 1993 but have not yet been summarized.

Table 15. Reproductive performance of thick-billed murres at Chowiet Island, Alaska. No data were collected in 1982-1988, 1992, 1994, 1996-1997, 1999-2001, 2003, 2008, or 2020.

Year	Nest sites w/ eggs	Nest sites w/ chicks	Nest sites w/ chicks fledged	Nesting success (D/B) ^a		Fledging success (F/D) ^b		Reproductive success (F/B)		No. plots ^c	Sampling design ^d
	(B)	(D)	(F)	Total	SD	Total	SD	Total	SD		
1979	102	54	48	0.53	0.08	0.89	0.03	0.47	0.07	6	Cluster by plot
1980	100	61	51	0.61	0.02	0.84	0.04	0.51	0.01	6	Cluster by plot
1981	100	73	65	0.73	0.04	0.89	0.02	0.65	0.03	6	Cluster by plot
1989	108	69	49	0.64	0.09	0.71	0.05	0.45	0.10	4	Cluster by plot
1990	122	74	52	0.61	0.04	0.70	0.06	0.43	0.04	5	Cluster by plot
1991	155	101	80	0.65	0.05	0.79	0.04	0.52	0.06	7	Cluster by plot
1993	xx ^e	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1995	100	80	40	0.80	xx	0.50	xx	0.40	xx	xx	xx
1998	63	15	8	0.24	0.11	0.53	0.22	0.13	0.08	4	Cluster by plot
2002	95	56	38	0.59	0.05	0.68	0.05	0.40	0.06	4	Cluster by plot
2004	154	67	44	0.44	0.06	0.66	0.07	0.29	0.04	6	Cluster by plot
2005	148	77	64	0.52	0.05	0.83	0.03	0.43	0.06	7	Cluster by plot
2006	150	88	77	0.59	0.04	0.88	0.05	0.51	0.05	5	Cluster by plot
2007	148	86	71	0.58	0.06	0.83	0.04	0.48	0.05	7	Cluster by plot
2009	125	76	50	0.61	0.05	0.66	0.08	0.40	0.06	8	Cluster by plot
2010	153	79	64	0.52	0.02	0.81	0.03	0.42	0.03	7	Cluster by plot
2011	125	26	10	0.21	0.05	0.38	0.05	0.08	0.02	8	Cluster by plot
2012	156	100	83	0.64	0.03	0.83	0.03	0.53	0.04	7	Cluster by plot
2013	148	72	47	0.49	0.04	0.65	0.04	0.32	0.03	6	Cluster by plot
2014	173	89	76	0.51	0.04	0.85	0.03	0.44	0.04	6	Cluster by plot
2015	4	0	0	0.00	0.00	0.00	0.00	0.00	0.00	2	Cluster by plot
2016	146	90	61	0.62	0.06	0.68	0.06	0.42	0.07	6	Cluster by plot
2017	124	90	66	0.73	0.04	0.73	0.03	0.53	0.04	5	Cluster by plot
2018	108	70	61	0.65	0.04	0.87	0.04	0.56	0.04	5	Cluster by plot
2019	148	96	79	0.65	0.03	0.82	0.05	0.53	0.06	5	Cluster by plot
2021	137	56	44	0.41	0.06	0.79	0.04	0.32	0.06	6	Cluster by plot

^aFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^bFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^cPlots that are combined for analysis are counted as a single “plot”.

^dSampling for murres is clustered by plot except when sample sizes per plot are too small or plot data are not available. For sampling clustered by plot, standard deviation values are calculated based on plot as a sample unit; for simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

^exx indicates data potentially exist but have not yet been summarized.

Table 16. Reproductive performance of thick-billed murres at Chowiet Island, Alaska in 2021.

Parameter	Plot						Total	SD ^b
	P03M03/ 04/05 ^a	P03MJW1/ 06/07 ^a	P03 MJH1	P03 MJH2/3 ^a	P03 MJH4	P09M01/ 03 ^a		
Nest sites w/ eggs (B)	26	21	27	23	25	15	137	-
Nest sites w/ chicks (D)	10	3	10	10	12	11	56	-
Nest sites w/ chicks fledged (F)	7	2	9	7	9	10	44	-
Nesting success (D/B) ^c	0.38	0.14	0.37	0.43	0.48	0.73	0.41	0.06
Fledging success (F/D) ^d	0.70	0.67	0.90	0.70	0.75	0.91	0.79	0.04
Reproductive success (F/B)	0.27	0.10	0.33	0.30	0.36	0.67	0.32	0.06

^aPlots were combined for statistical purposes.

^bStandard deviations are calculated based on plot as a sample unit.

^cFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B) equals total eggs (C), and nest sites w/ chicks (D) equals total chicks (E).

^dFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D) equals total chicks (E), and nest sites w/ chicks fledged (F) equals total chicks fledged (G).

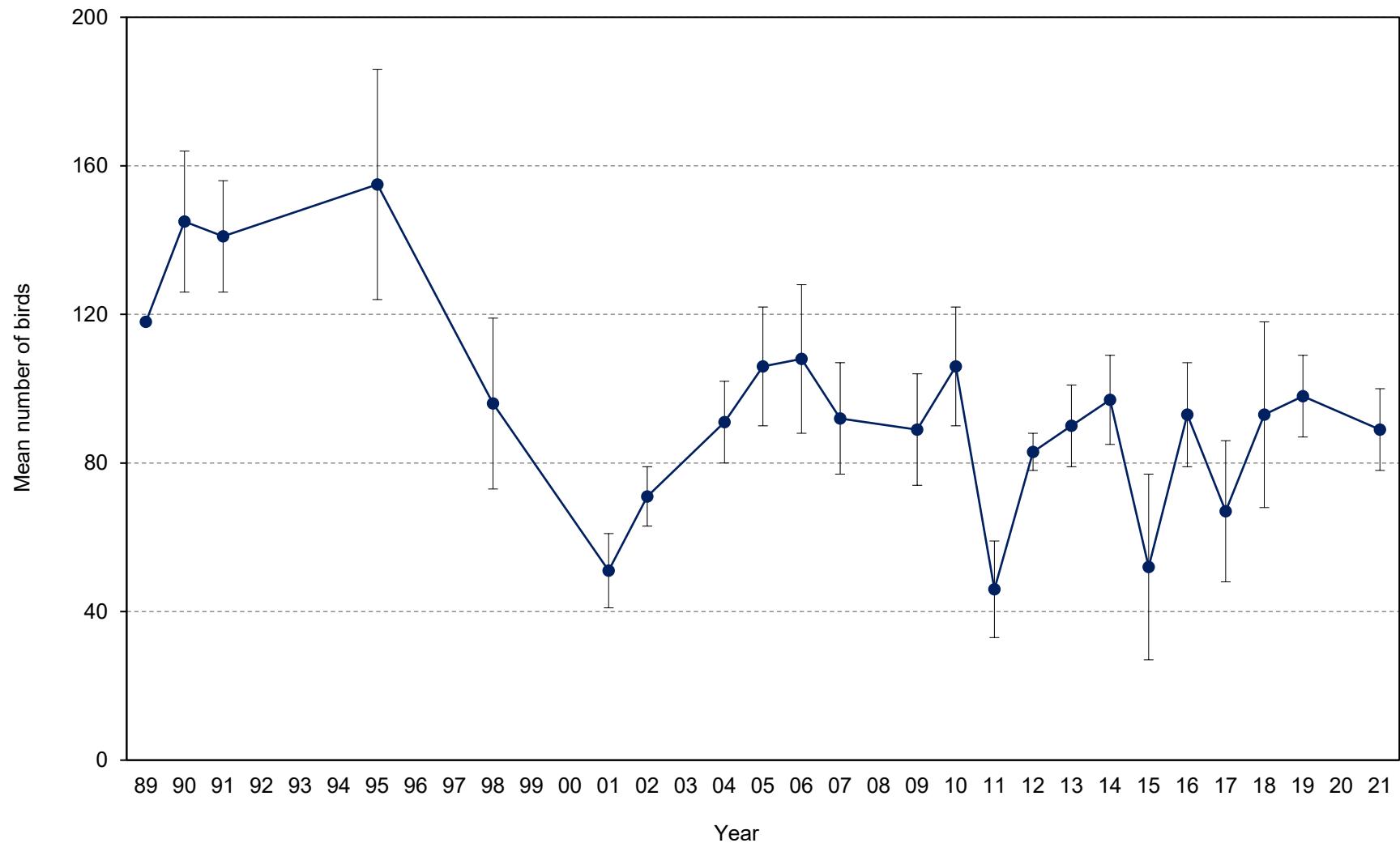


Figure 11. Mean numbers of thick-billed murres counted on index plots at Chowiet Island, Alaska. Error bars represent standard deviation. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020; data potentially exist in 1977-1981 but have not yet been summarized.

Table 17. Numbers of thick-billed murres counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	1977	1978	1979	1980	1981	1989	1990	1991	1993	1995	1998	2001	2002	2004	2005
1	xx ^a	xx	xx	xx	xx	xx	139	156	xx	177	76	53	78	108	96
2	xx	xx	xx	xx	xx	xx	152	137	xx	151	90	59	72	101	73
3	xx	xx	xx	xx	xx	xx	114	161	xx	186	110	40	78	86	108
4	xx	xx	xx	xx	xx	xx	139	146	xx	117	74	-	76	107	92
5	xx	xx	xx	xx	xx	xx	130	140	xx	174	129	-	75	75	109
6	xx	xx	xx	xx	xx	xx	144	131	xx	141	-	-	63	90	119
7	xx	xx	xx	xx	xx	xx	185	161	xx	-	-	-	66	87	130
8	xx	xx	xx	xx	xx	xx	137	132	xx	-	-	-	56	94	107
9	xx	xx	xx	xx	xx	xx	155	134	xx	-	-	-	71	83	115
10	xx	xx	xx	xx	xx	xx	152	113	xx	-	-	-	-	82	112
Mean	xx	xx	xx	xx	xx	118	145	141	xx	158	96	51	71	91	106
n	xx	xx	xx	xx	xx	4	10	10	xx	6	5	3	9	10	10
SD	xx	xx	xx	xx	xx	xx	19	15	xx	26	23	10	8	11	16
First count	20 Jun	22 Jun	20 Jun	20 Jun	20 Jun	21 Jun	25 Jun	28 Jun	xx	24 Jun	1 Jul	19 Jul	19 Jun	26 Jun	21 Jun
Last count	1 Aug	28 Jun	1 Aug	1 Aug	1 Aug	27 Jul	1 Aug	21 Jul	xx	28 Jul	21 Jul	23 Jul	29 Jul	19 Jul	31 Jul

Table 17 (continued). Numbers of thick-billed murres counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	2006	2007	2009	2010	2011	2012	2013	2014	2015 ^b	2016	2017	2018	2019	2021
1	100	64	108	88	39	77	72	104	92	97	44	97	97	104
2	120	81	99	88	35	85	105	89	70	115	41	72	113	87
3	127	80	116	90	38	78	100	115	65	84	54	50	93	67
4	82	96	81	127	55	84	97	94	62	115	59	68	113	83
5	130	98	91	112	58	83	100	82	76	90	60	89	91	95
6	113	80	89	118	61	81	89	95	37	94	68	124	89	95
7	68	102	79	128	54	77	87	113	45	91	95	114	106	77
8	118	111	89	113	50	92	83	87	34	94	77	114	78	94
9	117	106	71	108	51	87	80	108	14	79	92	107	101	96
10	107	102	69	89	21	85	82	83	26	72	83	-	102	-
Mean	108	92	89	106	46	83	90	97	52	93	67	93	98	89
<i>n</i>	10	10	10	10	10	10	10	10	10	10	10	9	10	9
SD	20	15	15	16	13	5	11	12	25	14	19	25	11	11
First count	21 Jun	26 Jun	6 Jul	22 Jun	20 Jun	23 Jun	21 Jun	20 Jun	22 Jun	20 Jun	20 Jun	20 Jun	22 Jun	21 Jul
Last count	30 Jul	28 Jul	31 Jul	27 Jul	29 Jul	29 Jul	29 Jul	28 Jul	18 Jun	17 Jul	20 Jul	1 Aug	23 Jul	26 Jul

^axx indicates data potentially exist but have not yet been summarized.

^bLow counts for most replicates in 2015 due to reproductive failure; murres abandoned the cliffs, rafting offshore for a few weeks after cliff abandonment.

Table 18. Numbers of thick-billed murres counted on index plots at Chowiet Island, Alaska in 2021.

Plot	Date									Mean	SD
	21 Jun	27 Jun	1 Jul	5 Jul	10 Jul	15 Jul	16 Jul	19 Jul	25 Jul		
A03M04	14	13	12	16	12	12	10	12	11	-	-
A03M05	10	9	10	9	11	10	10	8	10	-	-
A06M01	5	2	2	3	3	5	4	4	3	-	-
A09M02	75	63	43	55	69	68	53	70	72	-	-
Total	104	87	67	83	95	95	77	94	96	89	11

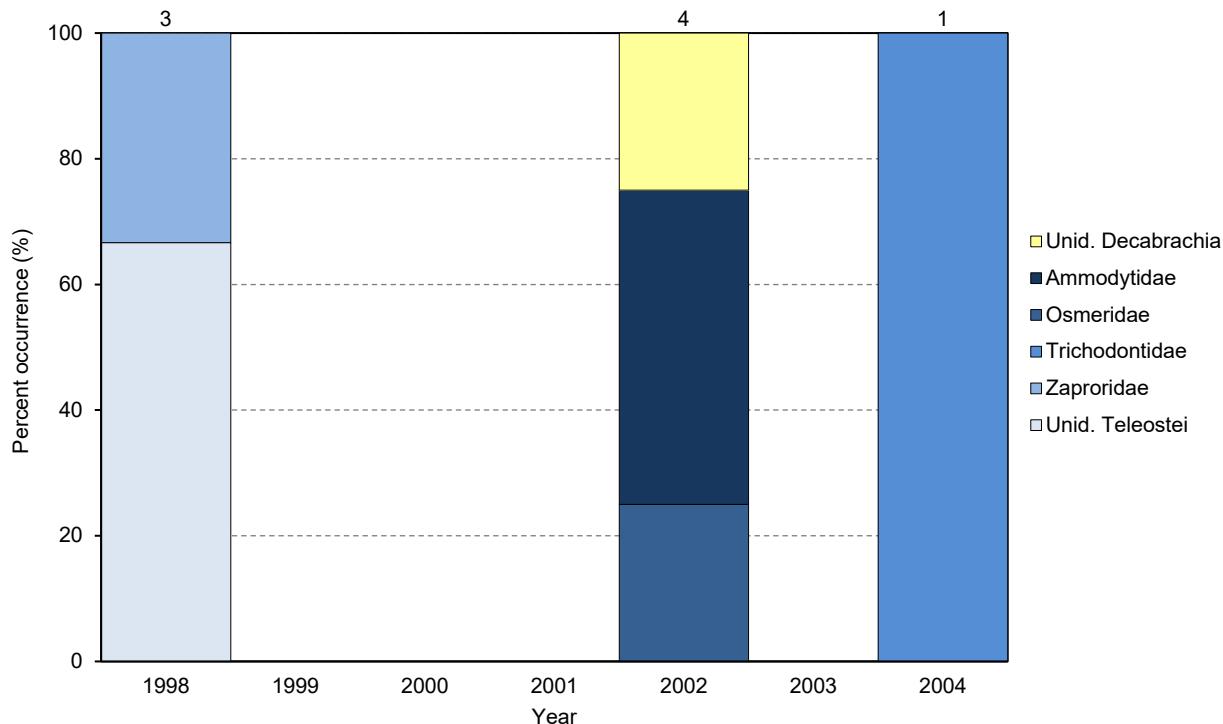


Figure 12. Frequency of occurrence of major prey items in diets of thick-billed murre chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of bill-loads observed from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1999-2001, 2003, or after 2004.

Table 19. Frequency of occurrence of major prey items in diets of thick-billed murre chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified in the field to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads observed from adults returning to the colony to feed chicks. No diet samples were collected in 1999-2001, 2003, or after 2004. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1998	2002	2004
No. samples	3	4	1
Invertebrates			
Cephalopoda	-	25.0	-
Unid. Decabracchia	-	25.0	-
Fish			
Teleostei	100.0	75.0	100.0
Ammodytidae	-	50.0	-
Ammodytes spp.	-	50.0	-
Osmeridae	-	25.0	-
<i>Mallotus villosus</i>	-	25.0	-
Trichodontidae	-	-	100.0
<i>Trichodon trichodon</i>	-	-	100.0
Zaproridae	33.3	-	-
<i>Zaprora silenus</i>	33.3	-	-
Unid. Teleostei	66.7	-	-

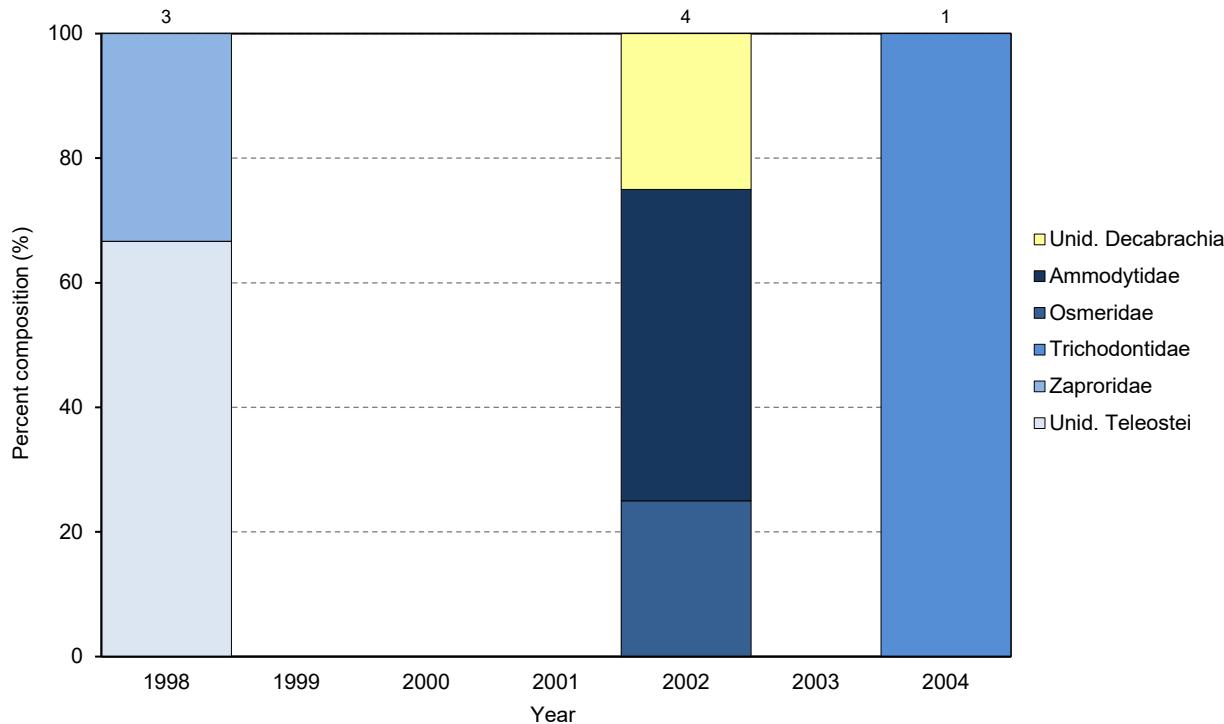


Figure 13. Percent composition of major prey items in diets of thick-billed murre chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of bill-loads observed from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1999-2001, 2003, or after 2004.

Table 20. Percent composition of major prey items in diets of thick-billed murre chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified in the field to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads observed from adults returning to the colony to feed chicks. No diet samples were collected in 1999-2001, 2003, or after 2004. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1998	2002	2004
No. samples	3	4	1
No. individuals	3	4	1
Invertebrates	-	25.0	-
Cephalopoda	-	25.0	-
Unid. Decabracchia	-	25.0	-
Fish	100.0	75.0	100.0
Teleostei	100.0	75.0	100.0
Ammodytidae	-	50.0	-
<i>Ammodytes</i> spp.	-	50.0	-
Osmeridae	-	25.0	-
<i>Mallotus villosus</i>	-	25.0	-
Trichodontidae	-	-	100.0
<i>Trichodon trichodon</i>	-	-	100.0
Zaproridae	33.3	-	-
<i>Zaprora silenus</i>	33.3	-	-
Unid. Teleostei	66.7	-	-

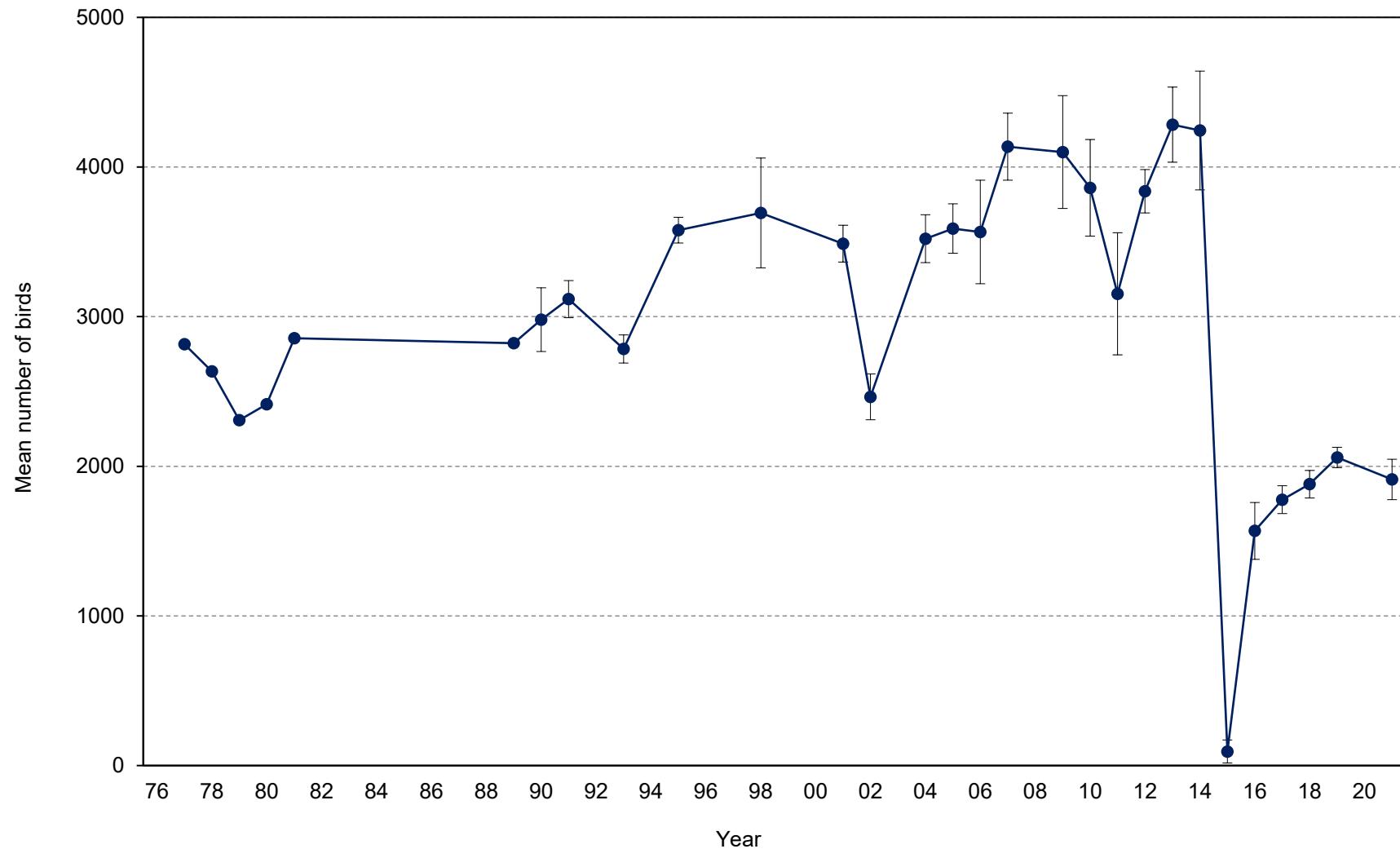


Figure 14. Mean numbers of murres (common, thick-billed, and unknown murres) counted on index plots at Chowiet Island, Alaska. Error bars represent standard deviation. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Table 21. Numbers of murres (common, thick-billed, and unknown murres) counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	1977	1978	1979	1980	1981	1989	1990	1991	1993	1995	1998	2001	2002	2004	2005
1	xx ^a	xx	xx	xx	xx	xx	2547	3062	xx	3376	3075	3627	2526	3947	3218
2	xx	xx	xx	xx	xx	xx	2887	2851	xx	3089	3795	3445	2594	3543	3421
3	xx	xx	xx	xx	xx	xx	2772	3186	xx	3573	3928	3392	2485	3453	3536
4	xx	xx	xx	xx	xx	xx	3053	3139	xx	3678	3674	-	2201	3502	3715
5	xx	xx	xx	xx	xx	xx	2907	2990	xx	3590	3994	-	2392	3485	3677
6	xx	xx	xx	xx	xx	xx	2999	3162	xx	3469	-	-	2238	3502	3673
7	xx	xx	xx	xx	xx	xx	3256	3254	xx	-	-	-	2594	3334	3747
8	xx	xx	xx	xx	xx	xx	3025	3263	xx	-	-	-	2559	3456	3728
9	xx	xx	xx	xx	xx	xx	3206	3147	xx	-	-	-	2588	3460	3575
10	xx	xx	xx	xx	xx	xx	3143	3114	xx	-	-	-	-	3523	3596
Mean	2816	2635	2308	2415	2856	2823	2980	3117	2784	3463	3693	3488	2464	3521	3589
<i>n</i>	xx	xx	xx	xx	xx	13	10	10	10	6	5	3	9	10	10
SD	xx	xx	xx	xx	xx	xx	212	124	94	211	367	123	153	160	165
First count	20 Jun	22 Jun	20 Jun	20 Jun	20 Jun	21 Jun	25 Jun	28 Jun	xx	24 Jun	1 Jul	19 Jul	19 Jun	26 Jun	21 Jun
Last count	1 Aug	28 Jun	1 Aug	1 Aug	1 Aug	27 Jul	1 Aug	21 Jul	xx	28 Jul	21 Jul	23 Jul	29 Jul	19 Jul	31 Jul

Table 21 (continued). Numbers of murres (common, thick-billed, and unknown murres) counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	2006	2007	2009	2010	2011	2012	2013	2014	2015 ^b	2016	2017	2018	2019	2021
1	3137	3939	4423	3008	2712	3994	3878	3617	209	1760	1737	2003	1962	1673
2	3828	4309	4886	3786	2582	3732	4179	3834	110	1875	1767	1759	2017	1689
3	3808	3779	4231	4063	3188	3756	4214	4005	153	1705	1684	1785	2099	1879
4	3076	3915	3995	3976	2778	3820	4364	3889	38	1720	1690	1884	2183	1905
5	3758	4346	4060	3934	3353	3761	4264	4332	17	1616	1739	1871	1958	2046
6	3784	4186	3846	3955	3362	4164	4062	4640	35	1458	1763	2043	2100	2031
7	3021	4350	3954	4226	3722	3841	4274	4696	-	1445	1847	1885	2099	2048
8	3584	4398	4299	3870	3549	3878	4827	4657	-	1398	1760	1837	2053	1966
9	3881	4204	3681	3848	3513	3672	4291	4602	-	1335	2007	1851	2064	1971
10	3779	3932	3622	3939	2774	3767	4472	4163	-	1371	1774	-	2055	-
Mean	3566	4136	4100	3861	3153	3839	4283	4244	94	1568	1777	1880	2059	1912
<i>n</i>	10	10	10	10	10	10	10	10	6	10	10	9	10	9
SD	346	224	377	323	408	145	251	397	77	190	93	92	68	135
First count	21 Jun	26 Jun	6 Jul	22 Jun	22 Jun	23 Jun	21 Jun	20 Jun	6 Jul	20 Jun	20 Jun	20 Jun	22 Jun	21 Jun
Last count	30 Jul	28 Jul	31 Jul	27 Jul	29 Jul	29 Jul	29 Jul	28 Jul	18 Jul	17 Jul	20 Jul	1 Aug	23 Jul	26 Jul

^axx indicates data potentially exist but have not yet been summarized.

^bLow counts for most replicates in 2015 due to reproductive failure; murres abandoned the cliffs, rafting offshore for a few weeks after cliff abandonment. Additionally, four replicates in June, with higher numbers, were excluded due to counts for several common murre plots being obtained from photos.

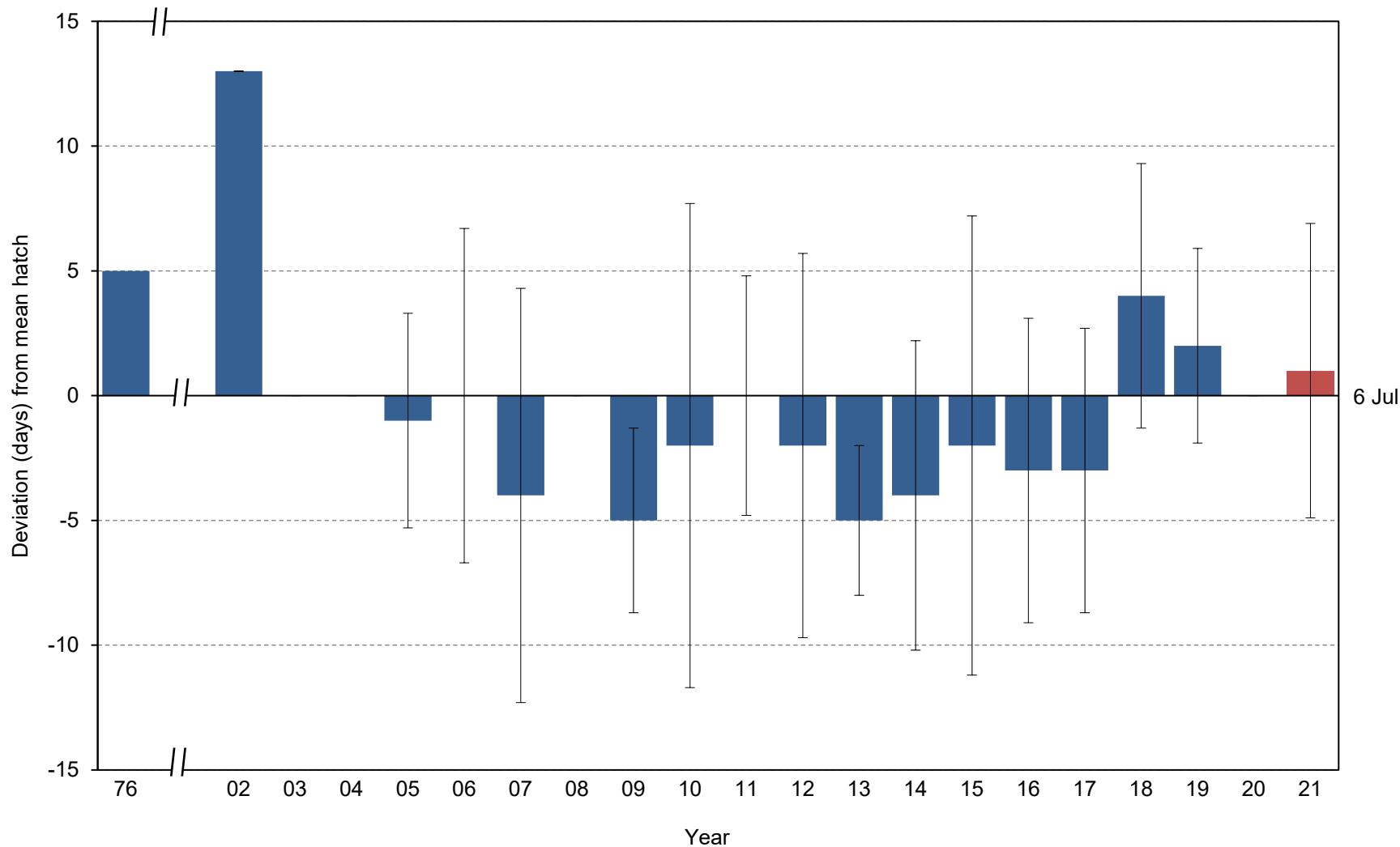


Figure 15. Yearly hatch date deviation (from the 1976-2020 average of 6 July) for parakeet auklets at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date (no value available for 1976); red highlights the current year. No data were collected in 1977-1997, 1999-2001, 2003-2004, 2008, or 2020; no hatch dates were recorded with the appropriate egg to chick interval (≤ 7 days) in 1998.

Table 22. Breeding chronology of parakeet auklets at Chowiet Island, Alaska. No data were collected in 1977-1997, 1999-2001, 2003-2004, 2008, or 2020; no hatch dates were recorded with the appropriate egg to chick interval (≤ 7 days) in 1998.

Year	Mean hatch	SD	n ^a	First hatch	Last hatch	First fledge
1976	10 Jul	-	5	25 Jun	16 Jul	-
1998	-	-	-	-	-	17 Aug
2002	19 Jul	0.0	2	19 Jul	-	-
2005	5 Jul	4.3	13	27 Jun	13 Jul	1 Aug
2006	6 Jul	6.7	7	30 Jun	21 Jun	28 Jul
2007	2 Jul	8.3	7	23 Jun	21 Jul	2 Aug
2009	1 Jul	3.7	9	25 Jun	7 Jul	1 Aug
2010	4 Jul	9.7	10	23 Jun	31 Jul	31 Jul
2011	6 Jul	4.8	4	29 Jun	11 Jul	7 Aug
2012	3 Jul	7.7	10	24 Jun	22 Jul	29 Jul
2013	1 Jul	3.0	13	25 Jun	5 Jul	28 Jul
2014	2 Jul	6.2	20	24 Jun	15 Jul	27 Jul
2015	4 Jul	9.2	10	23 Jun	19 Jul	28 Jul
2016	2 Jul	6.1	14	24 Jun	22 Jul	29 Jul
2017	3 Jul	5.7	41	25 Jun	19 Jul	28 Jul
2018	10 Jul	5.3	33	1 Jul	29 Jul	4 Aug
2019	8 Jul	3.9	5	1 Jul	13 Jul	31 Jul
2021	7 Jul	5.9	12	27 Jun	20 Jul	8 Aug

^aSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

Table 23. Frequency distribution of hatch dates for parakeet auklets at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1977-1997, 1999-2001, 2003-2004, 2008, or 2020; no hatch dates were recorded with the appropriate egg to chick interval in 1998 and data from individual nests are not available in 1976.

Julian date ^a	No. nests hatching on Julian date																		
	02	05	06	07	09	10	11	12	13	14	15	16	17	18	19	21			
174	-	-	-	1	-	1	-	-	-	-	3	-	-	-	-	-	-	-	-
175	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
176	-	-	-	-	1	-	-	1	1	4	-	1	4	-	-	-	-	-	-
177	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
178	-	1	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	1
179	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
180	2	1	-	-	2	2	1	4	-	3	2	1	13	-	-	-	-	-	-
181	-	-	1	-	-	2	-	-	4	-	-	-	-	-	-	-	-	-	1
182	-	-	2	2	1	-	-	-	-	1	-	6	2	1	1	-	-	-	-
183	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
184	-	5	-	-	-	-	1	-	3	-	-	1	1	1	-	-	-	-	1
185	-	-	-	1	3	-	-	2	3	-	-	-	-	-	1	-	-	-	-
186	-	1	-	-	-	3	-	-	1	6	1	4	11	6	-	-	-	-	5
187	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
189	-	-	-	-	-	-	-	-	-	2	-	-	-	-	3	-	-	-	-
190	-	1	-	-	-	-	1	2	-	-	-	-	-	2	8	2	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
192	-	1	-	-	-	-	1	-	-	-	1	-	2	5	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	1	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	1
195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
196	-	-	-	-	-	-	-	-	-	1	-	-	2	6	-	-	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
202	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
211	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>n</i>		2	13	7	7	9	10	4	10	13	20	10	14	41	33	5	12		

^aIn leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

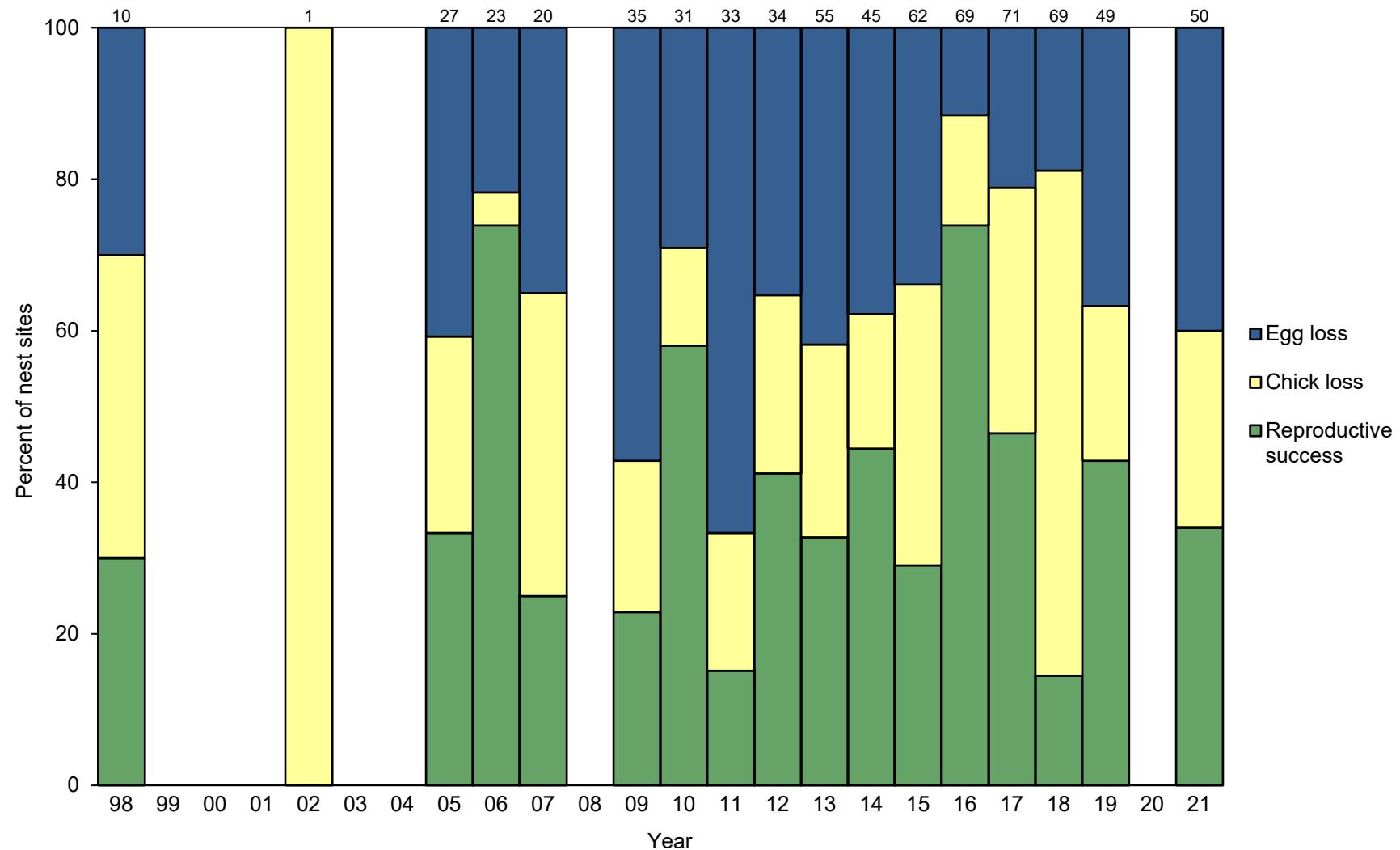


Figure 16. Reproductive performance of parakeet auklets at Chowiet Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (B). No data were collected in 1977-1997, 1999-2001, 2003-2004, 2008, or 2020; data potentially exist in 1976 but have not yet been summarized.

Table 24. Reproductive performance of parakeet auklets at Chowiet Island, Alaska. No data were collected in 1977-1997, 1999-2001, 2003-2004, 2008, or 2020.

Year	Nest sites w/ eggs	Nest sites w/ chicks	Nest sites w/ chicks fledged	Nesting success (D/B) ^a		Fledging success (F/D) ^b		Reproductive success (F/B)		Sampling design ^c
	(B)	(D)	(F)	Total	SD	Total	SD	Total	SD	
1976	7	5	xx ^d	0.71	0.17	xx	-	xx	-	Simple random
1998	10	7	3	0.70	0.14	0.43	0.19	0.30	0.14	Simple random
2002	1	1	0	1.00	0.00	0.00	0.00	0.00	0.00	Simple random
2005	27	16	9	0.59	0.09	0.56	0.12	0.33	0.09	Simple random
2006	23	18	17	0.78	0.09	0.94	0.06	0.74	0.09	Simple random
2007	20	13	5	0.65	0.11	0.38	0.13	0.25	0.10	Simple random
2009	35	15	8	0.43	0.08	0.53	0.13	0.23	0.07	Simple random
2010	31	22	18	0.71	0.08	0.82	0.08	0.58	0.09	Simple random
2011	33	11	5	0.33	0.08	0.45	0.15	0.15	0.06	Simple random
2012	34	22	14	0.65	0.08	0.64	0.10	0.41	0.08	Simple random
2013	55	32	18	0.58	0.07	0.56	0.09	0.33	0.06	Simple random
2014	45	28	20	0.62	0.07	0.71	0.09	0.44	0.07	Simple random
2015	62	41	18	0.66	0.06	0.44	0.08	0.29	0.06	Simple random
2016	69	61	51	0.88	0.04	0.84	0.05	0.74	0.05	Simple random
2017	71	56	33	0.79	0.05	0.59	0.07	0.46	0.06	Simple random
2018	69	56	10	0.81	0.05	0.18	0.05	0.14	0.04	Simple random
2019	49	31	21	0.63	0.07	0.68	0.08	0.43	0.07	Simple random
2021	50	30	17	0.60	0.07	0.57	0.09	0.34	0.07	Simple random

^aFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^bFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^cSampling for auklets is based on nests as the sample unit. For simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

^dxx indicates data potentially exist but have not yet been summarized.

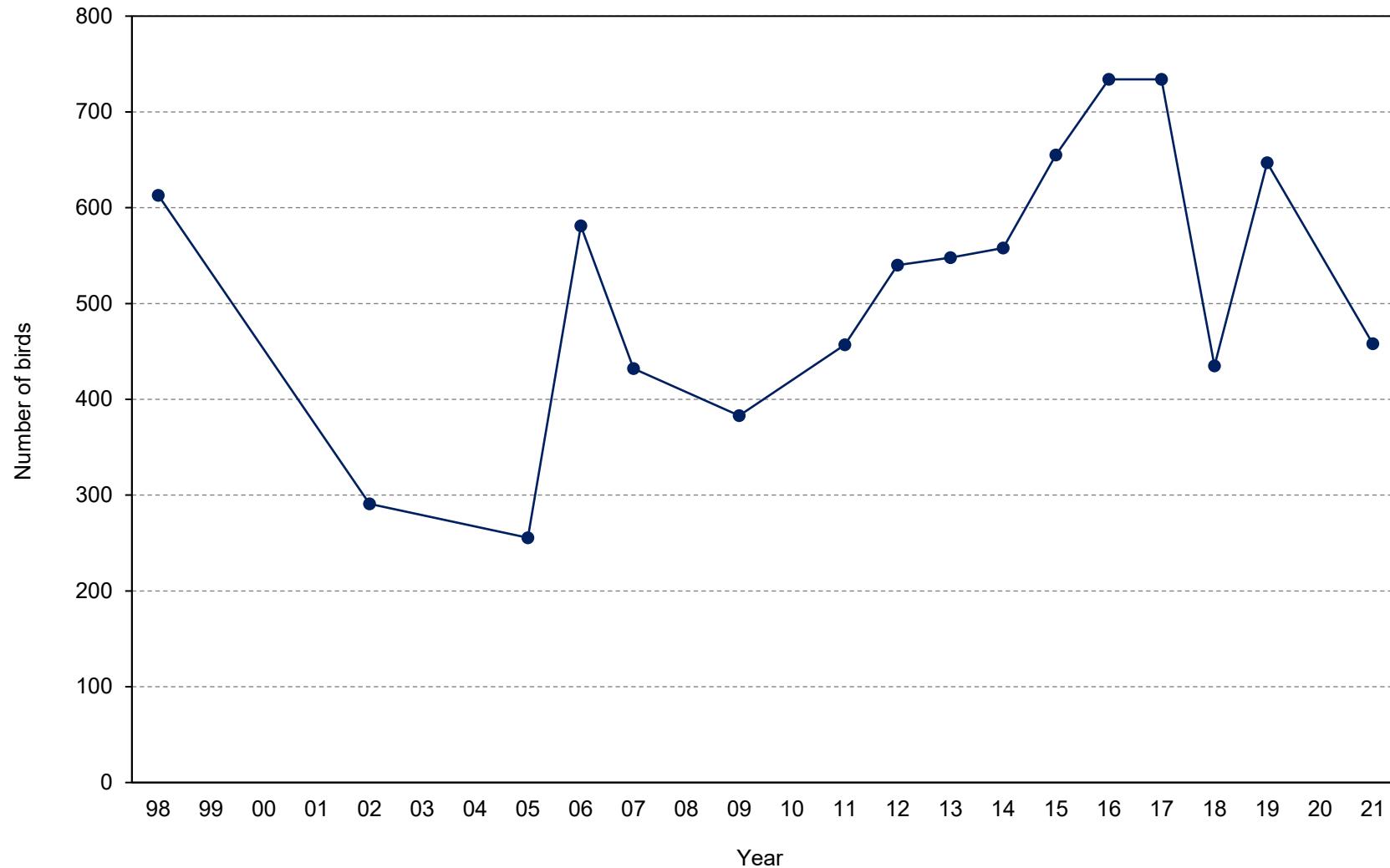


Figure 17. Maximum numbers of parakeet auklets counted on a water index plot at Chowiet Island, Alaska. Data include only counts conducted from 1 June to 15 July (mid egg-laying through hatching) each year. No counts were conducted in 1978-1992, 1996-1997, 1999-2001, 2003-2004, 2008, 2010, or 2020; data potentially exist in 1977 and 1993-1995 but have not yet been summarized.

Table 25. Numbers of parakeet auklets counted on a water index plot at Chowiet Island, Alaska. Data include only counts conducted from 1 June to 15 July (mid egg-laying through hatching) each year. No counts were conducted in 1978-1992, 1996-1997, 1999-2001, 2003-2004, 2008, 2010, or 2020.

Replicate	1977	1993	1994	1995	1998	2002	2005	2006	2007	2009	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
1	xx ^a	xx	xx	xx	299	138	245	293	137	264	194	208	276	186	397	687	111	82	153	50
2	xx	xx	xx	xx	342	231	221	243	212	383	167	167	278	328	264	535	405	142	191	128
3	xx	xx	xx	xx	417	228	241	111	287	342	313	407	190	360	262	677	362	269	119	109
4	xx	xx	xx	xx	613	134	119	267	211	349	412	467	176	558	267	587	734	435	95	199
5	xx	xx	xx	xx	613	274	131	269	133	266	352	262	176	251	269	395	371	286	215	217
6	xx	xx	xx	xx	427	126	137	194	187	274	457	159	273	223	404	496	491	361	647	218
7	xx	xx	xx	xx	270	291	256	292	216	364	217	67	376	226	655	392	660	234	419	366
8	xx	xx	xx	xx	356	240	144	290	292	310	321	287	548	349	385	637	340	94	351	159
9	xx	xx	xx	xx	314	-	205	388	401	175	-	540	510	235	466	734	532	297	216	138
10	xx	xx	xx	xx	-	-	-	560	199	259	-	283	346	472	116	469	275	67	598	161
11	xx	xx	xx	xx	-	-	-	306	432	262	-	-	359	478	-	-	244	-	583	458
12	xx	xx	xx	xx	-	-	-	376	375	205	-	-	354	-	-	-	499	-	315	-
13	xx	xx	xx	xx	-	-	-	581	67	135	-	-	269	-	-	-	-	-	-	-
14	xx	xx	xx	xx	-	-	-	-	133	-	-	-	-	-	-	-	-	-	-	-
Mean	xx	xx	xx	xx	406	208	189	321	234	276	304	285	318	333	349	561	419	227	325	200
Max.	xx	xx	xx	xx	613	291	256	581	432	383	457	540	548	558	655	734	734	435	647	458
<i>n</i>	xx	xx	xx	xx	9	8	9	13	14	13	8	10	13	11	10	10	12	10	12	11
SD	xx	xx	xx	xx	128	66	55	131	109	74	104	148	116	124	148	123	176	126	196	117
First count	xx	xx	xx	xx	3 Jun	4 Jun	4 Jun	1 Jun	1 Jun	2 Jun	5 Jun	5 Jun	5 Jun	2 Jun	2 Jun	2 Jun	2 Jun	3 Jun	1 Jun	2 Jun
Last count	xx	xx	xx	xx	13 Jul	11 Jul	14 Jul	12 Jul	11 Jul	11 Jul	8 Jul	4 Jul	14 Jul	27 Jun	22 Jun	20 Jun	19 Jun	13 Jul	29 Jun	6 Jul
Count protocol ^b	A	A	A	A	B	B	C	D	C	C	E	E	E	E	E	E	E	E	E	E

^axx indicates data potentially exist but have not yet been summarized.

^bA=all replicates represent single count per day, all between 0700-0930h; B=all replicates represent single count per day, all between 0730h-0930h; C=all replicates represent the mean of two or more counts per day within 5%, all between 0730-0930h; D=some replicates represent single count per day, some represent the mean of two counts per day within 5%, all between 0730-0930h. E=all replicates represent the mean of two or more counts per day within 5%, all between 0700-0930.

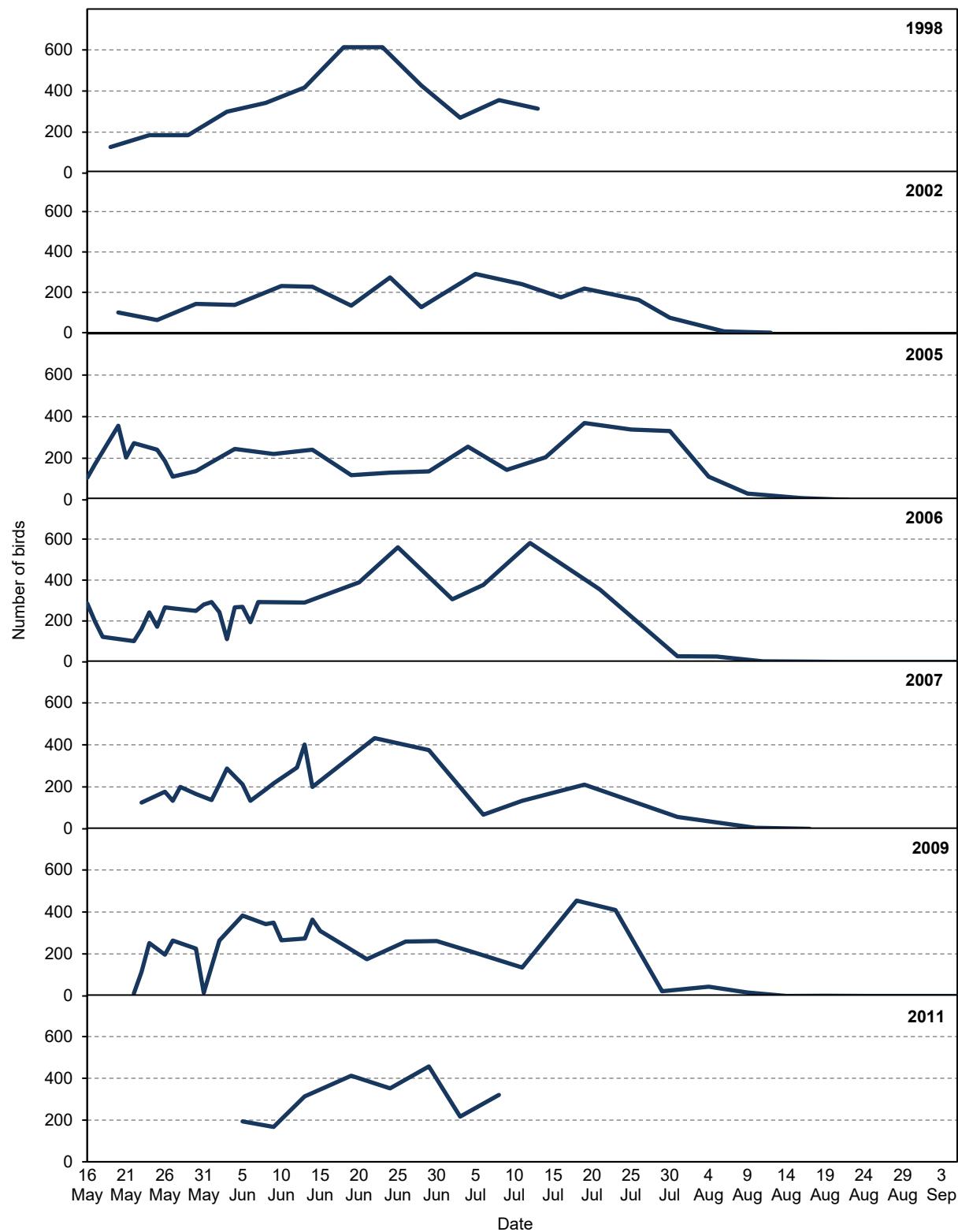


Figure 18. Numbers of parakeet auklets counted on a water index plot at Chowiet Island, Alaska. Starting in 2011, counts were conducted only during the period in the breeding season with lowest day-to-day variability; thus fewer counts during a smaller count window were conducted. No counts were conducted in 1999-2001, 2003-2004, 2008, 2010, or 2020.

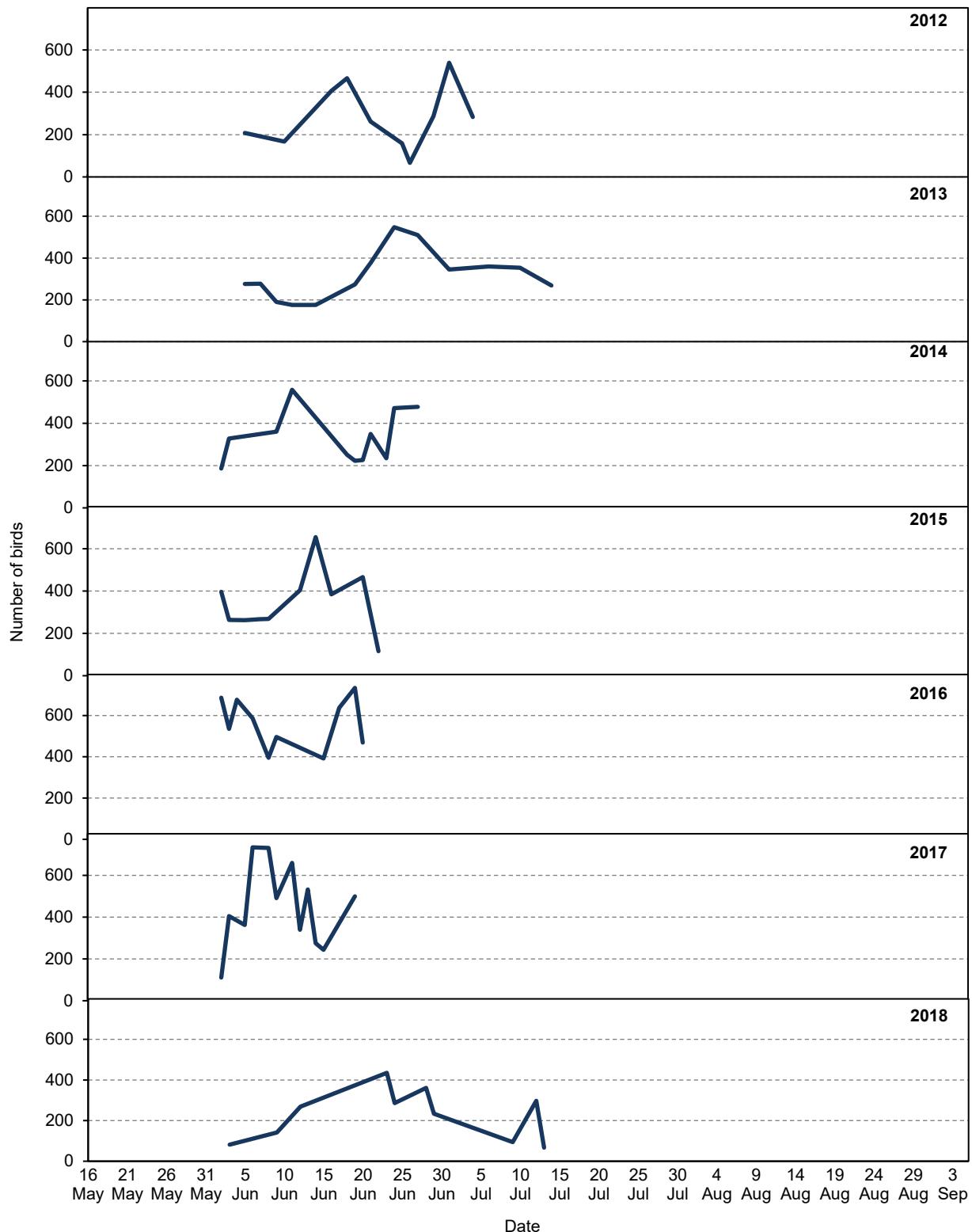


Figure 18 (continued). Numbers of parakeet auklets counted on a water index plot at Chowiet Island, Alaska. Starting in 2011, counts were conducted only during the period in the breeding season with lowest day-to-day variability; thus fewer counts during a smaller count window were conducted. No counts were conducted in 1999-2001, 2003-2004, 2008, 2010, or 2020.

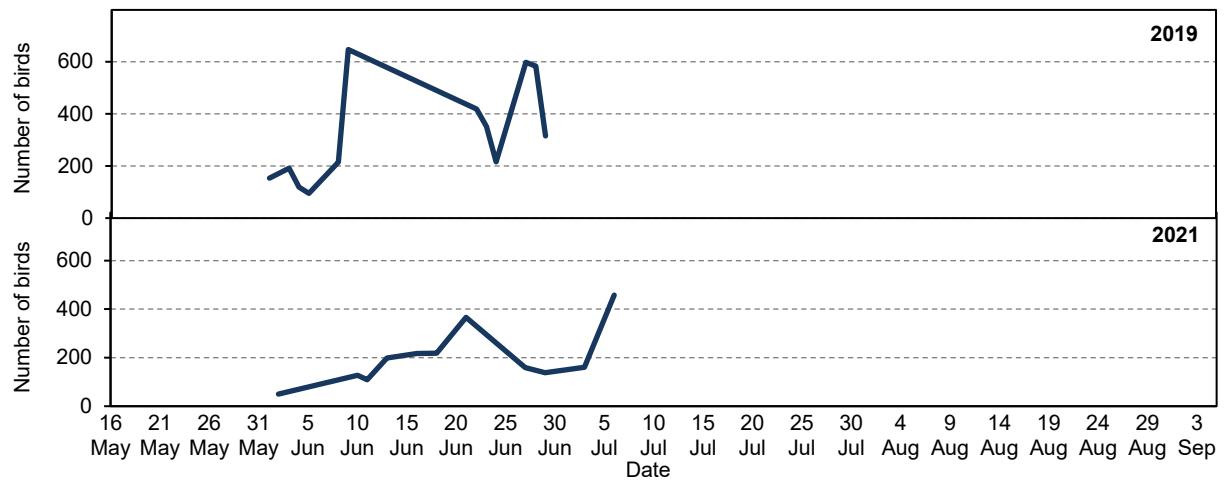


Figure 18 (continued). Numbers of parakeet auklets counted on a water index plot at Chowiet Island, Alaska. Starting in 2011, counts were conducted only during the period in the breeding season with lowest day-to-day variability; thus fewer counts during a smaller count window were conducted. No counts were conducted in 1999-2001, 2003-2004, 2008, 2010, or 2020.

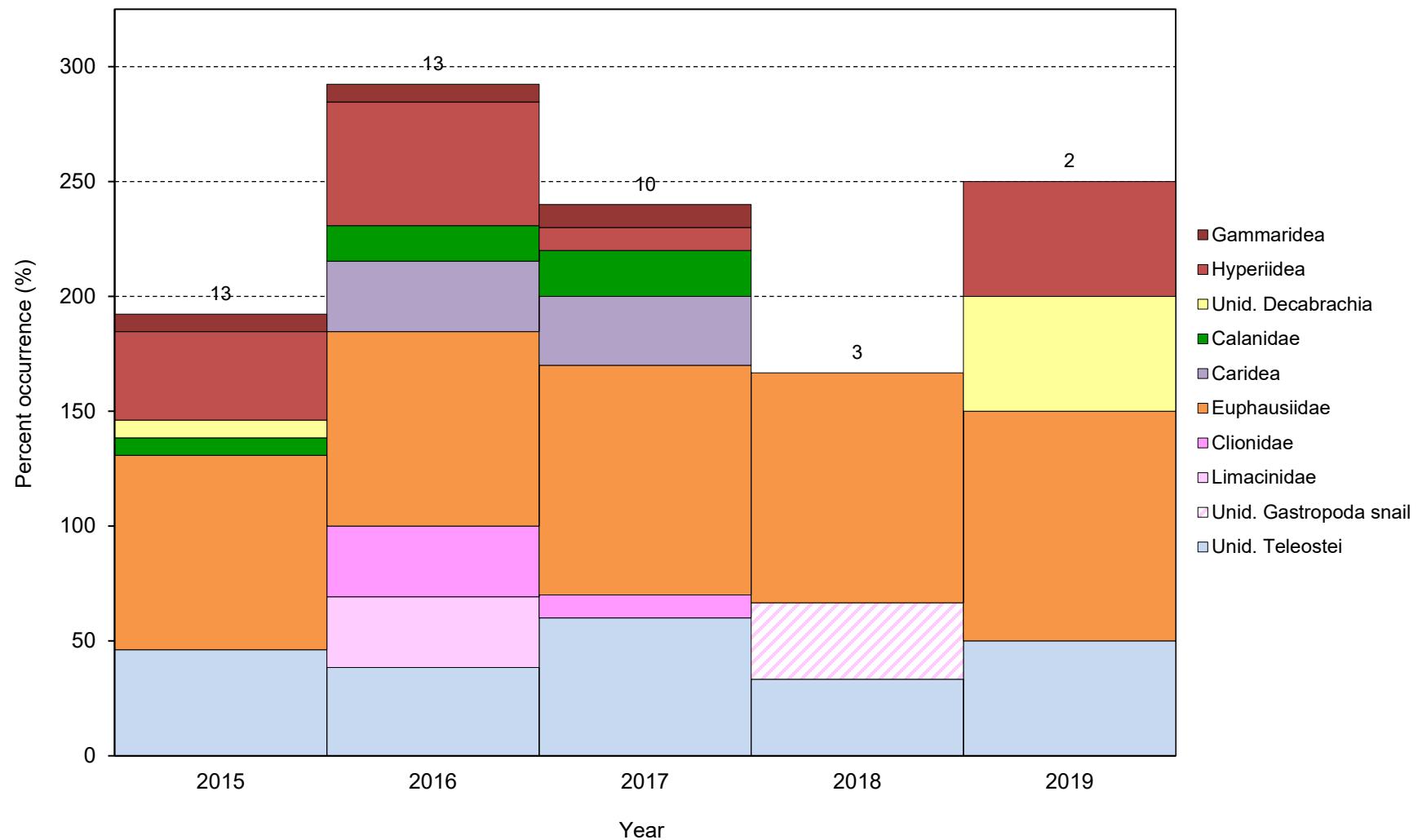


Figure 19. Frequency of occurrence of major prey items in diets of parakeet auklet chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of regurgitations collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 2020; samples were collected in 2021 but have not yet been analyzed.

Table 26. Frequency of occurrence of major prey items in diets of parakeet auklet chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks. No diet samples were collected in 2020; samples were collected in 2021 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2015	2016	2017	2018	2019	2021
No. samples	13	13	10	3	2	8
Invertebrates	100.0	100.0	100.0	100.0	100.0	<i>pending</i>
Amphipoda	46.2	61.5	20.0	-	-	-
Gammaridea	7.7	7.7	10.0	-	-	-
Hyperiidea	38.5	53.8	10.0	-	50.0	-
<i>Hyperia medusarum</i>	30.8	53.8	-	-	50.0	-
Other Hyperiidea	7.7	-	10.0	-	-	-
Cephalopoda	7.7	7.7	-	-	50.0	-
Unid. Decabrachia	7.7	-	-	-	50.0	-
Other Cephalopoda	-	7.7	-	-	-	-
Copepoda	7.7	15.4	20.0	-	-	-
Calanidae	7.7	15.4	20.0	-	-	-
<i>Neocalanus cristatus</i>	7.7	7.7	10.0	-	-	-
Other Calanidae	-	7.7	10.0	-	-	-
Other Copepoda	-	-	10.0	-	-	-
Decapoda	-	38.5	30.0	-	-	-
Caridea	-	30.8	30.0	-	-	-
Pandalidae	-	23.1	30.0	-	-	-
Other Caridea	-	7.7	-	-	-	-
Other Decapoda	-	15.4	-	-	-	-
Euphausiacea	84.6	84.6	100.0	100.0	100.0	-
Euphausiidae	84.6	84.6	100.0	100.0	100.0	-
<i>Euphausia pacifica</i>	7.7	-	20.0	-	-	-
<i>Thysanoessa inermis</i>	53.8	53.8	100.0	66.7	100.0	-
<i>T. spinifera</i>	-	-	-	-	50.0	-
<i>T. spinifera</i>	46.2	46.2	100.0	33.3	100.0	-
<i>Thysanoessa</i> spp.	23.1	46.2	10.0	33.3	50.0	-
Unid. Euphausiidae	23.1	7.7	20.0	100.0	100.0	-
Other Euphausiidae	-	-	10.0	-	-	-
Gastropoda	-	46.2	10.0	33.3	-	-
Clionidae	-	30.8	10.0	-	-	-
<i>Clione</i> spp.	-	23.1	10.0	-	-	-
Other Clionidae	-	7.7	-	-	-	-
Limacinidae	-	30.8	-	-	-	-
<i>Limacina helicina</i>	-	30.8	-	-	-	-
Unid. Gastropoda snail	-	-	-	33.3	-	-
Other Invertebrates	7.7	7.7	-	-	-	-
Fish	46.2	38.5	60.0	33.3	50.0	-
Teleostei	46.2	38.5	60.0	33.3	50.0	-
Unid. Teleostei	46.2	38.5	60.0	33.3	50.0	-

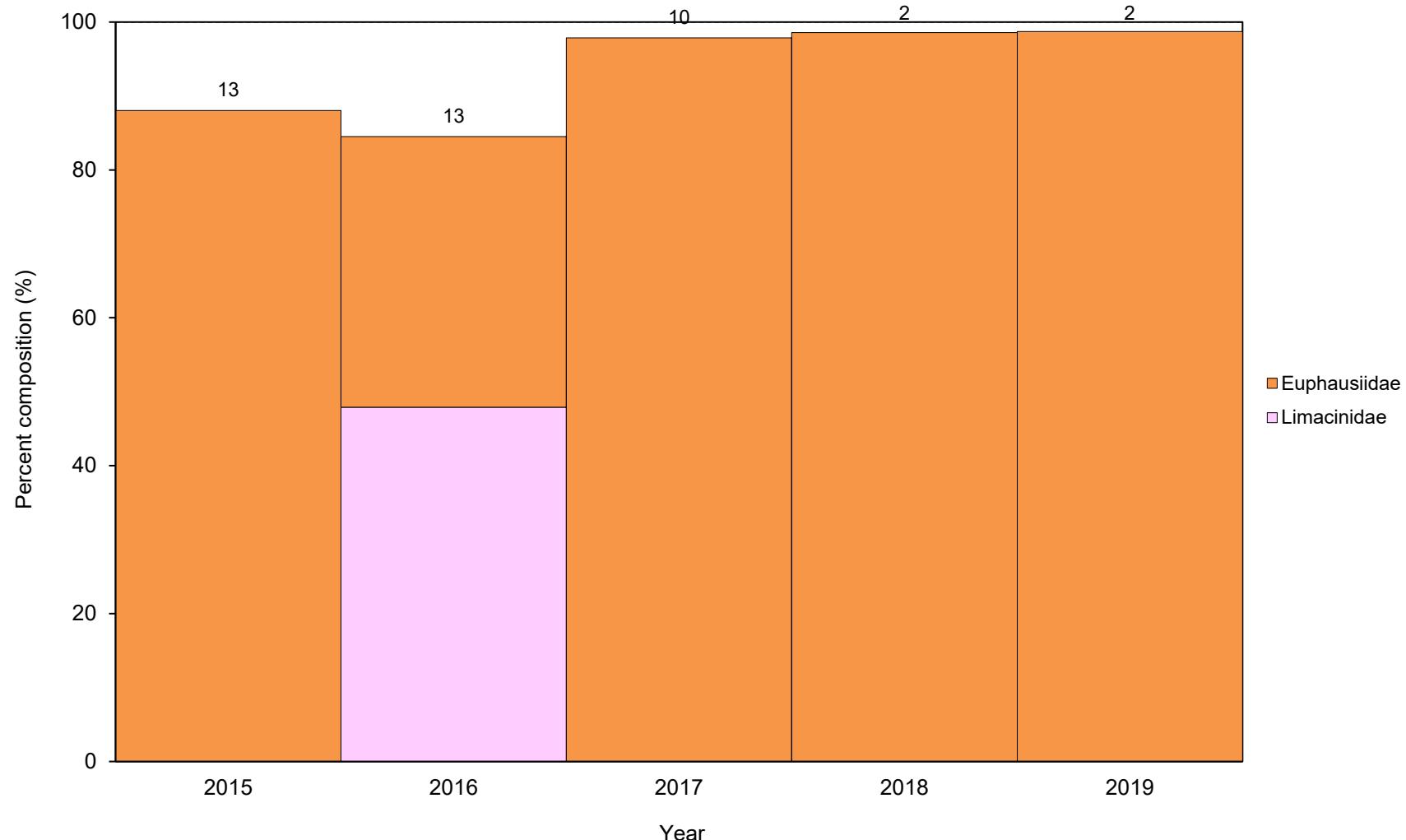


Figure 20. Percent composition of major prey items in diets of parakeet auklet chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of regurgitations collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 2020; samples were collected in 2021 but have not yet been analyzed.

Table 27. Percent composition of major prey items in diets of parakeet auklet chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. No diet samples were collected in 2020; samples were collected in 2021 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2015	2016	2017	2018	2019	2021
No. samples	13	13	10	2	2	8
No. individuals	526	879	1210	142	313	pending
Invertebrates	97.3	98.3	99.4	99.3	99.7	-
Euphausiacea	88.0	36.6	97.9	98.6	98.7	-
Euphausiidae	88.0	36.6	97.9	98.6	98.7	-
<i>Thysanoessa inermis</i>	54.4	16.5	81.2	57.7	63.9	-
<i>T. spinifera</i>	26.4	12.5	14.0	4.9	22.0	-
<i>Thysanoessa</i> spp.	4.6	5.6	1.5	28.2	2.2	-
Other Euphausiidae	2.7	2.0	1.2	7.7	0.3	-
Gastropoda	-	51.8	0.4	0.7	-	-
Limacinidae	-	47.9	-	-	-	-
<i>Limacina helicina</i>	-	47.9	-	-	-	-
Other Gastropoda	-	3.9	0.4	0.7	-	-
Other Invertebrates	9.3	9.9	1.2	-	1.0	-
Fish	2.7	1.7	0.6	0.7	0.3	-

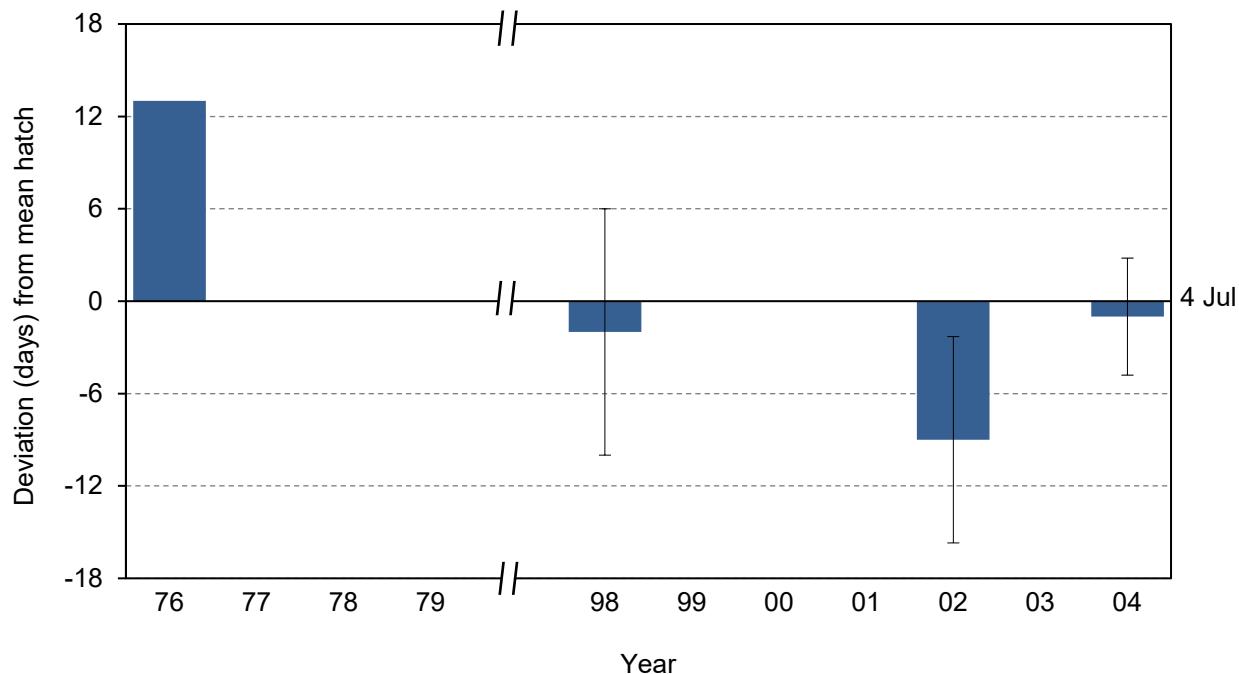


Figure 21. Yearly hatch date deviation (from the 1976-2004 average of 4 July) for rhinoceros auklets at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date. No data were collected in 1978, 1980-1997, 1999-2001, or 2003; data potentially exist in 1977 and 1979 but have not yet been summarized. Monitoring has not occurred since 2004 due to concerns about erosion and investigator disturbance at the South Bay colony.

Table 28. Breeding chronology of rhinoceros auklets at Chowiet Island, Alaska. No data were collected in 1978, 1980-1997, 1999-2001, or 2003. Monitoring has not occurred since 2004 (except limited fledge data in 2010) due to concerns about erosion and investigator disturbance at the South Bay colony.

Year	Mean hatch	SD	n ^a	First hatch	Last hatch	First fledge
1976	16 Jul	xx ^b	xx	xx	xx	19 Aug
1977	xx	xx	xx	xx	xx	xx
1979	xx	xx	xx	xx	xx	xx
1998	2 Jul	8.x	24	xx	xx	xx
2002	26 Jun	7.x	14	16 Jun	6 Jul	1 Aug
2004	2 Jul	4.x	13	28 Jun	8 Jul	-
2010	-	-	-	-	-	14 Aug

^aSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

^bxx indicates data potentially exist but have not yet been summarized.

Table 29. Frequency distribution of hatch dates for rhinoceros auklets at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1978, 1980-1997, 1999-2001, or 2003. Monitoring has not occurred since 2004 due to concerns about erosion and investigator disturbance at the South Bay colony.

Julian date ^a	No. nests hatching on Julian date					
	76	77	79	98	02	04
167	xx ^b	xx	xx	xx	1	-
168	xx	xx	xx	xx	-	-
169	xx	xx	xx	xx	1	-
170	xx	xx	xx	xx	2	-
171	xx	xx	xx	xx	-	-
172	xx	xx	xx	xx	1	-
173	xx	xx	xx	xx	-	-
174	xx	xx	xx	xx	1	-
175	xx	xx	xx	xx	1	-
176	xx	xx	xx	xx	1	-
177	xx	xx	xx	xx	1	-
178	xx	xx	xx	xx	-	-
179	xx	xx	xx	xx	-	-
180	xx	xx	xx	xx	1	5
181	xx	xx	xx	xx	-	-
182	xx	xx	xx	xx	-	-
183	xx	xx	xx	xx	1	-
184	xx	xx	xx	xx	1	-
185	xx	xx	xx	xx	-	5
186	xx	xx	xx	xx	-	-
187	xx	xx	xx	xx	2	-
188	xx	xx	xx	xx	-	-
189	xx	xx	xx	xx	-	-
190	xx	xx	xx	xx	-	3
191	xx	xx	xx	xx	-	-
192	xx	xx	xx	xx	-	-
193	xx	xx	xx	xx	-	-
194	xx	xx	xx	xx	-	-
195	xx	xx	xx	xx	-	-
196	xx	xx	xx	xx	-	-
197	xx	xx	xx	xx	-	-
198	xx	xx	xx	xx	-	-
199	xx	xx	xx	xx	-	-
200	xx	xx	xx	xx	-	-
201	xx	xx	xx	xx	-	-
<i>n</i>	xx	xx	xx	24	14	13

^aIn leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

^bxx indicates data potentially exist but have not yet been summarized.

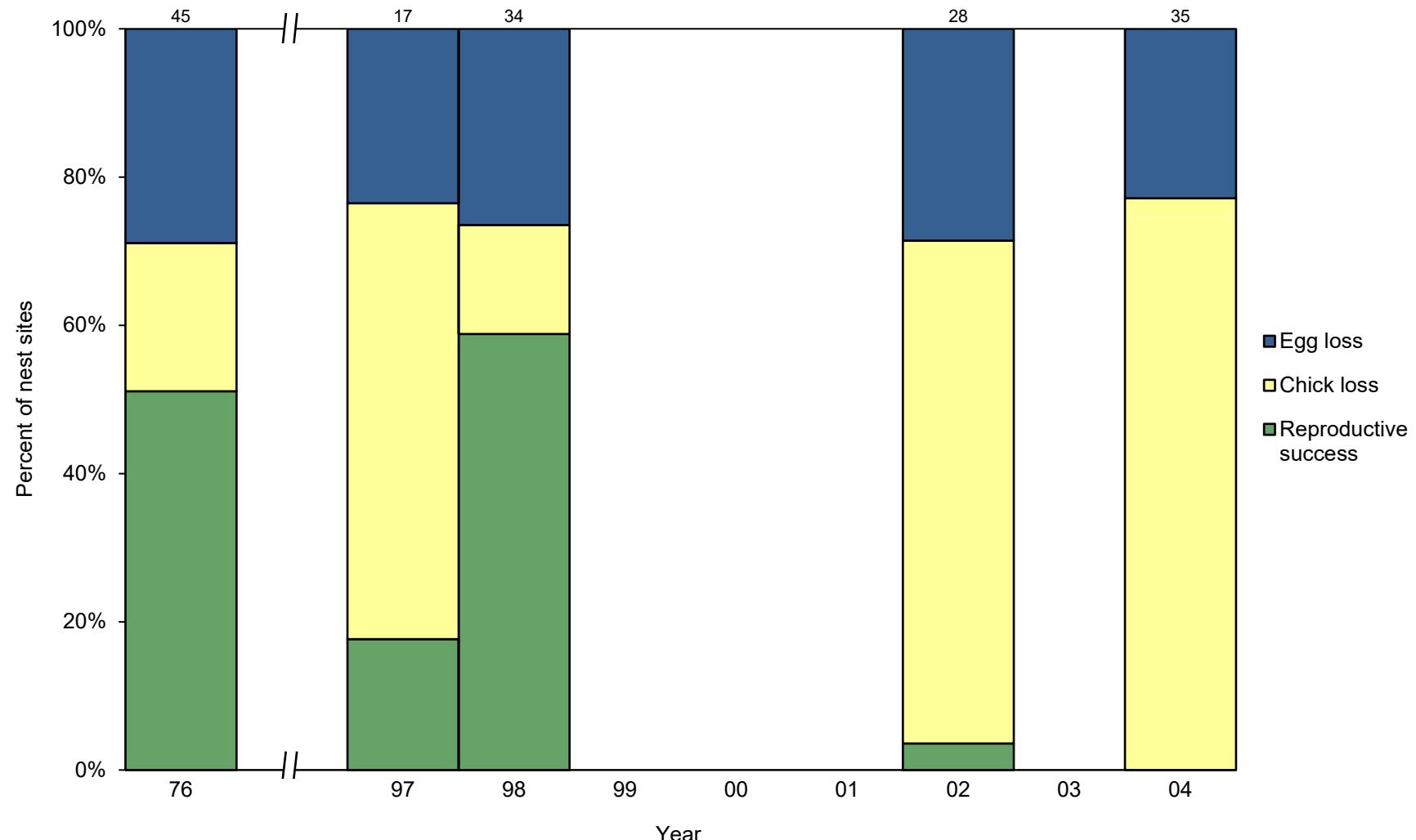


Figure 22. Reproductive performance of rhinoceros auklets at Chowiet Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (B). No data were collected in 1978, 1980-1996, 1999-2001, or 2003; data potentially exist in 1977 and 1979 but have not yet been summarized. Monitoring has not occurred since 2004 due to concerns about erosion and investigator disturbance at the South Bay colony. Some data exist in 2010 but only after chicks hatched so values are not comparable to those from previous years.

Table 30. Reproductive performance of rhinoceros auklets at Choviet Island, Alaska. No data were collected in 1978, 1980-1996, 1999-2001, or 2003. Monitoring has not occurred since 2004 due to concerns about erosion and investigator disturbance at the South Bay colony. Some data exist in 2010 but only after chicks hatched, so values are not comparable to those from previous years (see Konyukhov 2011 for details).

Year	Nest sites w/ eggs	Nest sites w/ chicks	Nest sites w/ chicks fledged	Nesting success (D/B) ^a		Fledging success (F/D) ^b		Reproductive success (F/B)		Sampling design ^c
	(B)	(D)	(F)	Total	SD	Total	SD	Total	SD	
1976	45	32	23	0.71	0.07	0.72	0.08	0.51	0.07	Simple random
1977	xx ^d	xx	xx	xx	-	xx	-	xx	-	Simple random
1979	xx	xx	xx	xx	-	xx	-	xx	-	Simple random
1997	17	13	3	0.76	0.10	0.23	0.12	0.18	0.09	Simple random
1998	34	25	20	0.74	0.08	0.80	0.08	0.59	0.08	Simple random
2002	28	20	1	0.71	0.09	0.05	0.05	0.04	0.04	Simple random
2004	35	27	0	0.77	0.07	0.00	0.00	0.00	0.00	Simple random

^aFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^bFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^cSampling for rhinoceros auklets is based on nests as the sample unit. For simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

^dxx indicates data potentially exist but have not yet been summarized.

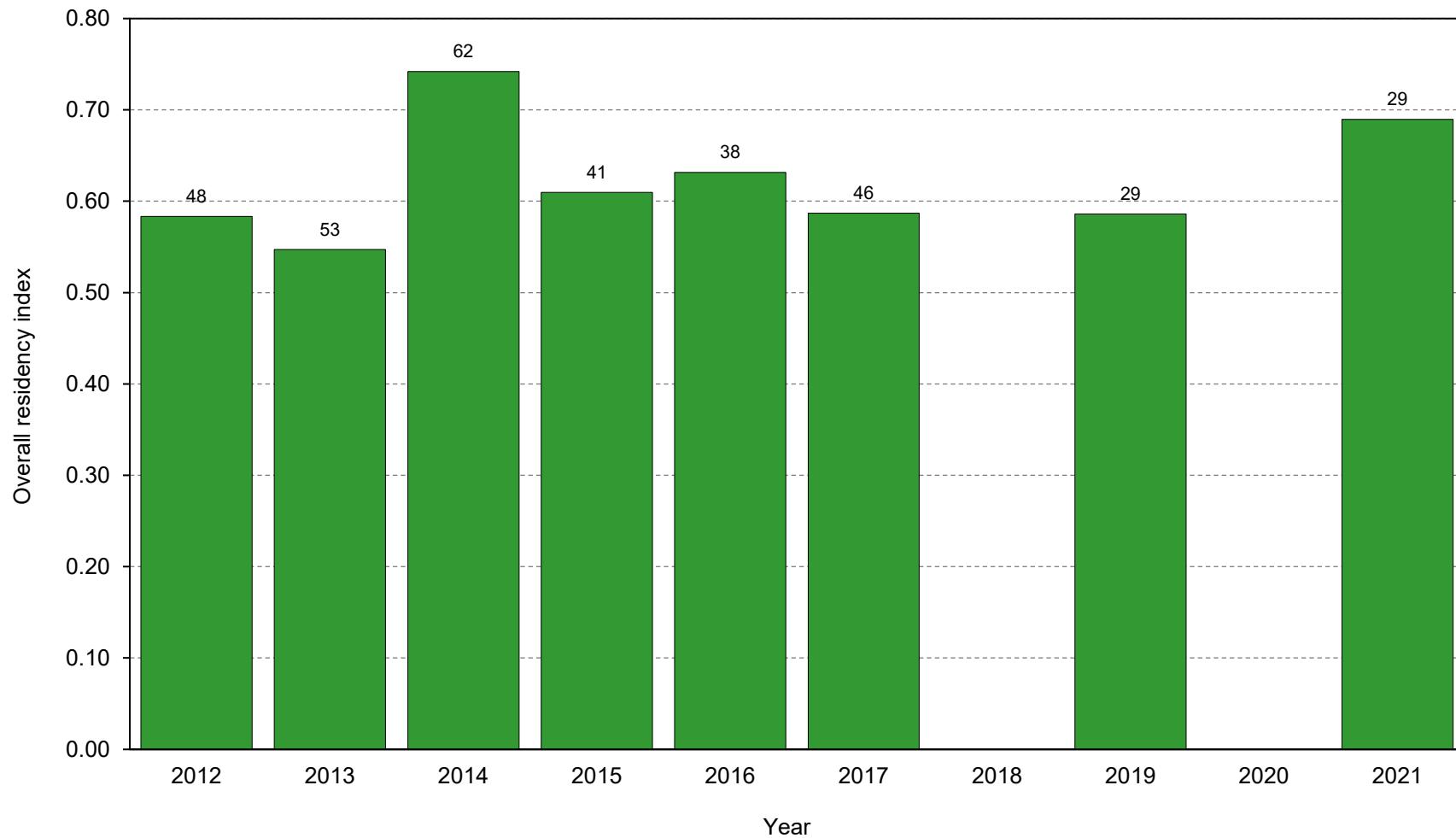


Figure 23. Residency indices of rhinoceros auklets at Chowiet Island, Alaska. Residency indices are considered surrogates for measures of reproductive performance when actual nest contents cannot be observed. Overall residency index= f/b , where b =nests with evidence of apparent occupancy early in the season (representing eggs) and f =nests with evidence of apparent occupancy late in the season (representing large chicks/potential fledglings). Numbers above columns indicate sample sizes (b). The residency index includes a sub-set of active nests (those found active during the early visit) and may not equal values of active nests reported in apparent occupancy rates. No data were collected in 2020; data are not presented for 2018 due to methodology concerns.

Table 31. Residency indices of rhinoceros auklets at Chowiet Island, Alaska. Residency indices are considered surrogates for measures of reproductive performance when actual nest contents cannot be observed, based on the assumption that evidence of apparent occupancy during early and late periods in the breeding season represent the presence of eggs and large chicks/potential fledglings, respectively. Surveys are conducted around hatching (late June to mid-July) and late in chick-rearing (late July to mid-August). Evidence of apparent occupancy includes observations of feathers, droppings, prey, eggs, eggshell fragments, or chicks in the burrow. The residency index is calculated using only the subset of nests occupied on the first visit and thus may not equal values reported in apparent occupancy rates (Tables 31-32). No data were collected in 2020; data are not presented for 2018 due to methodology concerns.

Year	Medium/large (≥ 9.5 cm) burrows ^a with apparent occupancy		Overall residency index ^b (f/b)
	Early (b)	Late (f)	
2012	48	28	0.58
2013	53	29	0.55
2014	62	46	0.74
2015	41	25	0.61
2016	38	24	0.63
2017	46	27	0.59
2019	29	17	0.59
2021	29	20	0.69

^aBy definition, burrows must be ≥ 30 cm in length.

^bOverall residency index (f/b) is a surrogate for reproductive success (F/B).

Table 32. Residency indices of rhinoceros auklets at Chowiet Island, Alaska in 2021. Residency indices are considered surrogates for measures of reproductive performance when actual nest contents cannot be observed, based on the assumption that evidence of apparent occupancy during early and late periods in the breeding season represent the presence of eggs and large chicks/potential fledglings, respectively. Surveys are conducted around hatching (late June to mid-July) and late in chick-rearing (late July to mid-August). Evidence of apparent occupancy includes observations of feathers, droppings, prey, eggs, eggshell fragments, or chicks in the burrow. The residency index is calculated using only the subset of nests occupied on the first visit and thus may not equal values reported in apparent occupancy rates (Tables 31-32).

Parameter	South Bay Plots			Spruce Cove Plots			Total	Mean	SD
	1	2	3	4	5	6			
Medium/large (≥ 9.5 cm) burrows ^a with apparent occupancy									
Early (b)	14	7	2	2	3	1	29	-	-
Late (f)	9	5	2	2	1	1	20	-	-
Overall residency index (f/b) ^b	0.64	0.71	1.00	1.00	0.33	1.00	0.69	0.78	0.27
Survey dates									
Early	21 May	21 May	21 May	22 May	22 May	22 May	-	-	-
Late	20 Aug	20 Aug	20 Aug	19 Aug	19 Aug	19 Aug	-	-	-

^aBy definition, burrows must be ≥ 30 cm in length.

^bOverall residency index (f/b) is a surrogate for reproductive success (F/B).

Table 33. Mean growth rates of rhinoceros auklet chicks at Chowiet Island, Alaska. Data include chicks measured at least three times during the linear phase of growth (defined as chick age 10-40 days; Leschner and Burrell 1977). No data exist in 1996-1997, 1999-2001, or 2003. No chicks have been measured since 2004 due to limited availability of accessible chicks and concerns about balancing the importance of chick growth data with the disturbance caused by data collection.

Year	Mass (g/day)				Wing chord (mm/day)			
	Mean	SD	Range	n	Mean	SD	Range	n
1995	xx ^a	xx	xx-xx	xx	xx	xx	xx-xx	xx
1998	xx	xx	xx-xx	xx	xx	xx	xx-xx	xx
2002	6.9	0.6	xx-xx	23	-	-	-	-
2004	5.9	2.1	4.4-7.4	2	3.6	0.1	3.5-3.7	2

^axx indicates data potentially exist but have not yet been summarized.

Table 34. Numbers of rhinoceros auklet burrows counted during censuses at Chowiet Island, Alaska. No counts were conducted in 1978, 1980-1992, 2004, 2008, or after 2012.

Colony	1976	1977	1979	1993	1998	2003	2005	2006	2007	2009	2010 ^a	2011	2012
Spruce Cove													
Sub-colony A	57	xx ^b	xx	-	-	-	293	64	113	78	81	46	146
Sub-colony B	-	xx	xx	-	-	-	408	-	233	130	88	197	221
Sub-colony C	285	xx	xx	430	-	-	178	86	91	125	95	83	109
Total	342	xx	xx	430	782	997	879	150	437	333	264	326	476
Landing Cove	45	xx	xx	116	204	112	33	7	19	9	10	27	43
South Bay													
Sub-colony 1	-	xx	xx	-	-	-	-	89	68	58	110	72	133
Sub-colony 2	-	xx	xx	-	-	-	-	42	54	44	35	47	49
Sub-colony 3	-	xx	xx	-	-	-	-	73	39	67	61	80	113
Sub-colony 4	-	xx	xx	-	-	-	-	18	44	25	23	53	35
Sub-colony 5	-	xx	xx	-	-	-	-	45	100	81	57	29	78
Total	179	xx	xx	531	565	830	375	267	305	275	286	281	408
South East Colony	-	-	-	-	-	-	-	-	-	18	-	-	-
Island-wide total	566	xx	xx	>1077	1551	1939	1287	>424	779	617	560	634	927

^aIn 2010 the count was conducted in August, thus likely not directly comparable to other years when the protocol has been to conduct the count in late May to mid-June.

^bxx indicates data potentially exist but have not yet been summarized.

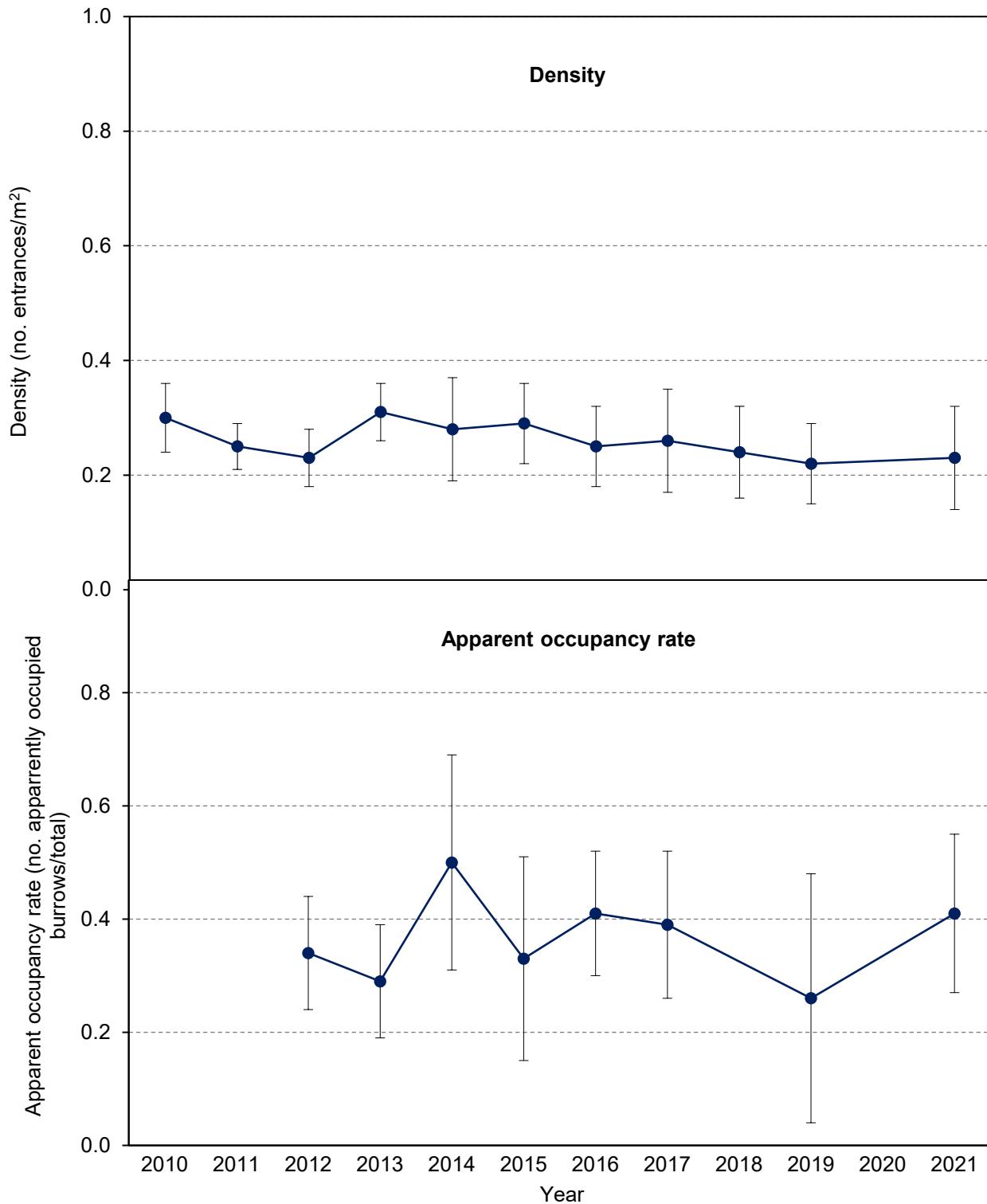


Figure 24. Burrow entrance densities and apparent occupancy rates of rhinoceros auklets on index plots at Chowiet Island, Alaska. No data were collected in 2020; apparent occupancy rates are not presented for 2010 and 2011 due to changes in methodology and for 2018 due to methodology concerns.

Table 35. Burrow entrance densities and apparent occupancy rates of rhinoceros auklets on index plots at Chowiet Island, Alaska. Density is expressed as the number of medium-large (≥ 9.5 cm) burrow entrances per m^2 and potentially includes burrows belonging to arctic ground squirrels. Apparent occupancy rate is expressed as the proportion of medium-large (≥ 9.5 cm) burrows with evidence of apparent occupancy late in the nesting period. Evidence of apparent occupancy includes observations of feathers, droppings, fresh vegetation, eggs, eggshell fragments, or chicks in the burrow. Density is assessed in late May or early June, before laying, whereas apparent occupancy rate is assessed in mid to late August, towards the end of the chick-rearing period. The number of burrows used to calculate apparent occupancy rate is not necessarily the same as those presented for density because not all nests counted during density surveys are refound later in the season, and some nests are excluded from apparent occupancy rate analysis (e.g., undetermined apparent occupancy statuses). No data were collected in 2020.

Year	South Bay Plots			Spruce Cove Plots			Total	Mean	SD
	1	2	3	4	5	6			
Density									
2010	0.35	0.32	0.23	-	-	-	-	0.30	0.06
2011	0.28	0.27	0.20	-	-	-	-	0.25	0.04
2012	0.32	0.19	0.19	0.18	0.27	0.22	0.23	0.23	0.05
2013	0.33	0.30	0.24	0.30	0.41	0.29	0.31	0.31	0.05
2014	0.39	0.24	0.15	0.22	0.37	0.32	0.28	0.28	0.09
2015	0.34	0.24	0.22	0.28	0.41	0.27	0.29	0.29	0.07
2016	0.32	0.22	0.15	0.29	0.32	0.18	0.25	0.25	0.07
2017	0.37	0.22	0.14	0.28	0.34	0.22	0.26	0.26	0.09
2018	0.28	0.20	0.11	0.24	0.34	0.24	0.24	0.24	0.08
2019	0.28	0.19	0.11	0.24	0.30	0.20	0.22	0.22	0.07
2021	0.34	0.19	0.11	0.24	0.34	0.17	0.23	0.23	0.09
Plot area (m^2)	78.8	78.8	78.8	78.8	78.8	78.8	472.5	-	-
Apparent occupancy rate									
2010 ^a	-	-	-	-	-	-	-	-	-
2011 ^a	-	-	-	-	-	-	-	-	-
2012	0.35	0.31	0.33	0.50	0.20	0.35	0.33	0.34	0.10
2013	0.33	0.31	0.33	0.41	0.31	0.22	0.29	0.29	0.10
2014	0.48	0.44	0.46	0.87	0.38	0.36	0.48	0.50	0.19
2015	0.15	0.32	0.41	0.59	0.13	0.43	0.31	0.34	0.18
2016	0.52	0.47	0.25	0.50	0.36	0.36	0.42	0.42	0.11
2017	0.21	0.29	0.55	0.32	0.48	0.47	0.37	0.39	0.13
2018 ^b	-	-	-	-	-	-	-	-	-
2019	0.55	0.40	0.00	0.21	0.04	0.38	0.28	0.26	0.22
2021	0.56	0.53	0.44	0.32	0.19	0.42	0.39	0.41	0.14

^aApparent occupancy rate methodology was standardized in 2012. Historical data (South Bay plots in 2010 and 2011) presented in previous reports has been removed given it is not comparable to current methods.

^bApparent occupancy rates for 2018 are not presented due to methodology concerns.

Table 36. Burrow entrance densities and apparent occupancy rates of rhinoceros auklets on index plots at Chowiet Island, Alaska in 2021. Density is expressed as the number of medium-large (≥ 9.5 cm) burrow entrances per m^2 and potentially includes burrows belonging to arctic ground squirrels. Apparent occupancy rate is expressed as the proportion of medium-large (≥ 9.5 cm) burrows with evidence of apparent occupancy late in the nesting period. Evidence of apparent occupancy includes observations of feathers, droppings, fresh vegetation, eggs, eggshell fragments, or chicks in the burrow. Density is assessed in late May or early June, before laying, whereas apparent occupancy rate is assessed in mid to late August, towards the end of the chick-rearing period. The number of burrows used to calculate apparent occupancy rate is not necessarily the same as those presented for density because not all nests counted during density surveys are refound later in the season, and some nests are excluded from apparent occupancy rate analysis (e.g., nests with storm-petrels and undetermined apparent occupancy statuses).

Parameter	South Bay Plots			Spruce Cove Plots			Total	Mean	SD
	1	2	3	4	5	6			
Density									
Number of medium-large (≥ 9.5 cm) burrow entrances	27	15	9	19	27	13	110	-	-
Plot area (m^2)	78.8	78.8	78.8	78.8	78.8	78.8	472.5	-	-
Density of medium-large burrows	0.34	0.19	0.11	0.24	0.34	0.17	0.23	0.23	0.09
Survey date	21 May	21 May	21 May	22 May	22 May	22 May	-	-	-
Apparent occupancy rate^a									
Medium-large (≥ 9.5 cm) burrows w/ apparent occupancy	15	8	4	6	5	5	43	-	-
Total medium-large (≥ 9.5 cm) burrows	27	15	9	19	27	12	109	-	-
Apparent occupancy rate of medium-large burrows	0.56	0.53	0.44	0.32	0.19	0.42	0.39	0.41	0.14
Survey date	20 Aug	20 Aug	20 Aug	19 Aug	19 Aug	19 Aug	-	-	-

^aApparent occupancy rates for 2018 are not presented due to methodology concerns.

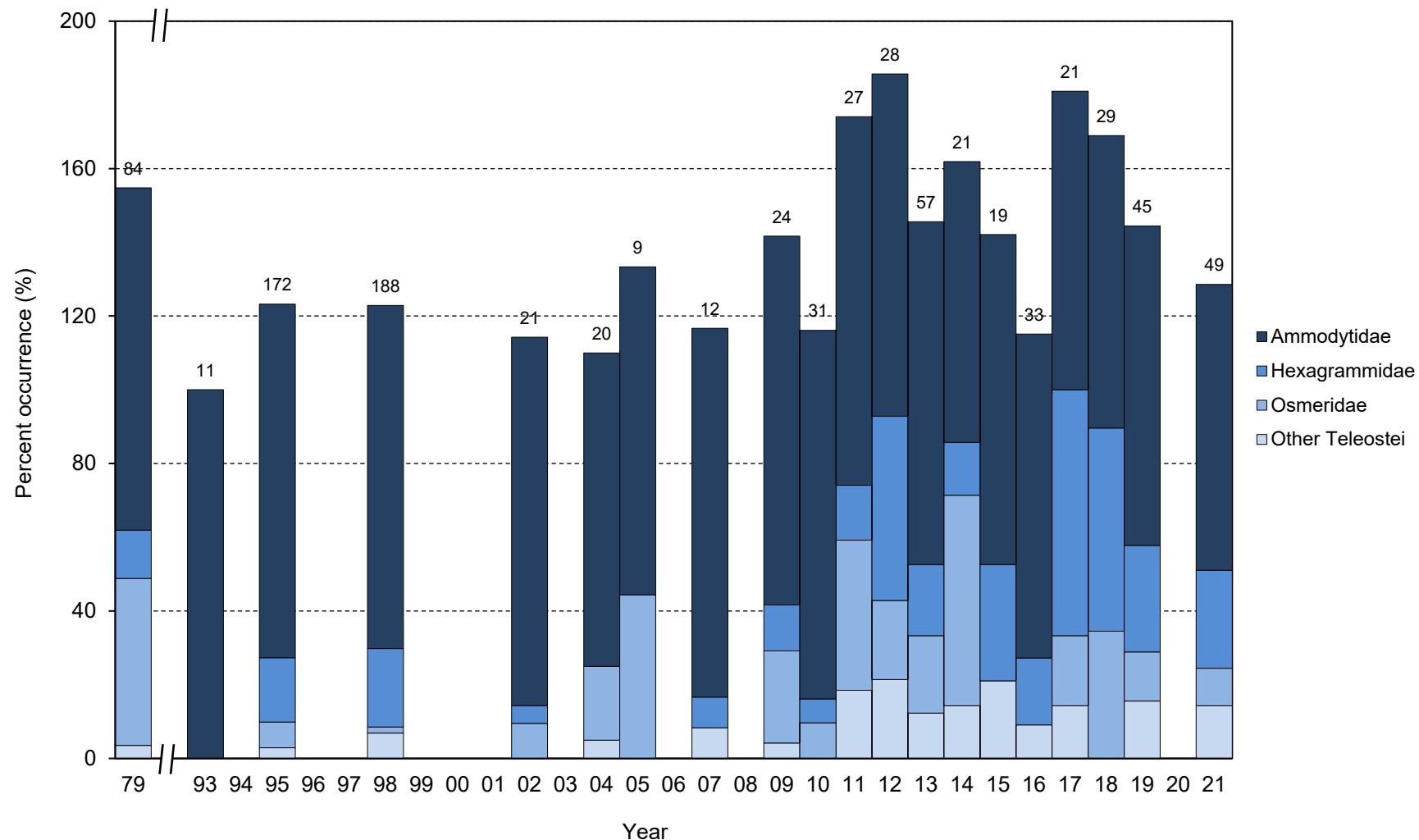


Figure 25. Frequency of occurrence of major prey items in diets of rhinoceros auklet chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks or from chicks themselves. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1992, 1994, 1996-1997, 1999-2001, 2003, 2006, 2008, or 2020.

Table 37. Frequency of occurrence of major prey items in diets of rhinoceros auklet chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified and measured in the field (1998, 2005, 2007), the laboratory (2002, 2004, 2009-2021) or a location unknown (1979, 1993, 1995) to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks or from chicks themselves. No diet samples were collected in 1980-1992, 1994, 1996-1997, 1999-2001, 2003, 2006, 2008, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1979	1993	1995	1998	2002	2004	2005	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	84	11	172	188	21	20	9	12	24	31	27	28	57	21	19	33	21	29	45	49
Invertebrates	4.8	-	4.1	-	-	-	-	-	-	11.1	-	3.5	-	-	-	-	-	2.2	4.1	
Fish	100.0	98.0																		
Teleostei	100.0	98.0																		
Ammodytidae	92.9	100.0	95.9	93.1	100.0	85.0	88.9	100.0	100.0	100.0	100.0	92.9	93.0	76.2	89.5	87.9	81.0	79.3	86.7	77.6
<i>Ammodytes</i> spp.	92.9	100.0	95.9	93.1	100.0	85.0	88.9	100.0	100.0	100.0	100.0	92.9	93.0	76.2	89.5	87.9	81.0	79.3	86.7	77.6
Hexagrammidae	13.1	-	17.4	21.3	4.8	-	-	8.3	12.5	6.5	14.8	50.0	19.3	14.3	31.6	18.2	66.7	55.2	28.9	26.5
<i>Pleurogrammus monopterygius</i>	4.8	-	-	-	-	-	-	12.5	3.2	14.8	3.6	3.5	14.3	31.6	15.2	66.7	55.2	28.9	26.5	
Other Hexagrammidae	9.5	-	17.4	21.3	4.8	-	-	8.3	-	3.2	-	50.0	19.3	-	-	9.1	-	-	-	
Osmeridae	45.2	-	7.0	1.6	9.5	20.0	44.4	-	25.0	9.7	40.7	21.4	21.1	57.1	-	-	19.0	34.5	13.3	10.2
<i>Mallotus villosus</i>	45.2	-	7.0	1.6	9.5	20.0	-	-	25.0	9.7	40.7	21.4	21.1	57.1	-	-	19.0	34.5	13.3	10.2
Other Osmeridae	-	-	-	-	-	-	44.4	-	-	-	-	-	-	-	-	-	-	2.2	2.0	
Other Teleostei	3.6	-	2.9	6.9	-	5.0	-	8.3	4.2	-	18.5	21.4	12.3	14.3	21.1	9.1	14.3	-	15.6	14.3

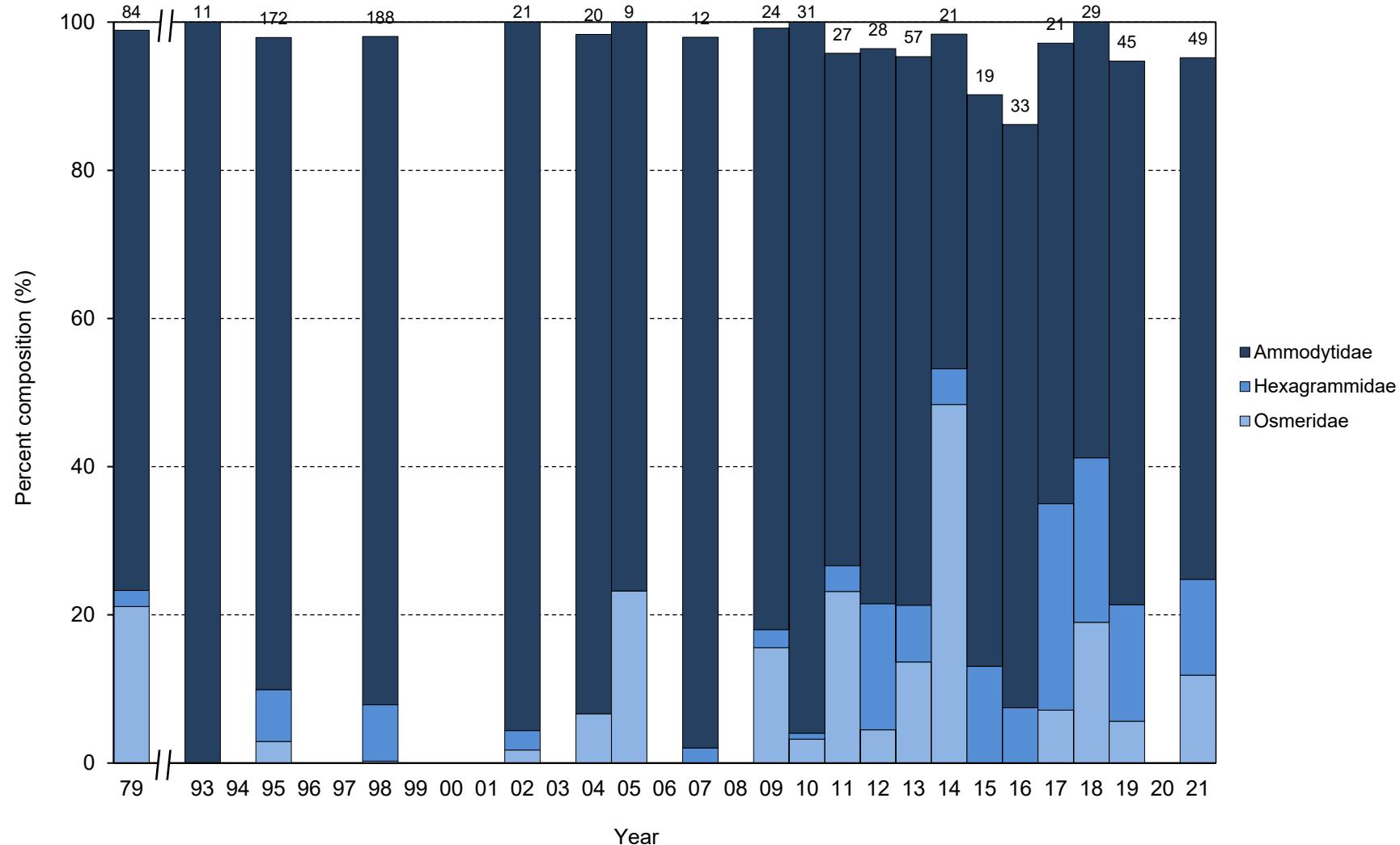


Figure 26. Percent composition of major prey items in diets of rhinoceros auklet chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1992, 1994, 1996-1997, 1999-2001, 2003, 2006, 2008, or 2020.

Table 38. Percent composition of major prey items in diets of rhinoceros auklet chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified and measured in the field (1998, 2005, 2007), the laboratory (2002, 2004, 2009-2021) or a location unknown (1979, 1993, 1995) to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 1980-1992, 1994, 1996-1997, 1999-2001, 2003, 2006, 2008, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1979	1993	1995	1998	2002	2004	2005	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	84	11	172	188	21	20	9	12	24	31	27	28	57	21	19	33	21	29	45	49
No. individuals	927	85	958	1129	114	60	56	49	122	248	285	223	366	186	92	188	140	216	248	270
Invertebrates	0.5	-	1.3	-	-	-	-	-	-	-	1.1	-	0.5	-	-	-	-	-	0.4	1.5
Fish	99.5	100.0	98.7	100.0	98.9	100.0	99.5	100.0	100.0	100.0	100.0	100.0	99.6	98.5						
Teleostei	99.5	100.0	98.7	100.0	98.9	100.0	99.5	100.0	100.0	100.0	100.0	100.0	99.6	98.5						
Ammodytidae	75.6	100.0	88.0	90.2	95.6	91.7	76.8	95.9	81.1	96.0	69.1	74.9	74.0	45.2	77.2	78.7	62.1	58.8	73.4	70.4
<i>Ammodytes</i> spp.	75.6	100.0	88.0	90.2	95.6	91.7	76.8	95.9	81.1	96.0	69.1	74.9	74.0	45.2	77.2	78.7	62.1	58.8	73.4	70.4
Hexagrammidae	2.2	-	7.0	7.6	2.6	-	-	2.0	2.5	0.8	3.5	17.0	7.7	4.8	13.0	7.4	27.9	22.2	15.7	13.0
<i>Pleurogrammus monopterygius</i>	0.4	-	-	-	-	-	-	2.5	0.4	3.5	0.4	0.5	4.8	13.0	3.2	27.9	22.2	15.7	13.0	
Other Hexagrammidae	1.7	-	7.0	7.6	2.6	-	-	2.0	-	0.4	-	16.6	7.1	-	-	4.3	-	-	-	
Osmeridae	21.1	-	2.9	0.3	1.8	6.7	23.2	-	15.6	3.2	23.2	4.5	13.7	48.4	-	-	7.1	19.0	5.6	11.9
<i>Mallotus villosus</i>	21.1	-	2.9	0.3	1.8	6.7	-	-	15.6	3.2	23.2	4.5	13.7	48.4	-	-	7.1	19.0	5.2	11.1
Other Osmeridae	-	-	-	-	-	-	23.2	-	-	-	-	-	-	-	-	-	-	0.4	0.7	
Other Teleostei	0.5	-	0.8	1.9	-	1.7	-	2.0	0.8	-	3.2	3.6	4.1	1.6	9.8	13.8	2.9	-	4.8	3.3

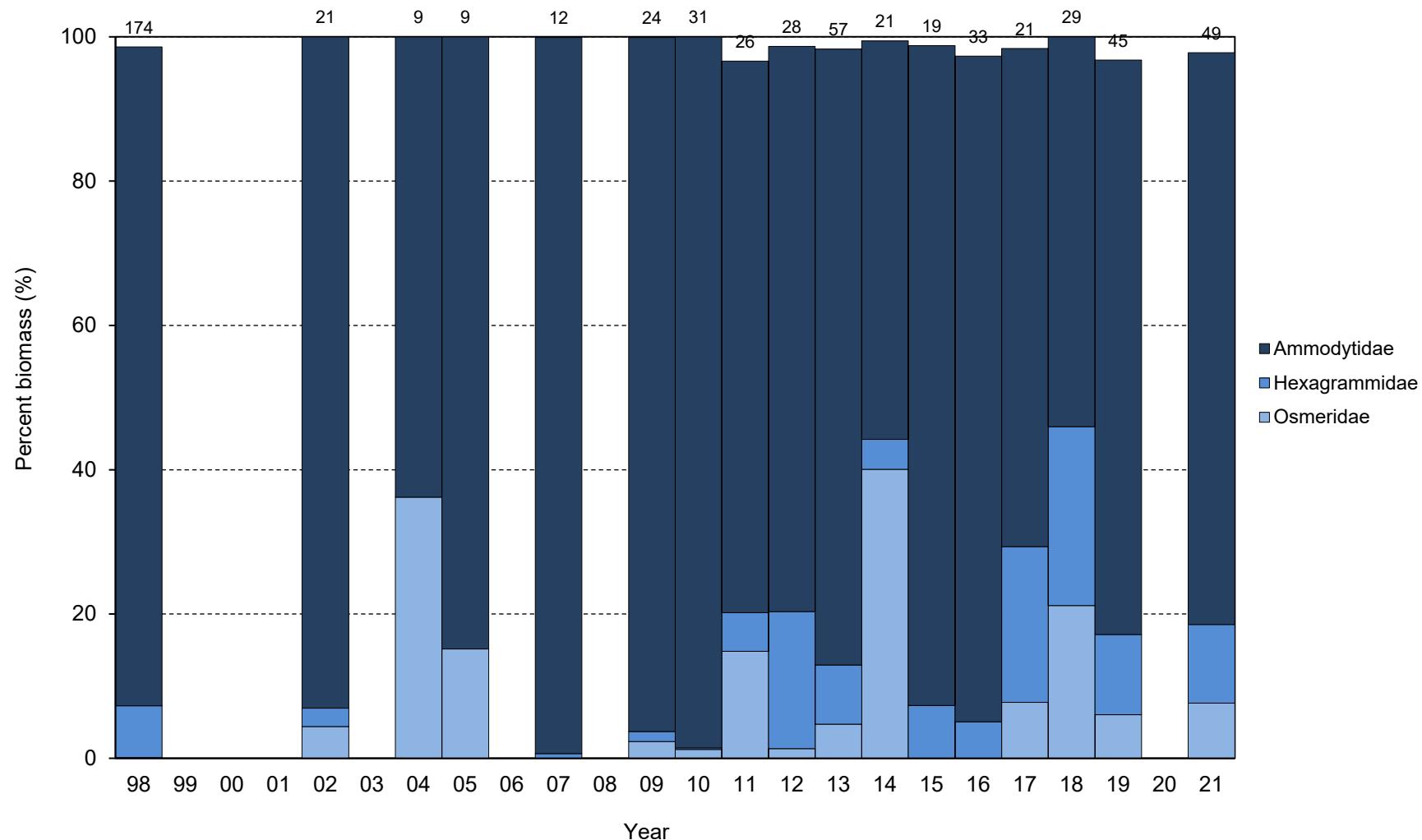


Figure 27. Relative biomass of major prey items in diets of rhinoceros auklet chicks at Chowiet Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average biomass of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1992, 1994, 1996-1997, 1999-2001, 2003, 2006, 2008, or 2020 and no mass data exist in 1979, 1993, or 1995.

Table 39. Relative biomass of major prey items in diets of rhinoceros auklet chicks at Chowiet Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year). Prey was identified and measured in the field (1998, 2005, 2007) or the laboratory (2002, 2004, 2009-2021) to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average biomass of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 1980-1992, 1994, 1996-1997, 1999-2001, 2003, 2006, 2008, or 2020 and no mass data exist in 1979, 1993, or 1995. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1998	2002	2004	2005	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	174	21	9	9	12	24	31	26	28	57	21	19	33	21	29	45	49
Total mass (g)	3680	315	81	282	228	550	945	564	523	1236	602	92	732	581	797	872	971
Invertebrates	-	-	-	-	-	-	-	1.2	-	0.6	-	-	-	-	-	<0.1	0.7
Fish	100.0	98.8	100.0	99.4	100.0	100.0	100.0	100.0	100.0	100.0	99.3						
Teleostei	100.0	98.8	100.0	99.4	100.0	100.0	100.0	100.0	100.0	100.0	99.3						
Ammodytidae	91.3	93.1	63.8	84.9	99.3	96.2	98.6	76.4	78.3	85.4	55.2	91.5	92.3	69.0	54.0	79.6	79.3
<i>Ammodytes</i> spp.	91.3	93.1	63.8	84.9	99.3	96.2	98.6	76.4	78.3	85.4	55.2	91.5	92.3	69.0	54.0	79.6	79.3
Hexagrammidae	7.2	2.5	-	-	0.7	1.4	0.2	5.4	19.0	8.2	4.1	7.3	5.1	21.6	24.8	11.1	10.9
<i>Pleurogrammus monopterygius</i>	-	-	-	-	-	1.4	0.1	5.4	3.6	3.0	4.1	7.3	2.5	21.6	24.8	11.1	10.9
Other Hexagrammidae	7.2	2.5	-	-	0.7	-	0.1	-	15.4	5.2	-	-	2.6	-	-	-	-
Osmeridae	0.1	4.4	36.2	15.1	-	2.3	1.2	14.8	1.3	4.7	40.1	-	-	7.8	21.2	6.0	7.6
<i>Mallotus villosus</i>	0.1	4.4	36.2	-	-	2.3	1.2	14.8	1.3	4.7	40.1	-	-	7.8	21.2	5.8	7.1
Other Osmeridae	-	-	-	15.1	-	-	-	-	-	-	-	-	-	-	-	0.2	0.6
Other Teleostei	1.4	-	-	-	0.1	0.1	-	2.1	1.3	1.1	0.6	1.2	2.7	1.6	-	3.2	1.5

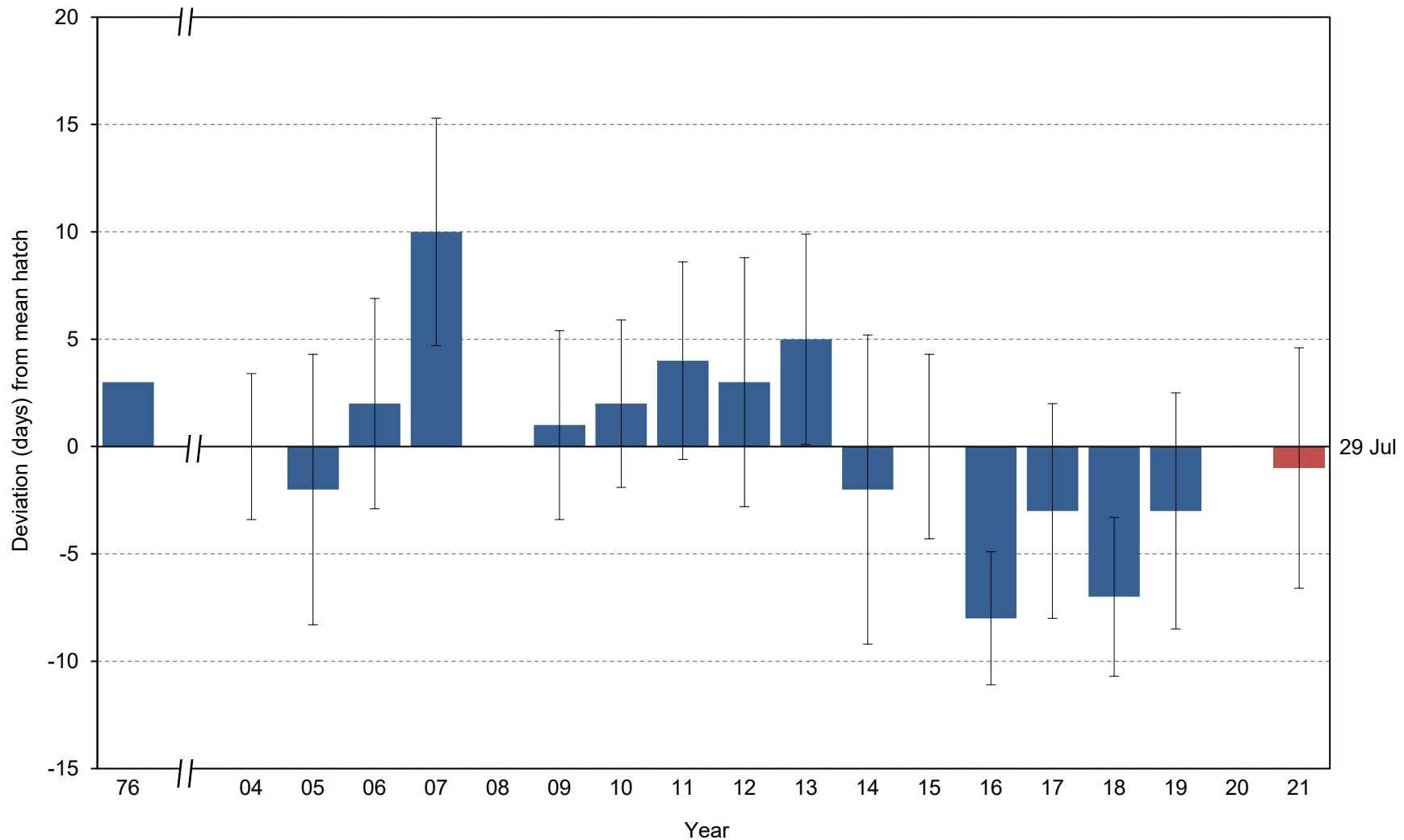


Figure 28. Yearly hatch date deviation (from the 1976-2020 average of 29 July) for horned puffins at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date (no value available for 1976); red highlights the current year. No data were collected in 1977-2003, 2008, or 2020.

Table 40. Breeding chronology of horned puffins at Chowiet Island, Alaska. No data were collected in 1977-2003, 2008, or 2020.

Year	Mean hatch	SD	n ^a	First hatch	Last hatch	First fledge ^b
1976	31 Jul	-	56	23 Jul	17 Aug	>4 Sep
2004	28 Jul	3.4	6	24 Jul	3 Aug	>15 Aug
2005	27 Jul	6.3	37	17 Jul	14 Aug	>2 Sep
2006	31 Jul	4.9	29	21 Jul	16 Aug	26 Aug
2007	8 Aug	5.3	14	27 Jul	15 Aug	>2 Sep
2009	30 Jul	4.4	13	21 Jul	10 Aug	>4 Sep
2010	31 Jul	3.9	16	25 Jul	10 Aug	1 Sep
2011	2 Aug	4.6	17	27 Jul	10 Aug	>6 Sep
2012	31 Jul	5.8	22	22 Jul	13 Aug	>2 Sep
2013	3 Aug	4.9	42	23 Jul	18 Aug	>30 Aug
2014	27 Jul	7.2	48	18 Jul	16 Aug	26 Aug
2015	29 Jul	4.3	17	23 Jul	5 Aug	>1 Sep
2016	20 Jul	3.1	51	13 Jul	26 Jul	20 Aug
2017	26 Jul	5.0	71	19 Jul	14 Aug	>1 Sep
2018	22 Jul	3.7	47	15 Jul	31 Jul	23 Aug
2019	26 Jul	5.5	33	19 Jul	9 Aug	>2 Sep
2021	28 Jul	5.6	41	20 Jul	14 Aug	>29 Aug

^aSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

^bIn years when no chicks fledged before the field crew left the island at the end of the season, date of first fledge is listed as > the date of last nest check.

Table 41. Frequency distribution of hatch dates for horned puffins at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1977–2003, 2008, or 2020; data from individual nests are not available in 1976.

Julian date ^a	No. nests hatching on Julian date																	
	04	05	06	07	09	10	11	12	13	14	15	16	17	18	19	21		
195	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
196	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
198	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-
200	-	-	-	-	-	-	-	-	-	5	-	23	8	16	4	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
202	-	5	1	-	1	-	-	-	-	2	-	7	1	2	-	-	1	-
203	-	-	-	-	-	-	-	-	-	4	-	1	-	4	1	-	-	-
204	-	12	1	-	-	-	-	1	1	5	3	9	2	12	14	1	-	-
205	-	1	-	-	-	-	-	-	-	2	-	-	-	25	-	-	-	-
206	2	1	1	-	-	1	-	2	-	2	-	1	10	1	-	-	7	-
207	-	1	3	-	-	1	-	-	-	4	1	1	2	1	-	-	5	-
208	-	8	2	1	3	2	3	1	1	10	2	6	3	1	3	4	-	-
209	-	-	-	-	-	-	-	-	3	-	5	-	6	-	2	1	-	-
210	3	-	3	-	3	-	4	6	-	3	-	-	3	4	-	-	-	-
211	-	1	-	-	1	-	-	-	1	-	-	-	-	-	1	9	-	-
212	-	1	7	-	2	8	-	5	7	1	2	-	1	1	1	2	-	-
213	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
214	-	-	7	2	2	1	4	2	17	3	-	-	2	-	4	1	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
216	1	-	1	-	-	1	1	1	1	-	2	-	-	-	1	3	-	-
217	-	1	-	-	-	-	-	-	3	-	2	-	-	-	-	-	-	-
218	-	3	2	1	-	1	1	-	4	2	-	-	5	-	1	-	-	-
219	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	5	-	-	3	1	-	-	-	-	-	-	-	-	-	-
221	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
222	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-
223	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
224	-	1	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-
225	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
226	-	1	-	-	-	-	-	2	-	-	-	-	1	-	-	2	-	-
227	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
229	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
<i>n</i>	6	37	29	14	13	16	17	22	42	48	17	51	71	47	33	41		

^aIn leap years, hatch dates are calculated using a leap year-specific Julian date calendar

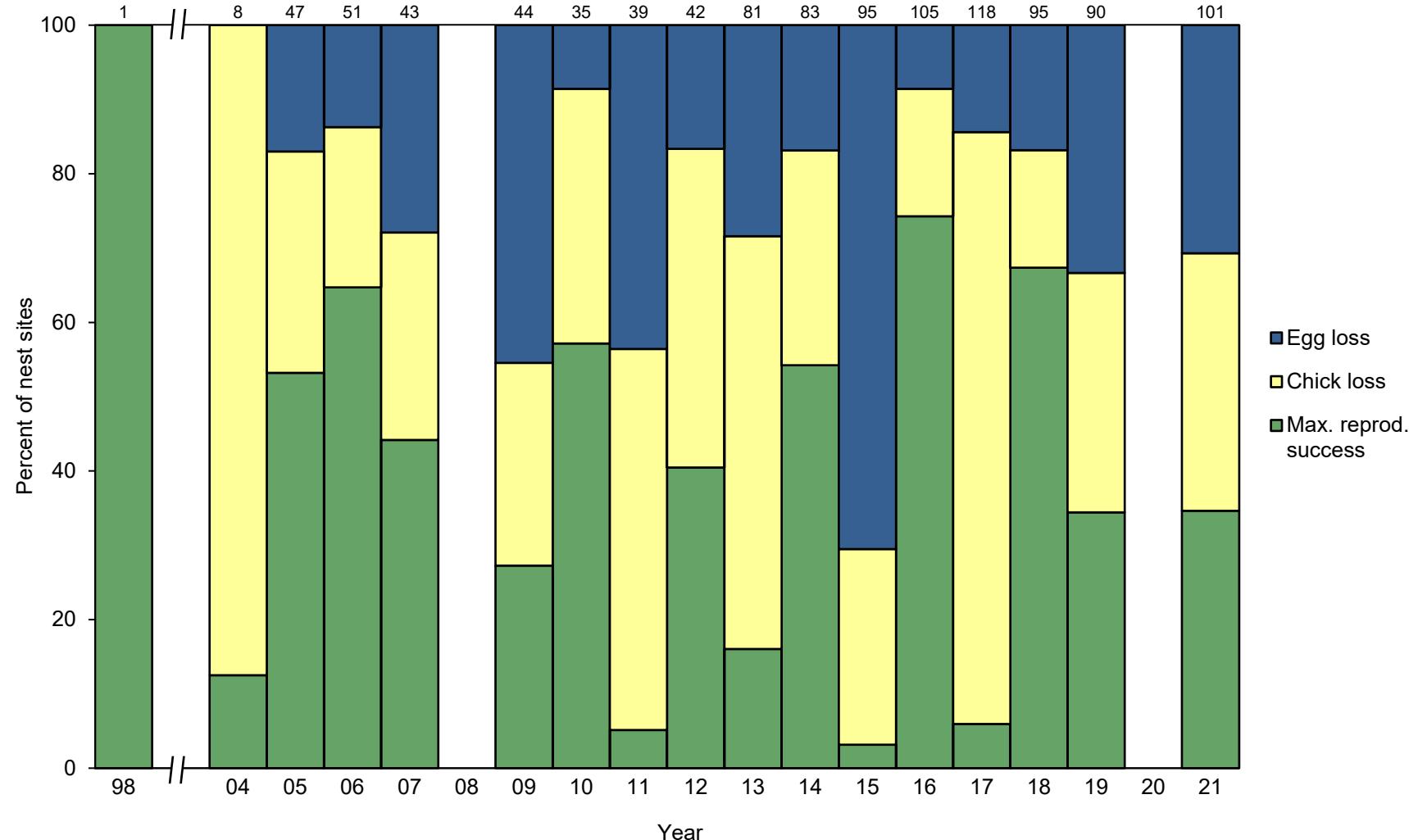


Figure 29. Maximum potential reproductive performance of horned puffins at Chowiet Island, Alaska. Values include nest sites with chicks still present but too young to consider fledged at the last check. Egg loss=[(B+H)-D+H]/(B+H); Chick loss=[(D+H)-F+H]/(B+H); Maximum potential reproductive success=[(F+H)/(B+H)], where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged; H=nest sites with young chicks still present. Numbers above columns indicate sample sizes (B+H). No data were collected in 1977-1997, 1999-2003, 2008, or 2020; maximum values are not available in 1976.

Table 42. Reproductive performance of horned puffins at Chowiet Island, Alaska. No data were collected in 1977-1997, 1999-2003, 2008, or 2020.

Year	Nest sites w/ young chicks still present ^a				Nesting success (D/B) ^b		Fledging success (F/D) ^c		Reproductive success (F/B)		Max. potential nesting success ^d [(D+H)/(B+H)]		Max. potential fledging success ^d [(F+H)/(D+H)]		Max. potential reproductive success ^d [(F+H)/(B+H)]		Sampling design ^e
	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Total (H)	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	
1976	48	32	19	-	0.67	0.07	0.59	0.09	0.40	0.07	-	-	-	-	-	Simple random	
1998	0	0	0	1	-	-	-	-	-	-	1.00	0.00	1.00	0.00	1.00	0.00	Simple random
2004	7	7	0	1	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.13	0.12	0.13	0.12	Simple random
2005	44	36	22	3	0.82	0.06	0.61	0.08	0.50	0.08	0.83	0.05	0.64	0.08	0.53	0.07	Simple random
2006	45	38	27	6	0.84	0.05	0.71	0.07	0.60	0.07	0.86	0.05	0.75	0.07	0.65	0.07	Simple random
2007	26	14	2	17	0.54	0.10	0.14	0.09	0.08	0.05	0.72	0.07	0.61	0.09	0.44	0.08	Simple random
2009	44	24	12	0	0.55	0.08	0.50	0.10	0.27	0.07	0.55	0.08	0.50	0.10	0.27	0.07	Simple random
2010	30	27	15	5	0.90	0.05	0.56	0.10	0.50	0.09	0.91	0.05	0.63	0.09	0.57	0.08	Simple random
2011	38	21	1	1	0.55	0.08	0.05	0.05	0.03	0.03	0.56	0.08	0.09	0.06	0.05	0.03	Simple random
2012	36	29	11	6	0.81	0.07	0.38	0.09	0.31	0.08	0.83	0.06	0.49	0.08	0.40	0.08	Simple random
2013	70	47	2	11	0.67	0.06	0.04	0.03	0.03	0.02	0.72	0.05	0.22	0.05	0.16	0.04	Simple random
2014	74	60	36	9	0.81	0.05	0.60	0.06	0.49	0.06	0.83	0.04	0.65	0.06	0.54	0.05	Simple random
2015	93	26	1	2	0.28	0.05	0.04	0.04	0.01	0.01	0.29	0.05	0.11	0.06	0.03	0.02	Simple random
2016	105	96	78	0	0.91	0.03	0.81	0.04	0.74	0.04	0.91	0.03	0.81	0.04	0.74	0.04	Simple random
2017	118	101	7	0	0.86	0.03	0.07	0.03	0.06	0.02	0.86	0.03	0.07	0.03	0.06	0.02	Simple random
2018	88	72	57	7	0.82	0.04	0.79	0.05	0.65	0.05	0.83	0.04	0.81	0.04	0.67	0.05	Simple random
2019	88	58	29	2	0.66	0.05	0.50	0.07	0.33	0.05	0.67	0.05	0.52	0.06	0.34	0.05	Simple random
2021	91	60	25	10	0.66	0.05	0.42	0.06	0.27	0.05	0.69	0.05	0.50	0.06	0.35	0.05	Simple random

^aChicks still present at last check but too young to consider successfully fledged by fledging age conventions (still present ≥ 30 d for horned puffins). These nests are not included in the number of nest sites w/ eggs (B) or chicks (D) or estimates of success but are used only to calculate a value of maximum potential reproductive success.

^bFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^cFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^dValues of maximum potential success include nest sites with chicks still present but too young to consider fledged at the last check; these values may be useful in years when crews leave the island before many chicks reach fledging age.

^eSampling for puffins is based on nests as the sample unit. For simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

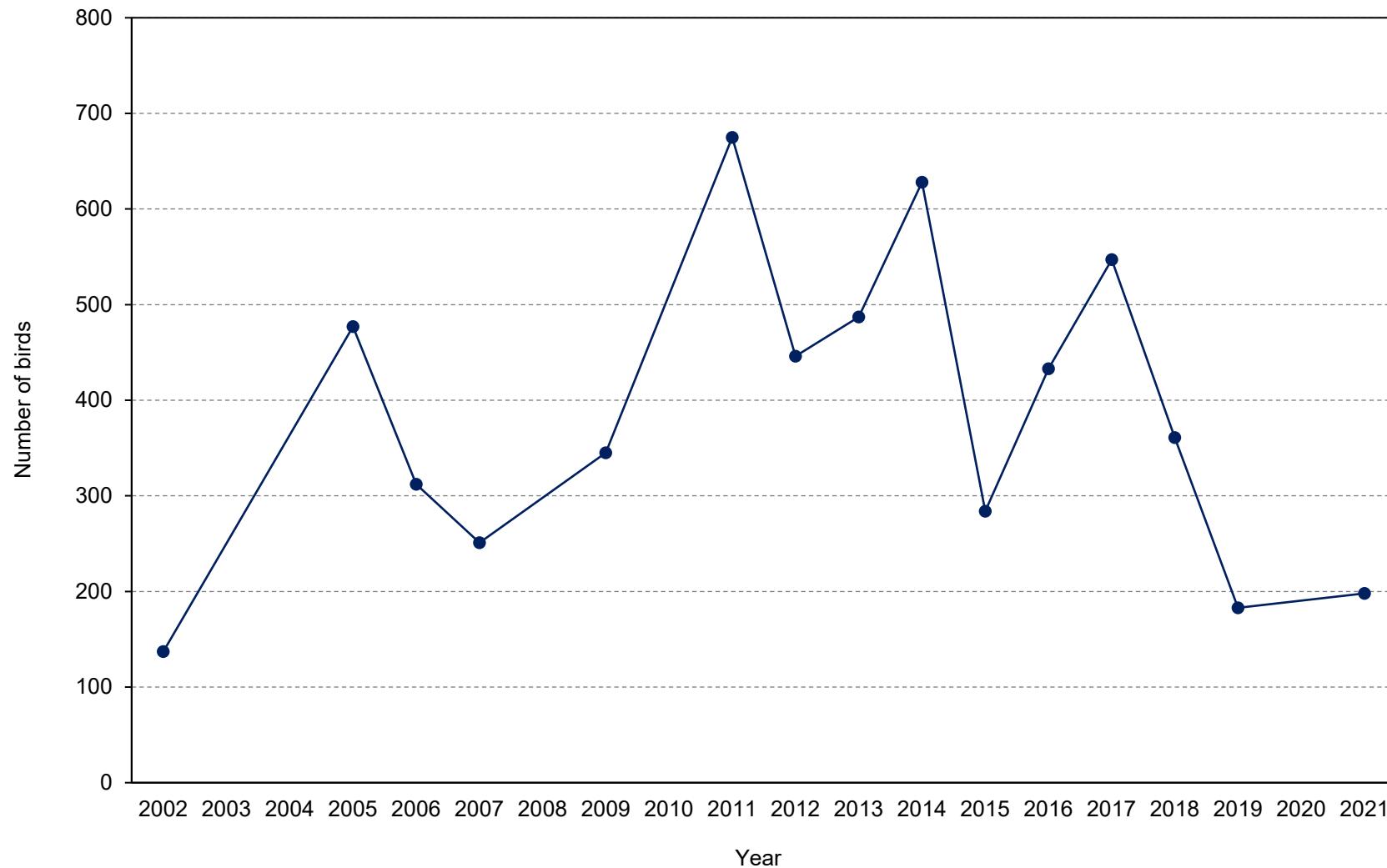


Figure 30. Maximum numbers of horned puffins counted on a water index plot at Chowiet Island, Alaska. Data include only counts conducted during last 30 days of incubation each year. No counts were conducted in 1978-1992, 1996-1997, 1999-2001, 2003-2004, 2008, 2010, or 2020; data potentially exist in 1977, 1993-1995, and 1998 but have not yet been summarized.

Table 43. Numbers of horned puffins counted on a water index plot at Chowiet Island, Alaska. Data include only counts conducted during last 30 days of incubation each year (defined as 30 days before first hatch date; Table 36). No counts were conducted in 1978-1992, 1996-1997, 1999-2001, 2003-2004, 2008, 2010, or 2020.

Replicate	1977	1993	1994	1995	1998	2002	2005	2006	2007	2009
1	xx ^a	xx	xx	xx	xx	90	469	82	251	76
2	xx	xx	xx	xx	xx	117	270	301	133	161
3	xx	xx	xx	xx	xx	81	244	299	136	345
4	xx	xx	xx	xx	xx	137	271	312	173	300
5	xx	xx	xx	xx	xx	61	398	157	148	127
6	xx	xx	xx	xx	xx	62	477	-	-	321
7	xx	xx	xx	xx	xx	67	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-
Mean	xx	xx	xx	xx	xx	88	355	230	168	221
Max.	xx	xx	xx	xx	xx	137	477	312	251	345
<i>n</i>	xx	xx	xx	xx	xx	7	6	5	5	6
SD	xx	xx	xx	xx	xx	29	106	105	49	114
First hatch	20 Jul ^b	20 Jul ^b	20 Jul ^b	20 Jul ^b	xx	20 Jul ^b	17 Jul	21 Jul	23 Jul	19 Jul
First count	xx	xx	xx	xx	xx	19 Jun	19 Jun	20 Jun	22 Jun	21 Jun
Last count	xx	xx	xx	xx	xx	19 Jul	14 Jul	12 Jul	19 Jul	18 Jul
Count protocol ^c	A	A	A	A	xx	B	C	D	C	C

Table 43 (continued). Numbers of horned puffins counted on a water index plot at Chowiet Island, Alaska. Data include only counts conducted during last 30 days of incubation each year (defined as 30 days before first hatch date; Table 36). No counts were conducted in 1978-1992, 1996-1997, 1999-2001, 2003-2004, 2008, 2010, or 2020.

Replicate	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
1	248	378	496	282	194	270	218	208	99	178
2	485	414	162	264	96	237	151	152	55	198
3	175	446	193	458	177	394	404	153	114	109
4	418	254	234	410	284	426	85	150	131	126
5	556	251	487	514	85	371	547	361	183	109
6	389	339	467	322	108	426	291	62	160	46
7	675	327	120	369	124	334	402	-	46	140
8	79	353	388	151	250	383	397	-	12	74
9	-	-	-	230	201	433	327	-	50	42
10	-	-	-	416	-	345	233	-	46	18
11	-	-	-	181	-	-	-	-	-	-
12	-	-	-	628	-	-	-	-	-	-
13	-	-	-	221	-	-	-	-	-	-
Mean	378	345	318	342	169	362	306	181	90	104
Max.	675	446	496	628	284	433	547	361	183	198
<i>n</i>	8	8	8	13	9	10	10	6	10	10
SD	200	69	157	140	70	67	138	100	56	59
First hatch	23 Jul	22 Jul	23 Jul	18 Jul	23 Jul	13 Jul	19 Jul	15 Jul	19 Jul	20 Jul
First count	25 Jun	21 Jun	24 Jun	18 Jun	22 Jun	17 Jun	21 Jun	23 Jun	22 Jun	21 Jun
Last count	21 Jul	15 Jul	21 Jul	9 Jul	19 Jul	3 Jul	5 Jul	13 Jul	11 Jul	16 Jul
Count protocol ^c	E	E	E	E	E	E	E	E	E	E

^axx indicates data potentially exist but have not yet been summarized.

^bIn years when date of first hatch is unknown, count period is determined by the average date of first hatch across other years (20 July).

^cA=all replicates represent single count per day, all between 0700-0930h; B=all replicates represent single count per day, all between 0730h-0930h; C=all replicates represent the mean of two or more counts per day within 5%, all between 0730-0930h; D=some replicates represent single count per day, some represent the mean of two counts per day within 5%, all between 0730-0930h. E=all replicates represent the mean of two or more counts per day within 5%, all between 0700-0930h.

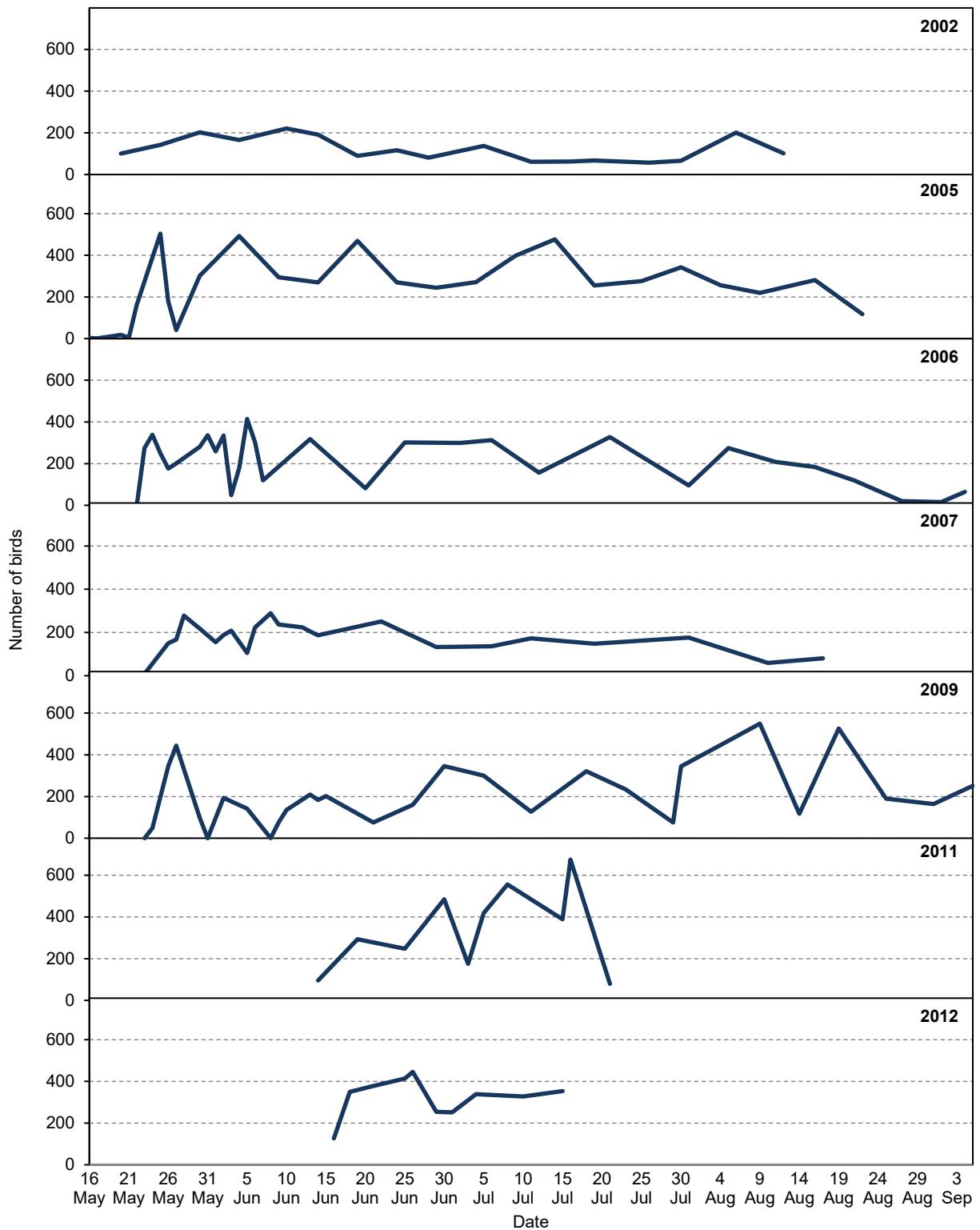


Figure 31. Number of horned puffins counted on a water index plot at Chowiet Island, Alaska. Starting in 2011, counts were conducted only during the period in the breeding season with lowest day-to-day variability; thus fewer counts during a smaller count window were conducted. No counts were conducted in 2003-2004, 2008, 2010, or 2020.

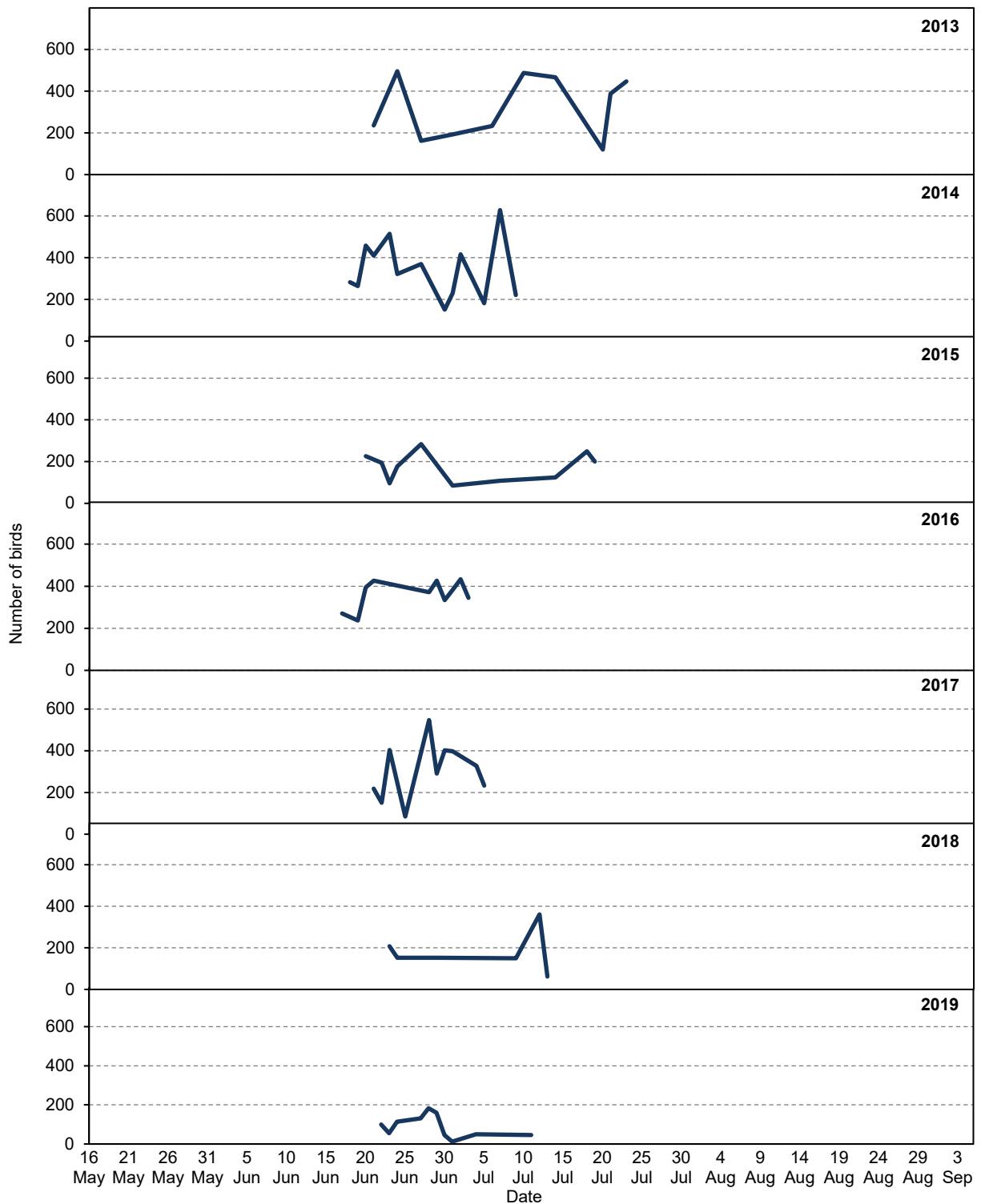


Figure 31 (continued). Number of horned puffins counted on a water index plot at Chowiet Island, Alaska. Starting in 2011, counts were conducted only during the period in the breeding season with lowest day-to-day variability; thus fewer counts during a smaller count window were conducted. No counts were conducted in 2003-2004, 2008, 2010, or 2020.

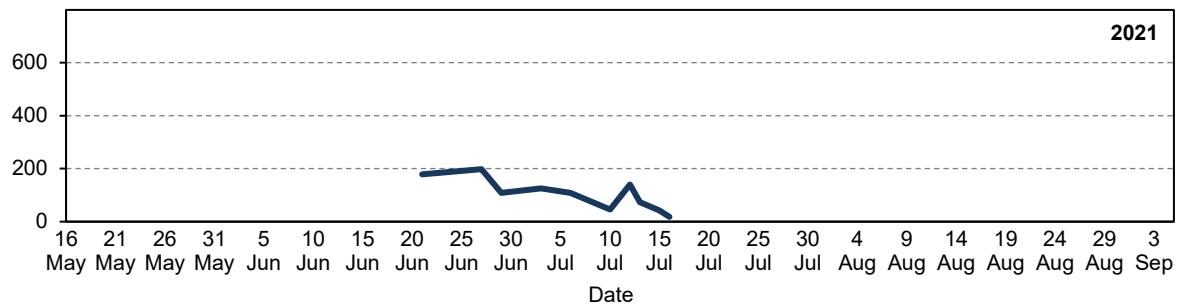


Figure 31 (continued). Number of horned puffins counted on a water index plot at Chowiet Island, Alaska. Starting in 2011, counts were conducted only during the period in the breeding season with lowest day-to-day variability; thus fewer counts during a smaller count window were conducted. No counts were conducted in 2003-2004, 2008, 2010, or 2020.

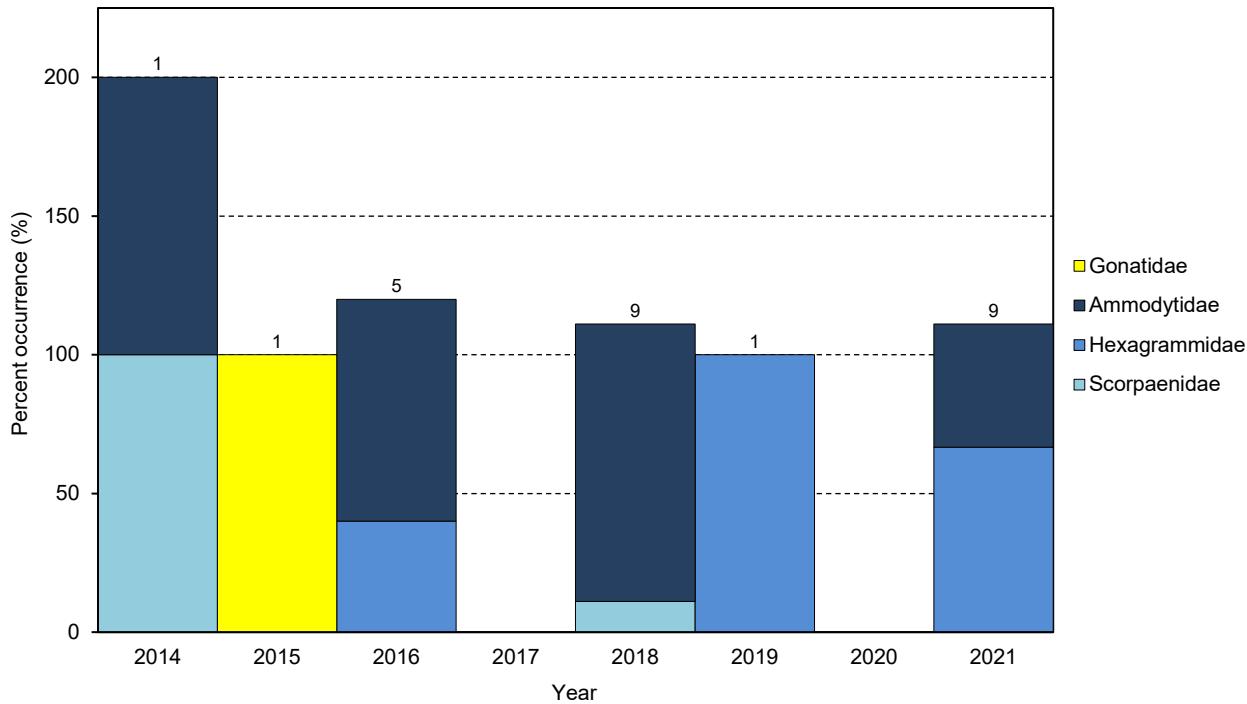


Figure 32. Frequency of occurrence of major prey items in diets of horned puffin chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of bill loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 2017 or 2020.

Table 44. Frequency of occurrence of major prey items in diets of horned puffin chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 2017 or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2014	2015	2016	2018	2019	2021
No. samples	1	1	5	9	1	9
Invertebrates	-	100.0	20.0	-	-	-
Cephalopoda	-	100.0	20.0	-	-	-
Gonatidae	-	100.0	-	-	-	-
<i>Gonatus madokai</i>	-	100.0	-	-	-	-
Other Cephalopoda	-	-	20.0	-	-	-
Fish	100.0	-	100.0	100.0	100.0	100.0
Teleostei	-	-	100.0	100.0	100.0	100.0
Ammodytidae	100.0	-	80.0	100.0	-	44.4
<i>Ammodytes</i> spp.	100.0	-	80.0	100.0	-	44.4
Hexagrammidae	-	-	40.0	-	100.0	66.7
<i>Pleurogrammus monopterygius</i>	-	-	40.0	-	100.0	66.7
Scorpaenidae	100.0	-	-	11.1	-	-
<i>Sebastes</i> spp.	100.0	-	-	11.1	-	-
Other Teleostei	-	-	-	-	-	11.1

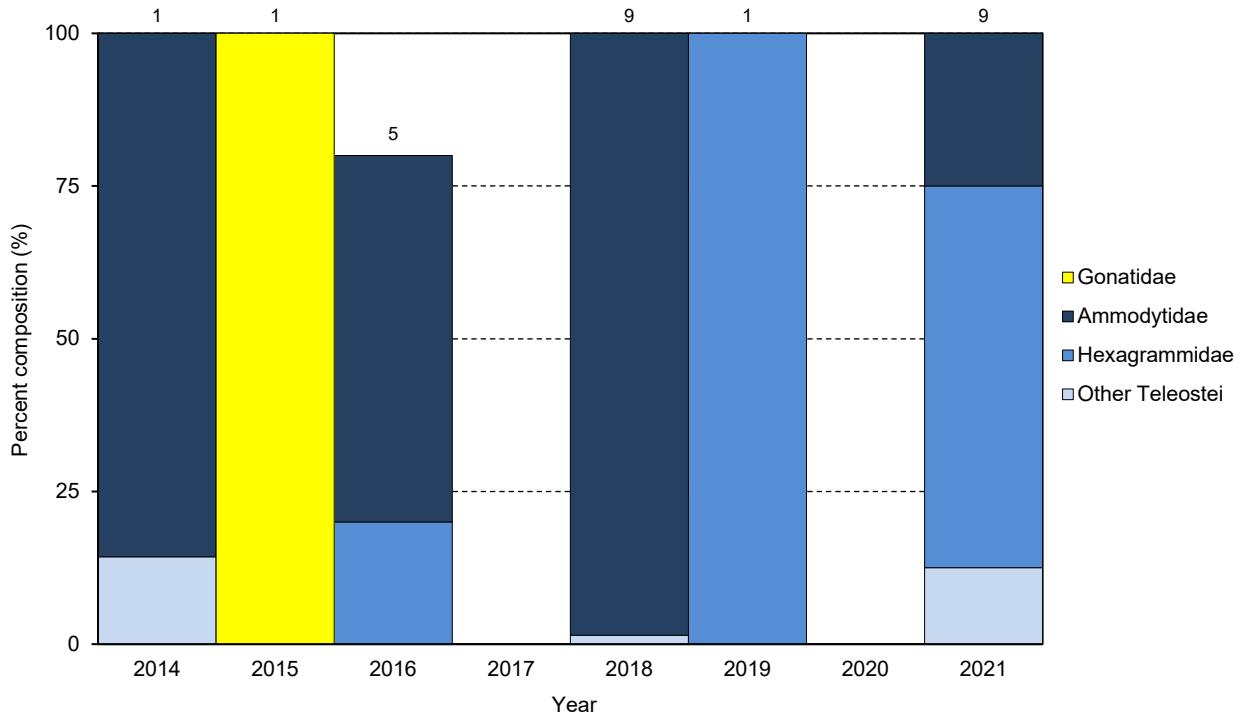


Figure 33. Percent composition of major prey items in diets of horned puffin chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of bill loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 2017 or 2020.

Table 45. Percent composition of major prey items in diets of horned puffin chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 2017 or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2014	2015	2016	2018	2019	2021
No. samples	1	1	5	9	1	9
No. individuals	7	1	10	69	1	16
Invertebrates	-	100.0	20.0	-	-	-
Cephalopoda	-	100.0	20.0	-	-	-
Gonatidae	-	100.0	-	-	-	-
<i>Gonatus madokai</i>	-	100.0	-	-	-	-
Other Cephalopoda	-	-	20.0	-	-	-
Fish	100.0	-	80.0	100.0	100.0	100.0
Teleostei	100.0	-	80.0	100.0	100.0	100.0
Ammodytidae	85.7	-	60.0	98.6	-	25.0
<i>Ammodytes</i> spp.	85.7	-	60.0	98.6	-	25.0
Hexagrammidae	-	-	20.0	-	100.0	62.5
<i>Pleurogrammus monopterygius</i>	-	-	20.0	-	100.0	62.5
Other Teleostei	14.3	-	-	1.4	-	12.5

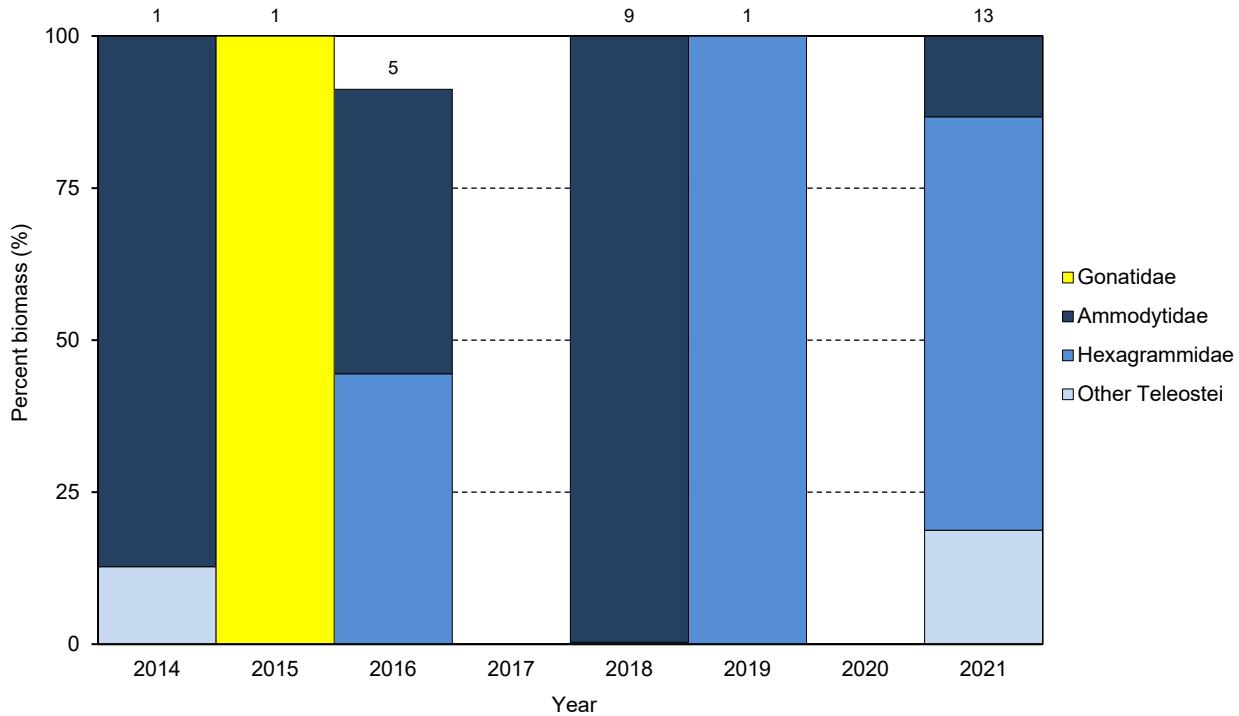


Figure 34. Relative biomass of major prey items in diets of horned puffin chicks at Chowiet Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average biomass of at least 5% are shown. Samples consist of bill loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 2017 or 2020.

Table 46. Relative biomass of major prey items in diets of horned puffin chicks at Chowiet Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average biomass of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 2017 or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2014	2015	2016	2018	2019	2021
No. samples	1	1	5	9	1	9
Total mass (g)	8	1	14	39	3	43
Invertebrates	-	100.0	8.8	-	-	-
Cephalopoda	-	100.0	8.8	-	-	-
Gonatidae	-	100.0	-	-	-	-
<i>Gonatus madokai</i>	-	100.0	-	-	-	-
Other Cephalopoda	-	-	8.8	-	-	-
Fish	100.0	-	91.2	100.0	100.0	100.0
Teleostei	100.0	-	91.2	100.0	100.0	100.0
Ammodytidae	87.3	-	46.8	99.7	-	13.3
<i>Ammodytes</i> spp.	87.3	-	46.8	99.7	-	13.3
Hexagrammidae	-	-	44.5	-	100.0	68.0
<i>Pleurogrammus monopterygius</i>	-	-	44.5	-	100.0	68.0
Other Teleostei	12.7	-	-	0.3	-	18.8

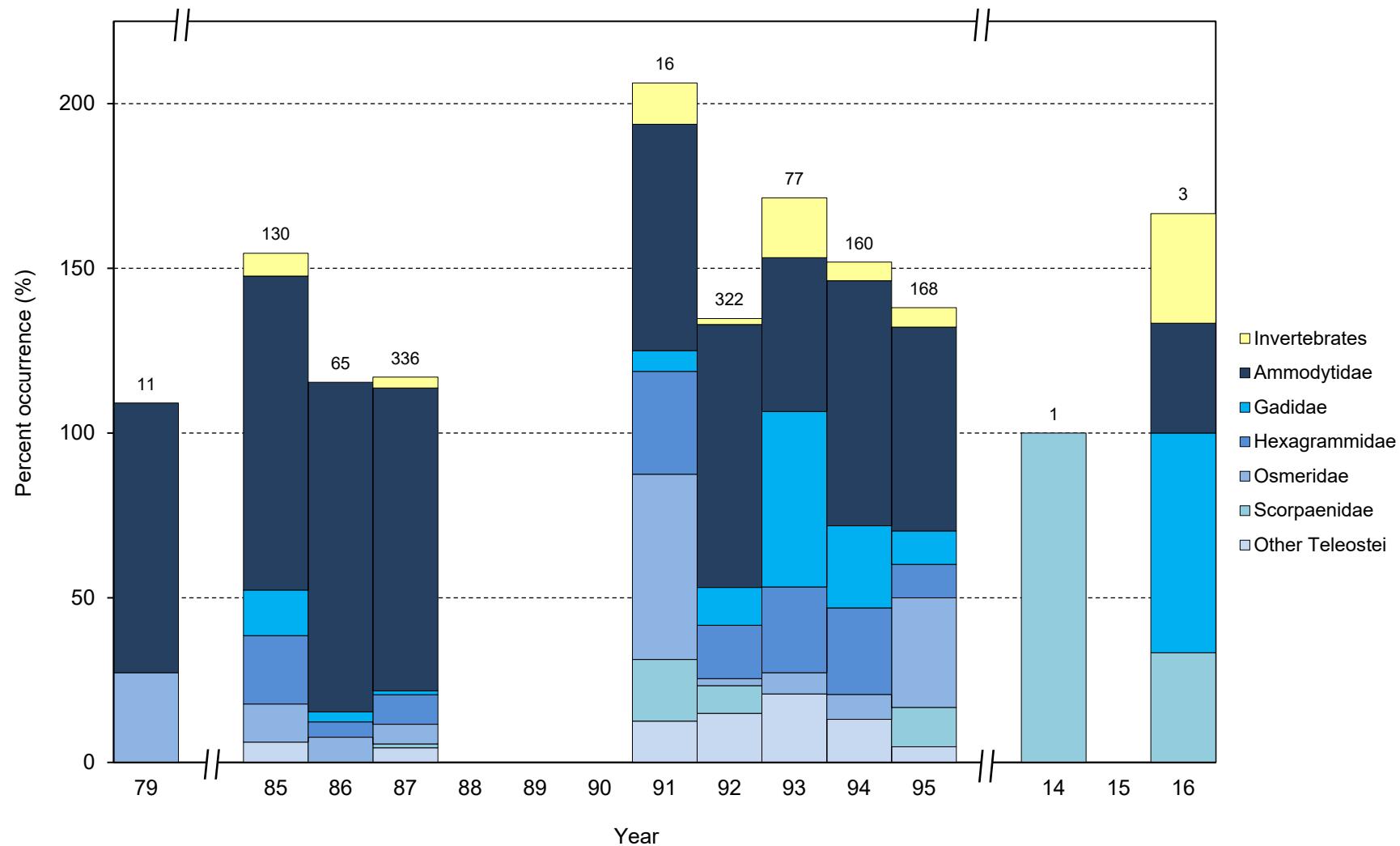


Figure 35. Frequency of occurrence of major prey items in diets of horned puffin chicks at Suklik Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2015, or 2017-2021.

Table 47. Frequency of occurrence of prey items in diets of horned puffin chicks at Suklik Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2015, or 2017-2021. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1979	1985	1986	1987	1991	1992	1993	1994	1995	2014	2016
No. samples	11	130	65	336	16	322	77	160	168	1	3
Invertebrates	-	6.9	-	3.3	12.5	1.9	18.2	5.6	6.0	-	33.3
Fish	100.0	100.0	100.0	99.1	100.0	99.7	93.5	99.4	100.0	100.0	100.0
Teleostei	100.0	100.0	100.0	99.1	100.0	99.7	93.5	99.4	100.0	100.0	100.0
Ammodytidae	81.8	95.4	100.0	92.0	68.8	79.8	46.8	74.4	61.9	-	33.3
<i>Ammodytes</i> spp.	81.8	95.4	100.0	92.0	68.8	79.8	46.8	74.4	61.9	-	33.3
Gadidae	-	13.8	3.1	1.2	6.3	11.5	53.2	25.0	10.1	-	66.7
<i>Gadus chalcogrammus</i>	-	13.8	3.1	1.2	6.3	10.9	51.9	18.8	9.5	-	66.7
Other Gadidae	-	-	-	-	6.3	2.8	2.6	13.1	0.6	-	-
Hexagrammidae	-	20.8	4.6	8.9	31.3	16.1	26.0	26.3	10.1	-	-
<i>Hexagrammos decagrammus</i>	-	-	-	-	-	-	22.1	23.8	-	-	-
Unid. Hexagrammidae	-	-	-	-	31.3	16.1	5.2	2.5	-	-	-
Other Hexagrammidae	-	20.8	4.6	8.9	-	-	-	1.9	10.1	-	-
Osmeridae	27.3	11.5	7.7	6.0	56.3	2.2	6.5	7.5	33.3	-	-
<i>Mallotus villosus</i>	27.3	11.5	7.7	6.0	56.3	2.2	6.5	7.5	33.3	-	-
Scorpaenidae	-	-	-	1.2	18.8	8.4	-	-	11.9	100.0	33.3
Unid. Scorpaenidae	-	-	-	-	18.8	8.4	-	-	-	100.0	-
Other Scorpaenidae	-	-	-	1.2	-	-	-	-	11.9	-	33.3
Other Teleostei	-	6.2	-	4.5	12.5	14.9	20.8	13.1	4.8	-	-

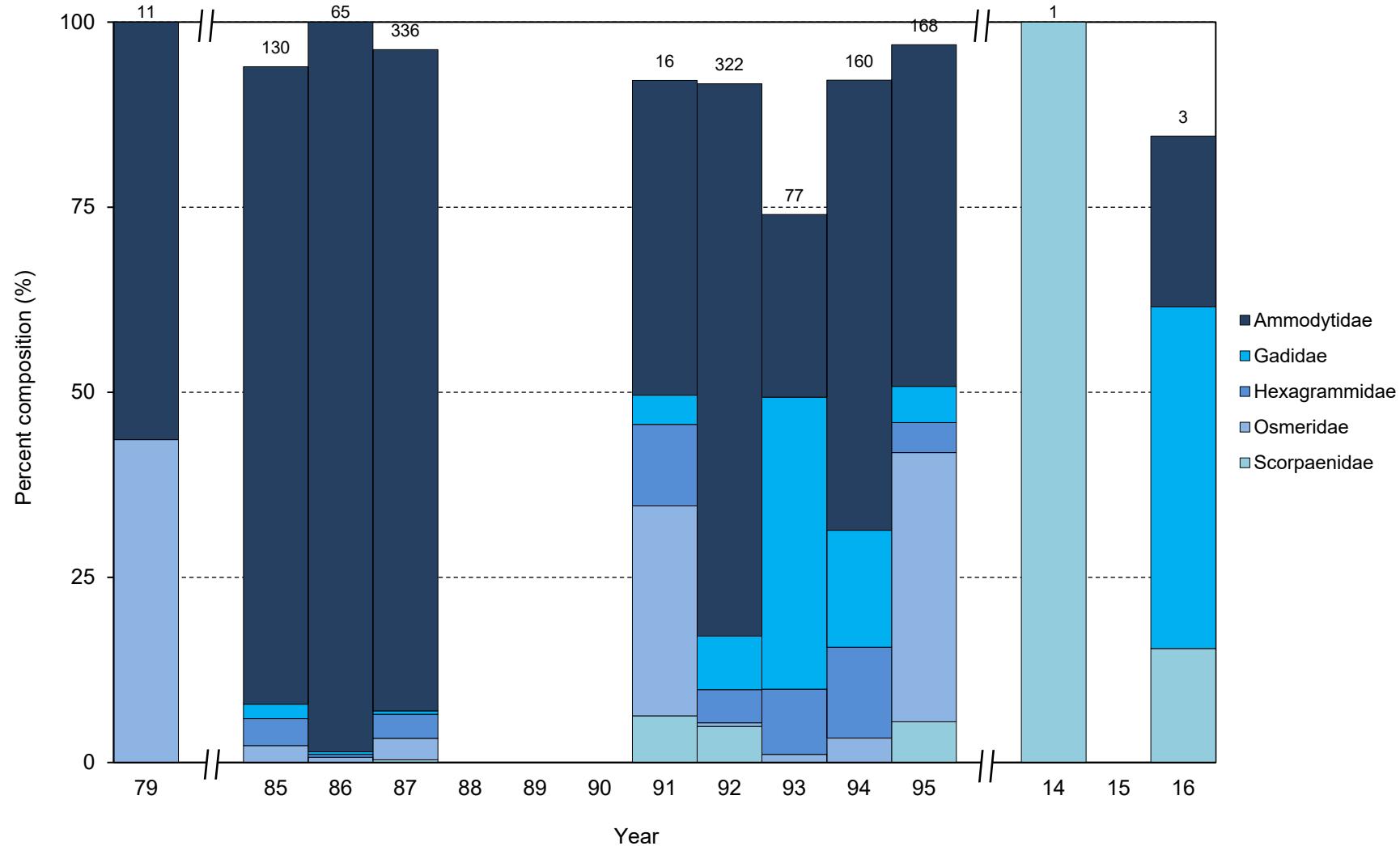


Figure 36. Percent composition of major prey items in diets of horned puffin chicks at Suklik Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2015, or 2017-2021.

Table 48. Percent composition of prey items in diets of horned puffin chicks at Suklik Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2015, or 2017-2021. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1979	1985	1986	1987	1991	1992	1993	1994	1995	2014	2016
No. samples	11	130	65	336	16	322	77	160	168	1	3
No. individuals	94	1928	833	1323	127	2050	454	816	817	2	13
Invertebrates	-	0.5	-	1.1	6.3	2.2	19.2	1.7	1.8	-	15.4
Fish	100.0	99.5	100.0	98.9	93.7	97.8	80.8	98.3	98.2	100.0	84.6
Teleostei	100.0	99.5	100.0	98.9	93.7	97.8	80.8	98.3	98.2	100.0	84.6
Ammodytidae	56.4	86.1	98.6	89.3	42.5	74.6	24.7	60.8	46.1	-	23.1
<i>Ammodytes</i> spp.	56.4	86.1	98.6	89.3	42.5	74.6	24.7	60.8	46.1	-	23.1
Gadidae	-	2.0	0.4	0.5	3.9	7.2	39.4	15.8	4.9	-	46.2
<i>Gadus chalcogrammus</i>	-	2.0	0.4	0.5	3.1	6.6	39.0	11.6	4.8	-	46.2
Other Gadidae	-	-	-	-	0.8	0.6	0.4	4.2	0.1	-	-
Hexagrammidae	-	3.6	0.4	3.3	11.0	4.5	8.8	12.3	4.0	-	-
Osmeridae	43.6	2.3	0.7	2.9	28.3	0.5	1.1	3.3	36.4	-	-
<i>Mallotus villosus</i>	43.6	2.3	0.7	2.9	28.3	0.5	1.1	3.3	36.4	-	-
Scorpaenidae	-	-	-	0.4	6.3	4.9	-	-	5.5	100.0	15.4
Unid. Scorpaenidae	-	-	-	-	6.3	4.9	-	-	-	100.0	-
Other Scorpaenidae	-	-	-	0.4	-	-	-	-	5.5	-	15.4
Other Teleostei	-	5.5	-	2.6	1.6	6.1	6.8	6.1	1.2	-	-

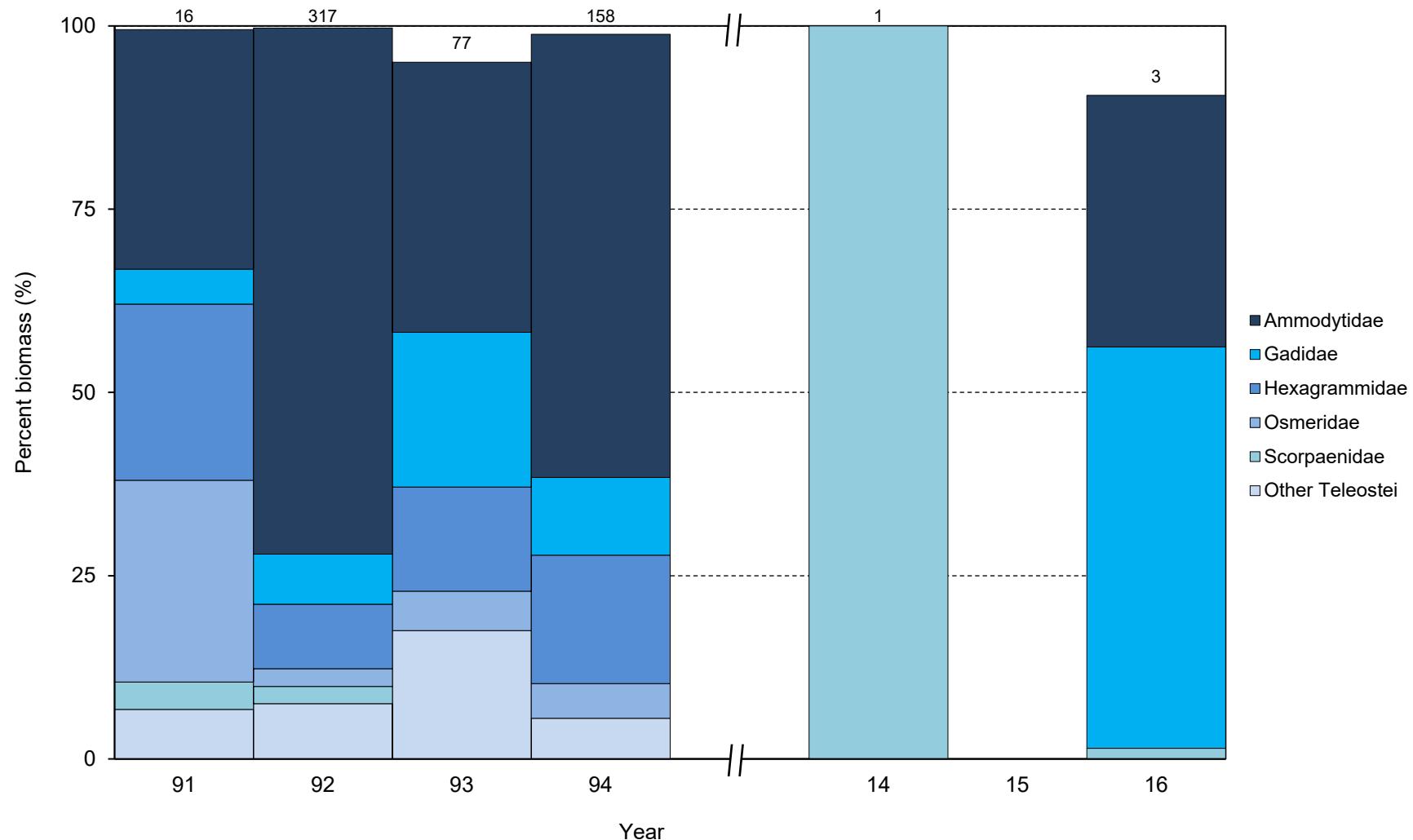


Figure 37. Relative biomass of major prey items in diets of horned puffin chicks at Suklik Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average biomass of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2015, or 2017-2021 and no mass data exist in 1979, 1985-1987, or 1995.

Table 49. Relative biomass of prey items in diets of horned puffin chicks at Suklik Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average biomass of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2015, or 2017-2021 and no mass data exist in 1979, 1985-1987, or 1995. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1991	1992	1993	1994	2014	2016
No. samples	16	317	77	158	1	3
Total mass (g)	201	2664	274	1117	3	22
Invertebrates	0.5	0.3	4.9	1.2	-	9.5
Fish	99.5	99.7	95.1	98.8	100.0	90.5
Teleostei	99.5	99.7	95.1	98.8	100.0	90.5
Ammodytidae	32.7	71.8	36.9	60.5	-	34.3
<i>Ammodytes</i> spp.	32.7	71.8	36.9	60.5	-	34.3
Gadidae	4.8	6.8	21.1	10.6	-	54.8
<i>Gadus chalcogrammus</i>	4.2	6.0	21.0	8.5	-	54.8
Other Gadidae	0.6	0.8	0.1	2.1	-	-
Hexagrammidae	24.0	8.8	14.2	17.5	-	-
<i>Hexagrammos decagrammus</i>	-	-	12.7	15.4	-	-
Unid. Hexagrammidae	24.0	8.8	1.5	0.5	-	-
Other Hexagrammidae	-	-	-	1.6	-	-
Osmeridae	27.5	2.4	5.4	4.8	-	-
<i>Mallotus villosus</i>	27.5	2.4	5.4	4.8	-	-
Scorpaenidae	3.7	2.3	-	-	100.0	1.4
Unid. Scorpaenidae	3.7	2.3	-	-	100.0	-
Other Scorpaenidae	-	-	-	-	-	1.4
Other Teleostei	6.8	7.5	17.5	5.5	-	-

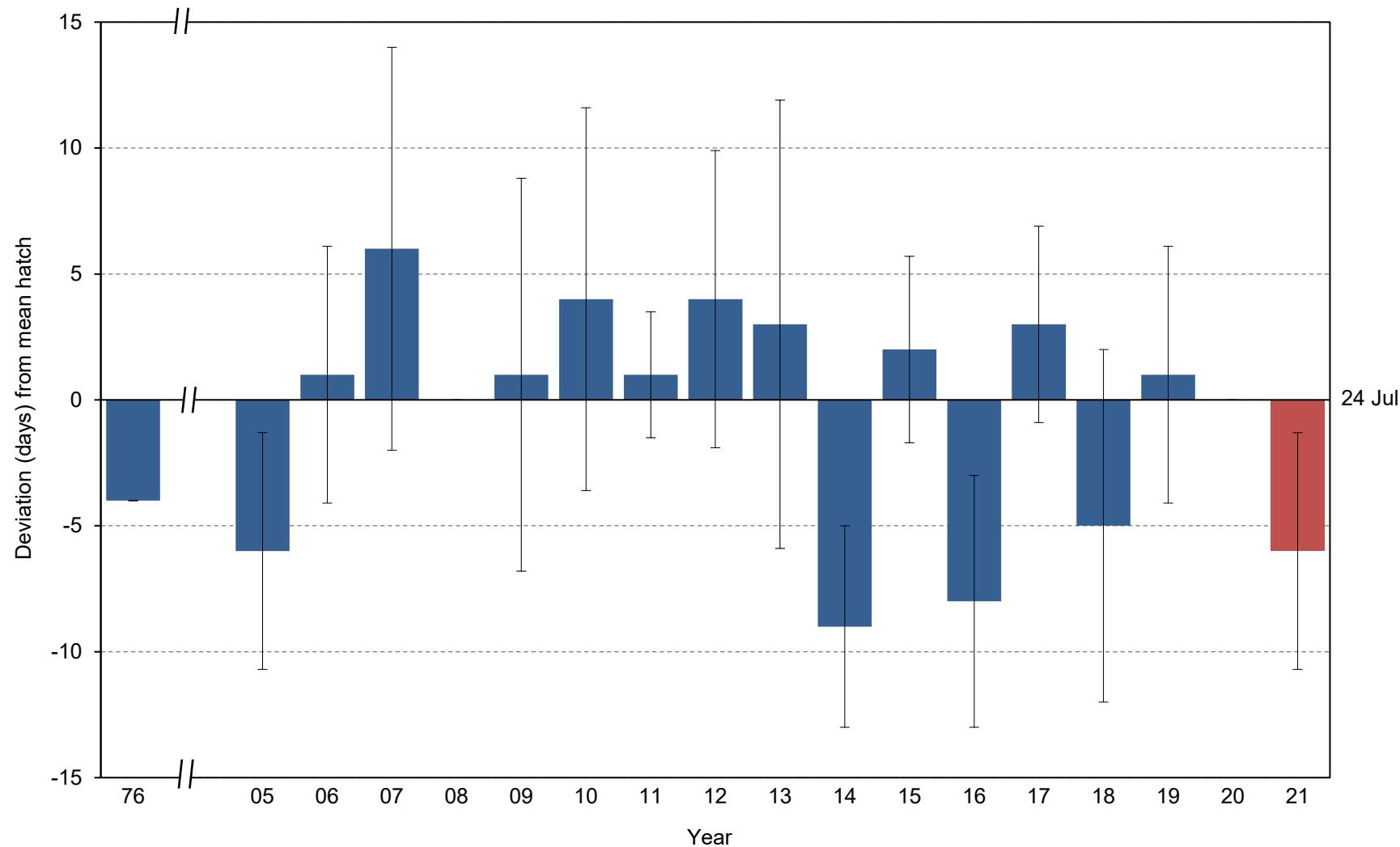


Figure 38. Yearly hatch date deviation (from the 1976-2020 average of 24 July) for tufted puffins at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year. No data were collected in 1977-2004, 2008, or 2020.

Table 50. Breeding chronology of tufted puffins at Chowiet Island, Alaska. No data were collected in 1977–2004, 2008, or 2020.

Year	Mean hatch	SD	n ^a	First hatch	Last hatch	First fledge ^b
1976	19 Jul	-	48	9 Jul	14 Aug	4 Sep
2005	18 Jul	4.7	28	9 Jul	27 Jul	26 Aug
2006	25 Jul	5.1	17	21 Jul	6 Aug	27 Aug
2007	30 Jul	8.0	15	23 Jul	24 Aug	>1 Sep
2009	25 Jul	7.8	12	13 Jul	6 Aug	2 Sep
2010	28 Jul	7.6	17	15 Jul	9 Aug	27 Aug
2011	25 Jul	2.5	4	23 Jul	29 Jul	>6 Sep
2012	27 Jul	5.9	12	14 Jul	9 Aug	31 Aug
2013	27 Jul	8.9	24	17 Jul	22 Aug	>30 Aug
2014	15 Jul	4.0	23	5 Jul	23 Jul	21 Aug
2015	26 Jul	3.7	26	23 Jul	5 Aug	>1 Sep
2016	15 Jul	5.0	40	8 Jul	2 Aug	20 Aug
2017	27 Jul	3.9	31	21 Jul	6 Aug	>1 Sep
2018	19 Jul	7.0	29	9 Jul	12 Aug	27 Aug
2019	25 Jul	5.1	26	16 Jul	6 Aug	>2 Sep
2021	18 Jul	4.7	26	11 Jul	31 Jul	22 Aug

^aSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

^bIn years when no chicks fledged before the field crew left the island at the end of the season, date of first fledge is listed as > the date of last nest check.

Table 51. Frequency distribution of hatch dates for tufted puffins at Chowiet Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1977–2004, 2008, or 2020; data from individual nests are not available in 1976.

Julian date ^a	No. nests hatching on Julian date															
	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	21
186	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	3	-	-	-	-	-	-	-	-	1	-	4	-	1	-	-
191	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	4
193	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
194	1	-	-	-	1	-	-	-	-	3	-	11	-	1	-	-
195	1	-	-	-	-	-	-	-	-	-	-	11	-	1	-	-
196	7	-	-	-	2	1	-	1	-	7	-	-	-	8	-	8
197	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
198	3	-	-	-	-	3	-	-	3	2	-	3	-	-	-	3
199	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	4	-	4	-	5	1	1
201	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	4
202	7	9	-	-	1	-	-	-	2	-	-	2	3	5	2	7
203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
204	1	-	4	-	-	1	2	1	1	1	9	1	-	2	5	-
205	-	-	-	-	-	-	1	-	-	-	5	-	4	-	-	-
206	2	-	-	-	-	-	-	3	1	-	-	-	10	1	-	1
207	-	1	-	-	-	-	-	-	4	-	-	2	-	-	1	-
208	1	3	1	-	-	3	-	-	-	-	2	-	-	-	5	-
209	-	-	-	-	-	1	-	-	2	-	5	-	6	-	3	-
210	-	-	6	-	4	-	1	3	1	-	-	-	4	1	-	-
211	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-
212	-	2	-	-	1	2	-	3	2	-	1	-	-	-	1	1
213	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-	-
214	-	1	-	-	-	-	-	-	1	-	-	-	1	-	1	-
215	-	-	1	-	1	-	-	-	-	-	-	1	-	-	-	-
216	-	-	-	-	-	2	-	-	1	-	-	-	-	1	-	-
217	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
218	-	1	2	-	1	2	-	-	-	-	-	-	2	-	1	-
219	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
221	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
223	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
229	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
231	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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233	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
234	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
235	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
236	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>n</i>	28	17	15	-	12	17	4	12	24	23	26	40	31	29	26	26

^aIn leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

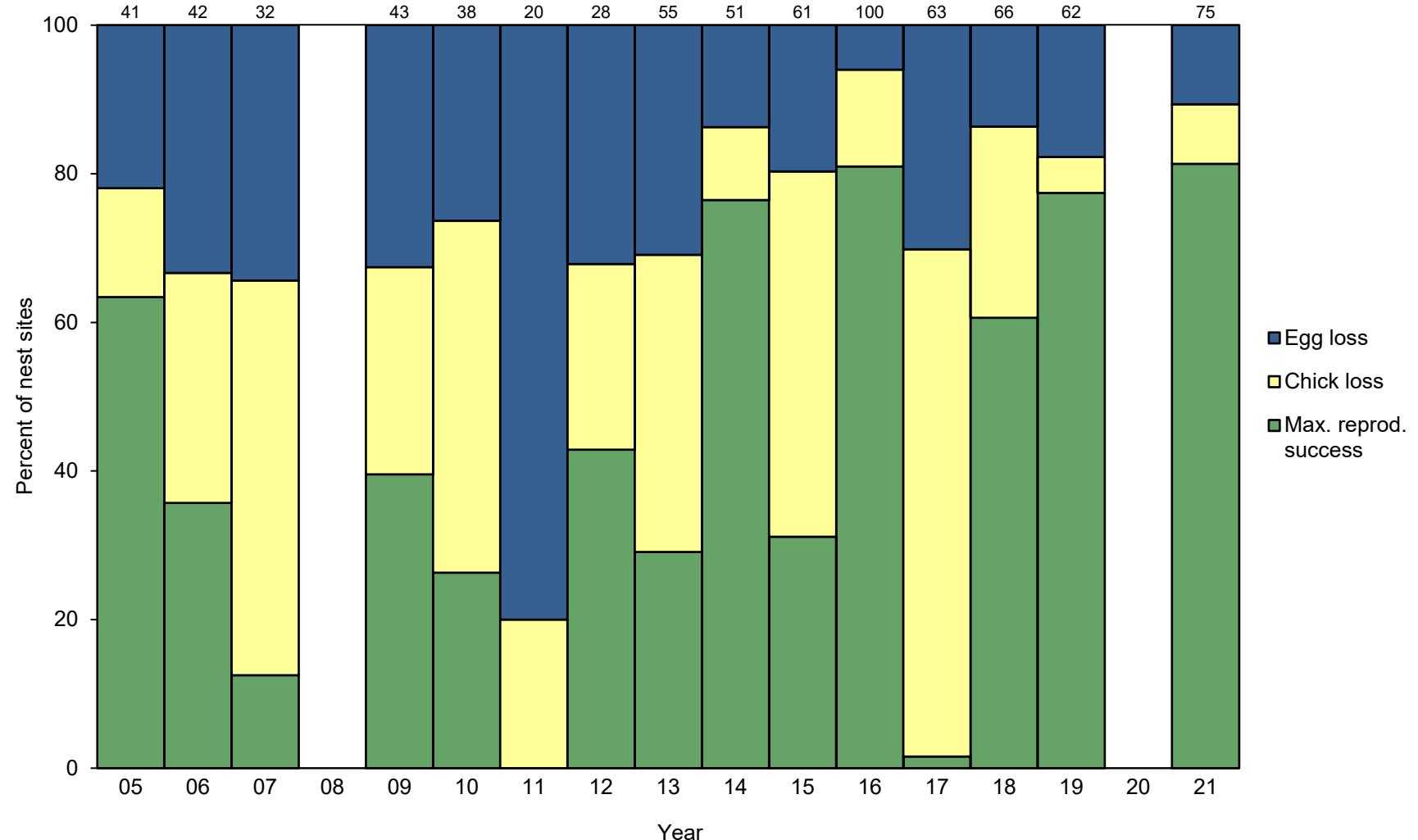


Figure 39. Maximum potential reproductive performance of tufted puffins at Chowiet Island, Alaska. Values include nest sites with chicks still present but too young to consider fledged at the last check. Egg loss=[(B+H)-D+H]/(B+H); Chick loss=[(D+H)-F+H]/(B+H); Maximum potential reproductive success=[(F+H)/(B+H)], where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged; H=nest sites with young chicks still present. Numbers above columns indicate sample sizes (B+H). No data were collected in 1977-2004, 2008, or 2020; maximum values are not available in 1976.

Table 52. Reproductive performance of tufted puffins at Chowiet Island, Alaska. No data were collected in 1977-2004, 2008, or 2020.

Year	Nest sites w/ young chicks still present ^a				Nesting success (D/B) ^b		Fledging success (F/D) ^c		Reproductive success (F/B)		Max. potential nesting success ^d [(D+H)/(B+H)]		Max. potential fledging success ^d [(F+H)/(D+H)]		Max. potential reproductive success ^d [(F+H)/(B+H)]		Sampling design ^e
	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	(H)	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	
1976	38	16	9	-	0.42	0.08	0.56	0.12	0.24	0.07	-	-	-	-	-	Simple random	
2005	41	32	26	0	0.78	0.06	0.81	0.07	0.63	0.08	0.78	0.06	0.81	0.07	0.63	0.08	Simple random
2006	38	24	11	4	0.63	0.08	0.46	0.10	0.29	0.07	0.67	0.07	0.54	0.09	0.36	0.07	Simple random
2007	29	18	1	3	0.62	0.09	0.06	0.06	0.03	0.03	0.66	0.08	0.19	0.09	0.13	0.06	Simple random
2009	40	26	14	3	0.65	0.08	0.54	0.10	0.35	0.08	0.67	0.07	0.59	0.09	0.40	0.07	Simple random
2010	35	25	7	3	0.71	0.08	0.28	0.09	0.20	0.07	0.74	0.07	0.36	0.09	0.26	0.07	Simple random
2011	20	4	0	0	0.20	0.09	0.00	0.00	0.00	0.00	0.20	0.09	0.00	0.00	0.00	0.00	Simple random
2012	27	18	11	1	0.67	0.09	0.61	0.11	0.41	0.09	0.68	0.09	0.63	0.11	0.43	0.09	Simple random
2013	49	32	10	6	0.65	0.07	0.31	0.08	0.20	0.06	0.69	0.06	0.42	0.08	0.29	0.06	Simple random
2014	48	41	36	3	0.85	0.05	0.88	0.05	0.75	0.06	0.86	0.05	0.89	0.05	0.76	0.06	Simple random
2015	54	42	12	7	0.78	0.06	0.29	0.07	0.22	0.06	0.80	0.05	0.39	0.07	0.31	0.06	Simple random
2016	100	94	81	0	0.94	0.02	0.86	0.04	0.81	0.04	0.94	0.02	0.86	0.04	0.81	0.04	Simple random
2017	63	44	1	0	0.70	0.06	0.02	0.02	0.02	0.02	0.70	0.06	0.02	0.02	0.02	0.02	Simple random
2018	61	52	35	5	0.85	0.05	0.67	0.07	0.57	0.06	0.86	0.04	0.70	0.06	0.61	0.06	Simple random
2019	48	37	34	14	0.77	0.06	0.92	0.04	0.71	0.07	0.82	0.05	0.94	0.03	0.77	0.05	Simple random
2021	71	63	57	4	0.89	0.04	0.90	0.04	0.80	0.05	0.89	0.04	0.91	0.03	0.81	0.05	Simple random

^aChicks still present at last check but too young to consider successfully fledged by fledging age conventions (still present ≥ 33 d for tufted puffins). These nests are not included in the number of nest sites w/ eggs (B) or chicks (D) or estimates of success but are used only to calculate a value of maximum potential reproductive success.

^bFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^cFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^dValues of maximum potential success include nest sites with chicks still present but too young to consider fledged at the last check; these values may be useful in years when crews leave the island before many chicks reach fledging age.

^eSampling for puffins is based on nests as the sample unit. For simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho) / n}$, where ρ is the success rate and n is the sample size of individual nests.

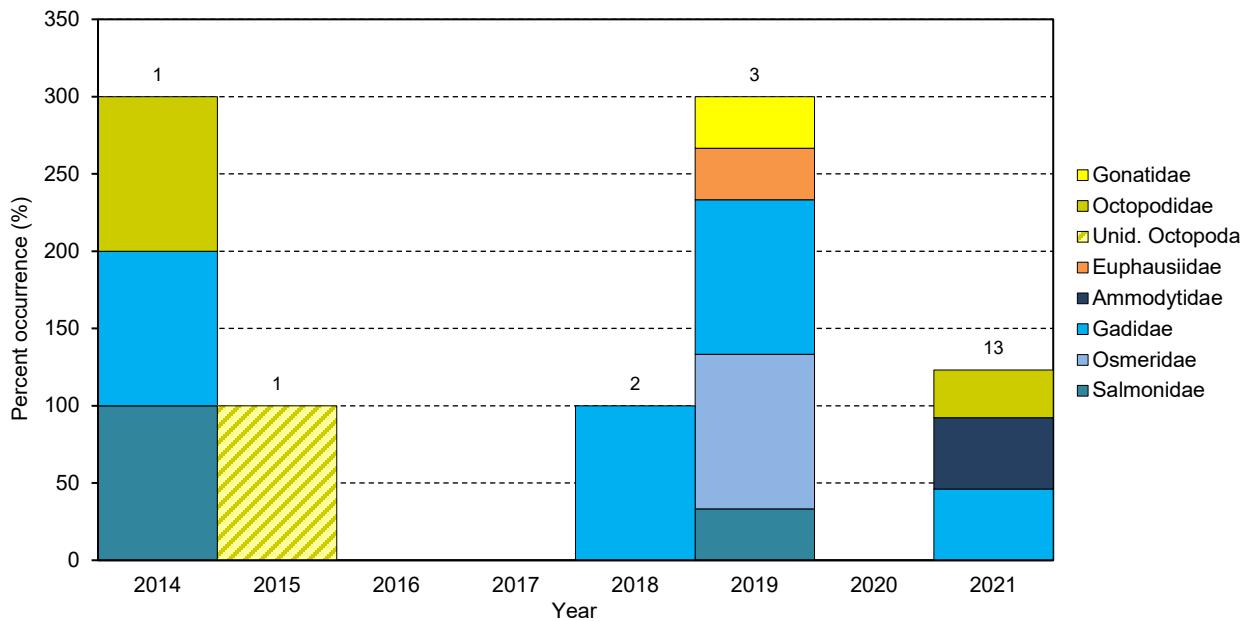


Figure 40. Frequency of occurrence of major prey items in diets of tufted puffin chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of bill loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 2016-2017 or 2020.

Table 53. Frequency of occurrence of major prey items in diets of tufted puffin chicks at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 2016-2017 or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2014	2015	2018	2019	2021
No. samples	1	1	2	3	13
Invertebrates	100.0	100.0	-	33.3	30.8
Cephalopoda	100.0	100.0	-	33.3	30.8
Gonatidae	-	-	-	33.3	-
Unid. Gonatidae	-	-	-	33.3	-
Octopodidae	100.0	-	-	-	30.8
<i>Enteroctopus dofleini</i>	100.0	-	-	-	-
Unid. Octopodidae	-	-	-	-	30.8
Unid. Octopoda	-	100.0	-	-	-
Euphausiacea	-	-	-	33.3	-
Euphausiidae	-	-	-	33.3	-
<i>Thysanoessa inermis</i>	-	-	-	33.3	-
Fish	100.0	0.0	100.0	100.0	76.9
Teleostei	100.0	0.0	100.0	100.0	76.9
Ammodytidae	-	-	-	-	46.2
<i>Ammodytes</i> spp.	-	-	-	-	46.2
Gadidae	-	-	-	100.0	46.2
<i>Gadus chalcogrammus</i>	-	-	-	100.0	46.2
Osmeridae	100.0	-	-	33.3	-
<i>Mallotus villosus</i>	100.0	-	-	33.3	-
Salmonidae	-	-	100.0	-	-
<i>Oncorhynchus</i> spp.	-	-	100.0	-	-
Other Teleostei	-	-	-	-	15.4

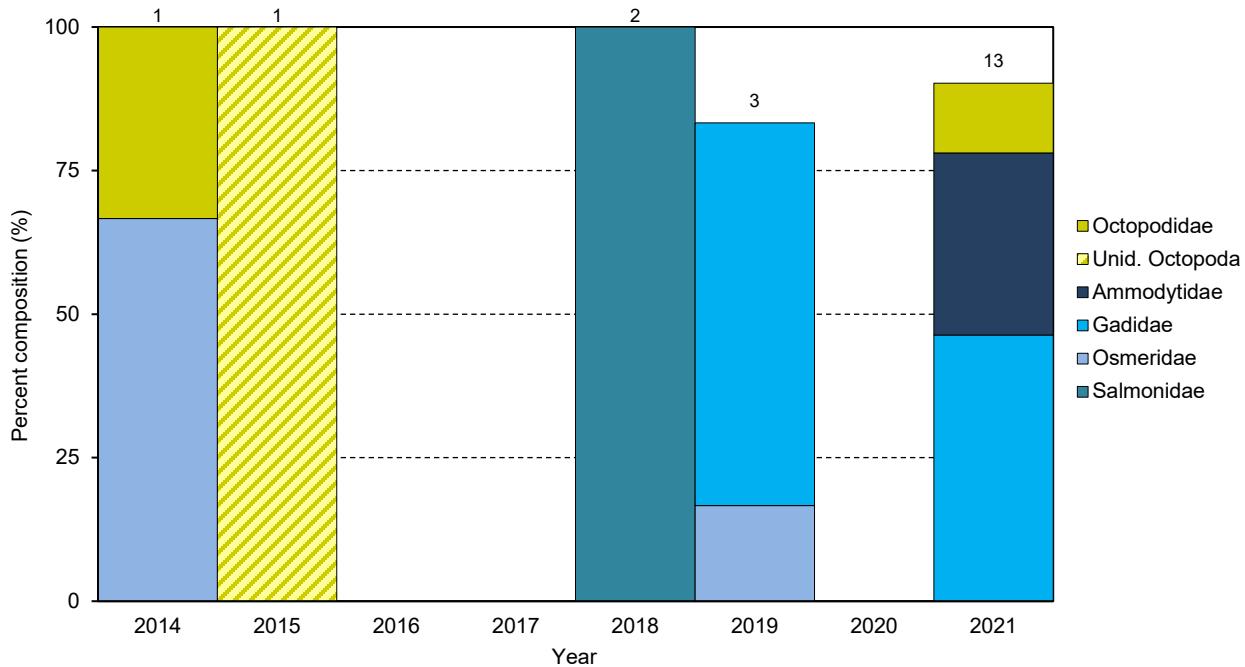


Figure 41. Percent composition of major prey items in diets of tufted puffin chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of bill loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 2016-2017 or 2020.

Table 54. Percent composition of major prey items in diets of tufted puffin chicks at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 2016-2017 or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2014	2015	2018	2019	2021
No. samples	1	1	2	3	13
No. individuals	6	1	2	12	41
Invertebrates	33.3	100.0	-	16.7	12.2
Cephalopoda	33.3	100.0	-	8.3	12.2
Octopodidae	33.3	-	-	-	12.2
<i>Enteroctopus dofleini</i>	33.3	-	-	-	-
Other Octopodidae	-	-	-	-	12.2
Unid. Octopoda	-	100.0	-	-	-
Other Cephalopda	-	-	-	8.3	-
Other Invertebrates	-	-	-	8.3	-
Fish	66.7	-	100.0	83.3	87.8
Teleostei	66.7	-	100.0	83.3	87.8
Ammodytidae	-	-	-	-	31.7
<i>Ammodytes</i> spp.	-	-	-	-	31.7
Gadidae	-	-	-	66.7	46.3
<i>Gadus chalcogrammus</i>	-	-	-	66.7	46.3
Osmeridae	66.7	-	-	16.7	-
<i>Mallotus villosus</i>	66.7	-	-	16.7	-
Salmonidae	-	-	100.0	-	-
<i>Oncorhynchus</i> spp.	-	-	100.0	-	-
Other Teleostei	-	-	-	-	9.8

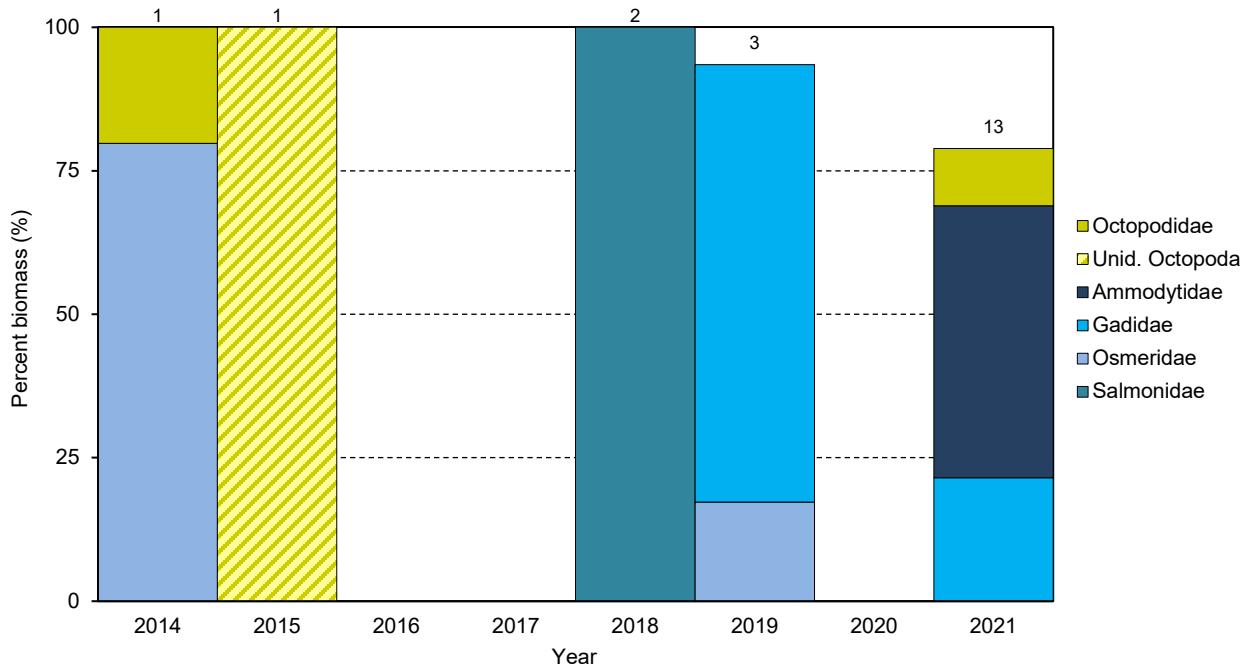


Figure 42. Relative biomass of major prey items in diets of tufted puffin chicks at Chowiet Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average biomass of at least 5% are shown. Samples consist of bill loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 2016-2017 or 2020.

Table 55. Relative biomass of major prey items in diets of tufted puffin chicks at Chowiet Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average biomass of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 2016-2017 or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2014	2015	2018	2019	2021
No. samples	1	1	2	3	13
Total mass (g)	9	1	59	19	52
Invertebrates	20.2	100.0	-	6.5	10.0
Cephalopoda	20.2	100.0	-	5.9	10.0
Octopodidae	20.2	-	-	-	10.0
Unid. Octopoda	-	100.0	-	-	-
Other Cephalopda	-	-	-	5.9	-
Other Invertebrates	-	-	-	0.6	-
Fish	79.8	-	100.0	93.5	90.0
Teleostei	79.8	-	100.0	93.5	90.0
Ammodytidae	-	-	-	-	47.4
<i>Ammodytes</i> spp.	-	-	-	-	47.4
Gadidae	-	-	-	76.2	21.5
<i>Gadus chalcogrammus</i>	-	-	-	76.2	21.5
Osmeridae	79.8	-	-	17.3	-
<i>Mallotus villosus</i>	79.8	-	-	17.3	-
Salmonidae	-	-	100.0	-	-
<i>Oncorhynchus</i> spp.	-	-	100.0	-	-
Other Teleostei	-	-	-	-	21.1

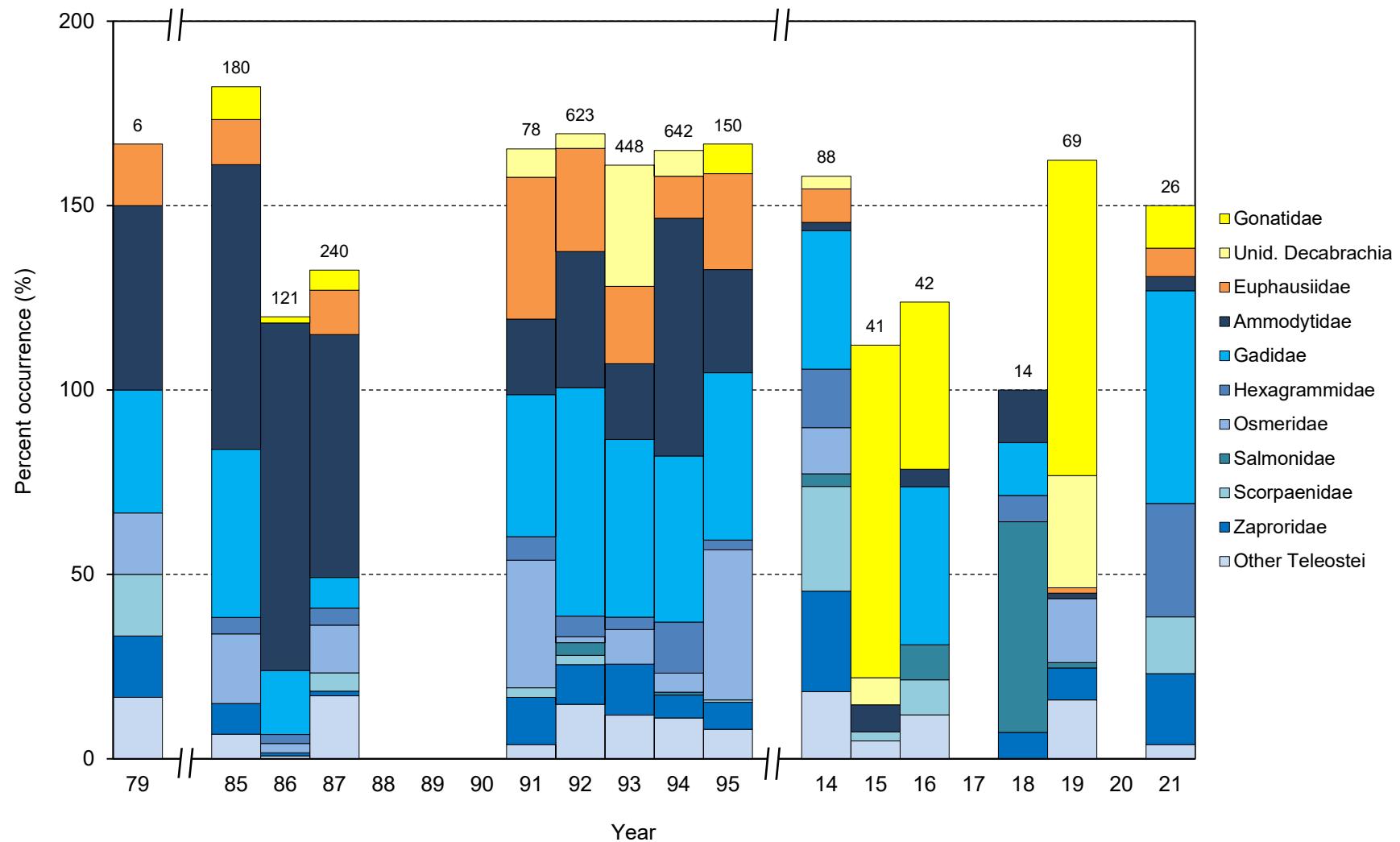


Figure 43. Frequency of occurrence of major prey items in diets of tufted puffin chicks at Suklik Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2017, or 2020.

Table 56. Frequency of occurrence of prey items in diets of tufted puffin chicks at Suklik Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2017, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1979	1985	1986	1987	1991	1992	1993	1994	1995	2014	2015	2016	2018	2019	2021
No. samples	6	180	121	240	78	623	448	642	150	88	41	42	14	69	26
Invertebrates	16.7	22.8	3.3	20.0	56.4	33.1	50.9	17.9	32.7	14.8	100.0	45.2	-	88.4	19.2
Cephalopoda	-	11.7	3.3	8.8	19.2	8.2	37.3	8.6	9.3	6.8	100.0	45.2	-	87.0	11.5
Gonatidae	-	8.9	1.7	5.4	-	-	-	-	8.0	-	90.2	45.2	-	85.5	11.5
Unid. Gonatidae	-	8.9	1.7	5.4	-	-	-	-	8.0	-	85.4	42.9	-	85.5	11.5
Other Gonatidae	-	-	-	-	-	-	-	-	-	4.9	4.8	-	-	-	-
Unid. Decabrachia	-	-	-	-	7.7	4.0	32.8	7.0	-	3.4	7.3	-	-	30.4	-
Other Cephalopoda	-	3.3	1.7	4.2	11.5	4.5	6.0	1.7	2.0	4.5	2.4	-	-	1.4	-
Euphausiacea	16.7	12.2	-	12.1	38.5	27.9	21.0	11.4	26.0	9.1	-	-	-	1.4	7.7
Euphausiidae	16.7	12.2	-	12.1	38.5	27.9	21.0	11.4	26.0	9.1	-	-	-	1.4	7.7
<i>Thysanoessa</i> spp.	16.7	12.2	-	12.1	-	-	-	-	26.0	-	-	-	-	-	3.8
Unid. Euphausiidae	-	-	-	-	38.5	27.9	21.0	11.4	-	9.1	-	-	-	-	3.8
Other Euphausiidae	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	3.8
Other Invertebrates	-	-	-	0.4	2.6	1.3	1.3	-	-	-	-	-	-	-	3.8
Fish	100.0	96.7	100.0	92.9	79.5	92.0	81.5	95.6	88.7	93.2	12.2	61.9	100.0	40.6	92.3
Teleostei	100.0	96.7	100.0	92.9	79.5	92.0	81.5	95.6	88.7	93.2	12.2	61.9	100.0	40.6	92.3
Ammodytidae	50.0	77.2	94.2	65.8	20.5	36.9	20.5	64.5	28.0	2.3	7.3	4.8	14.3	1.4	3.8
<i>Ammodytes</i> spp.	50.0	77.2	94.2	65.8	20.5	36.9	20.5	64.5	28.0	2.3	7.3	4.8	14.3	1.4	3.8
Gadidae	33.3	45.6	17.4	8.3	38.5	62.0	48.2	45.0	45.3	37.5	-	42.9	14.3	-	57.7
<i>Gadus chalcogrammus</i>	33.3	45.6	12.4	8.3	30.8	56.2	45.8	38.6	42.7	27.3	-	40.5	14.3	-	57.7
Other Gadidae	-	-	10.7	-	12.8	19.3	8.3	15.6	5.3	17.0	-	2.4	-	-	-
Hexagrammidae	-	4.4	2.5	4.6	6.4	5.6	3.3	13.9	2.7	15.9	-	-	7.1	-	30.8
Osmeridae	16.7	18.9	2.5	12.9	34.6	1.6	9.4	5.1	40.7	12.5	-	-	-	17.4	-
<i>Mallotus villosus</i>	16.7	17.8	2.5	12.9	34.6	1.3	9.4	5.1	40.7	11.4	-	-	-	7.2	-
Other Osmeridae	-	1.7	-	-	-	0.5	-	-	-	1.1	-	-	-	10.1	-
Salmonidae	-	-	-	-	-	3.4	-	0.8	-	3.4	-	9.5	57.1	1.4	-
Scorpaenidae	16.7	-	-	5.0	2.6	2.6	-	-	0.7	28.4	2.4	9.5	-	-	15.4
Zaproridae	16.7	8.3	0.8	1.3	12.8	10.8	13.8	6.2	7.3	27.3	-	-	7.1	8.7	19.2
<i>Zaprora silenus</i>	16.7	8.3	0.8	1.3	12.8	10.8	13.8	6.2	7.3	27.3	-	-	7.1	8.7	19.2
Other Teleostei	16.7	6.7	0.8	17.1	3.8	14.8	11.8	11.1	8.0	18.2	4.9	11.9	-	15.9	3.8
Other	-	-	-	-	2.6	0.2	-	-	-	-	-	-	-	-	-

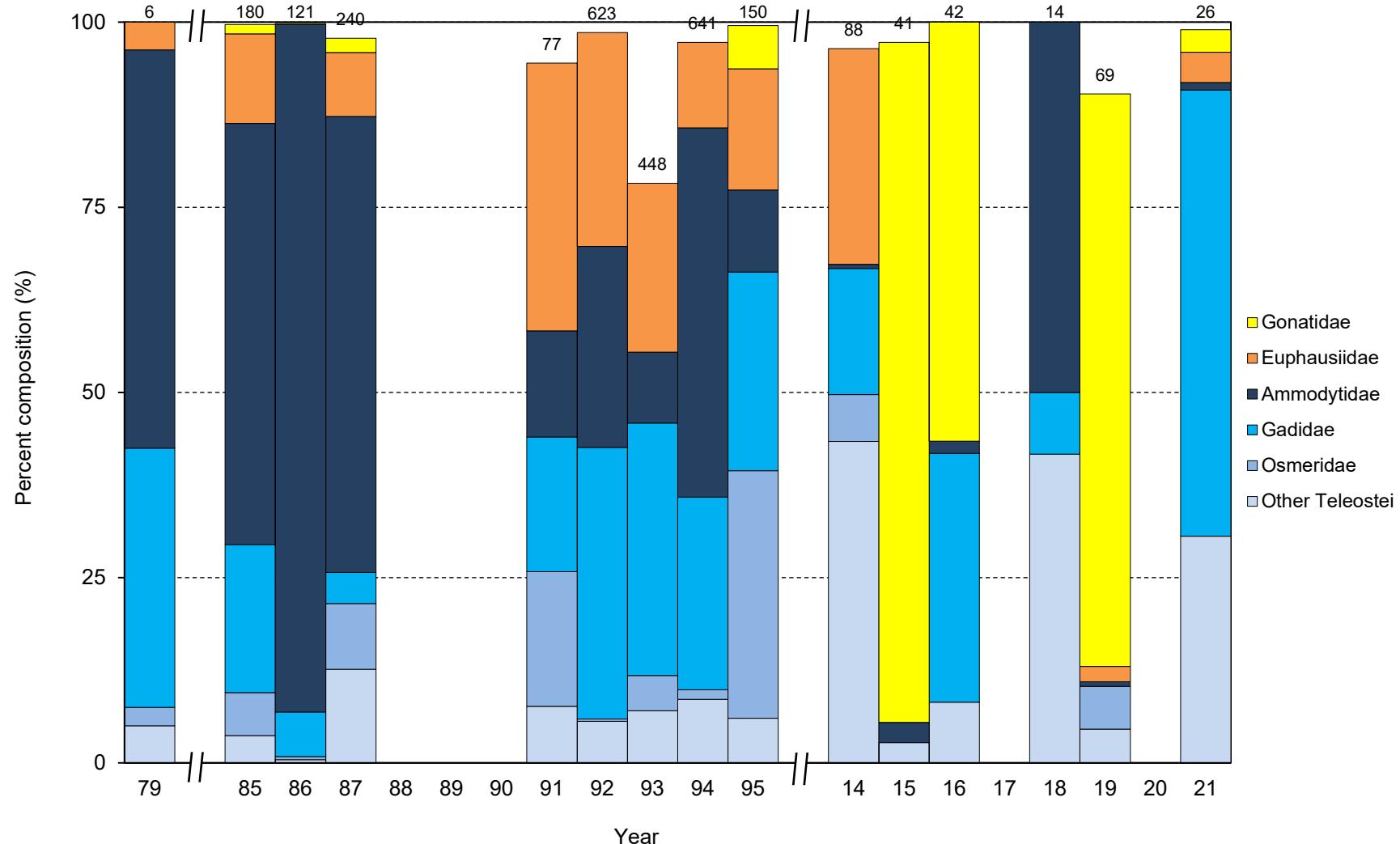


Figure 44. Percent composition of major prey items in diets of tufted puffin chicks at Suklik Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2017, or 2020.

Table 57. Percent composition of prey items in diets of tufted puffin chicks at Suklik Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2017, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1979	1985	1986	1987	1991	1992	1993	1994	1995	2014	2015	2016	2018	2019	2021
No. samples	6	180	121	240	77	623	448	641	150	88	41	42	14	69	26
No. individuals	80	1812	1180	879	523	5869	2840	4328	649	364	183	122	24	484	98
Invertebrates	3.8	13.7	0.3	12.7	41.3	30.3	44.5	14.3	22.7	32.7	94.5	56.6	-	89.0	8.2
Cephalopoda	-	1.6	0.3	4.0	4.8	1.2	21.5	2.7	6.3	3.6	94.5	56.6	-	87.0	3.1
Gonatidae	-	1.3	0.2	1.9	-	-	-	-	5.9	-	91.8	56.6	-	77.3	3.1
Unid. Gonatidae	-	1.3	0.2	1.9	-	-	-	-	5.9	-	89.6	54.9	-	77.3	3.1
Other Gonatidae	-	-	-	-	-	-	-	-	-	2.2	1.6	-	-	-	-
Other Cephalopoda	-	0.3	0.2	2.0	-	-	21.5	2.7	0.5	3.6	2.7	-	-	9.7	-
Euphausiacea	3.8	12.1	-	8.6	36.1	28.9	22.8	11.6	16.3	29.1	-	-	-	2.1	4.1
Euphausiidae	3.8	12.1	-	8.6	36.1	28.9	22.8	11.6	16.3	29.1	-	-	-	2.1	4.1
Unid. Euphausiidae	-	-	-	-	36.1	28.9	22.8	11.6	-	29.1	-	-	-	-	1.0
Other Euphausiidae	3.8	12.1	-	8.6	-	-	-	-	16.3	-	-	-	-	2.1	3.1
Other Invertebrates	-	-	-	0.1	0.4	0.2	0.2	-	-	-	-	-	-	-	1.0
Fish	96.3	86.3	99.7	87.3	58.3	69.7	55.5	85.7	77.3	67.3	5.5	43.4	100.0	11.0	91.8
Teleostei	96.3	86.3	99.7	87.3	58.3	69.7	55.5	85.7	77.3	67.3	5.5	43.4	100.0	11.0	91.8
Ammodytidae	53.8	56.8	92.8	61.5	14.3	27.1	9.6	49.8	11.1	0.5	2.7	1.6	50.0	0.6	1.0
Ammodytes spp.	53.8	56.8	92.8	61.5	14.3	27.1	9.6	49.8	11.1	0.5	2.7	1.6	50.0	0.6	1.0
Gadidae	35.0	20.0	6.0	4.2	18.2	36.7	34.1	26.0	26.8	17.0	-	33.6	8.3	-	60.2
Gadus chalcogrammus	35.0	20.0	2.5	4.2	14.5	32.8	31.8	22.0	25.6	11.8	-	32.0	8.3	-	60.2
Other Gadidae	-	-	3.6	-	3.6	3.8	2.3	4.0	1.2	5.2	-	1.6	-	-	-
Osmeridae	2.5	5.8	0.4	8.9	18.2	0.3	4.8	1.3	33.4	6.3	-	-	-	5.8	-
Mallotus villosus	2.5	4.0	0.4	8.9	18.2	0.2	4.8	1.3	33.4	6.0	-	-	-	3.9	-
Other Osmeridae	-	1.8	-	-	-	0.1	-	-	-	0.3	-	-	-	1.9	-
Other Teleostei	5.0	3.7	0.4	12.6	7.6	5.6	7.0	8.6	6.0	43.4	2.7	8.2	41.7	4.5	30.6
Other	-	-	-	-	0.4	<0.1	-	-	-	-	-	-	-	-	-

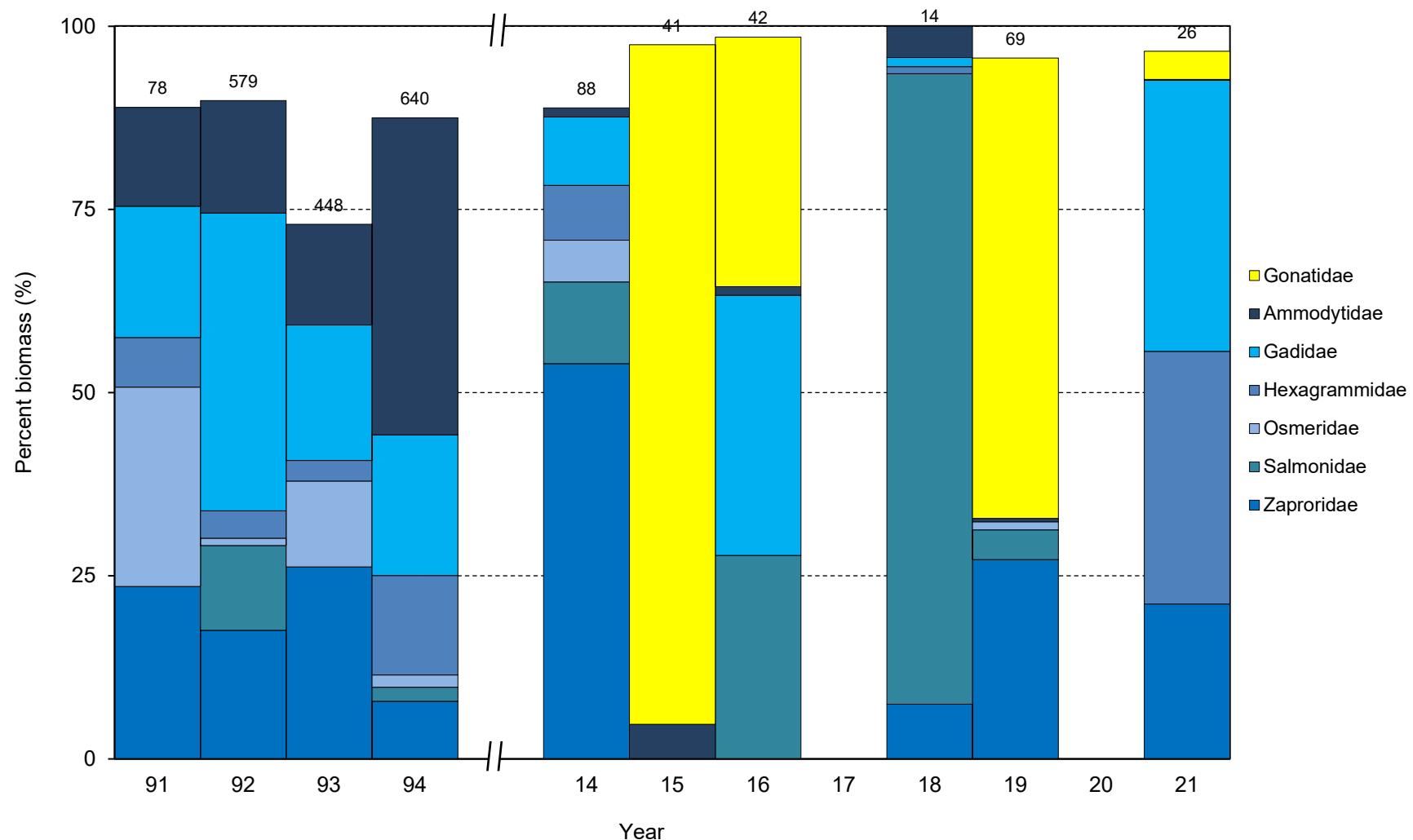


Figure 45. Relative biomass of major prey items in diets of tufted puffin chicks at Suklik Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average biomass of at least 5% are shown. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. Numbers above columns indicate sample sizes. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2017, or 2020 and no mass data exist in 1979, 1985-1987, or 1995.

Table 58. Relative biomass of prey items in diets of tufted puffin chicks at Suklik Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average biomass of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill-loads collected from adults returning to the colony to feed chicks. No diet samples were collected in 1980-1984, 1988-1990, 1996-2013, 2017, or 2020 and no mass data exist in 1979, 1985-1987, or 1995. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1991	1992	1993	1994	2014	2015	2016	2018	2019	2021
No. samples	78	579	448	640	88	41	42	14	69	26
Total mass (g)	566	5199	2099	3250	738	195	313	242	619	139
Invertebrates	10.2	5.8	22.1	6.3	3.3	94.9	34.1	-	66.3	4.0
Cephalopoda	5.1	2.3	19.3	4.6	2.2	94.9	34.1	-	66.2	3.8
Gonatidae	-	-	-	-	-	92.7	34.1	-	62.8	3.8
Unid. Gonatidae	-	-	-	-	-	89.6	32.2	-	62.8	3.8
Other Gonatidae	-	-	-	-	-	3.1	1.9	-	-	-
Other Cephalopoda	5.1	2.3	19.3	4.6	2.2	2.2	-	-	3.3	-
Other Invertebrates	5.1	3.5	2.7	1.7	1.1	-	-	-	0.2	0.2
Fish	89.7	94.1	77.9	93.7	96.7	5.1	65.9	100.0	33.7	96.0
Teleostei	89.7	94.1	77.9	93.7	96.7	5.1	65.9	100.0	33.7	96.0
Ammodytidae	13.5	15.4	13.8	43.3	1.2	4.7	1.2	4.2	0.5	0.1
Ammodytes spp.	13.5	15.4	13.8	43.3	1.2	4.7	1.2	4.2	0.5	0.1
Gadidae	17.9	40.6	18.5	19.2	9.3	-	35.5	1.3	-	37.0
Gadus chalcogrammus	15.6	34.2	17.7	16.4	6.9	-	35.1	1.3	-	37.0
Other Gadidae	2.3	6.5	0.8	2.8	2.5	-	0.4	-	-	-
Hexagrammidae	6.8	3.7	2.8	13.6	7.5	-	-	0.9	-	34.5
Osmeridae	27.2	1.0	11.7	1.7	5.7	-	-	-	1.1	-
Mallotus villosus	27.2	0.7	11.7	1.7	5.5	-	-	-	0.9	-
Other Osmeridae	-	0.2	-	-	0.2	-	-	-	0.2	-
Salmonidae	-	11.6	-	1.9	11.1	-	27.8	86.1	4.1	-
Oncorhynchus spp.	-	-	-	-	-	-	21.5	86.1	4.1	-
Other Salmonidae	-	11.6	-	1.9	11.1	-	6.3	-	-	-
Zaproridae	23.6	17.6	26.2	7.9	54.0	-	-	7.5	27.2	21.2
Zaprora silenus	23.6	17.6	26.2	7.9	54.0	-	-	7.5	27.2	21.2
Other Teleostei	0.8	4.3	5.0	6.2	7.9	0.3	1.5	-	0.8	3.2
Other	0.1	<0.1	-	-	-	-	-	-	-	-

Table 59. Frequency of occurrence of major prey items in diets of tufted puffin chicks at Kateekuk Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average occurrence of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2021
No. samples	5
Invertebrates	
Cephalopoda	40.0
Gonatidae	20.0
Unid. Gonatidae	20.0
Euphausiacea	20.0
Euphausiidae	20.0
<i>Thysanoessa spinifera</i>	20.0
Fish	60.0
Teleostei	60.0
Gadidae	40.0
<i>Gadus chalcogrammus</i>	20.0
Unid. Gadidae	20.0
Zaproridae	20.0
<i>Zaprora silenus</i>	20.0

Table 60. Percent composition of major prey items in diets of tufted puffin chicks at Kateekuk Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2021
No. samples	5
No. individuals	5
Invertebrates	
Cephalopoda	40.0
Gonatidae	20.0
Unid. Gonatidae	20.0
Euphausiacea	20.0
Euphausiidae	20.0
<i>Thysanoessa spinifera</i>	20.0
Fish	60.0
Teleostei	60.0
Gadidae	40.0
<i>Gadus chalcogrammus</i>	20.0
Unid. Gadidae	20.0
Zaproridae	20.0
<i>Zaprora silenus</i>	20.0

Table 61. Relative biomass of major prey items in diets of tufted puffin chicks at Kateekuk Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year). Prey was identified and measured in the laboratory to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average biomass of at least 5% are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of bill loads collected from adults returning to the colony to feed chicks. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2021
No. samples	5
Total mass (g)	24
Invertebrates	
Cephalopoda	2.5
Gonatidae	2.2
Unid. Gonatidae	2.2
Euphausiacea	0.4
Euphausiidae	0.4
<i>Thysanoessa spinifera</i>	0.4
Fish	97.5
Teleostei	97.5
Gadidae	2.6
<i>Gadus chalcogrammus</i>	1.6
Unid. Gadidae	1.1
Zaproridae	94.8
<i>Zaprora silenus</i>	94.8

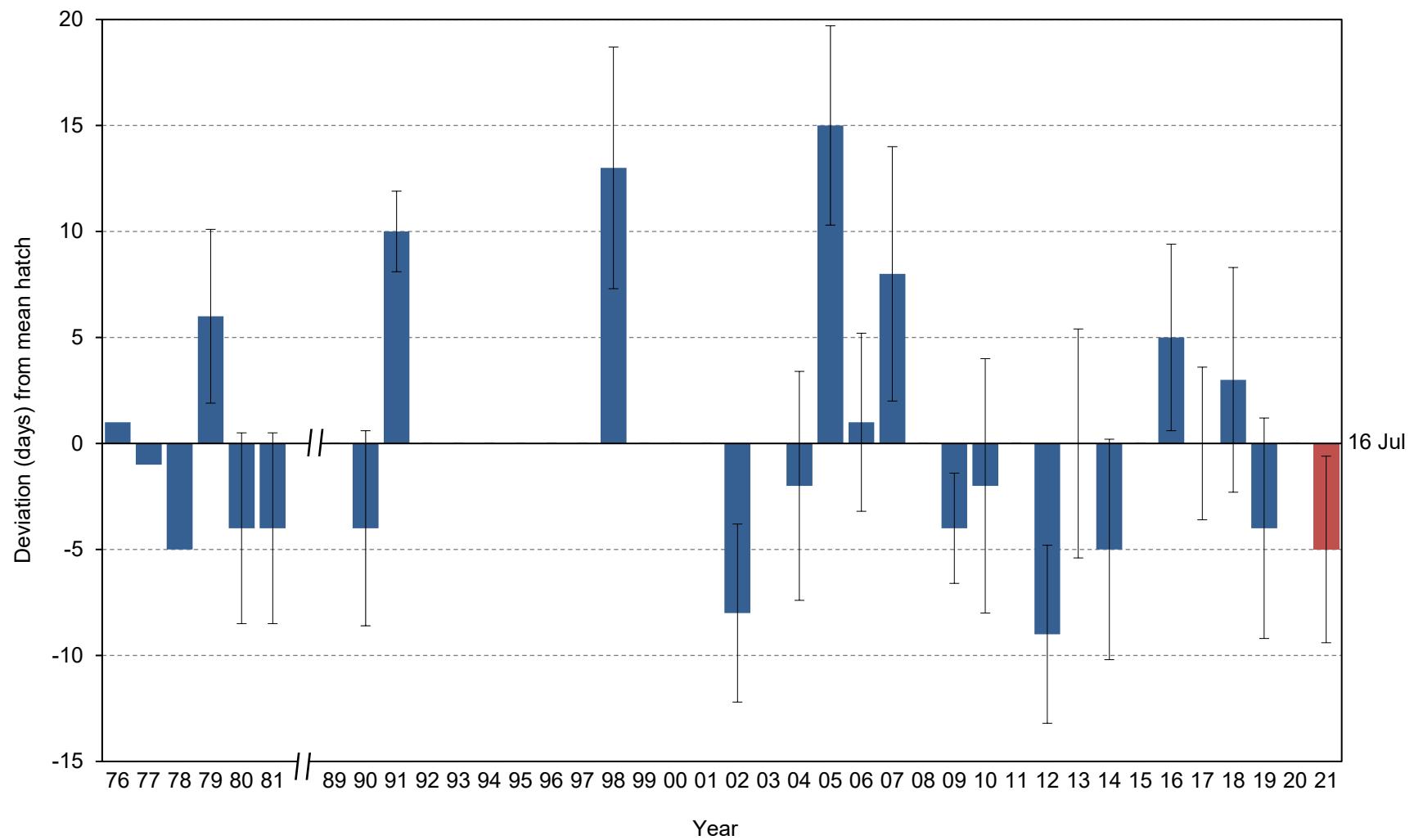


Figure 46. Yearly hatch date deviation (from the 1976-2020 average of 16 July) for black-legged kittiwakes at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date (no values available for 1976-1978); red highlights the current year. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched in plots in 1989, 2011, or 2015 and data potentially exist in 1995 but have not yet been summarized.

Table 62. Breeding chronology of black-legged kittiwakes at Chowiet Island, Alaska. Data represent the dates of the first egg laid and the first chick hatched in each nest. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched in plots in 1989, 2011, or 2015.

Year	Mean lay	SD	n ^a	Mean hatch	SD	n ^b	First lay	First hatch	Last hatch	First fledge ^c
1976	20 Jun	-	40	16 Jul ^d	-	-	10 Jun	7 Jul	4 Aug	20 Aug
1977	19 Jun	-	54	15 Jul ^d	-	-	9 Jun	-	-	-
1978	15 Jun	-	46	11 Jul ^d	-	-	5 Jun	3 Jul	26 Jul	12 Aug
1979	25 Jun	4.3	99	22 Jul	4.1	70	19 Jun	15 Jul	4 Aug	>25 Aug
1980	14 Jun	5.1	120	11 Jul	4.5	46	6 Jun	2 Jul	20 Jul	19 Aug
1981	14 Jun	4.4	126	12 Jul	4.5	109	6 Jun	4 Jul	1 Aug	17 Aug
1989	1 Jul	2.8	23	-	-	-	27 Jun	-	-	-
1990	-	-	-	12 Jul	4.6	11	-	3 Jul	21 Jul	15 Aug
1991	28 Jun	3.5	14	26 Jul	1.9	3	23 Jun	25 Jul	29 Jul	-
1995	xx ^e	xx	xx	xx	xx	xx	17 Jun	xx	xx	xx
1998	1 Jul	7.0	57	29 Jul	5.7	30	19 Jun	19 Jul	10 Aug	28 Aug
2002	11 Jun	4.6	121	8 Jul	4.2	108	2 Jun	29 Jun	25 Jul	18 Aug
2004	15 Jun	4.2	121	13 Jul	5.4	41	10 Jun	4 Jul	24 Jul	>15 Aug
2005	4 Jul	6.9	32	31 Jul	4.7	23	16 Jun	25 Jul	12 Aug	30 Aug
2006	21 Jun	4.9	319	17 Jul	4.2	222	9 Jun	9 Jul	29 Jul	21 Aug
2007	29 Jun	5.1	99	24 Jul	6.0	71	19 Jun	13 Jul	6 Aug	25 Aug
2009	20 Jun	3.2	65	12 Jul	2.6	107	17 Jun	5 Jul	19 Jul	18 Aug
2010	20 Jun	4.7	75	14 Jul	6.0	85	15 Jun	1 Jul	3 Aug	15 Aug
2011	19 Jul	0.0	1	-	-	-	19 Jul	-	-	-
2012	11 Jun	4.2	135	6 Jul	5.2	90	<6 Jun	24 Jun	19 Jul	13 Aug
2013	18 Jun	4.3	143	16 Jul	5.4	96	9 Jun	6 Jul	1 Aug	18 Aug
2014	14 Jun	5.7	240	11 Jul	5.2	188	7 Jun	3 Jul	25 Jul	14 Aug
2015	2 Jul	2.5	27	-	-	-	25 Jun	-	-	-
2016	23 Jun	4.4	178	20 Jul	4.4	203	16 Jun	14 Jul	15 Aug	20 Aug
2017	20 Jun	4.3	101	16 Jul	3.6	101	13 Jun	7 Jul	27 Jul	19 Aug
2018	24 Jun	5.7	221	19 Jul	5.3	93	13 Jun	7 Jul	6 Aug	21 Aug
2019	15 Jun	5.3	262	12 Jul	5.2	186	7 Jun	3 Jul	29 Jul	13 Aug
2021	15 Jun	4.3	273	11 Jul	4.4	169	5 Jun	3 Jul	23 Jul	12 Aug

^aSample sizes for mean lay dates are a sub-sample of total nests for which no egg to egg interval is ≤ 7 days.

^bSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

^cIn years when no chicks fledged before the field crew left the island at the end of the season, date of first fledge is listed as > the date of last nest check.

^dExtrapolated from lay dates using mean incubation period.

^exx indicate data potentially exist but have not yet been summarized.

Table 63. Frequency distribution of hatch dates for black-legged kittiwakes at Chowiet Island, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched in plots in 1989, 2011, or 2015 and data from individual nests are not available in 1976-1978.

Julian date ^a	No. nests hatching on Julian date										
	79	80	81	90	91	95	98	02	04	05	06
176	-	-	-	-	-	xx ^b	-	-	-	-	-
177	-	-	-	-	-	xx	-	-	-	-	-
178	-	-	-	-	-	xx	-	-	-	-	-
179	-	-	-	-	-	xx	-	-	-	-	-
180	-	-	-	-	-	xx	-	2	-	-	-
181	-	-	-	-	-	xx	-	-	-	-	-
182	-	-	-	-	-	xx	-	5	-	-	-
183	-	-	-	-	-	xx	-	-	-	-	-
184	-	2	-	1	-	xx	-	-	-	-	-
185	-	-	1	-	-	xx	-	-	-	-	-
186	-	2	-	-	-	xx	-	22	2	-	-
187	-	-	3	-	-	xx	-	-	-	-	-
188	-	4	-	-	-	xx	-	42	3	-	-
189	-	-	26	-	-	xx	-	-	1	-	-
190	-	7	-	1	-	xx	-	-	2	-	4
191	-	-	27	2	-	xx	-	-	2	-	3
192	-	11	-	2	-	xx	-	18	3	-	28
193	-	-	23	-	-	xx	-	-	-	-	2
194	-	6	-	2	-	xx	-	1	8	-	3
195	-	-	11	-	-	xx	-	13	4	-	12
196	1	3	-	-	-	xx	-	-	1	-	51
197	-	-	5	-	-	xx	-	-	-	-	21
198	5	5	-	2	-	xx	-	3	3	-	8
199	-	-	5	-	-	xx	-	-	-	-	24
200	17	5	-	-	-	xx	1	1	7	-	26
201	-	-	1	-	-	xx	-	-	-	-	1
202	18	1	-	1	-	xx	2	-	1	-	3
203	-	-	2	-	-	xx	-	-	-	-	5
204	16	-	-	-	-	xx	3	-	-	-	17
205	-	-	4	-	-	xx	2	-	-	-	5
206	5	-	-	-	2	xx	-	1	4	3	1
207	-	-	-	-	-	xx	1	-	-	-	-
208	2	-	-	-	-	xx	2	-	-	-	5
209	-	-	-	-	-	xx	1	-	-	1	-
210	-	-	-	-	1	xx	5	-	-	11	3
211	-	-	-	-	-	xx	1	-	-	-	-
212	3	-	-	-	-	xx	4	-	-	-	-
213	-	-	1	-	-	xx	-	-	-	-	-
214	1	-	-	-	-	xx	2	-	-	4	-
215	-	-	-	-	-	xx	-	-	-	-	-
216	2	-	-	-	-	xx	2	-	-	-	-
217	-	-	-	-	-	xx	-	-	-	-	-
218	-	-	-	-	-	xx	1	-	-	-	-
219	-	-	-	-	-	xx	-	-	-	-	-
220	-	-	-	-	-	xx	1	-	-	3	-
221	-	-	-	-	-	xx	-	-	-	-	-
222	-	-	-	-	-	xx	2	-	-	-	-
223	-	-	-	-	-	xx	-	-	-	-	-
224	-	-	-	-	-	xx	-	-	-	1	-
225	-	-	-	-	-	xx	-	-	-	-	-
226	-	-	-	-	-	xx	-	-	-	-	-
227	-	-	-	-	-	xx	-	-	-	-	-
228	-	-	-	-	-	xx	-	-	-	-	-
<i>n</i>	70	46	109	11	3	xx	30	108	41	23	222

Table 63 (continued). Frequency distribution of hatch dates for black-legged kittiwakes at Chowiet Island, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1982-1988, 1992-1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; no eggs hatched in plots in 1989, 2011, or 2015 and data from individual nests are not available in 1976-1978.

Julian date ^a	No. nests hatching on Julian date										
	07	09	10	12	13	14	16	17	18	19	21
176	-	-	-	2	-	-	-	-	-	-	-
177	-	-	-	-	-	-	-	-	-	-	-
178	-	-	-	-	-	-	-	-	-	-	-
179	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-
182	-	-	1	21	-	-	-	-	-	-	-
183	-	-	-	5	-	-	-	-	-	-	-
184	-	-	-	-	-	18	-	-	-	2	4
185	-	-	-	-	-	-	-	-	-	8	6
186	-	1	-	-	-	2	-	-	-	5	-
187	-	-	-	28	1	5	-	-	-	1	-
188	-	-	14	8	1	47	-	3	1	1	16
189	-	9	8	-	1	7	-	-	2	34	56
190	-	-	-	-	4	8	-	-	1	16	-
191	-	-	1	-	3	2	-	-	-	-	3
192	-	24	3	10	23	35	-	-	1	56	1
193	-	16	-	2	-	8	-	-	-	1	-
194	2	46	26	-	4	8	-	48	19	-	49
195	1	-	3	-	1	1	-	-	-	-	-
196	2	-	-	-	21	2	4	-	-	22	-
197	-	1	-	7	-	21	25	-	-	-	-
198	-	2	-	6	18	5	10	12	11	14	4
199	9	-	18	-	-	2	1	16	-	1	29
200	11	8	-	-	-	2	34	11	17	-	-
201	2	-	-	1	-	-	-	-	-	5	-
202	3	-	-	-	5	9	71	5	19	13	-
203	-	-	-	-	-	1	-	-	7	-	-
204	-	-	5	-	5	2	8	5	-	-	1
205	13	-	3	-	-	-	19	-	-	-	-
206	5	-	-	-	2	3	14	-	9	6	-
207	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	3	-	-	1	2	-	-
209	-	-	-	-	-	-	8	-	-	-	-
210	3	-	2	-	3	-	2	-	1	1	-
211	3	-	-	-	-	-	-	-	1	-	-
212	12	-	-	-	-	-	-	-	-	-	-
213	-	-	-	-	1	-	2	-	1	-	-
214	-	-	-	-	-	-	3	-	-	-	-
215	-	-	1	-	-	-	-	-	-	-	-
216	4	-	-	-	-	-	-	-	-	-	-
217	-	-	-	-	-	-	-	-	-	-	-
218	1	-	-	-	-	-	-	-	1	-	-
219	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-	-	-	-
221	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	-	-	-	-
223	-	-	-	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	1	-	-	-	-
225	-	-	-	-	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	-	-	-	1	-	-	-
<i>n</i>	71	107	85	90	96	188	203	101	93	186	169

^aIn leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

^bxx indicates data potentially exist but have not yet been summarize

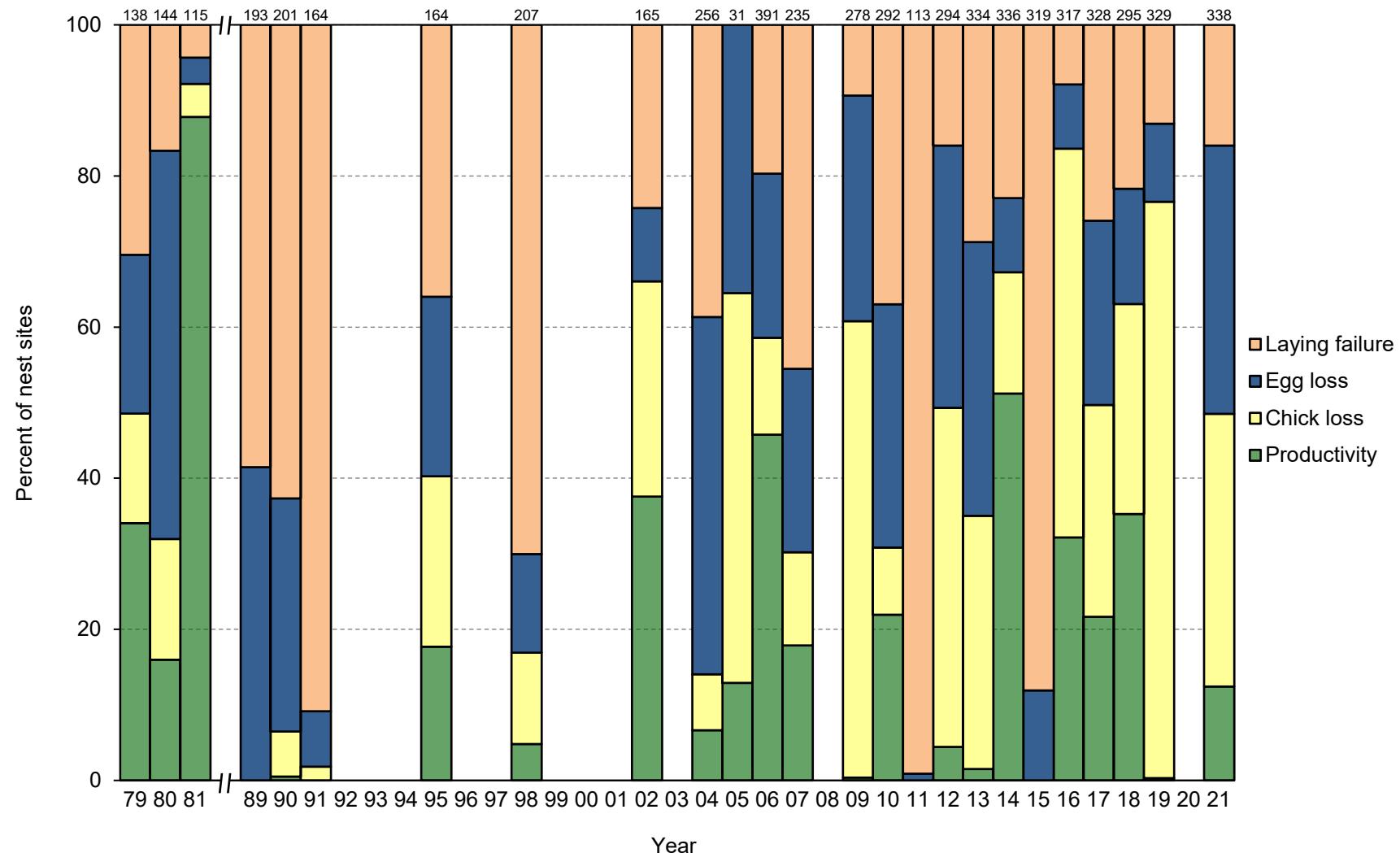


Figure 47. Reproductive performance of black-legged kittiwakes at Chowiet Island, Alaska. Laying failure=(A-B)/A; Egg loss=(B-D)/A; Chick loss=(D-F)/A; Productivity=F/A, where A=total nests; B=nests with eggs; D=nests with chicks; F=nests with chicks fledged. Numbers above columns indicate sample sizes (A). No data were collected in 1982-1988, 1992, 1994, 1996-1997, 1999-2001, 2003, 2008, or 2020; data potentially exist in 1976-1978 and 1993 but have not yet been summarized.

Table 64. Reproductive performance of black-legged kittiwakes at Chowiet Island, Alaska. No data were collected in 1982-1988, 1992, 1994, 1996-1997, 1999-2001, 2003, 2008, or 2020.

Year	Total nest starts	Nests w/ eggs	Total eggs	Nests w/ chicks	Total chicks	Nests w/ chicks fledged	Total chicks fledged	Laying success	Mean clutch size	Nesting success	Hatching success	Chick success	Egg success	Fledging success	Reprod. success	Fledglings /nest start	Prod.
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(B/A)	(C/B)	(D/B)	(E/C)	(G/E)	(G/C)	(F/D)	(F/B)	(G/A)	(F/A)
1976	65	27	xx ^a	xx	xx	xx	xx	0.42	1.8	xx	xx	xx	xx	xx	- ^b	xx	xx
1977	61	54	xx	xx	xx	xx	xx	0.89	1.6	xx	xx	xx	xx	xx	- ^b	xx	xx
1978	66	46	xx	xx	xx	xx	xx	0.70	1.7	xx	xx	xx	xx	xx	- ^b	xx	xx
1979	138	96	96	67	67	47	47	0.70	1.0	0.70	0.70	0.70	0.49	0.70	0.49	0.34	0.34
1980	144	120	120	46	46	23	23	0.83	1.0	0.38	0.38	0.50	0.19	0.50	0.19	0.16	0.16
1981	115	110	110	106	106	101	101	0.96	1.0	0.96	0.96	0.95	0.92	0.95	0.92	0.88	0.88
1989	193	80	100	0	0	0	0	0.41	1.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	201	75	106	13	16	1	1	0.37	1.4	0.17	0.15	0.06	0.01	0.08	0.01	<0.01	<0.01
1991	164	15	16	3	4	0	0	0.09	1.1	0.20	0.25	0.00	0.00	0.00	0.00	0.00	0.00
1993	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	- ^b	xx	xx	
1995	164	105	125	66	74	20	20	0.64	1.2	0.63	0.59	0.27	0.16	0.30	0.19	0.12	0.12
1998	207	62	74	35	41	10	10	0.30	1.2	0.56	0.55	0.24	0.14	0.29	0.16	0.05	0.05
2002	165	125	236	109	171	62	64	0.76	1.9	0.87	0.72	0.37	0.27	0.57	0.50	0.39	0.38
2004	256	157	234	36	48	17	18	0.61	1.5	0.23	0.21	0.38	0.08	0.47	0.11	0.07	0.07
2005	31	31	34	20	21	4	4	1.00	1.1	0.65	0.62	0.19	0.12	0.20	0.13	0.13	0.13
2006	391	314	520	229	304	179	189	0.80	1.7	0.73	0.58	0.62	0.36	0.78	0.57	0.48	0.46
2007	235	128	148	71	75	42	44	0.54	1.2	0.55	0.51	0.59	0.30	0.59	0.33	0.19	0.18
2009	278	252	388	169	187	1	1	0.91	1.5	0.67	0.48	0.01	<0.01	0.01	<0.01	<0.01	<0.01
2010	292	184	243	90	108	64	66	0.63	1.3	0.49	0.44	0.61	0.27	0.71	0.35	0.23	0.22
2011	113	1	1	0	0	0	0	0.01	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2012	294	247	389	145	154	13	13	0.84	1.6	0.59	0.40	0.08	0.03	0.09	0.05	0.04	0.04
2013	334	238	334	117	138	5	5	0.71	1.4	0.49	0.41	0.04	0.01	0.04	0.02	0.01	0.01
2014	336	259	444	226	337	172	186	0.77	1.7	0.87	0.76	0.55	0.42	0.76	0.66	0.55	0.51
2015	319	38	44	0	0	0	0	0.12	1.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	317	292	492	265	383	102	102	0.92	1.7	0.91	0.78	0.27	0.21	0.38	0.35	0.32	0.32
2017	328	243	347	163	191	71	71	0.74	1.4	0.67	0.55	0.37	0.20	0.44	0.29	0.22	0.22
2018	295	231	317	186	218	104	107	0.78	1.4	0.81	0.69	0.49	0.34	0.56	0.45	0.36	0.35
2019	329	286	502	252	307	1	1	0.87	1.8	0.88	0.61	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2021	338	284	460	164	208	42	42	0.84	1.6	0.58	0.45	0.20	0.09	0.26	0.15	0.12	0.12

^axx indicates data potentially exist but have not yet been summarized.

^bProductivity data exist in historical reports for total chicks fledged/nests with eggs (G/B): 1976: 0.18; 1977: 0.70; 1978: 0.00; 1993: 0.00.

^cProductivity data exist in 1994 based on one visit method (not comparable to other years), nests with chicks/nests present at visit, and was 0.56.

Table 65. Standard deviation in reproductive performance parameters of black-legged kittiwakes at Chowiet Island, Alaska. No data were collected in 1982-1988, 1992, 1994, 1996-1997, 1999-2001, 2003, 2008, or 2020.

Year	No. plots ^a	Total nest starts	Sampling design ^b	Laying success	Mean clutch size ^c	Nesting success	Hatching success	Chick success	Egg success	Fledgling success	Reprod. success	Fledglings /nest start ^c	Prod.
1976	xx ^d	65	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1977	xx	61	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1978	xx	66	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1979	2	138	Cluster by plot	0.08	0.00	0.05	0.05	0.11	0.11	0.11	0.11	0.04	0.12
1980	2	144	Cluster by plot	0.02	0.00	0.22	0.22	0.11	0.15	0.11	0.15	0.03	0.12
1981	2	115	Cluster by plot	0.02	0.00	0.02	0.02	0.03	0.04	0.03	0.04	0.03	0.06
1989	7	193	Cluster by plot	0.08	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	8	201	Cluster by plot	0.09	0.06	0.09	0.08	0.05	0.01	0.06	0.01	<0.01	0.01
1991	8	164	Cluster by plot	0.02	0.07	0.12	0.15	0.00	0.00	0.00	0.00	0.00	0.00
1993	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1995	7	164	Cluster by plot	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1998	9	207	Cluster by plot	0.04	0.05	0.13	0.13	0.07	0.06	0.08	0.07	0.01	0.02
2002	7	165	Cluster by plot	0.11	0.03	0.04	0.09	0.05	0.04	0.06	0.07	0.04	0.09
2004	11	256	Cluster by plot	0.04	0.04	0.04	0.04	0.10	0.02	0.12	0.04	0.02	0.02
2005	9	31	Simple random	0.00	0.05	0.09	0.08	0.09	0.06	0.09	0.06	0.06	0.06
2006	14	391	Cluster by plot	0.02	0.03	0.05	0.05	0.03	0.03	0.03	0.05	0.03	0.04
2007	10	235	Cluster by plot	0.04	0.03	0.05	0.04	0.05	0.04	0.06	0.05	0.03	0.03
2009	10	278	Cluster by plot	0.02	0.03	0.05	0.04	0.01	<0.01	0.01	<0.01	<0.01	<0.01
2010	10	292	Cluster by plot	0.04	0.03	0.08	0.07	0.06	0.06	0.06	0.07	0.03	0.05
2011	6	113	Cluster by plot	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2012	10	294	Cluster by plot	0.04	0.03	0.04	0.02	0.03	0.01	0.03	0.02	0.01	0.02
2013	11	334	Cluster by plot	0.03	0.03	0.03	0.02	0.02	<0.01	0.02	0.01	0.01	<0.01
2014	11	336	Cluster by plot	0.03	0.03	0.02	0.03	0.04	0.04	0.04	0.05	0.03	0.05
2015	11	319	Cluster by plot	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	11	317	Cluster by plot	0.02	0.03	0.02	0.04	0.03	0.02	0.04	0.04	0.03	0.04
2017	11	328	Cluster by plot	0.03	0.03	0.05	0.03	0.06	0.03	0.06	0.04	0.02	0.03
2018	11	295	Cluster by plot	0.03	0.03	0.02	0.02	0.06	0.04	0.07	0.06	0.03	0.05
2019	11	329	Cluster by plot	0.02	0.03	0.02	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2021	11	338	Cluster by plot	0.02	0.03	0.05	0.04	0.04	0.02	0.06	0.04	0.02	0.04

^aPlots that are combined for analysis are counted as a single "plot".

^bSampling for kittiwakes is clustered by plot except when sample sizes per plot are too small or plot data are not available. For sampling clustered by plot, values are calculated based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

^cStandard deviation values for reproductive success parameters that can exceed 1 are calculated by non-parametric bootstrapping.

^dxx indicates data potentially exist but have not yet been summarized.

Table 66. Clutch sizes of black-legged kittiwakes at Chowiet Island, Alaska. Sample units consist of total nests, not plots. No data were collected in 1982-1988, 1992, 1994, 1996-1997, 1999-2001, 2003, 2008, or 2020.

Year	Total nest starts (A)	Nest sites w/ x eggs:				Nest sites w/ eggs (B)	Total eggs (C)	Mean clutch size (C/B)
		0	1	2	3			
1976	65	xx ^a	xx	xx	xx	27	xx	1.8
1977	61	xx	xx	xx	xx	54	xx	1.6
1978	66	xx	xx	xx	xx	46	xx	1.7
1979	138	42	96	0	0	96	96	1.0
1980	144	24	120	0	0	120	120	1.0
1981	115	5	110	0	0	110	110	1.0
1989	193	113	60	20	0	80	100	1.3
1990	201	126	44	31	0	75	106	1.4
1991	164	149	14	1	0	15	16	1.1
1993	xx	xx	xx	xx	xx	xx	xx	xx
1995	164	xx	xx	xx	xx	105	xx	xx
1998	207	145	50	12	0	62	74	1.2
2002	165	40	16	107	2	125	236	1.9
2004	256	99	80	77	0	157	234	1.5
2005	31	0	28	3	0	31	34	1.1
2006	391	77	108	206	0	314	520	1.7
2007	235	107	108	20	0	128	148	1.2
2009	278	26	116	136	0	252	388	1.5
2010	292	108	125	59	0	184	243	1.3
2011	113	112	1	0	0	1	1	1.0
2012	294	47	106	140	1	247	389	1.6
2013	334	96	142	96	0	238	334	1.4
2014	336	77	74	185	0	259	444	1.7
2015	319	281	32	6	0	38	44	1.2
2016	317	25	92	200	0	292	492	1.7
2017	328	85	139	104	0	243	347	1.4
2018	295	64	145	86	0	231	317	1.4
2019	329	43	70	216	0	286	502	1.8
2021	338	54	108	176	0	284	460	1.6

^axx indicates data potentially exist but have not yet been summarized.

Table 67. Reproductive performance of black-legged kittiwakes at Chowiet Island, Alaska in 2021.

Parameter	Plot											Total	SD ^a
	P03 B02	P03 B03	P03 B04	P03 B05	P06 B01	P06 B02	P06 B03	P09 B01	P09 B02	P10 B02	P11 B01		
Total nest starts (A)	33	23	24	31	35	34	36	32	42	29	19	338	-
Nests w/ eggs (B)	30	19	16	27	30	28	34	26	36	24	14	284	-
Total eggs (C)	52	35	29	36	54	48	56	35	58	36	21	460	-
Nests w/ chicks (D)	17	12	11	6	24	19	19	11	24	14	7	164	-
Total chicks (E)	28	14	13	7	34	26	26	11	26	15	8	208	-
Nests w/ chicks fledged (F)	5	6	4	1	11	2	9	0	4	0	0	42	-
Total chicks fledged (G)	5	6	4	1	11	2	9	0	4	0	0	42	-
Laying success (B/A)	0.91	0.83	0.67	0.87	0.86	0.82	0.94	0.81	0.86	0.83	0.74	0.84	0.02
Mean clutch size (C/B)	1.7	1.8	1.8	1.3	1.8	1.7	1.7	1.4	1.6	1.5	1.5	1.6	0.03
Nesting success (D/B)	0.57	0.63	0.69	0.22	0.80	0.68	0.56	0.42	0.67	0.58	0.50	0.58	0.05
Hatching success (E/C)	0.54	0.40	0.45	0.19	0.63	0.54	0.46	0.31	0.45	0.42	0.38	0.45	0.04
Chick success (G/E)	0.18	0.43	0.31	0.14	0.32	0.08	0.35	0.00	0.15	0.00	0.00	0.20	0.04
Egg success (G/C)	0.10	0.17	0.14	0.03	0.20	0.04	0.16	0.00	0.07	0.00	0.00	0.09	0.02
Fledgling success (F/D)	0.29	0.50	0.36	0.17	0.46	0.11	0.47	0.00	0.17	0.00	0.00	0.26	0.06
Reproductive success (F/B)	0.17	0.32	0.25	0.04	0.37	0.07	0.26	0.00	0.11	0.00	0.00	0.15	0.04
Fledglings/nest start (G/A)	0.15	0.26	0.17	0.03	0.31	0.06	0.25	0.00	0.10	0.00	0.00	0.12	0.02
Productivity (F/A)	0.15	0.26	0.17	0.03	0.31	0.06	0.25	0.00	0.10	0.00	0.00	0.12	0.04

^aStandard deviations are calculated based on plot as a sample unit; for reproductive success parameters that can exceed 1 (mean clutch size and fledglings/nest start), standard deviations are calculated by non-parametric bootstrapping.

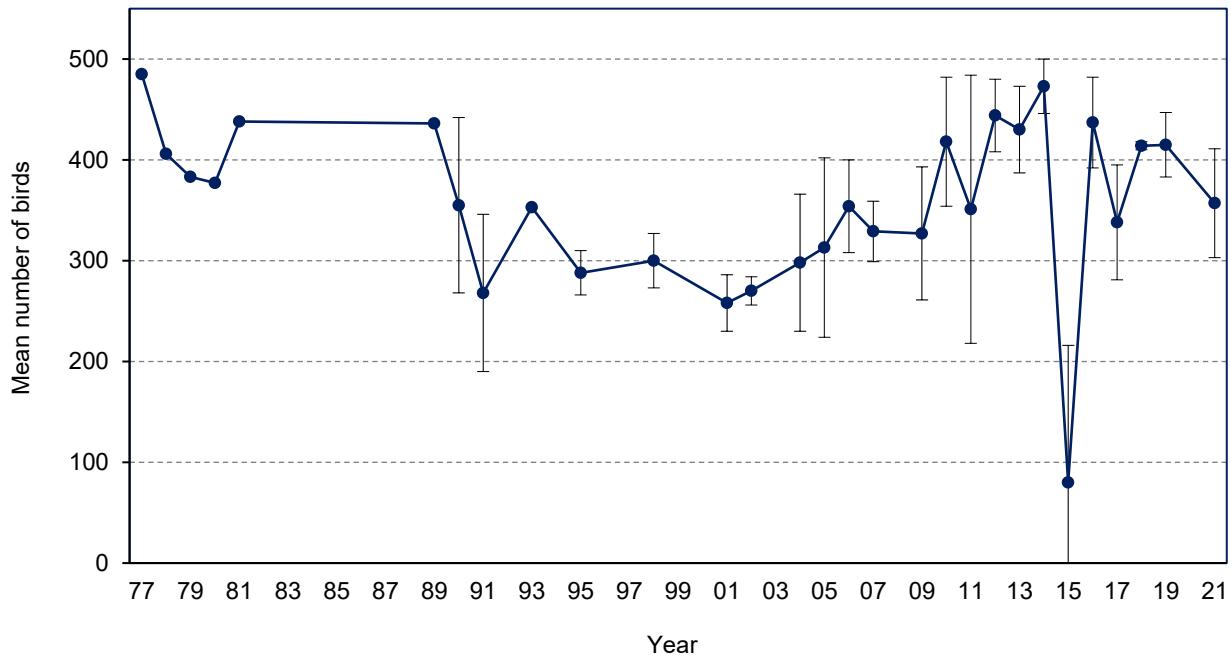


Figure 48. Mean numbers of black-legged kittiwakes counted on index plots at Chowiet Island, Alaska. Error bars represent standard deviation. No counts were conducted in 1982-1988, 1992, 1996-1997, 1999-2000, 2003, 2008, or 2020; data potentially exist in 1994 but have not yet been summarized.

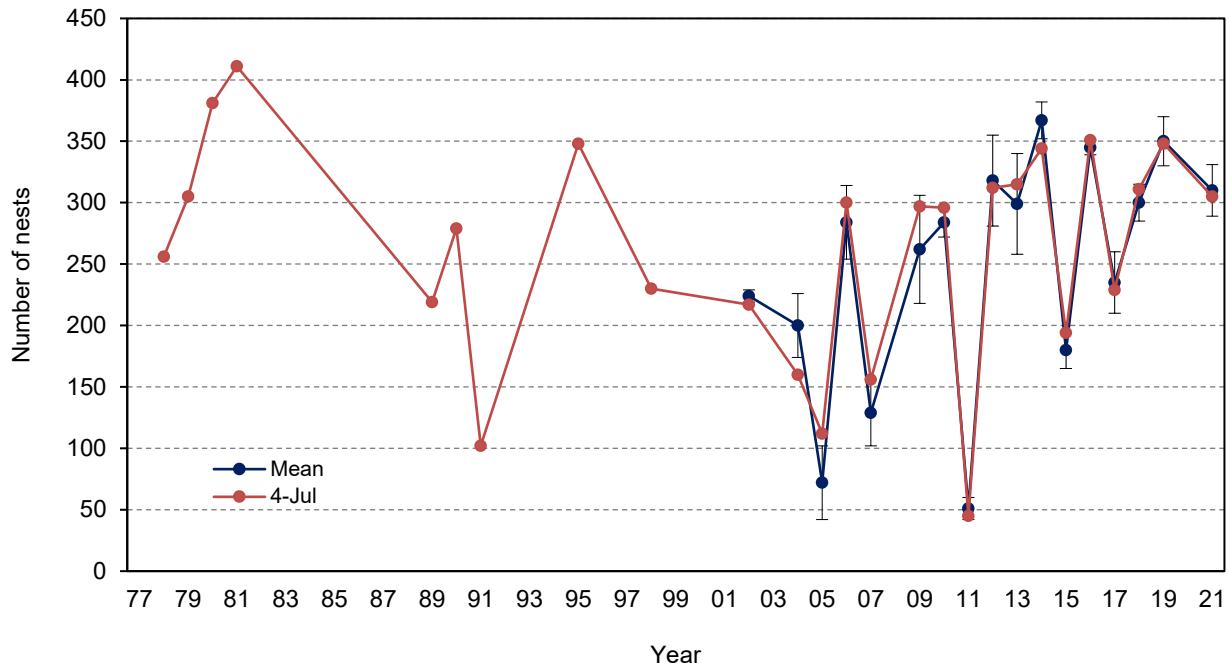


Figure 49. Numbers of black-legged kittiwake nests counted on index plots at Chowiet Island, Alaska. Data are presented as both mean numbers of nests and numbers of nests counted on 4 July (± 7 days). Error bars represent standard deviation around mean values. No counts were conducted in 1977, 1982-1988, 1992, 1996-1997, 1999-2001, 2003, 2008, or 2020; data potentially exist in 1993 and 1994 but have not yet been summarized.

Table 68. Numbers of black-legged kittiwakes counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	1977	1978	1979	1980	1981	1989 ^a	1990 ^b	1991	1993	1994	1995	1998	2001	2002	2004
1	xx ^c	xx	xx	xx	xx	xx	470	321	xx	xx	264	258	279	304	334
2	xx	xx	xx	xx	xx	xx	493	285	xx	xx	292	330	269	283	329
3	xx	xx	xx	xx	xx	xx	406	220	xx	xx	308	298	226	264	366
4	xx	xx	xx	xx	xx	-	453	153	xx	xx	266	314	-	272	365
5	xx	xx	xx	xx	xx	-	365	184	xx	xx	323	299	-	269	346
6	xx	xx	xx	xx	xx	-	298	232	xx	xx	305	-	-	267	348
7	xx	xx	xx	xx	xx	-	341	231	xx	xx	271	-	-	247	367
8	xx	xx	xx	xx	xx	-	284	293	xx	xx	274	-	-	267	246
9	xx	xx	xx	xx	xx	-	224	388	xx	xx	-	-	-	272	211
10	xx	xx	xx	xx	xx	-	369	375	xx	xx	-	-	-	257	208
11	xx	xx	xx	xx	xx	-	280	-	xx	xx	-	-	-	273	248
12	xx	xx	xx	xx	xx	-	271	-	xx	xx	-	-	-	259	205
13	xx	xx	xx	xx	xx	-	-	-	xx	xx	-	-	-	281	-
Mean	485	406	383	377	438	436	355	268	353	xx	288	300	258	270	298
<i>n</i>	47	21	48	44	49	xx	12	10	xx	xx	8	5	3	13	12
SD	xx	xx	xx	xx	xx	xx	87	78	xx	xx	22	27	28	14	68
First count	10 Jun	6 Jun	18 Jun	6 Jun	6 Jun	xx	xx	22 Jun	xx	xx	22 Jun	1 Jul	19 Jul	12 Jun	10 Jun
Last count	29 Jul	28 Jun	6 Aug	25 Jul	25 Jul	xx	xx	18 Jul	xx	xx	16 Jul	21 Jul	23 Jul	19 Jul	4 Jul

Table 68 (continued). Numbers of black-legged kittiwakes counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015 ^d	2016	2017	2018 ^e	2019	2021
1	283	413	314	378	394	289	510	478	516	389	504	405	411	449	414
2	332	379	275	397	397	399	489	483	478	268	502	426	417	461	438
3	331	378	339	439	380	502	431	474	469	76	487	422	-	452	420
4	432	345	340	342	376	436	454	433	511	40	443	315	-	428	365
5	415	385	327	298	366	121	432	407	480	12	405	330	-	404	381
6	416	381	314	296	346	357	425	345	474	0	429	324	-	413	316
7	269	299	318	294	496	-	395	408	436	3	420	336	-	408	328
8	280	355	315	327	516	-	405	432	442	0	381	323	-	390	297
9	175	349	382	300	403	-	432	442	446	10	397	291	-	388	291
10	199	256	367	203	511	-	465	397	477	1	504	293	-	361	322
11	-	-	-	-	-	-	-	-	-	-	-	251	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	313	354	329	327	419	351	444	430	473	80	447	338	414	415	357
<i>n</i>	10	10	10	10	10	6	10	10	10	10	10	11	2	10	10
SD	89	46	30	66	64	133	36	43	27	136	48	57	4	32	54
First count	21 Jun	20 Jun	17 Jun	25 Jun	17 Jun	4 Jul	10 Jun	15 Jun	9 Jun	29 Jun	19 Jun	16 Jun	25 Jun	9 Jun	12 Jun
Last count	25 Jul	22 Jul	3 Aug	27 Jul	23 Jul	25 Jul	20 Jul	26 Jul	9 Jul	27 Jul	13 Jul	20 Jul	5 Jul	19 Jul	21 Jul

^aFor 1989, summary presented is from 3 replicates. A total of 13 replicates were completed; additional replicate values exist but not yet summarized.

^bFor 1990, a total of 12 replicates were completed. Prior to 2015 report, only first 4 replicates were presented and used in summary.

^cxx indicates data potentially exist but have not yet been summarized.

^dLow counts for most replicates in 2015 due to reproductive failure; black-legged kittiwakes abandoned the cliffs.

^eIn 2018, eight additional replicates were conducted but excluded from this summary due to an incorrect plot boundary in one of the plots.

Table 69. Numbers of black-legged kittiwake nests counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1977, 1982-1988, 1992, 1996-1997, 1999-2001, 2003, 2008, or 2020.

Replicate	1978	1979	1980	1981	1989	1990	1991	1993	1994	1995	1998	2002	2004	2005
1	XX ^a	XX	222	208	20									
2	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	225	207	47
3	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	228	210	50
4	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	224	211	86
5	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	231	230	95
6	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	230	233	112
7	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	223	233	109
8	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	217	194	84
9	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	216	180	60
10	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	216	174	54
11	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	223	163	-
12	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	225	160	-
13	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	229	-	-
Mean	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	224	200	72
4 Jul count ^b	256	305	381	411	219	279	102	XX	XX	348	230	217	160	112
<i>n</i>	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	13	12	10
SD	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	5	26	30
First count	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	12 Jun	10 Jun	21 Jun
Last count	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	19 Jul	4 Jul	25 Jul

Table 69 (continued). Numbers of black-legged kittiwake nests counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1977, 1982-1988, 1992, 1996-1997, 1999-2001, 2003, 2008, or 2020.

Replicate	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 ^c	2019	2021
1	328	83	305	293	45	361	353	383	213	344	263	290	304	321
2	321	91	294	288	60	349	353	368	194	334	273	311	367	335
3	311	121	314	295	52	350	341	384	172	339	266	-	377	338
4	300	159	297	298	40	349	315	386	175	343	243	-	359	325
5	287	156	273	296	60	326	294	368	188	346	229	-	361	324
6	279	161	267	291	-	331	293	371	181	351	230	-	348	305
7	253	136	259	276	-	312	280	361	170	353	219	-	349	296
8	255	126	215	267	-	279	267	350	169	352	209	-	343	288
9	252	131	217	270	-	269	249	344	179	342	210	-	346	289
10	253	122	181	270	-	260	243	352	158	348	205	-	341	279
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	284	129	262	284	51	319	299	367	180	345	235	300	350	310
4 Jul count ^b	300	156	297	296	45	312	315	344	194	351	229	311	348	305
<i>n</i>	10	10	10	10	5	10	10	10	10	10	10	2	10	10
SD	30	27	44	12	9	37	41	15	15	6	25	15	20	21
First count	20 Jun	17 Jun	25 Jun	17 Jun	4 Jul	10 Jun	15 Jun	9 Jun	29 Jun	19 Jun	20 Jun	25 Jun	9 Jun	12 Jun
Last count	23 Jul	3 Aug	27 Jul	23 Jul	25 Jul	20 Jul	26 Jul	9 Jul	27 Jul	13 Jul	20 Jul	5 Jul	19 Jul	21 Jul

^axx indicates data potentially exist but have not yet been summarized.

^bCount closest to 4 July (± 7 days).

^cIn 2018, eight additional replicates were conducted but excluded from this summary due to an incorrect plot boundary in one of the plots.

Table 70. Numbers of black-legged kittiwake adults counted on index plots at Chowiet Island, Alaska in 2021.

Plot	Date										Mean	SD
	12 Jun	16 Jun	21 Jun	27 Jun	1 Jul	5 Jul	10 Jul	15 Jul	16 Jul	19 Jul		
A02B01	49	50	48	47	48	37	37	39	40	41	-	-
A02B02	81	97	86	79	87	68	64	63	52	72	-	-
A03B01	26	27	34	32	31	23	27	18	19	25	-	-
A03B02	43	46	44	38	42	34	36	25	29	31	-	-
A03B03	0	0	0	0	0	1	0	0	0	0	-	-
A06B01	51	49	45	39	42	32	37	35	34	27	-	-
A06B02	35	40	35	29	35	26	32	27	31	31	-	-
A09B01	40	46	39	29	30	25	25	25	23	29	-	-
A09B02	89	83	89	72	66	70	70	65	63	66	-	-
Total	414	438	420	365	381	316	328	297	291	322	357	54

Table 71. Numbers of black-legged kittiwake nests counted on index plots at Chowiet Island, Alaska in 2021.

Plot	Date										Mean	SD	Max. ^a
	12 Jun	16 Jun	21 Jun	27 Jun	1 Jul	5 Jul	10 Jul	15 Jul	16 Jul	19 Jul			
A02B01	38	35	42	39	38	36	36	36	39	35	-	-	42
A02B02	70	68	68	70	76	69	60	61	56	59	-	-	76
A03B01	23	24	26	25	24	24	25	24	24	24	-	-	26
A03B02	34	36	38	36	37	35	33	32	35	30	-	-	38
A03B03	0	0	0	0	0	0	0	0	0	0	-	-	0
A06B01	35	36	37	36	33	32	31	29	32	31	-	-	37
A06B02	24	26	26	27	25	24	23	24	24	24	-	-	27
A09B01	34	37	34	23	24	21	21	18	20	21	-	-	37
A09B02	63	73	67	69	67	64	67	64	59	55	-	-	73
Total	321	335	338	325	324	305	296	288	289	279	310	21	356

^aMaximum count represents the sum of the maximum counts for each plot, and may not correspond to the maximum count of a single replicate.

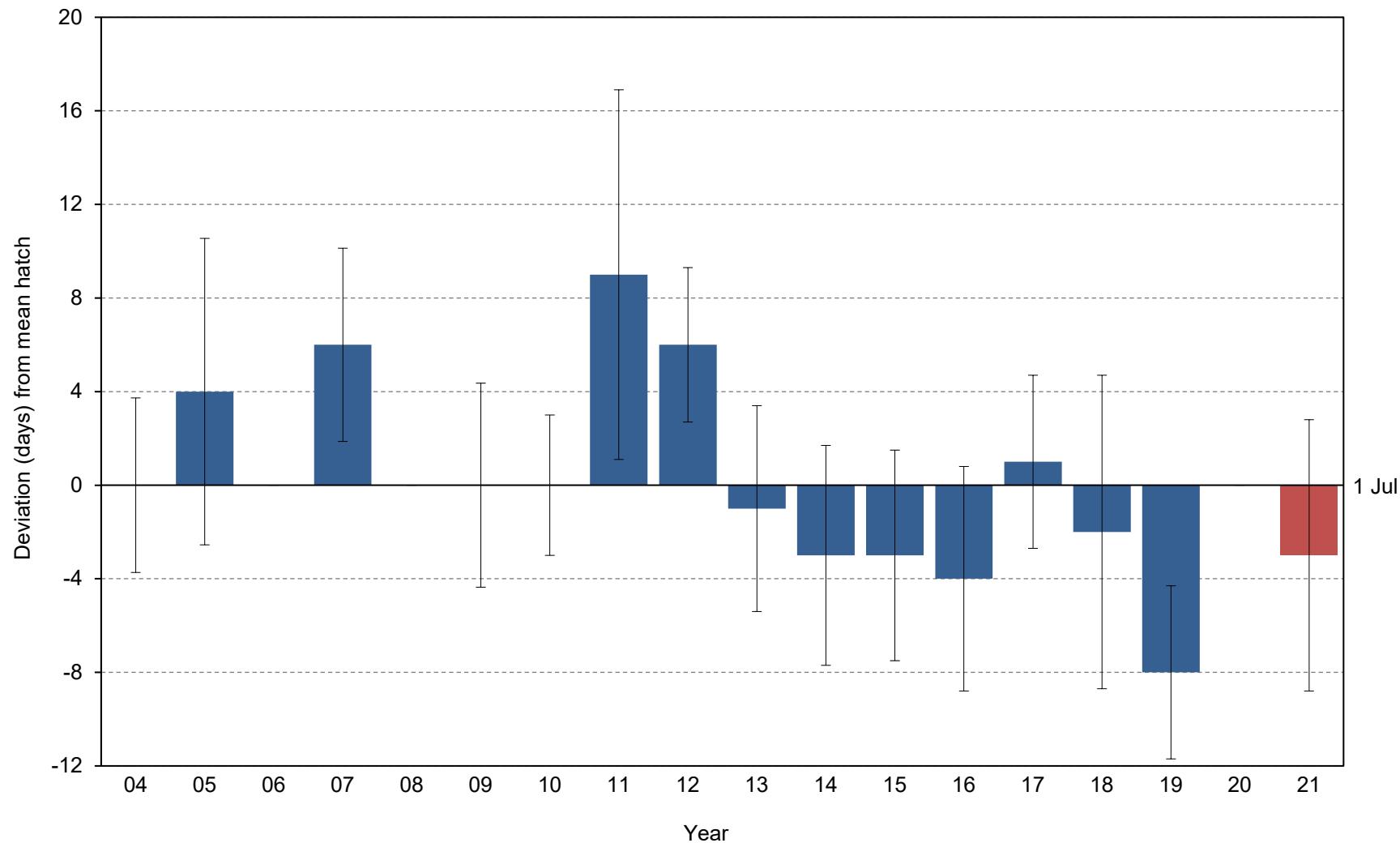


Figure 50. Yearly hatch date deviation (from the 1976-2020 average of 1 July) for glaucous-winged gulls at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year. No data were collected in 1977, 1980-1994, 1996-1997, 1999-2003, 2006, 2008, or 2020; data potentially exist in 1976, 1978-1979, 1995, and 1998 but have not yet been summarized.

Table 72. Breeding chronology of glaucous-winged gulls at Chowiet Island, Alaska. Data represent the dates of the first egg laid and the first chick hatched in each nest. No data were collected in 1977, 1980-1994, 1996-1997, 1999-2003, 2006, 2008, or 2020.

Year	Mean lay ^a	SD	n ^b	Mean hatch	SD	n ^c	First lay ^a	First hatch	Last hatch
1976	xx ^d	xx	xx	xx	xx	xx	xx	xx	xx
1978	xx	xx	xx	xx	xx	xx	xx	xx	xx
1979	xx	xx	xx	xx	xx	xx	xx	xx	xx
1995	xx	xx	xx	xx	xx	xx	xx	xx	xx
1998	xx	xx	xx	xx	xx	xx	xx	xx	xx
2004	xx	xx	xx	30 Jun	3.7	10	xx	22 Jun	3 Jul
2005	xx	xx	xx	5 Jul	6.6	18	xx	22 Jun	15 Jul
2007	xx	xx	xx	7 Jul	4.1	15	xx	1 Jul	11 Jul
2009	xx	xx	xx	1 Jul	4.4	36	xx	27 Jun	13 Jul
2010 ^e	xx	xx	xx	1 Jul	3.0	35	xx	24 Jun	5 Jul
2011 ^e	xx	xx	xx	9 Jul	7.9	24	xx	27 Jun	24 Jul
2012	-	-	-	6 Jul	3.3	15	< 3 Jun	3 Jul	14 Jul
2013	2 Jun	5.7	45	30 Jun	4.4	30	25 May	21 Jun	8 Jul
2014	-	-	-	28 Jun	4.7	29	< 22 May	20 Jun ^f	9 Jul
2015	-	-	-	28 Jun	4.5	60	< 23 May	19 Jun	7 Jul
2016	-	-	-	26 Jun	4.8	69	< 27 May	13 Jun	11 Jul
2017	-	-	-	2 Jul	3.7	32	< 27 May	24 Jun	11 Jul
2018	-	-	-	29 Jun	6.7	33	< 22 May	18 Jun	11 Jul
2019	-	-	-	23 Jun	3.7	44	< 28 May	16 Jun	1 Jul
2021	31 May	6.0	24	28 Jun	5.8	27	18 May	19 Jun	11 Jul

^aIn years when birds are already on eggs at the first visit, mean lay date is not calculated and date of first lay is listed as < the date of first nest check.

^bSample sizes for mean lay dates are a sub-sample of total nests for which no egg to egg interval is ≤ 7 days.

^cSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

^dxx indicates data potentially exist but have not yet been summarized.

^eIn 2010 and 2011, sample sizes were small and recorded hatch dates were late due to high rates of egg loss during the early egg-laying period.

^fIn 2014, date reflects first hatch within monitored nests. Actual first hatch on island occurred earlier.

Table 73. Frequency distribution of hatch dates for glaucous-winged gulls at Chowiet Island, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days. No data were collected in 1977, 1980-1994, 1996-1997, 1999-2003, 2006, 2008, or 2020.

Julian date ^a	No. nests hatching on Julian date																				
	76	78	79	95	98	04	05	07	09	10	11	12	13	14	15	16	17	18	19	21	
165	xx ^b	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	
166	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
167	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	
168	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
169	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	
170	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	1	2	-	-	-	1	
171	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	1	-	4	-	-	3	-	
172	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	1	-	1	1	-	-	11	6	
173	xx	xx	xx	xx	xx	-	2	-	-	-	-	-	-	-	1	-	-	1	-	-	
174	xx	xx	xx	xx	xx	1	-	-	4	-	-	-	-	3	20	6	-	8	1	-	
175	xx	xx	xx	xx	xx	-	-	-	-	3	-	-	1	-	-	19	1	-	5	-	
176	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	2	10	-	-	2	-	-	1	
177	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	6	-	-	2	-	-	17	-	
178	xx	xx	xx	xx	xx	-	-	-	2	-	1	-	-	5	2	-	3	-	6	-	
179	xx	xx	xx	xx	xx	-	-	-	-	1	-	-	2	-	7	3	10	-	-	-	
180	xx	xx	xx	xx	xx	4	1	-	11	-	5	-	5	6	15	7	4	-	1	1	
181	xx	xx	xx	xx	xx	-	-	-	-	21	-	-	1	-	-	5	-	-	1	1	
182	xx	xx	xx	xx	xx	-	-	3	1	-	-	-	2	3	2	6	-	1	7	-	
183	xx	xx	xx	xx	xx	-	4	-	6	-	-	-	2	-	6	5	-	1	-	-	
184	xx	xx	xx	xx	xx	-	2	1	-	-	-	-	6	-	-	-	2	-	-	-	
185	xx	xx	xx	xx	xx	5	-	-	8	5	-	8	2	2	6	4	6	-	-	-	
186	xx	xx	xx	xx	xx	-	-	4	-	5	-	-	-	1	-	-	7	3	-	-	
187	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	
188	xx	xx	xx	xx	xx	-	-	-	1	-	6	1	3	-	2	1	-	-	-	-	
189	xx	xx	xx	xx	xx	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-	
190	xx	xx	xx	xx	xx	-	7	1	-	-	1	5	-	2	-	-	-	1	-	1	
191	xx	xx	xx	xx	xx	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	
192	xx	xx	xx	xx	xx	-	-	6	-	-	-	-	-	-	-	-	1	6	-	1	
193	xx	xx	xx	xx	xx	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	
194	xx	xx	xx	xx	xx	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	
195	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
196	xx	xx	xx	xx	xx	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	
197	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
198	xx	xx	xx	xx	xx	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	
199	xx	xx	xx	xx	xx	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	
200	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
201	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
202	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
203	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
204	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
205	xx	xx	xx	xx	xx	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	

n xx xx xx xx xx 10 18 15 36 35 24 15 30 29 60 69 32 33 44 27

^aIn leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

^bxx indicates data potentially exist but have not yet been summarized

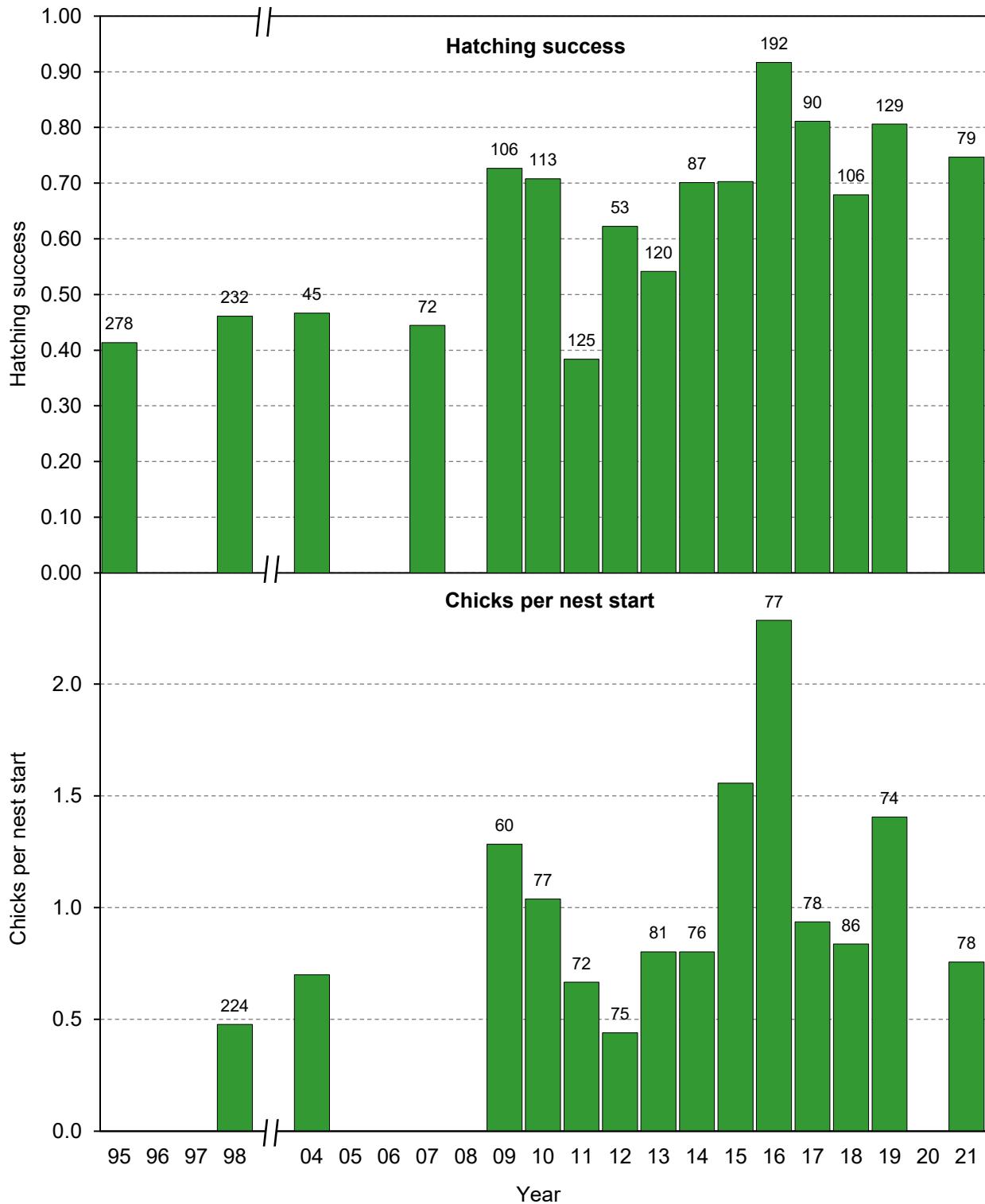


Figure 51. Reproductive performance of glaucous-winged gulls at Chowiet Island, Alaska. Hatching success=E/C; Chicks per nest start=E/A; where A=total nest starts, C=total eggs; E=total chicks. Numbers above columns indicate sample sizes ([C] for hatching success, [A] for chicks per nest start). No data were collected in 1980-1994, 1996-1997, 1999-2003, 2005-2006, 2008, or 2020; data potentially exist in 1976-1979, 2004-2005, and 2007 but have not yet been summarized.

Table 74. Reproductive performance of glaucous-winged gulls at Chowiet Island, Alaska, as determined by a nest-monitoring methodology. Measures of success are based on frequent monitoring of individual nests (as opposed to count methodology presented in Table 77). No data were collected in 1980-1994, 1996-1997, 1999-2003, 2005-2006, 2008, or 2020 (some reproductive performance data exist from the count methodology in 2002 and 2006; see Table 77).

Year	Total nest starts	Nest sites w/ x eggs:					Nest sites w/ eggs	Total eggs	Nest sites w/ x chicks:			Nest sites w/ chicks	Total chicks	Laying success	Mean clutch size	Mean brood size	Nesting success	Hatching success	Prop. nest sites w/ chicks	Chicks/nest start	
		(A)	0	1	2	3			1	2	3										
1976	xx ^d	xx	6	30	54	0	90	228	xx	xx	xx	xx	xx	xx	2.53	xx	xx	xx	xx	xx	
1977	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	
1978	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	
1979	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	
1995	-	xx	xx	xx	xx	xx	xx	123	278	xx	xx	xx	xx	115	xx	2.3	xx	xx	0.41	xx	xx
1998	224	114	30	45	35	0	106	232	32	27	7	66	107	0.47	2.2	1.6	0.62	0.46	0.29	0.5	
2004 ^e	30	13	0	6	11	0	17	45	3	3	4	10	21	0.57	2.6	2.1	0.59	0.47	0.33	0.7	
2007 ^e	- ^f	- ^f	2	11	16	0	29	72	2	9	4	15	32	- ^f	2.5	2.1	0.52	0.44	- ^f	- ^f	
2009	60	17	3	17	23	0	43	106	7	17	12	36	77	0.72	2.5	2.1	0.84	0.73	0.60	1.3	
2010	77	34	2	12	29	0	43	113	5	18	13	36	80	0.56	2.6	2.2	0.84	0.71	0.47	1.0	
2011	72	19	5	24	24	0	53	125	7	10	7	24	48	0.74	2.4	2.0	0.45	0.38	0.33	0.7	
2012	75	53	1	11	10	0	22	53	3	6	6	15	33	0.29	2.4	2.2	0.68	0.62	0.20	0.4	
2013	81	36	4	7	34	0	45	120	7	11	12	30	65	0.56	2.7	2.2	0.67	0.54	0.37	0.8	
2014	76	45	1	4	26	0	31	87	6	14	9	29	61	0.41	2.8	2.1	0.94	0.70	0.38	0.8	
2015	79	14	4	12	49	0	65	175	14	29	17	60	123	0.82	2.7	2.1	0.92	0.70	0.76	1.6	
2016	78	8	0	14	56	0	70	196	2	31	37	70	175	0.90	2.8	2.6	1.00	0.89	0.90	2.2	
2017	78	41	4	13	20	0	37	90	2	19	11	32	73	0.47	2.4	2.3	0.86	0.81	0.41	0.9	
2018	86	47	0	11	28	0	39	106	7	13	13	33	72	0.45	2.7	2.2	0.85	0.68	0.38	0.8	
2019	74	26	2	11	35	0	48	129	6	16	22	44	104	0.65	2.7	2.4	0.92	0.81	0.59	1.4	
2021	78	0	0	9	19	1	29	79	6	10	11	27	59	0.37	2.7	2.2	0.93	0.75	0.35	0.8	

^aNests with chicks include nests with hatched eggshells at which no chicks were found.

^bChick totals include dead chicks and hatched eggshells that had no associated chick found.

^cProportion of nests with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^dxx indicates data potentially exist but have not yet been summarized.

^eData in 2004 and 2007 come from a subsample of nests followed in subplot B only.

^fOnly nests with eggs were followed so number of total nest starts does not exist.

Table 75. Standard deviation in reproductive performance parameters of glaucous-winged gulls at Chowiet Island, Alaska. No data were collected in 1980-1994, 1996-1997, 1999-2003, 2006, 2008, or 2020.

Year	No. plots ^a	Total nest starts	Sampling design ^b	Laying success	Mean clutch size ^c	Mean brood size ^c	Nesting success	Hatching success	Prop. nest sites w/ chicks	Chicks/nest start ^c
1976	xx ^d	xx	xx	xx	xx	xx	xx	xx	xx	xx
1977	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1978	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1979	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1995	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1998	xx	xx	xx	xx	0.07	0.08	xx	xx	xx	0.06
2004	xx	xx	Cluster by plot	xx	0.12	0.26	xx	xx	xx	0.20
2007	xx	xx	Cluster by plot	xx	0.12	0.16	xx	xx	xx	0.22
2009	xx	xx	Cluster by plot	xx	0.10	0.12	xx	xx	xx	0.15
2010	xx	xx	Cluster by plot	xx	0.09	0.11	xx	xx	xx	0.14
2011	3	71	Cluster by plot	xx	0.09	0.16	xx	xx	xx	0.12
2012	3	75	Cluster by plot	0.07	0.12	0.19	0.08	0.07	0.03	0.11
2013	3	81	Cluster by plot	0.07	0.09	0.14	0.03	0.02	0.03	0.13
2014	3	76	Cluster by plot	0.02	0.08	0.13	0.05	0.02	0.01	0.13
2015	3	79	Cluster by plot	0.05	0.07	0.09	0.02	0.03	0.05	0.12
2016	3	78	Cluster by plot	0.07	0.05	0.07	0.00	0.01	0.07	0.10
2017	3	78	Cluster by plot	0.02	0.11	0.10	0.06	0.05	0.01	0.13
2018	3	86	Cluster by plot	0.10	0.07	0.13	0.02	0.02	0.09	0.13
2019	3	74	Cluster by plot	0.09	0.08	0.11	0.07	0.02	0.12	0.15
2021	3	78	Cluster by plot	0.02	0.10	0.15	0.09	0.07	0.05	0.13

^aPlots that are combined for analysis are counted as a single “plot”.

^bSampling for gulls is clustered by plot except when sample sizes per plot are too small or plot data are not available. For sampling clustered by plot, values are calculated using ratio estimator spreadsheets based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1 - \rho) / n}$, where ρ is the success rate and n is the sample size of individual nests.

^cStandard deviation values for reproductive success parameters that can exceed 1 are calculated by non-parametric bootstrapping.

^dxx indicates data potentially exist but have not yet been summarized.

Table 76. Reproductive performance of glaucous-winged gulls at Chowiet Island, Alaska in 2021, as determined by a nest-monitoring methodology. Data derived from frequent monitoring of individual nests.

Parameter	Plot			Total	SD ^a
	A	B	C		
Total nest starts (A)	16	40	22	78	-
Nests w/ x eggs:					
0	0	0	0	0	-
1	0	0	0	0	-
2	1	3	5	9	-
3	4	11	4	19	-
4	0	1	0	1	-
Nests w/ eggs (B)	5	15	9	29	-
Total eggs (C)	14	43	22	79	-
Nests w/ x chicks:					
1	0	3	3	6	-
2	2	5	3	10	-
3	1	7	3	11	-
Nests w/ chicks (D) ^b	3	15	9	27	-
Total chicks (E) ^c	7	34	18	59	-
Laying success (B/A)	0.31	0.38	0.41	0.37	0.02
Mean clutch size (C/B)	2.8	2.9	2.4	2.7	0.10
Mean brood size (E/D)	2.3	2.3	2.0	2.2	0.15
Nesting success (D/B)	0.60	1.00	1.00	0.93	0.09
Hatching success (E/C)	0.50	0.79	0.82	0.75	0.07
Prop. nests w/ chicks (D/A) ^d	0.19	0.38	0.41	0.35	0.05
Chicks/nest start (E/A) ^d	0.4	0.9	0.8	0.8	0.13

^aStandard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit; for reproductive success parameters that can exceed 1 (mean clutch size, mean brood size, and chicks/nest start), standard deviations are calculated by non-parametric bootstrapping.

^bNests with chicks include nests with hatched eggshells at which no chicks were found.

^cChick totals include dead chicks and hatched eggshells that had no associated chick found.

^dProportion of nests with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

Table 77. Reproductive performance of glaucous-winged gulls at Chowiet Island, Alaska, as determined by a count methodology. Measures of success are based on count of nests, eggs, and chicks at varying intervals during the nesting period (as opposed to nest-monitoring methodology presented in Table 74); numbers of nests, eggs, and chicks represent maximum counts each year. As of 2011, chicks were not counted following a protocol change so only laying success and mean clutch size can be calculated. No data were collected in 1976-1977, 1980-1997, 1999-2001, 2003, 2008, or 2020. Although monitoring individual nests (Table 74) is considered a better way to measure gull reproductive performance, data are collected and presented using count methodology to allow for comparisons with historic data.

Year	Total nest starts	Nest sites w/ x eggs:				Nest sites w/ eggs	Total eggs	Nest sites w/ chicks	Total chicks	Laying success	Mean clutch size	Mean brood size	Nesting success	Hatching success	Prop. nest sites w/ chicks	Chicks/nest start	
		(A) ^a	1	2	3	4	(B)	(C)	(D) ^b	(E) ^c	(B/A)	(C/B)	(E/D)	(D/B)	(E/C)	(D/A) ^d	(E/A) ^d
1978	xx ^e	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1979	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1998	224 ^f	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002	138	1	6	92	0	99	289	-	153	0.72	2.9	-	-	0.53	-	1.11	
2004	131	8	17	62	0	87	228	17	36	0.66	2.6	2.1	0.20	0.16	0.13	0.27	
2005	130	9	23	18	0	50	109	20	44	0.38	2.2	2.2	0.40	0.40	0.15	0.34	
2006	157	6	31	42	0	79	194	38	71	0.50	2.5	1.9	0.48	0.37	0.24	0.45	
2007	159	6	28	24	0	58	134	22	37	0.36	2.3	1.7	0.37	0.28	0.14	0.23	
2009	172	9	37	62	0	108	269	66	116	0.63	2.5	1.8	0.61	0.43	0.38	0.67	
2010	163	2	18	76	0	96	266	63	103	0.59	2.8	1.6	0.66	0.39	0.39	0.63	
2011	79	8	21	15	0	44	95	-	-	0.56	2.2	-	-	-	-	-	
2012	175	3	25	40	0	68	173	-	-	0.39	2.5	-	-	-	-	-	
2013	225	5	19	75	0	99	268	-	-	0.44	2.7	-	-	-	-	-	
2014	212	11	14	87	0	112	300	-	-	0.53	2.7	-	-	-	-	-	
2015	155	5	23	74	0	102	273	-	-	0.66	2.7	-	-	-	-	-	
2016	151	1	17	81	0	99	278	-	-	0.66	2.8	-	-	-	-	-	
2017	126	7	24	30	0	61	145	-	-	0.48	2.4	-	-	-	-	-	
2018	154	9	22	39	0	70	170	-	-	0.45	2.4	-	-	-	-	-	
2019	168	11	19	70	0	100	259	-	-	0.60	2.6	-	-	-	-	-	
2021	250	11	32	63	1	107	268	-	-	0.43	2.5	-	-	-	-	-	

^aProductivity estimates based on only few visits (three in 2002, four in 2006) and represent a Boom-or-Bust estimate only; measures of success may not be comparable to other years when counts were conducted on a weekly basis throughout the season.

^bNests with chicks includes nests with hatched eggshells at which no chicks were found.

^cChick totals include dead chicks and hatched eggshells that had no associated chick found.

^dProportion of nests with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^exx indicates data potentially exist but have not yet been summarized.

^fProductivity in 1998 done using nest monitoring method, but all nests were included; data on total nests starts only included in this table and in Figure 55, all other data presented in Table 74.

Table 78. Standard deviation in reproductive performance parameters of glaucous-winged gulls at Chowiet Island, Alaska, as determined by a count methodology. As of 2011, chicks were not counted following a protocol change so only laying success and mean clutch size can be calculated. No data were collected in 1976-1977, 1980-1997, 1999-2001, 2003, 2008, or 2020. Although monitoring individual nests is considered a better way to measure gull reproductive performance, data is collected and presented using count methodology to allow for comparisons with historic data.

Year	No. plots ^a	Total nest starts	Sampling design ^b	Laying success	Mean clutch size ^c	Mean brood size ^c	Nesting success	Hatching success	Prop. nest sites w/ chicks	Chicks/nest start ^c
1978	Xx ^d	xx	xx	xx	xx	xx	xx	xx	xx	xx
1979	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
1998	3	224 ^e	-	-	-	-	-	-	-	-
2002	3	138	Cluster by plot	0.02	0.03	-	-	0.01	-	-
2004	3	131	Cluster by plot	<0.01	0.07	-	-	0.05	-	-
2005	3	130	Cluster by plot	0.05	0.10	0.18	0.03	0.05	0.03	0.16
2006	3	157	Cluster by plot	0.01	0.07	0.12	0.07	0.06	0.04	0.12
2007	3	159	Cluster by plot	0.03	0.08	0.15	0.01	0.02	0.01	0.12
2009	3	172	Cluster by plot	0.06	0.06	-	-	-	-	-
2010	3	163	Cluster by plot	0.05	0.05	-	-	-	-	-
2011	3	79	Cluster by plot	0.01	0.11	-	-	-	-	-
2012	3	175	Cluster by plot	0.03	0.07	-	-	-	-	-
2013	3	225	Cluster by plot	0.03	0.06	-	-	-	-	-
2014	3	212	Cluster by plot	0.04	0.06	-	-	-	-	-
2015	3	155	Cluster by plot	0.05	0.06	-	-	-	-	-
2016	3	151	Cluster by plot	0.08	0.04	-	-	-	-	-
2017	3	126	Cluster by plot	0.03	0.09	-	-	-	-	-
2018	3	154	Cluster by plot	0.08	0.08	-	-	-	-	-
2019	3	168	Cluster by plot	0.04	0.07	-	-	-	-	-
2021	3	250	Cluster by plot	0.03	0.07	-	-	-	-	-

^aPlots that are combined for analysis are counted as a single "plot".

^bSampling for gulls is clustered by plot except when sample sizes per plot are too small or plot data are not available. For sampling clustered by plot, values are calculated based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1 - \rho) / n}$, where ρ is the success rate and n is the sample size of individual nests.

^cStandard deviation values for reproductive success parameters that can exceed 1 are calculated by non-parametric bootstrapping.

^dxx indicates data potentially exist but have not yet been summarized.

^eProductivity in 1998 done using nest monitoring method, but all nests were included; data on total nests starts only included in this table and in Figure 51, all other data presented in Table 67.

Table 79. Reproductive performance of glaucous-winged gulls at Chowiet Island, Alaska in 2021, as determined by a count methodology. Data come from counts of nests, eggs, and chicks on plots throughout the nesting period. As of 2011, chicks were not counted following a protocol change.

Date	Total nest starts (A)	Nests w/ x eggs:				Nests w/ eggs (B)	Total eggs (C)	Total chicks (D)
		1	2	3	4			
Plot A								
1 Jun	19	1	2	1	0	4	8	-
6 Jun	19	0	1	3	0	4	11	-
11 Jun	20	1	2	2	0	5	11	-
Plot B								
1 Jun	168	16	5	20	0	41	86	-
6 Jun	190	11	18	47	1	76	188	-
11 Jun	187	7	23	55	0	86	222	-
Plot C								
1 Jun	30	2	1	6	0	9	22	-
6 Jun	40	1	4	5	0	10	24	-
11 Jun	36	3	7	6	0	16	35	-

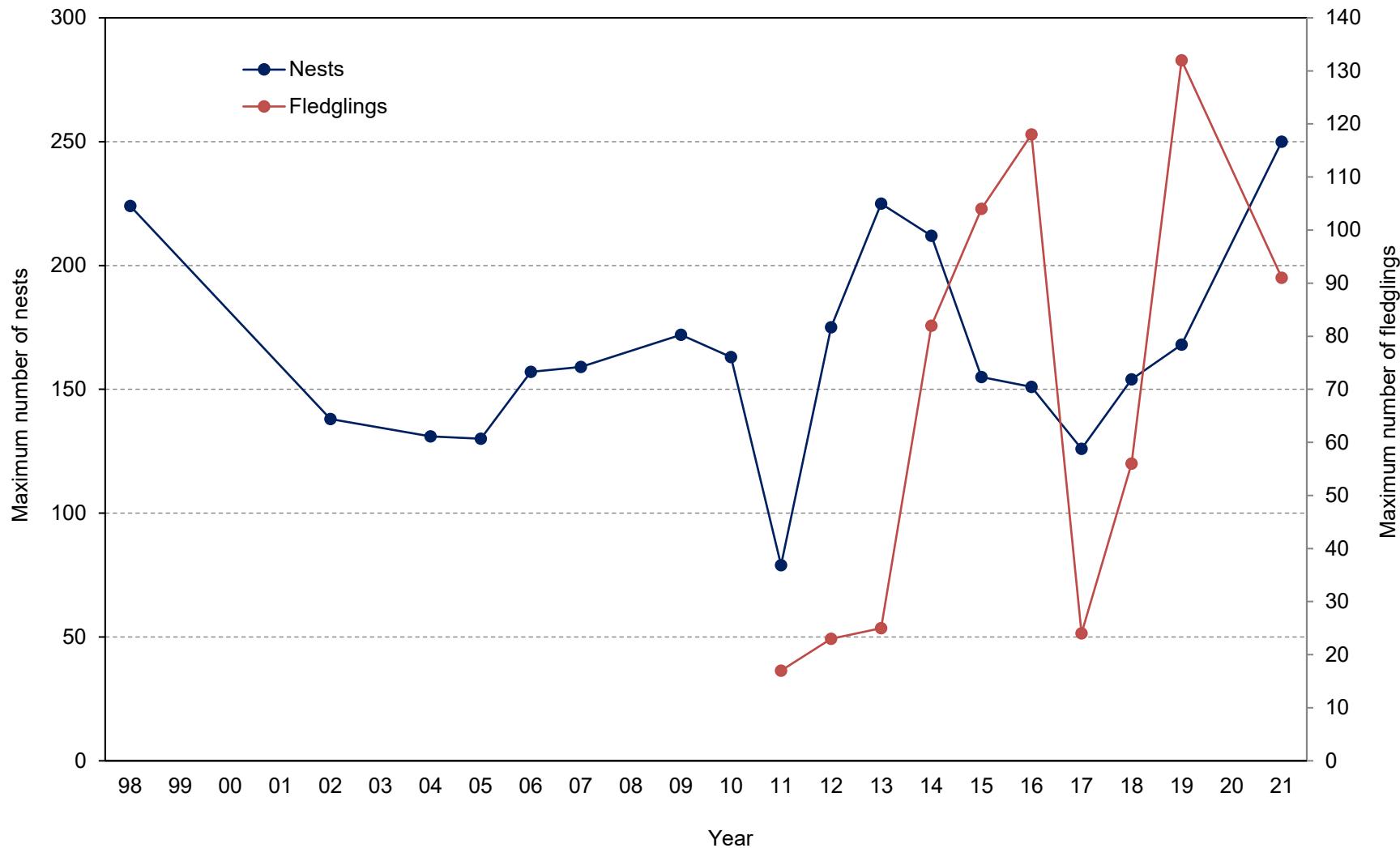


Figure 52. Maximum numbers of glaucous-winged gull nests and fledglings counted on sub-colonies A, B, and C at South Bay, Chowiet Island, Alaska. Nest data come from total nest starts (A) recorded during reproductive performance monitoring using a count methodology (Table 77); fledgling data come from replicate counts of fledglings conducted at the end of the breeding season. No data were collected in 2020.

Table 80. Numbers of glaucous-winged gull fledglings counted along South Bay sub-colony areas and the beach adjacent to sub-colony A at Chowiet Island, Alaska. No data were collected in 2020.

Replicate	2011 ^a	2012 ^a	2013	2014 ^a	2015	2016	2017 ^a	2018	2019	2021
1	3	11	11	76	6	48	14	22	3	11
2	10	22	25	81	23	108	18	30	7	26
3	17	23	22	82	64	118	23	54	81	48
4	15	16	16	64	69	78	24	56	132	63
5	16	9	-	68	104	48	9	33	75	91
6	6	-	-	-	-	16	-	16	87	69
7	3	-	-	-	-	-	-	-	-	70
Max.	17	23	25	82	104	118	24	56	132	91
<i>n</i>	7	5	4	5	5	6	5	6	6	7
SD	6	6	6	8	39	39	6	16	50	28
First count	13 Aug	11 Aug	9 Aug	5 Aug	6 Aug	5 Aug	6 Aug	4 Aug	29 Jul	3 Aug
Last count	5 Sep	2 Sep	24 Aug	25 Aug	28 Aug	31 Aug	31 Aug	30 Aug	28 Aug	29 Aug

^aCounts in these years may or may not have included fledglings on the beach adjacent to sub-colony A.

Table 81. Numbers of glaucous-winged gull fledglings counted along South Bay sub-colony areas and the beach adjacent to sub-colony A at Chowiet Island, Alaska in 2021.

Plot	Date							Max.
	3 Aug	8 Aug	11 Aug	15 Aug	20 Aug	25 Aug	29 Aug	
A	0	1	4	5	6	7	19	-
B	6	17	35	34	59	47	39	-
C	5	8	9	15	14	4	9	-
Beach	0	0	0	9	12	11	3	-
Total	11	26	48	63	91	69	70	91

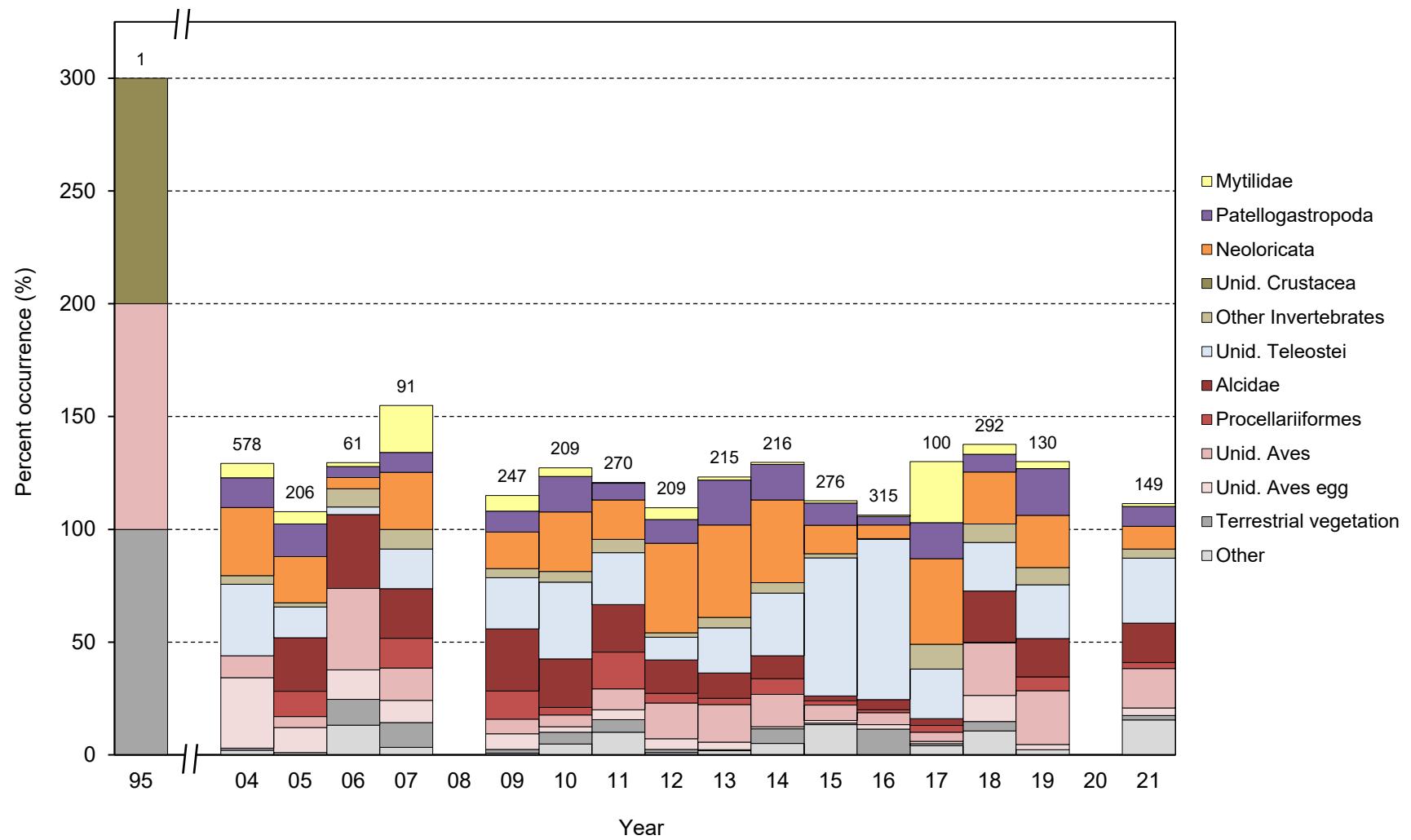


Figure 53. Frequency of occurrence of major prey items in diets of glaucous-winged gull adults at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of stomach contents from adults collected at or near the colony (1995) and pellets regurgitated by adults at the colony (2004-2007 and 2009-2021). Numbers above columns indicate sample sizes. No diet samples were collected in 1996-2003, 2008, or 2020.

Table 82. Frequency of occurrence of major prey items in diets of glaucous-winged gull adults at Chowiet Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified in the laboratory (1995) or field (2004-2021) to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey that occurred in at least 5% of diets on average across all years are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group, with values in bold showing totals for those taxa. Samples consist of stomach contents from adults collected at or near the colony (1995) and pellets regurgitated by adults at the colony (2004-2007 and 2009-2021). No diet samples were collected in 1996-2003, 2008, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1995	2004	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	1	578	206	61	91	247	209	270	209	215	216	276	315	100	292	130	149
Invertebrates	100.0	43.1	36.4	16.4	47.3	27.5	43.1	25.9	52.6	62.3	48.1	23.9	10.8	76.0	33.9	43.1	21.5
Bivalvia	-	6.4	7.3	1.6	23.1	6.9	6.7	0.4	5.3	1.4	0.9	1.1	0.6	27.0	4.5	3.1	1.3
Mytilidae	-	6.4	5.3	1.6	20.9	6.9	3.8	0.4	5.3	1.4	0.9	1.1	0.6	27.0	4.5	3.1	1.3
Unid. Mytilidae	-	6.4	5.3	1.6	20.9	6.9	3.8	0.4	5.3	1.4	0.9	1.1	0.6	27.0	4.5	3.1	1.3
Other Bivalvia	-	-	1.9	-	2.2	-	2.9	-	-	-	-	-	-	-	-	-	-
Gastropoda	-	13.3	14.6	4.9	8.8	9.3	16.3	7.4	11.5	28.8	15.7	9.8	3.8	16.0	7.9	20.8	8.7
Patellogastropoda	-	13.1	14.6	4.9	8.8	9.3	15.8	7.4	10.5	20.0	15.7	9.8	3.8	16.0	7.9	20.8	8.7
Other Gastropoda	-	0.2	-	-	-	-	0.5	-	1.0	9.3	-	-	-	-	0.3	-	-
Polyplacophora	-	30.3	20.4	4.9	25.3	16.2	26.3	17.4	39.7	40.9	36.6	12.7	6.0	38.0	22.9	23.1	10.7
Neoloricata	-	30.3	20.4	4.9	25.3	16.2	26.3	17.4	39.7	40.9	36.6	12.7	6.0	38.0	22.9	23.1	10.1
Other Polyplacophora	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7
Unid. Crustacea	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Invertebrates	-	3.8	1.9	8.2	8.8	4.0	4.8	5.9	1.9	4.7	4.6	1.8	0.3	11.0	8.2	7.7	4.0
Fish	-	31.7	13.6	3.3	17.6	22.7	34.0	23.0	10.0	20.0	27.8	61.2	71.1	22.0	21.6	23.8	28.9
Teleostei	-	31.7	13.6	3.3	17.6	22.7	34.0	23.0	10.0	20.0	27.8	61.2	71.1	22.0	21.6	23.8	28.9
Unid. Teleostei	-	31.7	13.6	3.3	17.6	22.7	34.0	23.0	10.0	20.0	27.8	61.2	71.1	22.0	21.6	23.8	28.9
Birds	100.0	39.1	51.9	77.0	54.9	53.4	31.1	53.3	40.2	32.6	31.5	12.7	12.7	11.0	55.8	48.5	39.6
Charadriiformes	-	-	24.8	32.8	22.0	28.3	21.5	21.9	15.3	11.2	10.2	2.2	4.4	3.0	23.3	16.9	17.4
Alcidae	-	-	23.8	32.8	22.0	27.5	21.5	21.1	14.8	11.2	10.2	2.2	4.4	3.0	22.6	16.9	17.4
<i>Uria</i> spp. egg	-	-	22.3	23.0	12.1	24.7	17.2	17.4	11.0	8.8	6.9	0.4	1.9	3.0	7.2	7.7	9.4
Other Alcidae	-	-	1.5	9.8	9.9	2.8	5.3	4.1	3.8	2.3	3.2	1.8	2.5	-	15.8	9.2	8.1
Other Charadriiformes	-	-	1.0	-	-	0.8	-	0.7	0.5	-	-	-	-	0.7	-	-	-
Procellariiformes	-	-	11.2	-	13.2	12.6	3.3	16.3	4.3	2.8	6.9	1.8	1.3	3.0	0.3	6.2	2.7
Procellariidae	-	-	11.2	-	13.2	12.6	3.3	15.9	4.3	2.8	4.2	1.1	-	2.0	0.3	3.1	0.7
Other Procellariiformes	-	-	-	-	-	-	0.4	-	-	3.2	0.7	1.3	1.0	-	3.1	2.0	-
Unid. Aves	100.0	9.7	4.9	36.1	14.3	6.5	5.3	9.3	15.8	16.7	14.4	6.9	5.4	4.0	23.3	23.8	17.4
Unid. Aves egg	-	31.3	11.2	13.1	9.9	6.9	2.4	4.4	4.8	3.3	0.9	1.1	1.9	1.0	11.6	2.3	3.4
Other Birds	-	-	-	1.6	-	-	-	1.9	-	-	-	0.7	-	-	-	-	0.7
Mammals	-	3.8	-	-	1.1	-	2.4	3.0	-	-	-	0.7	-	-	1.7	0.8	-
Other	100.0	2.6	1.0	24.6	13.2	2.4	9.1	13.7	2.4	1.9	11.6	14.1	11.4	5.0	13.7	2.3	17.4
Terrestrial vegetation	100.0	0.9	-	11.5	11.0	1.6	5.3	5.6	1.4	0.5	6.5	0.7	11.4	1.0	4.1	-	2.0
Other	-	2.1	1.0	13.1	3.3	0.8	4.8	10.0	1.0	1.9	5.1	13.4	-	4.0	10.6	2.3	15.4

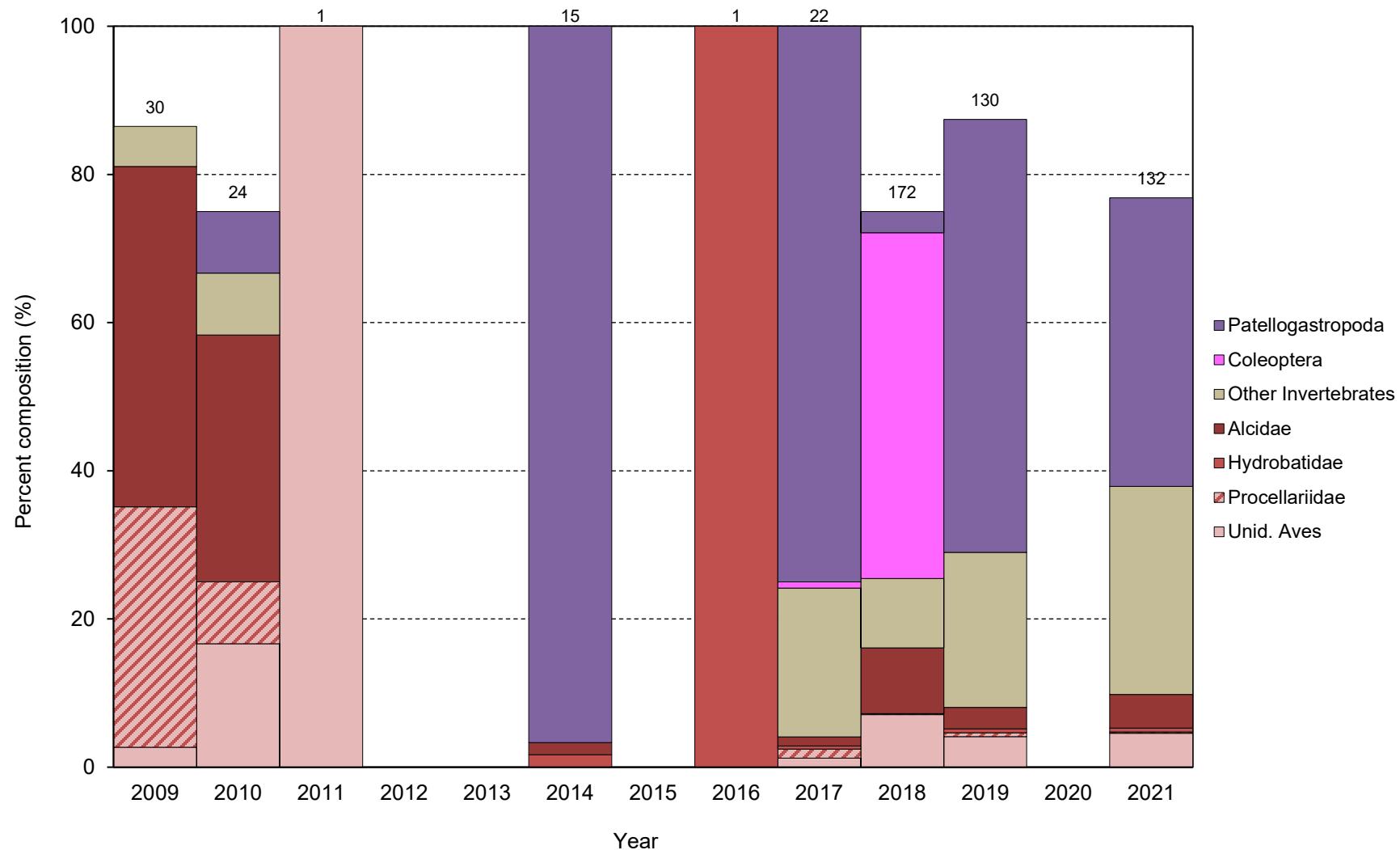


Figure 54. Percent composition of major prey items in diets of glaucous-winged gull adults at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of pellets regurgitated by adults at the colony. Numbers above columns indicate sample sizes. No diet samples were collected in 2020 and no count data exist before 2009 or in 2012-2013 or 2015.

Table 83. Percent composition of major prey items in diets of glaucous-winged gull adults at Chowiet Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year). Prey was identified and measured in the field to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey with an among-year average composition of at least 5% are shown to the lowest taxonomic level; others are lumped together as “others” in their respective taxonomic group with values in bold showing totals for those taxa. Samples consist of pellets regurgitated by adults at the colony. No data were collected in 2020 and no count data exist before 2009 or in 2012-2013 or 2015. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2009	2010	2011	2014	2016	2017	2018	2019	2021
No. samples	30	24	1	15	1	22	172	130	132
No. individuals	37	24	1	60	2	244	664	755	570
Invertebrates	5.4	20.8	-	96.7	-	95.9	58.9	79.3	77.5
Gastropoda	-	8.3	-	96.7	-	75.0	2.9	58.4	38.9
Patellogastropoda	-	8.3	-	96.7	-	75.0	2.9	58.4	38.9
Insecta	-	4.2	-	-	-	0.8	46.7	-	10.5
Coleoptera	-	-	-	-	-	0.8	46.7	-	-
Unid. Coleoptera	-	-	-	-	-	0.8	46.7	-	-
Other Insecta	-	4.2	-	-	-	12.3	-	-	10.5
Other Invertebrates	5.4	8.3	-	-	-	20.1	9.3	20.9	28.1
Fish	5.4	16.7	-	-	-	-	5.6	4.1	7.5
Birds	89.2	58.3	100.0	3.3	100.0	4.1	18.1	8.5	10.9
Charadriiformes	51.4	33.3	-	1.7	-	1.2	9.2	2.9	4.6
Alcidae	45.9	33.3	-	1.7	-	1.2	8.9	2.9	4.6
<i>Uria</i> spp. egg	35.1	4.2	-	-	-	1.2	2.1	1.3	2.5
Other Alcidae	10.8	29.2	-	1.7	-	-	6.8	1.6	2.1
Other Charadriiformes	5.4	-	-	-	-	-	0.3	-	-
Procellariiformes	32.4	8.3	-	1.7	100.0	1.6	0.2	1.1	0.7
Hydrobatidae	-	-	-	1.7	100.0	0.4	-	0.5	0.5
<i>Hydrobates</i> spp.	-	-	-	-	100.0	-	-	0.1	-
Other Hydrobatidae	-	-	-	1.7	-	0.4	-	0.4	0.5
Procellariidae	32.4	8.3	-	-	-	1.2	0.2	0.5	0.2
Unid. Aves	2.7	16.7	100.0	-	-	1.2	7.1	4.1	4.6
Other Birds	2.7	-	-	-	-	-	-	0.4	1.1
Mammals	-	-	-	-	-	-	0.5	0.1	-
Other	-	4.2	-	-	-	-	17.0	7.9	4.0

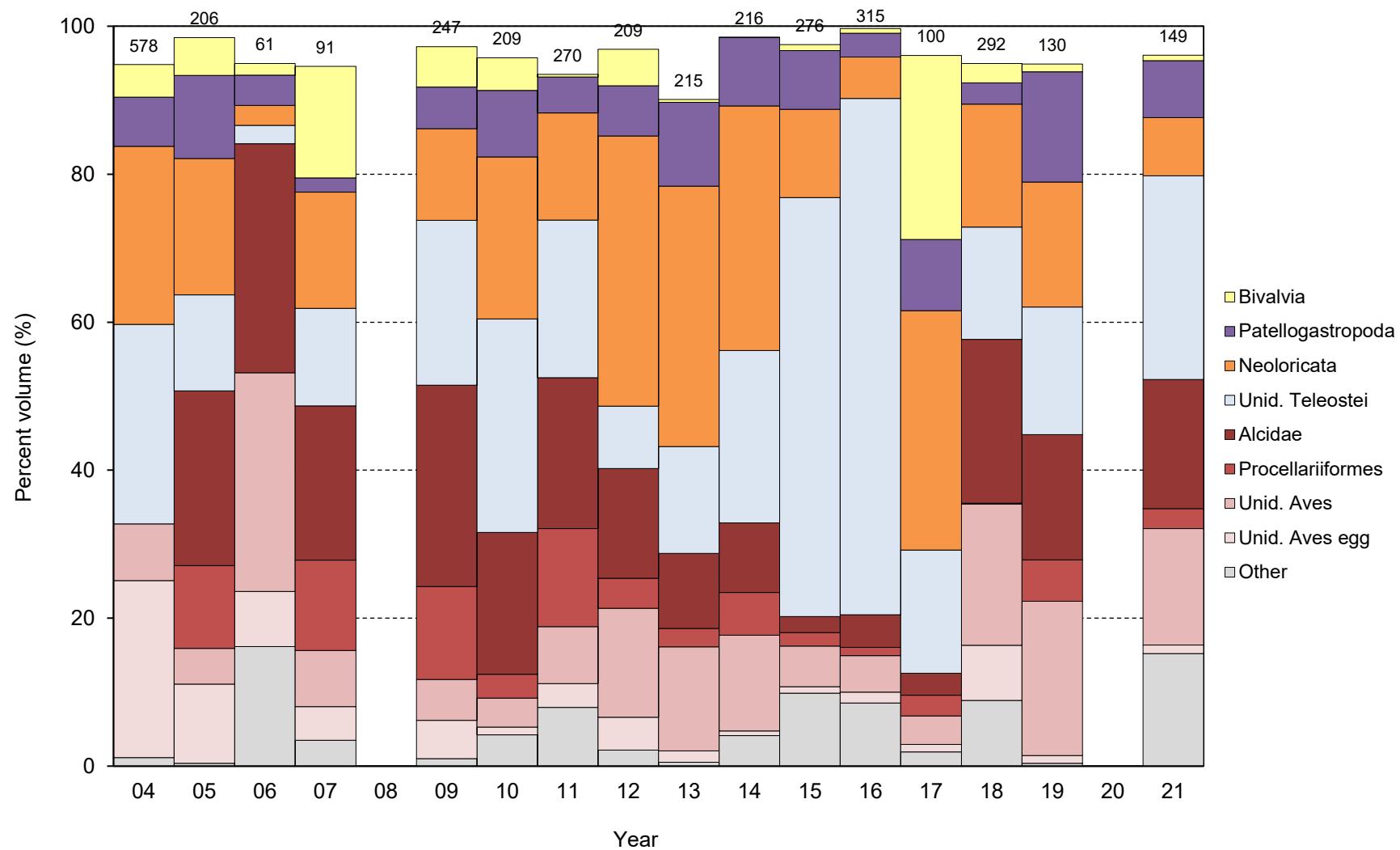


Figure 55. Percent volume of major prey items in diets of glaucous-winged gull adults at Chowiet Island, Alaska. Values represent the average percent volume of a prey item in all pellets. Prey is grouped to family level or higher; only taxa with an among-year average volume of at least 5% are shown. Samples consist of pellets regurgitated by adults at the colony. Numbers above columns indicate sample sizes. No diet samples were collected in 1996-2003, 2008, or 2020 and no volume data exist in 1995.

Table 84. Percent volume of prey in regurgitated pellets of glaucous-winged gull adults at Chowiet Island, Alaska. Values represent the average percent volume of a prey item in all pellets (sums to 100% each year). Prey was identified in the field to lowest taxon possible (some prey items were identified to species while others were only identified to genus, family, order, etc.). Any prey that made up at least 5% of diet volume on average across all years are shown to the lowest taxonomic level; others are lumped together as "others" in their respective taxonomic group, with values in bold showing totals for those taxa. No diet samples were collected in 1996-2003, 2008, or 2020 and no volume data exist in 1995. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2004	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	578	206	61	91	247	209	270	209	215	216	276	315	100	292	130	149
Invertebrates	37.1	35.3	12.8	37.0	25.4	38.0	22.0	50.9	56.8	43.8	21.7	9.8	70.8	24.9	37.3	19.6
Bivalvia	4.4	5.1	1.6	15.1	5.4	4.4	0.4	4.9	0.4	0.1	0.8	0.6	24.9	2.6	1.0	0.7
Gastropoda	6.7	11.2	4.1	1.9	5.6	9.5	4.9	7.8	19.6	9.2	7.9	3.2	9.6	2.9	14.9	7.7
Patellogastropoda	6.6	11.2	4.1	1.9	5.6	9.0	4.9	6.8	11.3	9.2	7.9	3.2	9.6	2.9	14.9	7.7
Other Gastropoda	<0.1	-	-	-	-	0.5	-	1.0	8.3	-	-	-	-	-	-	-
Polyplacophora	24.1	18.4	2.7	15.7	12.4	21.9	14.5	36.5	35.2	33.1	11.9	5.6	32.4	16.6	16.9	8.6
Neoloricata	24.1	18.4	2.7	15.7	12.4	21.9	14.5	36.5	35.2	33.1	11.9	5.6	32.4	16.6	16.9	7.9
Other Polyplacophora	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7
Other Invertebrates	1.9	0.6	4.4	4.3	2.0	2.2	2.3	1.7	1.6	1.5	1.0	0.3	3.9	2.8	4.4	2.6
Fish	27.0	13.0	2.5	13.2	22.3	28.8	21.3	8.4	14.4	23.3	56.6	69.8	16.6	15.2	17.2	27.5
Teleostei	27.0	13.0	2.5	13.2	22.3	28.8	21.3	8.4	14.4	23.3	56.6	69.8	16.6	15.2	17.2	27.5
Unid. Teleostei	26.9	13.0	2.5	13.2	22.3	28.8	21.3	8.4	14.4	23.3	56.6	69.8	16.6	15.2	17.2	27.5
Birds	31.7	51.3	68.5	45.2	51.3	27.4	47.2	38.5	28.2	28.8	11.1	11.9	10.7	49.5	44.4	37.7
Charadriiformes	-	24.6	31.0	20.9	28.0	19.2	21.1	15.3	10.2	9.4	2.2	4.4	3.0	22.8	16.9	17.4
Alcidae	-	23.6	31.0	20.9	27.2	19.2	20.4	14.8	10.2	9.4	2.2	4.4	3.0	22.1	16.9	17.4
<i>Uria</i> spp. egg	-	22.2	21.4	11.2	24.4	15.0	16.6	11.0	8.3	6.2	0.4	1.9	3.0	6.6	7.7	9.4
Other Alcidae	-	1.5	6.3	9.6	2.8	4.2	3.9	3.8	1.8	3.2	1.8	2.5	-	15.5	9.2	8.1
Other Charadriiformes	-	1.0	-	-	0.8	-	0.7	0.5	-	-	-	-	-	0.7	-	-
Procellariiformes	-	11.2	-	12.2	12.6	3.2	13.2	4.1	2.5	5.8	1.8	1.1	2.8	0.1	5.6	2.7
Unid. Aves	7.7	4.9	29.5	7.6	5.5	3.9	7.7	14.7	14.0	12.9	5.5	5.0	3.9	19.1	20.8	15.7
Unid. Aves egg	23.9	10.7	7.5	4.6	5.2	1.1	3.2	4.4	1.5	0.6	0.9	1.4	1.0	7.4	1.0	1.2
Other Birds	-	-	0.5	-	-	-	1.9	-	-	-	0.7	-	-	-	-	0.7
Mammals	3.3	-	-	1.1	-	1.6	1.6	-	-	-	0.7	-	-	1.6	0.7	-
Other	1.2	0.4	16.1	3.5	1.0	4.2	7.9	2.2	0.5	4.1	9.9	8.5	1.9	8.9	0.4	15.2

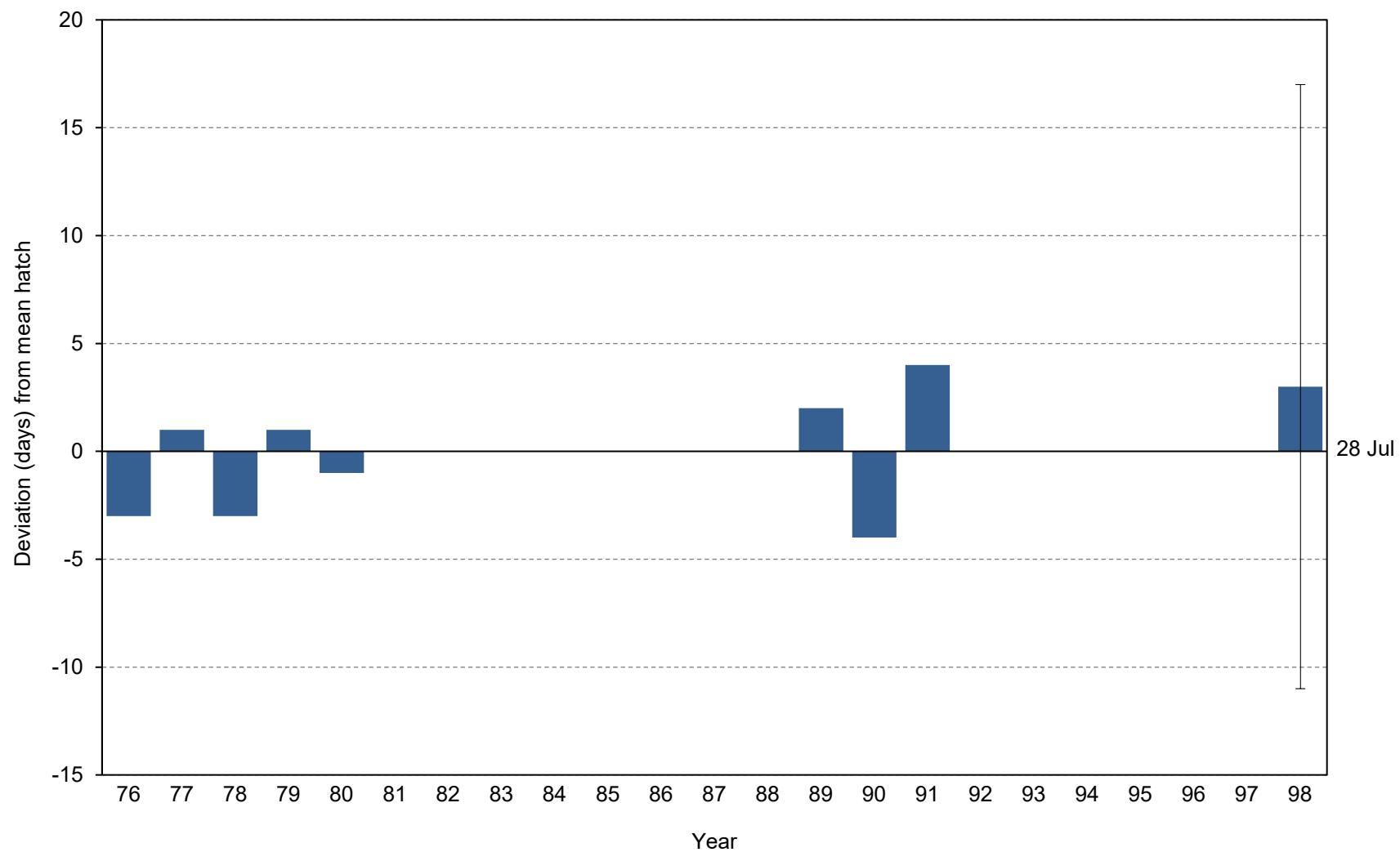


Figure 56. Yearly hatch date deviation (from the 1976-1998 average of 28 July) for northern fulmars at Chowiet Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date (only indicated for 1998, for other years presented standard deviation data potentially exists but have not yet been summarized). No data were collected in 1982-1988, 1992-1997, or after 1998.

Table 85. Breeding chronology of northern fulmars at Chowiet Island, Alaska. No data were collected in 1982-1988, 1992-1997, 1999-2001, 2003, 2008, or 2020. Data after 1998 are based on incidental observations because no nests were monitored.

Year	Mean lay	SD	n ^a	Mean hatch	SD	n ^b	First lay	First hatch	Last hatch
1976	6 Jun	xx ^c	208	24 Jul	xx	xx	29 May	xx	xx
1977	11 Jun	xx	386	29 Jul	xx	xx	2 Jun	xx	xx
1978	7 Jun	xx	397	25 Jul	xx	xx	26 May	xx	xx
1979	11 Jun	xx	400	29 Jul	xx	xx	2 Jun	xx	xx
1980	8 Jun	xx	389	26 Jul	xx	xx	27 May	xx	xx
1981	10 Jun	xx	395	28 Jul	xx	xx	31 May	xx	xx
1989	15 Jun	xx	31	30 Jul	xx	26	6 Jun	24 Jul	xx
1990	6 Jun	xx	68	24 Jul	xx	29	31 May	19 Jul	xx
1991	15 Jun	xx	91	1 Aug	xx	25	5 Jun	xx	xx
1998	15 Jun	5.0	80	31 Jul	14.0	11	8 Jun	26 Jul	xx
2002	-	-	-	-	-	-	1 Jun	16 Jul	-
2004	-	-	-	-	-	-	5 Jun	17 Jul	-
2005	-	-	-	-	-	-	24 May	23 Jul	-
2006	-	-	-	-	-	-	1 Jun	-	-
2007	-	-	-	-	-	-	8 Jun	-	-
2009	-	-	-	-	-	-	10 Jun	24 Jul	-
2010	-	-	-	-	-	-	4 Jun	-	-
2011	-	-	-	-	-	-	4 Jun	-	-
2012	-	-	-	-	-	-	30 May	-	-
2013	-	-	-	-	-	-	31 May	-	-
2014	-	-	-	-	-	-	27 May	17 Jul	-
2015	-	-	-	-	-	-	6 Jun	7 Aug	-
2016	-	-	-	-	-	-	6 Jun	30 Jul	-
2017	-	-	-	-	-	-	7 Jun	29 Jul	-
2018	-	-	-	-	-	-	9 Jun	-	-
2019	-	-	-	-	-	-	6 Jun	-	-
2021	-	-	-	-	-	-	3 Jun	26 Jul	-

^aSample sizes for mean lay dates are a sub-sample of total nests for which no egg to egg interval is ≤ 7 days.

^bSample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

^cxx indicates data potentially exist but have not yet been summarized.

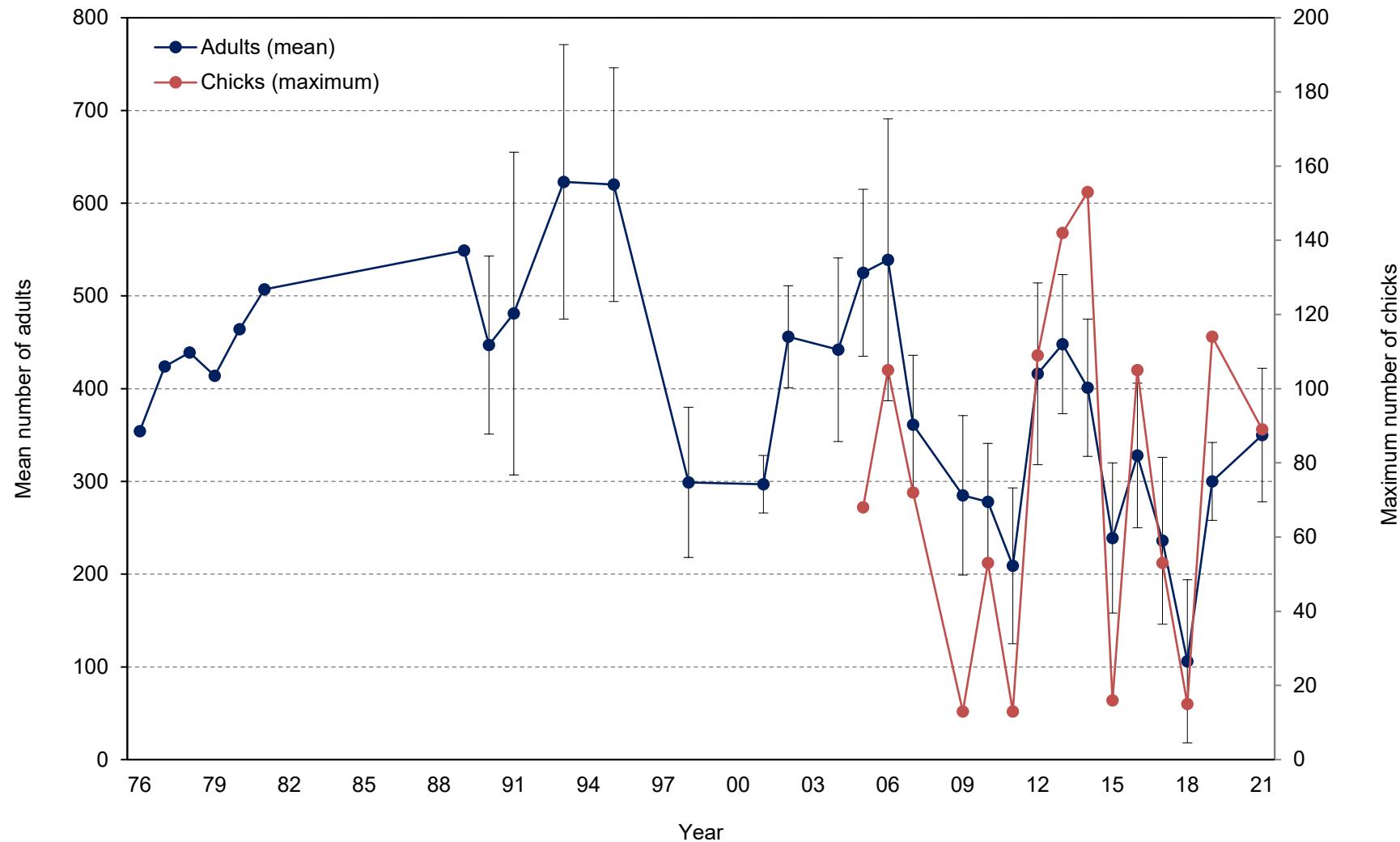


Figure 57. Mean numbers of northern fulmar adults and maximum numbers of chicks counted on index plots at Chowiet Island, Alaska. Error bars represent standard deviation. No adult counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020; no chick counts were conducted before 2005 or in 2008.

Table 86. Numbers of northern fulmar adults counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	1976	1977	1978	1979	1980	1981	1989	1990	1991	1993	1995	1998	2001	2002	2004
1	xx ^a	xx	598	327	xx ^a	552	571								
2	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	668	363	xx	477	613
3	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	740	208	xx	505	360
4	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	491	-	-	494	321
5	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	602	-	-	466	354
6	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	797	-	-	485	404
7	xx	xx	xx	xx	xx	xx	-	xx	xx	xx	446	-	-	486	417
8	xx	xx	xx	xx	xx	xx	-	xx	-	-	-	-	-	399	521
9	xx	xx	xx	xx	xx	xx	-	xx	-	-	-	-	-	441	482
10	xx	xx	xx	xx	xx	xx	-	xx	-	-	-	-	-	380	379
11	xx	xx	xx	xx	xx	xx	-	xx	-	-	-	-	-	402	-
12	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	382	-
13	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-
14	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-
15	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-
16	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-
17	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-
18	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-
19	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-
20	xx	xx	xx	xx	xx	xx	-	-	-	-	-	-	-	-	-
21	xx	xx	-	xx	xx	xx	-	-	-	-	-	-	-	-	-
22	xx	xx	-	xx	xx	xx	-	-	-	-	-	-	-	-	-
23	xx	xx	-	xx	xx	xx	-	-	-	-	-	-	-	-	-
24	xx	xx	-	xx	xx	xx	-	-	-	-	-	-	-	-	-
25	xx	xx	-	xx	xx	xx	-	-	-	-	-	-	-	-	-
26	xx	xx	-	xx	xx	xx	-	-	-	-	-	-	-	-	-
27	xx	xx	-	xx	xx	xx	-	-	-	-	-	-	-	-	-
28	xx	xx	-	xx	xx	xx	-	-	-	-	-	-	-	-	-
29	xx	xx	-	-	xx	xx	-	-	-	-	-	-	-	-	-
30	xx	-	-	-	xx	xx	-	-	-	-	-	-	-	-	-
Mean	354	424	439	414	464	507	549	447	481	623	620	299	297	456	442
n	xx	29	20	28	30	30	6	11	7	7	7	3	3	12	10
SD	xx	xx	xx	xx	xx	xx	xx	96	174	148	126	81	31	55	99
First count	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	20 Jun	1 Jul	xx	12 Jun	16 Jun
Last count	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	14 Jul	21 Jul	xx	16 Jul	7 Jul

Table 86 (continued). Numbers of northern fulmar adults counted on index plots at Chowiet Island, Alaska. No counts were conducted in 1982-1988, 1992, 1994, 1996-1997, 1999-2000, 2003, 2008, or 2020.

Replicate	2005	2006	2007	2009 ^b	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
1	589	644	400	331	362	355	473	489	474	204	339	227	278	359	419
2	536	830	413	353	339	256	566	551	544	227	418	228	170	316	436
3	499	508	387	353	319	210	340	446	395	216	496	461	199	347	363
4	548	556	416	314	305	151	525	512	417	163	329	273	60	262	385
5	600	585	451	211	290	267	459	476	449	261	328	242	61	282	435
6	626	441	308	145	293	206	401	410	364	190	314	250	39	281	325
7	443	371	274	-	212	126	412	371	286	290	296	206	43	251	313
8	318	379	322	-	215	97	275	325	373	382	260	183	23	-	338
9	537	-	418	-	161	-	306	-	327	339	281	152	83	-	262
10	562	-	221	-	287	-	-	-	378	117	224	134	-	-	223
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	526	539	361	285	278	209	417	448	401	239	329	236	106	300	350
<i>n</i>	10	8	10	6	10	8	9	8	10	10	10	10	9	7	10
SD	90	152	75	86	63	84	98	75	74	81	78	90	88	42	72
First count	21 Jun	15 Jun	17 Jun	24 Jun	17 Jun	15 Jun	10 Jun	11 Jun	9 Jun	17 Jun	17 Jun	20 Jun	20 Jun	22 Jun	16 Jun
Last count	12 Jul	13 Jul	10 Jul	19 Jul	11 Jul	14 Jul	9 Jul	9 Jul	10 Jul	14 Jul	12 Jul	10 Jul	19 Jul	16 Jul	11 Jul

^axx indicates data potentially exist but have not yet been summarized.

^bFour counts were excluded from data summary in 2009 because they occurred outside the standardized count window.

Table 87. Numbers of northern fulmar chicks counted on index plots at Chowiet Island, Alaska. No chick counts were conducted on index plots before 2005 (data from 2002 and 2004 are excluded because counts were conducted on a different set of productivity plots) or in 2008 or 2020.

Replicate	2005 ^a	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
1	62	69	58	13	42	7	78	109	135	16	66	42	5	81	68
2	62	75	66	-	44	12	74	130	139	12	69	35	9	80	78
3	-	95	68	-	50	6	108	131	138	13	82	42	7	88	83
4	-	105	72	-	46	6	-	136	152	10	99	50	14	97	73
5	-	-	-	-	-	8	-	136	147	11	98	49	9	110	81
6	-	-	-	-	-	-	-	-	-	-	96	-	-	-	-
Mean	62	86	66	13	46	8	87	128	142	12	85	44	9	91	77
Max. ^b	68	105	72	13	53	13	109	142	153	16	105	53	15	114	89
<i>n</i>	2	4	4	1	4	5	3	5	5	5	6	5	5	5	5
SD	0	17	6	-	3	2	19	11	7	2	15	6	3	13	6
First count	28 Aug	31 Aug	28 Aug	3 Sep	30 Aug	27 Aug	27 Aug	21 Aug	25 Aug	24 Aug	26 Aug	24 Aug	19 Aug	23 Aug	23 Aug
Last count	2 Sep	3 Sep	2 Sep	-	5 Sep	4 Sep	1 Sep	30 Aug	31 Aug	1 Sep	1 Sep	31 Aug	3 Sep	31 Aug	28 Aug

^aIncomplete replicates (in which not all plots were counted) in 2005 are excluded from analysis.

^bMaximum count represents the sum of the maximum counts for each plot, and may not correspond to the maximum count of a single replicate.

Table 88. Numbers of northern fulmar adults counted on index plots at Chowiet Island, Alaska in 2021.

Plot	Date									Mean	SD
	16 Jun	18 Jun	21 Jun	22 Jun	27 Jun	1 Jul	6 Jul	10 Jul	11 Jul		
A03N01	95	94	76	85	82	64	78	112	33	-	-
A04N01	18	12	12	15	19	17	18	16	12	-	-
A07N01	169	180	148	168	220	154	145	56	110	-	-
A10N01	49	59	42	40	34	25	18	18	13	-	-
A10N02	22	24	17	24	17	18	14	15	10	-	-
A12N01	36	31	33	32	38	25	20	26	27	-	-
A12N02	30	36	35	21	25	22	20	19	18	-	-
Total	419	436	363	385	435	325	313	338	262	350	72

Table 89. Numbers of northern fulmar chicks counted on index plots at Chowiet Island, Alaska in 2021.

Plot	Date					Mean	SD	Max.
	23 Aug	25 Aug	26 Aug	27 Aug	28 Aug			
A03N01	19	22	28	23	25	-	-	-
A04N01	4	3	3	3	2	-	-	-
A07N01	21	26	25	22	28	-	-	-
A10N01	5	9	9	7	8	-	-	-
A10N02	5	6	6	6	6	-	-	-
A12N01	9	9	9	9	9	-	-	-
A12N02	5	3	3	3	3	-	-	-
Total	68	78	83	73	81	77	6	89 ^a

^aMaximum count represents the sum of the maximum counts for each plot, and may not correspond to the maximum count of a single replicate.

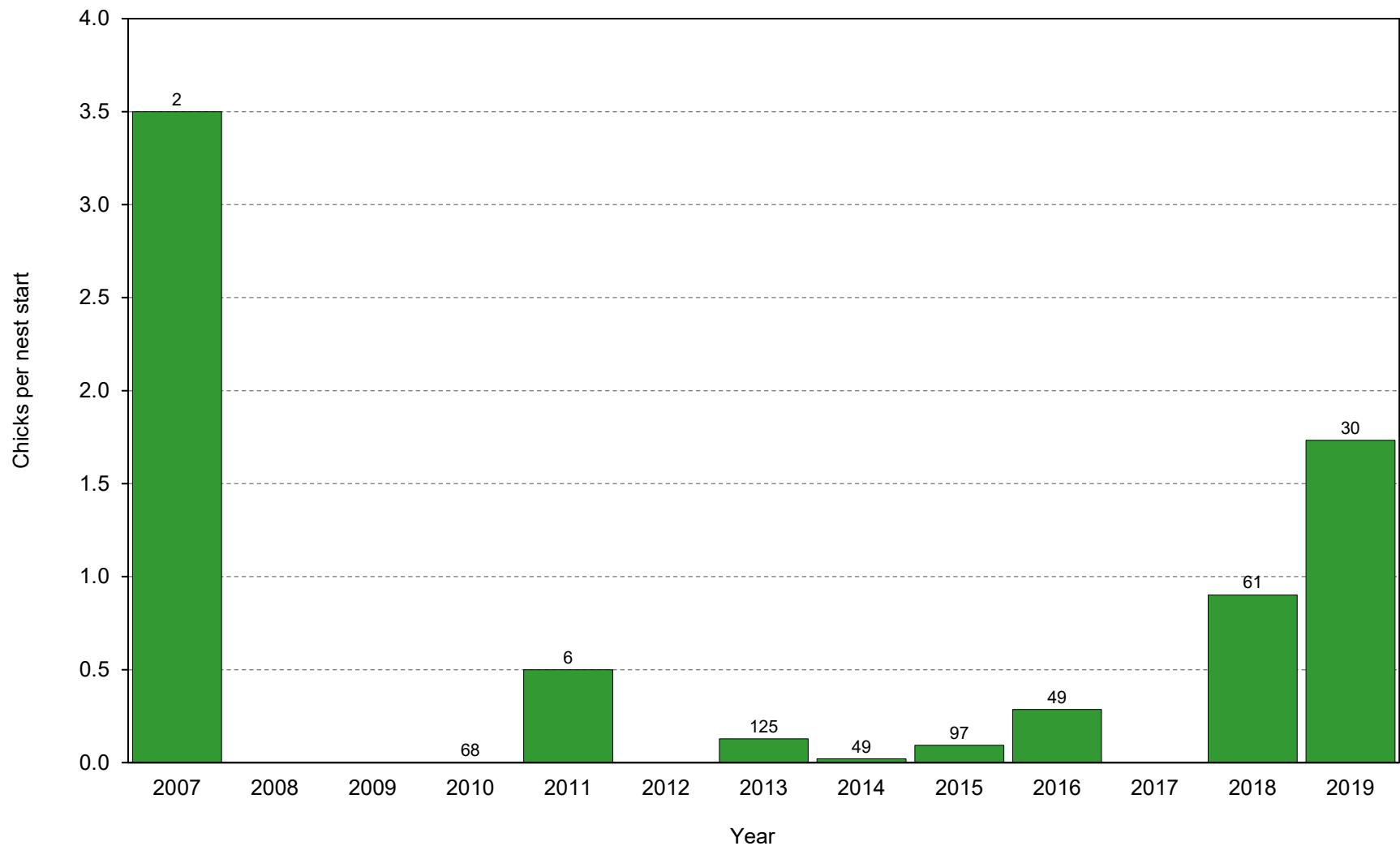


Figure 58. Reproductive performance of red-faced cormorants at Chowiet Island, Alaska, as determined by a Boom-or-Bust methodology. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A). No data were collected in 2002-2006, 2008-2009, 2012, 2017, or 2020-2021.

Table 90. Reproductive performance of red-faced cormorants at Chowiet Island, Alaska, as determined by a Boom-or-Bust methodology. Measures of success are based on a count of nests (or maximum of several counts) conducted early in the nesting period and a count of large chicks (or maximum of several counts) conducted late in the nesting period. No data were collected in 2002-2006, 2008-2009, 2012, 2017, or 2020-2021; historical data collected during the 1970s may potentially exist but have not yet been summarized.

Year	Total nest starts	Nest sites w/ x chicks ^a :				Nest sites w/ chicks	Total chicks	Mean brood size (E/D)	Prop. nest sites w/ chicks (D/A) ^b	Chicks/nest start (E/A) ^b	Date(s) of max. nest count	Date(s) of max. chick count	Sampling design ^c
		(A)	1	2	3	4	(D)	(E)	Total	SD ^d	Total	SD	Total
2007	2	0	0	1	1	2	7	3.5	0.35	1.00	0.00	3.5	0.35
2010	68	0	0	0	0	0	0	-	-	0.00	-	0.0	0.00
2011	6	1	1	0	0	2	3	1.5	0.35	0.33	0.19	0.5	0.31
2013	125	12	2	0	0	14	16	1.1	0.11	0.11	0.03	0.1	0.04
2014	49	1	0	0	0	1	1	1.0	0.00	0.02	0.02	<0.1	0.02
2015	97	7	1	0	0	8	9	1.1	0.12	0.08	0.03	0.1	0.03
2016	49	4	5	0	0	9	14	1.6	0.17	0.18	0.05	0.3	0.09
2018	61	4	13	7	1	25	55	2.2	0.15	0.41	0.06	0.9	0.15
2019	30	7	6	7	3	23	52	2.3	0.22	0.80	0.07	1.7	0.24

^aNumbers of chicks may represent a minimum count as not all may have been visible.

^bProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^cSampling for cormorants with Boom-or-Bust methodology is based on nests as the sample unit. For simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

^dStandard deviation values for reproductive success parameters that can exceed 1 are calculated by non-parametric bootstrapping.

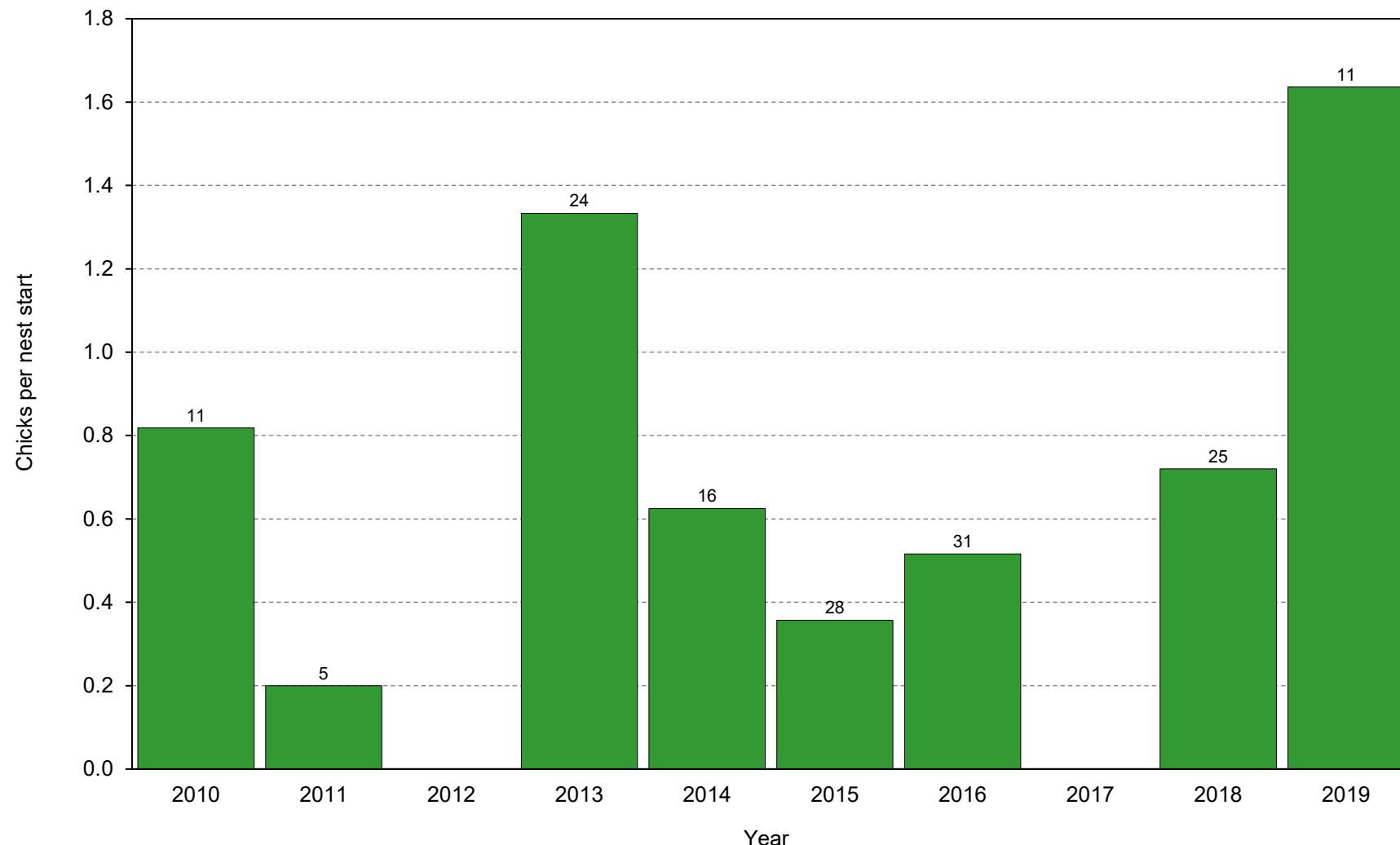


Figure 59. Reproductive performance of pelagic cormorants at Chowiet Island, Alaska, as determined by a Boom-or-Bust methodology. Success is measured by the number of chicks per nest start (E/A), where E =total chicks and A =total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A). No data were collected in 2002-2009, 2012, 2017, or 2020-2021.

Table 91. Reproductive performance of pelagic cormorants at Chowiet Island, Alaska, as determined by a Boom-or-Bust methodology. Measures of success are based on a count of nests (or maximum of several counts) conducted early in the nesting period and a count of large chicks (or maximum of several counts) conducted late in the nesting period. No data were collected in 2002-2009, 2012, 2017, or 2020-2021; historical data collected during the 1970s may potentially exist but have not yet been summarized.

Year	Total nest starts	Nest sites w/ x chicks ^a :				Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)		Prop. nest sites w/ chicks (D/A) ^b		Chicks/nest start (E/A) ^b		Date(s) of max. nest count	Date(s) of max. chick count	Sampling design ^c
		(A)	1	2	3			Total	SD ^d	Total	SD	Total	SD ^d			
2010	11	3	0	2	0	5	9	1.8	0.44	0.45	0.15	0.8	0.34	19 Jun	6+11 Aug	Simple random
2011	5	1	0	0	0	1	1	1.0	0.00	0.20	0.18	0.2	0.18	13 Jul	29 Jul	Simple random
2013	24	3	10	3	0	16	32	2.0	0.15	0.67	0.10	1.3	0.22	6+8 Jun	4+7 Aug	Simple random
2014	16	0	3	0	1	4	10	2.5	0.43	0.25	0.11	0.6	0.29	9+21 Jun	30 Jul	Simple random
2015	28	5	1	1	0	7	10	1.4	0.27	0.25	0.08	0.4	0.14	10+13 Jun	8+9 Aug	Simple random
2016	31	5	4	1	0	10	16	1.6	0.21	0.32	0.08	0.5	0.15	4 Jun	2 Aug	Simple random
2018	25	5	5	1	0	11	18	1.6	0.19	0.44	0.10	0.7	0.18	10 Jun+9 Aug	4 Aug+9 Aug	Simple random
2019	11	2	6	0	1	9	18	2.0	0.27	0.82	0.12	1.6	0.32	13 Jun+25 Jul	25 Jul	Simple random

^aNumbers of chicks may represent a minimum count as not all may have been visible.

^bProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^cSampling for cormorants with Boom-or-Bust methodology is based on nests as the sample unit. For simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

^dStandard deviation values for reproductive success parameters that can exceed 1 are calculated by non-parametric bootstrapping.

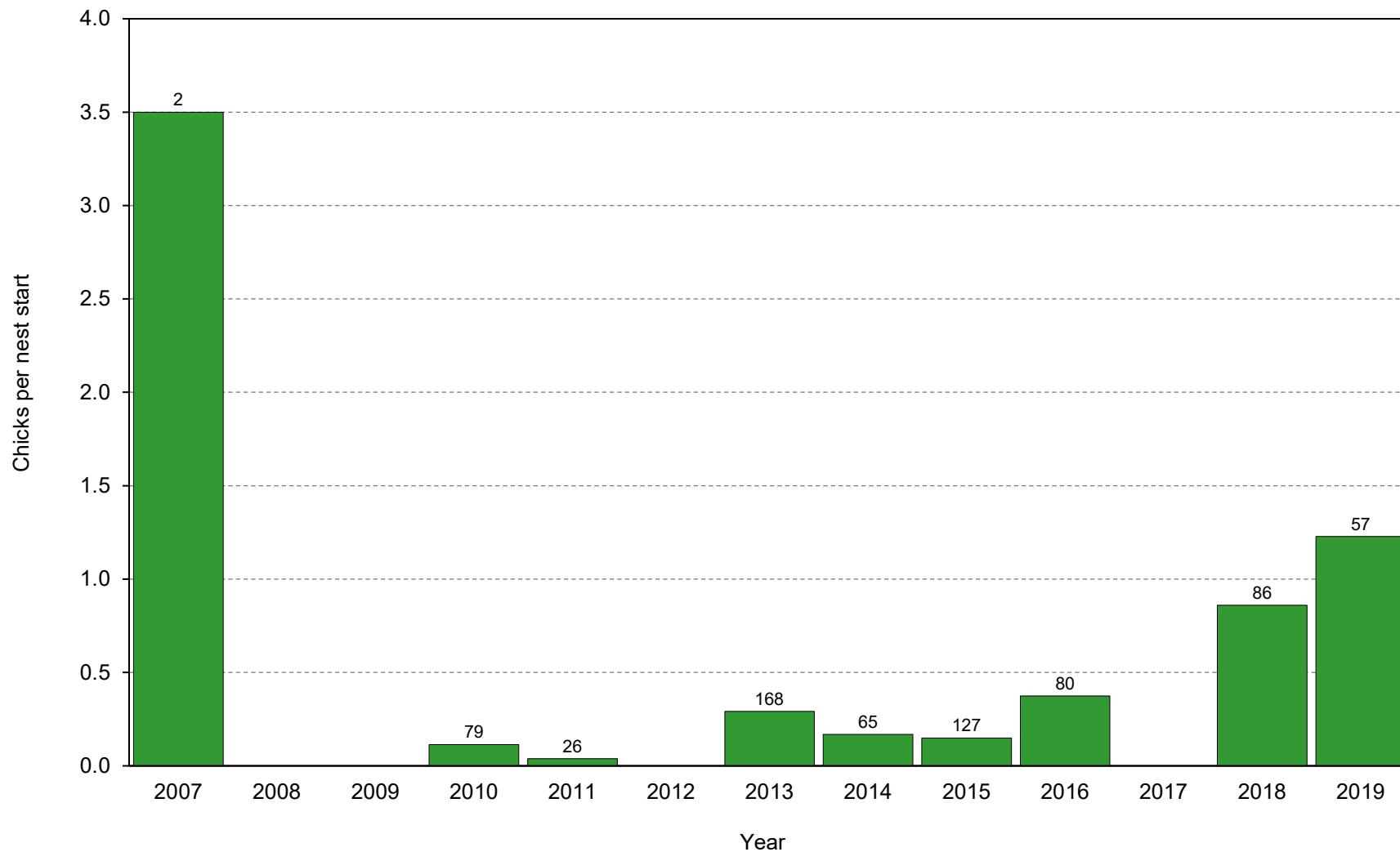


Figure 60. Reproductive performance of all cormorants (red-faced, pelagic, and unknown cormorant species) at Chowiet Island, Alaska, as determined by a Boom-or-Bust methodology. Success is measured by the number of chicks per nest start (E/A), where E =total chicks and A =total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A). No data were collected in 2002-2006, 2008-2009, 2012, 2017, or 2020-2021.

Table 92. Reproductive performance of all cormorants (red-faced, pelagic, and unknown cormorant species) at Chowiet Island, Alaska, as determined by a Boom-or-Bust methodology. Measures of success are based on a count of nests (or maximum of several counts) conducted early in the nesting period and a count of large chicks (or maximum of several counts) conducted late in the nesting period. No data were collected in 2002-2006, 2008-2009, 2012, 2017, or 2020-2021; historical data collected during the 1970s may potentially exist but have not yet been summarized.

Year	Total nest starts	Nest sites w/ x chicks ^a :				Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)	Prop. nest sites w/ chicks (D/A) ^b		Chicks/nest start (E/A) ^b	Date(s) of max. nest count	Date(s) of max. chick count	Sampling design ^c		
		(A)	1	2	3	4			Total	SD ^d						
2007	2	0	0	1	1	2	7	3.5	0.35	1.00	0.00	3.5	0.35	7 Jun	3 Aug	Simple random
2010	79	3	0	2	0	5	9	1.8	0.44	0.06	0.03	0.1	0.06	19 Jun	6+11 Aug	Simple random
2011	26	2	1	0	0	3	4	1.3	0.27	0.12	0.06	0.2	0.09	13 Jul	29 Jul	Simple random
2013	168	16	12	3	0	31	49	1.6	0.12	0.18	0.03	0.3	0.05	29 May+8 Jun	4+7 Aug	Simple random
2014	65	1	3	0	1	5	11	2.2	0.44	0.08	0.03	0.2	0.08	8+9+21 Jun	30,31Jul+12 Aug	Simple random
2015	127	12	2	1	0	15	19	1.3	0.15	0.12	0.03	0.2	0.04	6+10+13 Jun	8+9 Aug	Simple random
2016	80	9	9	1	0	19	30	1.6	0.14	0.24	0.05	0.4	0.08	4 Jun	2 Aug	Simple random
2018	86	10	18	8	1	37	74	2.0	0.13	0.43	0.05	0.9	0.12	1+10 Jun+9 Aug	3+4+9 Aug	Simple random
2019	57	9	12	7	4	32	70	2.2	0.17	0.60	0.06	1.2	0.17	6+23 Jun	25 Jul+3 Aug	Simple random

^aNumbers of chicks may represent a minimum count as not all may have been visible.

^bProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^cSampling for cormorants with Boom-or-Bust methodology is based on nests as the sample unit. For simple random sampling, standard deviation values are calculated using $\sqrt{\rho * (1 - \rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

^dStandard deviation values for reproductive success parameters that can exceed 1 are calculated by non-parametric bootstrapping.

Table 93. Numbers of birds detected during off-road point count survey (route 362) at Chowiet Island, Alaska. Data represent only individuals observed from survey points ($\leq 50\text{m}$) and do not include birds flying over census area. Counts were conducted for five minutes at each survey point. No counts were conducted in years not listed.

Species	2002	2007	2011
Black oystercatcher	1	0	0
Parasitic jaeger	2	0	0
Parakeet auklet	1	0	1
Glaucous-winged gull	0	0	8
Tree swallow	0	0	4
Pacific wren	4	3	8
Hermit thrush	0	0	3
American pipit	2	1	0
Gray-crowned rosy-finches	8	1	3
Lapland longspur	1	0	2
Snow bunting	1	0	0
Fox sparrow	5	5	0
Golden-crowned sparrow	2	6	12
Savannah sparrow	11	11	11
Song sparrow	2	1	21
Date	5 Jun	9 Jun	8 Jun

Table 94. Mean numbers of birds detected on beach transect surveys along South Bay Beach, Chowiet Island, Alaska. Data represent species' presence but not necessarily absence in all years. No counts were conducted before 2002 or in 2003, 2008, or 2020.

Species	2002	2004	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
Harlequin duck	0	0	0	0	1	4	<1	0	<1	4	0	2	<1	0	0	<1	0
Black oystercatcher	4	0	0	5	4	3	2	2	2	3	3	1	3	0	3	1	
Least sandpiper	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0
Wandering tattler	0	0	0	0	<1	0	0	0	0	0	0	0	<1	0	0	0	0
Pigeon guillemot	0	0	0	<1	1	0	0	0	0	0	0	0	0	3	0	1	0
Bald eagle	0	0	0	<1	1	<1	<1	0	<1	0	<1	<1	0	1	0	0	0
Common raven	0	0	0	<1	0	0	0	<1	0	<1	0	0	0	<1	0	0	0
Bank swallow	<1	0	0	<1	<1	0	0	0	0	0	0	0	0	<1	<1	0	<1
Pacific wren	1	1	3	3	2	2	2	2	1	2	2	2	2	1	1	2	2
Hermit thrush	0	0	0	0	0	0	<1	<1	0	0	0	0	0	0	<1	0	0
Gray-crowned rosy-finches	0	0	<1	1	1	<1	<1	0	1	<1	0	0	0	1	<1	0	<1
Fox sparrow	1	<1	<1	0	1	1	<1	<1	1	2	<1	<1	0	1	<1	0	<1
Golden-crowned sparrow	<1	<1	0	2	1	<1	<1	1	<1	<1	<1	<1	0	1	0	1	1
Savannah sparrow	1	2	1	2	2	<1	<1	<1	2	1	2	1	<1	1	1	1	2
Song sparrow	3	4	6	5	3	2	4	5	2	5	3	4	3	3	7	3	3
Yellow warbler	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	<1	0	0
Wilson's warbler	0	<1	<1	<1	0	0	<1	0	<1	<1	<1	0	0	0	0	0	0
<i>n</i>	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
First survey	2 Jun	6 Jun	7 Jun	3 Jun	1 Jun	3 Jun	2 Jun	5 Jun	3 Jun	4 Jun	2 Jun	2 Jun	2 Jun	2 Jun	4 Jun	2 Jun	1 Jun
Last survey	17 Jun	12 Jun	15 Jun	15 Jun	14 Jun	16 Jun	13 Jun	13 Jun	14 Jun	12 Jun	13 Jun	14 Jun	12 Jun	11 Jun	15 Jun	10 Jun	11 Jun

Table 95. Numbers of birds detected on beach transect surveys along South Beach, Chowiet Island, Alaska in 2021.

Species	Date					Mean	SD
	1 Jun	4 Jun	6 Jun	10 Jun	11 Jun		
Harlequin duck	0	0	0	0	0	0	0
Black oystercatcher	1	0	3	1	1	1	1
Least sandpiper	0	0	0	0	0	0	0
Wandering tattler	0	0	0	0	0	0	0
Pigeon guillemot	0	0	0	0	0	0	0
Bald eagle	0	0	0	0	0	0	0
Common raven	0	0	0	0	0	0	0
Bank swallow	0	0	0	0	2	<1	<1
Pacific wren	3	2	1	3	1	2	1
Hermit thrush	0	0	0	0	0	0	0
Gray-crowned rosy-finches	1	0	0	0	0	<1	<1
Fox sparrow	1	1	0	0	0	<1	<1
Golden-crowned sparrow	0	0	1	1	4	1	2
Savannah sparrow	2	1	1	3	1	2	1
Song sparrow	2	2	2	3	5	3	1
Yellow warbler	0	0	0	0	0	0	0
Wilson's warbler	0	0	0	0	0	0	0
Start time (AKST)	0756	0933	0854	0800	0929	-	-
End time (AKST)	0809	0941	0907	0812	0942	-	-

Table 96. Mean numbers of individuals found and encounter rates during COASST surveys along Landing Cove, Chowiet Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and does not include birds still present and re-encountered from previous surveys. Encounter rate is defined as the number of all birds (including both new individuals and re-encountered birds) found per km beach surveyed (0.1 km for Landing Cove) divided by the number of surveys. No data were collected in 2008 or 2020.

Species	2006		2007		2009		2010		2011		2012		2013	
	Mean # ind.	Enc. rate												
Common murre	-	-	-	-	-	-	0.1	1.3	-	-	-	-	-	-
Unidentified murre	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parakeet auklet	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glaucous-winged gull	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern fulmar	-	-	-	-	0.3	7.1	-	-	-	-	-	-	-	-
Sooty shearwater	0.1	1.3	0.3	5.7	-	-	-	-	-	-	-	-	-	-
Pelagic cormorant	-	-	-	-	-	-	-	-	-	-	0.1	2.9	-	-
Unidentified bird	0.3	2.5	-	-	-	-	-	-	-	-	0.1	1.4	-	-
All species	0.4	3.8	0.3	5.7	0.3	7.1	0.1	1.3	0.0	0.0	0.3	4.3	0.0	0.0
<i>n</i>	8		7		7		8		10		7		6	
First survey	3 Jul		28 May		24 May		25 May		2 Jun		25 May		28 May	
Last survey	29 Aug		23 Aug		25 Aug		31 Aug		24 Aug		25 Aug		26 Aug	

Table 96 (continued). Mean numbers of individuals found and encounter rates during COASST surveys along Landing Cove, Chowiet Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and does not include birds still present and re-encountered from previous surveys. Encounter rate is defined as the number of all birds (including both new individuals and re-encountered birds) found per km beach surveyed (0.1 km for Landing Cove) divided by the number of surveys. No data were collected in 2008 or 2020.

Species	2014		2015		2016		2017		2018		2019		2021	
	Mean # ind.	Enc. rate												
Common murre	0.2	1.7	1.3	43.3	0.1	10.0	-	-	-	-	-	-	-	-
Unidentified murre	-	-	0.2	1.7	-	-	-	-	-	-	-	-	-	-
Parakeet auklet	-	-	-	-	0.1	2.9	-	-	-	-	-	-	-	-
Glaucous-winged gull	0.2	1.7	0.2	6.7	-	-	-	-	-	-	-	-	-	-
Northern fulmar	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sooty shearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pelagic cormorant	-	-	-	-	0.1	8.6	-	-	-	-	0.2	1.7	-	-
Unidentified bird	-	-	0.2	1.7	-	-	-	-	-	-	-	-	-	-
All species	0.3	3.3	1.8	53.3	0.4	21.4	0.0	0.0	0.0	0.0	0.2	1.7	0.0	0.0
<i>n</i>	6		6		7		8		7		6		7	
First survey	28 May		28 May		22 May		21 May		23 May		10 Jun		27 May	
Last survey	31 Aug		20 Aug		20 Aug		29 Aug		21 Aug		25 Aug		26 Aug	

Table 97. Mean numbers of individuals found and encounter rates during COASST surveys along South Bay Beach, Chowiet Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and does not include birds still present and re-encountered from previous surveys. Encounter rate is defined as the number of all birds (including both new individuals and re-encountered birds) found per km beach surveyed (0.2 km for South Bay Beach) divided by the number of surveys. No data were collected in 2008 or 2020.

Species	2006		2007		2009		2010		2011		2012		2013	
	Mean # ind.	Enc. rate												
Black oystercatcher	-	-	-	-	-	-	-	-	-	-	-	-	0.2	5.0
Common murre	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown murre	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ancient murrelet	0.1	0.5	-	-	-	-	-	-	-	-	0.2	4.2	-	-
Cassin's auklet	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parakeet auklet	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhinoceros auklet	0.1	0.5	-	-	-	-	-	-	-	-	-	-	-	-
Black-legged kittiwake	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.8
Glaucous-winged gull	0.1	0.5	-	-	-	-	-	-	0.1	2.1	-	-	0.5	2.5
Northern fulmar	0.1	0.5	-	-	-	-	-	-	0.1	2.9	-	-	-	-
Short-tailed shearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pelagic cormorant	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bald eagle	-	-	-	-	0.1	1.4	-	-	0.1	5.0	-	-	-	-
All species	0.4	1.8	0.0	0.0	0.1	1.4	0.0	0.0	0.3	10.0	0.2	4.2	0.8	8.3
<i>n</i>	11		8		7		8		12		6		6	
First survey	24 May		25 May		26 May		24 May		2 Jun		31 May		31 May	
Last survey	13 Aug		27 Aug		26 Aug		31 Aug		24 Aug		23 Aug		24 Aug	

Table 97 (continued). Mean numbers of individuals found and encounter rates during COASST surveys along South Bay Beach, Chowiet Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and does not include birds still present and re-encountered from previous surveys. Encounter rate is defined as the number of all birds (including both new individuals and re-encountered birds) found per km beach surveyed (0.2 km for South Bay Beach) divided by the number of surveys. No data were collected in 2008 or 2020.

Species	2014		2015		2016		2017		2018		2019		2021	
	Mean # ind.	Enc. rate												
Black oystercatcher	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Common murre	-	-	0.2	2.5	-	-	-	-	-	-	-	-	-	-
Unknown murre	-	-	-	-	-	-	-	-	-	-	-	-	0.3	1.4
Ancient murrelet	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassin's auklet	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.7
Parakeet auklet	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.7
Rhinoceros auklet	-	-	-	-	0.1	1.4	-	-	0.1	0.7	-	-	0.3	6.4
Black-legged kittiwake	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glaucous-winged gull	-	-	-	-	-	-	0.1	0.6	-	-	-	-	0.1	1.4
Northern fulmar	-	-	-	-	0.1	0.7	0.1	0.6	-	-	-	-	0.1	0.7
Short-tailed shearwater	-	-	0.2	0.8	-	-	-	-	-	-	-	-	-	-
Pelagic cormorant	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.7
Bald eagle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
All species	0.0	0.0	0.3	3.3	0.3	2.1	0.3	1.3	0.1	0.7	0.0	0.0	1.3	12.1
<i>n</i>	6		6		7		8		7		6		7	
First survey	27 May		30 May		27 May		20 May		24 May		8 Jun		26 May	
Last survey	30 Aug		22 Aug		26 Aug		26 Aug		25 Aug		22 Aug		25 Aug	

Table 98. Numbers of birds encountered on COASST surveys along Landing Cove, Chowiet Island, Alaska in 2021. Data represent numbers of new individual birds found each survey; numbers of birds still present and re-encountered on each survey are shown parentheses.

Species	Date							Individuals ^a			Encounters ^b	
	26 May	13 Jun	29 Jun	13 Jul	28 Jul	12 Aug	26 Aug	Total	Mean	SD	Total	Enc. rate ^c
Total new individuals	0	0	0	0	0	0	0	0	0.0	0.0	-	-
Total encounters	0	0	0	0	0	0	0	-	-	-	0	0.0

^aIndividuals represent new birds seen on surveys only and do not include birds still present and re-encountered on surveys.

^bEncounters represent all birds seen on surveys, including both new individuals and all instances of re-encountered birds.

^cEncounter rate = number of birds encountered / km beach surveyed (0.1 km for Landing Cove) / number of surveys.

Table 99. Numbers of birds encountered on COASST surveys along South Bay Beach, Chowiet Island, Alaska in 2021. Data represent numbers of new individual birds found each survey; numbers of birds still present and re-encountered on each survey are shown parentheses.

Species	Date							Individuals ^a			Encounters ^b	
	27 May	13 Jun	29 Jun	13 Jul	28 Jul	11 Aug	25 Aug	Total	Mean	SD	Total	Enc. rate ^c
Unknown murre	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0)	0 (0)	2	0.3	0.8	2	1.4
Cassin's auklet	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1	0.1	0.4	1	0.7
Parakeet auklet	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	1	0.1	0.4	1	0.7
Rhinoceros auklet	0 (0)	2 (0)	0 (2)	0 (1)	0 (2)	0 (1)	0 (1)	2	0.3	0.8	9	6.4
Glaucous-winged gull	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)	0 (1)	1	0.1	0.4	2	1.4
Northern fulmar	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	1	0.1	0.4	1	0.7
Pelagic cormorant	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	1	0.1	0.4	1	0.7
Total new individuals	0	2	1	0	3	3	0	9	1.3	1.4	-	-
Total encounters	0	2	3	1	5	4	2	-	-	-	17	12.1

^aIndividuals represent new birds seen on surveys only and do not include birds still present and re-encountered on surveys.

^bEncounters represent all birds seen on surveys, including both new individuals and all instances of re-encountered birds.

^cEncounter rate = number of birds encountered / km beach surveyed (0.2 km for South Bay Beach) / number of surveys.

Annotated list of wildlife species observed at Chowiet Island, Alaska in 2021 (12 May to 31 August).

Abundance categories were defined as follows:

Abundant: annual, sure to see many
Common: annual, sure to see some
Uncommon: annual, likely to see some
Rare: annual but not guaranteed to see any
Irregular: not annual but numerous records
Casual: not annual, only a few records
Accidental: only one or two records ever

Status categories are defined as follows:

Breeder: evidence breeding, **either confirmed** (observations of current nests, eggs, or chicks; adults carrying nesting materials or food to nests or chicks; recently fledged young; distraction displays) **or probably** (observations of pairs or territorial behavior)
Resident non-breeder: occurs throughout season but does not breed at site
Migrant: through-migrant, recorded regularly but only during migratory period
Vagrant: recorded outside known breeding, wintering, and migrating range (category added in 2012)

Note that categories are general and should not change based on deviations in a single year.

BIRDS

Aleutian cackling goose (*Branta hutchensis leucopareia*). Uncommon breeder. Recorded on 12 days in 2021, including 15 individuals observed flying toward the ledges on 18 May and 37 individuals on 20 August at North Point. In mid-June, two to five individuals were regularly observed in the gull colony at West Rough. No nests were discovered in 2021.

Mallard (*Anas platyrhynchos*). Irregular migrant. On 11 June, one individual was seen flying over South Bay and was later flushed from the meadow above South Bay beach.

Green-winged teal (*Anas crecca*). Irregular migrant. One bird was observed in Landing Cove for two days at the end of August.

Greater scaup (*Aythya marila*). Irregular migrant. Recorded on five days in 2021 in May. Five individuals were observed on 27 May, including one male and four females.

Common eider (*Somateria mollissima*). Uncommon breeder. Common eiders were observed on 41 days in 2021, with a high count of 22 birds in late August. Two different adult females with one chick and 13 chicks respectively were observed between Landing Cove and Constant Colony beginning 12 July. At the end of August, one brood with five fledglings and one with one fledgling were still surviving.

Harlequin duck (*Histrionicus histrionicus*). Common resident non-breeder. Present throughout the summer and observed on 54 days in 2021, distributed evenly throughout the season. Harlequin ducks were found throughout the coast of Chowiet but were most commonly seen in South Bay and Chowiet Bay.

Red-necked grebe (*Podiceps grisegena*). Casual migrant. Observed in five years since 2002, and an additional record from 1971 mentioned in Dragoo et al. (1991a). In 2021, one individual was seen nearshore on the east side of Landing Cove on 30 May.

Rufous hummingbird (*Selasphorus rufus*). Casual vagrant. Observed on Chowiet in five years since 2002. In 2021, two individuals were detected in the lone spruce tree above Spruce Cove on 19 August.

Sandhill crane (*Antigone canadensis*). Irregular migrant. Recorded 10 out of the 20 years monitored since 1976. In 2021 a pair was observed on 3 June flying over Cabin Valley one day off from the 2019 observation.

Black oystercatcher (*Haematopus bachmani*). Common breeder. Observed most days in 2021. Notable observations included a high count of 22 individuals along our northern crevice routes on 17 August. The 2021 crew observed seven nests and four territories scattered between Chowiet Bay and South Bay. Of those nests, all were confirmed to hatch at least one chick and fleglings were observed at five sites.

Pacific golden-plover (*Pluvialis fulva*). Casual migrant. Pacific golden-plovers have been recorded on Chowiet in five years since 2002 with no records prior to 2002. In 2021, one individual was seen and heard flying over Stonehenge and a second individual was observed at North Point on 24 August. A third individual was heard flying over the ledgenester cliffs on 25 August.

Aleutian rock sandpiper (*Calidris ptilocnemis couesi*). Irregular migrant. Detected on six occasions in 2021. There was a popular roost at South Bay in Subcolony B; we had a high count of 24 birds at that roost.

Pribilof rock sandpiper (*Calidris ptilocnemis ptilocnemis*). Accidental migrant. Mixed with Aleutian rock sandpiper. Detected on at least two days in 2021.

Least sandpiper (*Calidris minutilla*). Irregular probable breeder. Least sandpipers have been suspected of breeding on Chowiet by multiple crews but breeding remains unconfirmed. Least sandpipers were observed on 18 days in 2021. A pair was suspected of nesting in the gull colony in Sub B and they were observed both in South Bay and Landing Cove.

Wilson's snipe (*Gallinago delicata*). Casual vagrant. Recorded on Chowiet in seven years since 2002. One individual was flushed from Cabin Valley on 31 May in 2021.

Wandering tattler (*Tringa incana*). Uncommon migrant. Observed five times along Chowiet Bay and South Bay including a pair in Landing Cove on 31 August.

Red-necked phalarope (*Phalaropus lobatus*). Accidental migrant. At least the fifth record for Chowiet. Two previous known records are from the 1940s (either 1940 or 1945 as noted in Hatch and Hatch 1979) and from 1990 (Dragoo et al. 1991a). In 2021, one individual was observed foraging on the eastern end of Clay Lick on 29 August.

Parasitic jaeger (*Stercorarius parasiticus*). Common breeder. Seen regularly throughout the season. Two nests were found in 2021 in the high elevation area of the island. A high count of 15 occurred on 24 August on a hike across the tundra.

Common murre (*Uria aalge*). Abundant breeder. Common murre is the most abundant avian species on Chowiet, outnumbering thick-billed murres by a ratio of approximately 10:1. Population counts of common murres in 2021 were just under half the number counted in most years but higher than in 2015-2019. For those birds that did breed, reproductive success was above average.

Thick-billed murre (*Uria lomvia*). Abundant breeder. On Chowiet, thick-billed murres are outnumbered by common murres by a ratio of approximately 10:1. Compared to the common murres, thick-billed murres typically nest in smaller clusters and on narrower cliff ledges. Mean numbers of individuals counted on

index plots in 2021 was only slightly higher than the previous 10 year mean and lower than most of the counts done in the 1980s and 1990s. Reproductive success was low for this species on Chowiet in 2021.

Pigeon guillemot (*Cephus columba*). Common breeder. Hatch and Hatch (1983a) estimated a pigeon guillemot population of 500 individuals on Chowiet in the late 1970s. Birds were observed on 37 days in 2021. One to five individuals were regularly seen while doing crevice work around Chowiet Bay with a few in South Bay. Much higher numbers were counted on the northeast coastline, with 20 seen around Spruce Cove and 21 seen on our way to Finger Point.

Ancient murrelet (*Synthliboramphus antiquus*). Uncommon breeder. Ancient murrelets are rarely encountered on Chowiet but are known to breed in small numbers. In 2021 one ancient murrelet successfully hatched a chick in a Mini Main crevice and individuals were seen offshore of Landing Cove. Additionally, a dead ancient murrelet was found in a Rough Cove crevice and many were encountered under the Rough Cove peregrine falcon nest. In 2021, ancient murrelets were heard calling from the cabin most nights the crew was awake after last light in June and July. Hatch and Hatch (1980) estimated Kateekuk and Anowik islands both have populations of 2,000 ancient murrelets.

Cassin's auklet (*Ptychoramphus aleuticus*). Irregular resident non-breeder. In 2021, one fresh beach-cast carcass was found while conducting a COASST survey on 29 June.

Parakeet auklet (*Aethia psittacula*). Abundant breeder. Hatch and Hatch (1979) estimated a population of greater than 100,000 parakeet auklets in the Semidis in the late 1970s. Observed every day in 2021 until early August when sightings became sporadic before ending completely 27 August. In 2021, parakeet auklets experienced slightly lower than average productivity. Raft counts were low for this species on Chowiet Island.

Crested auklet (*Aethia cristatella*). Accidental migrant. Three crested auklets were observed from the Tiglax east of Anowik Island on 11 May.

Rhinoceros auklet (*Cerorhinca monocerata*). Common breeder. Chowiet likely contains the only breeding population of rhinoceros auklets in the Semidi Islands; relatively large scattered colonies occur at South Bay and Spruce Cove, and a smaller colony occurs at Landing Cove. Rhinoceros auklets were observed 23 days in 2021. Observations outside nocturnal diet sampling were mostly concentrated in Landing Cove where they were seen during several raft counts. Carcasses were often found below the Rough Cove peregrine falcon nest.

Horned puffin (*Fratercula corniculata*). Abundant breeder. Hatch and Hatch (1983a) estimated that between a quarter and a third of the world population of horned puffins breeds in the Semidi Islands, and that 10% of the Semidi population nests on Chowiet. Searchable horned puffin crevices were concentrated in low coastal areas, but the species also nested throughout talus slopes at some of the highest elevations on the island. One potentially significant limiting factor to horned puffin nesting success on Chowiet is the presence of Arctic ground squirrels. Nearby Suklik and Aghik islands, which are squirrel free, are estimated to have 80% of the Semidi Islands breeding population. One horned puffin chick was confirmed to be depredated by Arctic ground squirrels in Landing Cove in 2016 with the aid of a motion-activated trail camera. In 2021, two eggs (one each in Constant Colony and Mini Main) were suspected of being depredated by Arctic ground squirrels because the eggs were seen within a meter of a monitored nest site with obvious bite marks (see Arctic ground squirrel below for more details). Horned puffin raft counts were much lower than the 13 year mean, and horned puffins on Chowiet had below average productivity in 2021.

Tufted puffin (*Fratercula cirrhata*). Abundant breeder. Tufted puffins nest along most of the coast of Chowiet and are most concentrated in South Bay and the east end of Constant Colony. In 2021, reproductive success was well above average.

Black-legged kittiwake (*Rissa tridactyla*). Abundant breeder. In the late 1970s, Hatch estimated a population of at least 200,000 black-legged kittiwakes throughout the Semidis (Hatch and Hatch 1979). Reproductive success for this species in 2021 was below average for this species on Chowiet. Two strong storms with high full moon swells during laying and mid chick-rearing washed the majority of nests off plots at stakes 11,10, 9, 6, and some at 3.

Glaucous-winged gull (*Larus glaucescens*). Abundant breeder. Glaucous-winged gulls bred across the island in approximately 10 colonies. First eggs were seen 21 May and the first chick was seen 18 June. Reproductive success was high compared to the average 10-year mean of 68%.

Fork-tailed storm-petrel (*Hydrobates furcatus*). Rare probable breeder. The occurrence of fork-tailed storm-petrels on the island is not well documented. Although present in similar numbers to Leach's storm-petrels on other Semidi Islands, fork-tailed storm-petrels have been recorded on Chowiet by monitoring crews in only six years since 2002. They were detected in 2016 and 2017 when individuals were heard in South Bay during rhinoceros auklet mist netting, and the 2016 crew found a decapitated adult in West Rough. In 2021, there were no detections of live individuals but a fork-tailed storm-petrel body was found in a gull pellet in South Bay.

Leach's storm-petrel (*Hydrobates leucorhous*). Uncommon probable breeder. Hatch and Hatch (1983a) estimated that 114,000 Leach's and 123,000 fork-tailed storm-petrels breed in the Semidi Islands; however, >80% of the population occurs on islands where ground squirrels are absent (Suklik, South, and Aghik islands). Their findings indicate that neither species were present on Chowiet in the late 1970s. Although no burrows have been documented, Leach's storm-petrel has been recorded on Chowiet by most annual monitoring crews since 2002, and it seems likely that small numbers breed on Chowiet. In both 2018 and 2019, detection of calls seemed to be most focused somewhere around the top of the large talus slope behind the cabin. In 2021, Leach's storm-petrels were heard near the cabin most nights the crew was awake during complete darkness. Calls were heard throughout the talus as well as near the outhouse in the ferns and by the raft count stake. Searching by future crews may yield confirmed nesting of this species in that area.

Northern fulmar (*Fulmaris glacialis*). Abundant breeder. Hatch and Hatch (1983a) estimated that 90,000 fulmars bred on Chowiet in the late 1970s, with over 440,000 breeding in the Semidi Islands as a whole; this constitutes virtually the entire population in the Gulf of Alaska and a third of the entire Alaskan population. Fulmars appeared to have a successful breeding year in 2021.

Red-faced cormorant (*Uria urile*). Common breeder. Red-faced cormorants regularly breed on Chowiet, but numbers appear to fluctuate widely among years. In 2021, red-faced cormorants nested in low numbers on the ledgenester cliffs, but success could not be determined.

Pelagic cormorant (*Uria pelagicus*). Common breeder. Pelagic cormorants nest most if not all years on Chowiet but are not always documented due to accessibility. In 2021, pelagic cormorants bred on the ledgenester cliffs and one additional nest was observed in Spruce Cove.

Double-crested cormorant (*Nannopterum auritus*). Irregular resident non-breeder. Recorded for the sixth year since 1976. In 2021, double-crested cormorants were seen on two occasions. One individual was

seen in Steller's Cove on 29 May and a second was seen in Chowiet Bay near the western end of Clay Lick on 23 June.

Bald eagle (*Haliaeetus leucocephalus*). Common breeder. In 2021, three active aeries were identified: Pupping Point, Otter Point, and north of Spruce Cove. The historical nest at Frog Rock was not occupied. The Pupping Point nest had two downy chicks on 4 June.

Gyrfalcon (*Falco rusticolus*). Irregular migrant. Detected on six occasion in 2021 above Cabin Valley and on Windy Pass. Birds were often being attacked by a peregrine falcon.

Peregrine falcon (*Falco peregrinus*). Common breeder. Peregrine falcons breed along the sea cliffs and rock outcroppings from the coast up to the highest areas on the island. In 2021, five aeries were located (see Figure 2). Three large downy chicks were seen in the South Bay nest on 22 May. Peregrine falcons anecdotaly did well in 2021 and for most of August the skies were often filled with shrieking juveniles harassing other their parents or playing with raven fledglings. The South Bay nest fledged at least one chick, and the Rough Cove nest fledged two chicks; fledglings were observed and/or adults displaying territorial behavior at the other three sites.

Alder flycatcher (*Empidonax alnorum*). Casual vagrant. One individual was observed in the lone tree in Spruce Cove on 19 August.

Common raven (*Corvus corax*). Common breeder. Observed almost every day in 2021. Common ravens nested successfully in at least three places in 2021 (see Figure 2). The stake 3 nest fledged at least five chicks, the Otter Point nest hatched at least three chicks, and the Puffin Point nest hatched at least six chicks.

Bank swallow (*Riparia riparia*). Uncommon probable breeder. Bank swallows persisted on Chowiet longer than most other species that only occur seasonally. Seen on 65 days throughout the season, they were last seen on 9 August. A high count of 32 individuals was observed. This species was confirmed breeding on Chowiet in 2005, when a small colony of bank swallows was discovered in a dirt bank on the west side of North Point. Breeding has not been confirmed since that time, although bank swallows were seen investigating the dirt banks to the west of Landing Cove on multiple occasions in 2018 and 2019. In 2021, they were present on the island for a 71 day period, which is long enough to raise a brood (minimum 31 days), but no evidence of breeding was observed.

Pacific wren (*Troglodytes pacificus*). Common breeder. Detected almost every day of the 2021 season. The first fledglings were observed on 27 June.

Red-breasted nuthatch (*Sitta canadensis*). Accidental vagrant. Detected in Cabin Valley on 30 August.

Hermit thrush (*Catharus guttatus*). Rare breeder. Detected on 28 days in 2021. Birds were heard singing from the talus above the cabin, the talus above Constant Colony, and the talus behind South Bay beach. One individual was seen on the bluff above Landing Cove in May and another was seen near the raft count stake in June.

American pipit (*Anthus rubescens*). Uncommon breeder. Detected on 25 days in 2021. Early season sightings were at high elevation areas, mostly at Windy Pass while hiking to South Bay. Several different males were observed displaying and defending territories on the tundra. During the last month of the season, flocks of five to 10 pipits were frequently seen while hiking on the tundra.

Gray-crowned rosy-finches (*Leucosticte tephrocotis*). Common breeder. Detected on most days in 2021 in all habitats and areas of the island. The first fledglings were observed 29 June.

Common redpoll (*Acanthis flammea*). Casual breeder. Four birds were observed in camp on 6 June; individuals were heard in the talus above the cabin with moderate regularity for the rest of the season. One fledgling was seen on 19 August.

Red crossbill (*Loxia curvirostra*). Accidental vagrant. Two females were observed in the spruce tree at Spruce Cove foraging with white-winged crossbills on 18 August.

White-winged crossbill (*Loxia leucoptera*). Accidental migrant. Juveniles were observed in Cabin Valley on the dock plants on 5 August, and were seen foraging on seeds from the adult spruce in Spruce Cove on 19 August.

Pine siskin (*Spinus pinus*). Casual vagrant. Up to two individuals were observed in Cabin Valley in July and August. A fledgling was observed on 19 August.

Lapland longspur (*Calcarius lapponicus*). Uncommon breeder. A singing male was encountered on the tundra above Puffin Point.

Fox sparrow (*Passerella iliaca*). Common breeder. Abundant at low and mid-elevations throughout the island. Seen daily throughout the season. The first fledglings were observed on 10 June.

Savannah sparrow (*Passerculus sandwichensis*). Common breeder. Abundant in low and mid-elevations throughout the island. Seen daily throughout the season. The first fledglings were observed on 29 June.

Song sparrow (*Melospiza melodia*). Common breeder. Abundant in low and mid-elevations throughout the island. Seen daily throughout the season. The first hatched chicks were found on 27 May and fledglings were observed on 10 June.

White-crowned sparrow (*Zonotrichia leucophrys*). Casual vagrant. One individual was seen in Cabin Valley on 25 May.

Golden-crowned sparrow (*Zonotrichia atricapilla*). Common breeder. Common in low and mid-elevations throughout the island. Detected most days of the season. Probably the least abundant breeding sparrow species on Chowiet. The first fledglings were observed on 4 July.

Yellow warbler (*Setophaga petechia*). Uncommon breeder. In 2021, yellow warblers were first detected on 5 June. Yellow warblers were seen most days in June and July with detections becoming less frequent in August. Fledglings were seen on occasion near the cabin in August with the first one seen on 8 August.

Wilson's warbler (*Cardellina pusilla*). Uncommon breeder. On Chowiet, Wilson's warblers are found in tall pitchki on the edges of streams and talus areas. In 2021, birds were detected most days in June, were rarely detected in July, and were intermittent in August. Individuals were seen most frequently in Cabin Valley, where fledglings were first observed on 5 August.

MAMMALS

Arctic ground squirrel (*Urocitellus parryii*). Common breeder. Arctic ground squirrels, the only terrestrial mammal on Chowiet, were found throughout the island in any habitat type where the substrate permitted burrowing. It is unclear whether this species is native to the Semidi Islands or was introduced by humans (Cook et al. 2010). Primarily herbivorous, the consumption of seabirds by Arctic ground squirrels has been documented on Chowiet by most monitoring crews, but estimating the extent of reproductive failure attributable to squirrels is difficult, and the ability to recognize squirrel kills may vary among observers. Further, without witnessing a predation event, it is impossible for field crews to determine whether a fed-upon carcass represents a kill or scavenging of a bird killed by other causes. We suspect that most carcasses that show signs of having been fed upon by squirrels are the result of kills, for simplicity we refer to these events as depredations but acknowledge that the possibility of scavenging cannot be excluded. Motion-activated trail cameras were placed in three puffin burrows in 2016; one camera clearly documented a squirrel entering a horned puffin burrow and attacking and killing a large chick.

Of the 201 active auklet and puffin crevices monitored in 2019, a minimum of two likely failed due to squirrel depredation. In both cases a depredated horned puffin egg was found just outside of the nest with obvious bite marks in them. Most eggs that were consumed by squirrels may not be detectable, and kills where the carcass was left out of sight or removed from the crevice also would go undetected. Based on the results of crevice-nester monitoring, the following instances of squirrel depredation were documented in the past eleven years:

Year	Adults			Chicks				Total sites	
	ANMU	PAAU	HOPU	ANMU	PAAU	RHAU	HOPU		
2009	0	2	0	0	1	0	3	4	10
2010	0	1	0	0	0	0	4	10	15
2011	0	0	0	0	0	0	1	1	2
2012	0	1	0	0	2	0	7	4	14
2013	0	5	0	0	5	0	8	3	22 ^a
2014	1	3	1	2	3 ^a	0	9	9 ^a	24
2015	0	0	0	0	3	0	1 ^a	1	5
2016	0	0	0	0	3	0	2 ^a	0	5
2017	0	0	0	0	0	0	5	2	7
2018	0	0	0	0	0	1	0	2	3
2019	0	0	0	0	0	0	2 ^b	0	2 ^b
Total	1	12	1	2	17	1	40	36	109

^aTotal includes one unknown puffin egg addled or abandoned due to squirrel depredation event in the crevice.

^bTotal includes two horned puffin eggs suspected of depredation by squirrel.

The extent of squirrel depredation on rhinoceros auklets is more difficult to gauge because burrows are not monitored for productivity due to difficulties in ascertaining site contents. Motion-activated trail cameras were placed outside of several active rhinoceros auklet burrows in 2018. One squirrel was observed on camera near a burrow entrance, but no predation event occurred. Arctic ground squirrels are common within rhinoceros auklet colonies at South Bay and Spruce Cove, and squirrel sign is regularly encountered in or near burrows deemed occupied by auklets. One rhinoceros auklet chick carcass was found in 2018 that appeared to have been depredated by a ground squirrel.

Ground squirrels are present on all of the Semidi Islands except South, Suklik, and Aghik islands, and based on the population estimates of Hatch and Hatch (1983a), these islands contain the bulk of the burrow-nesting seabirds in the group (i.e., >80% of the storm-petrels, Cassin's auklets, and horned puffins—which use burrows on squirrel-free islands in the Semidi Islands). Burrow-nesting seabirds are uncommon on

Chowiet, and it seems likely that the presence of Arctic ground squirrels is the limiting factor in this exclusion.

Sea otter (*Enhydra lutris*). Uncommon breeder. Sea otters were seen on 22 days in 2021; most sightings were of only one or two individuals. At least three individuals were seen along West Rough, in South Bay and off North Point. A female with a small pup was first observed on 1 June, and pups were observed several more times throughout the season. Sightings of sea otters were fairly evenly distributed throughout the season.

Steller sea lion (*Eumetopias jubatus*). Common breeder. Hatch and Hatch (1979) reported between 6,000 and 8,000 individuals on boulder beaches and islets on the southern end of the island in 1978. A recent aerial survey of the Chowiet rookery, conducted by NOAA, Alaska Fisheries Science Center in 2017, resulted in counts of 1154 non-pups and 562 pups (Sweeney et al. 2017 NOAA memorandum). Sea lions were observed regularly throughout the 2021 field season, increasing in July when individuals began to congregate near Frog Rock—an annual occurrence. Numbers at Frog Rock regularly reached around 20 individuals, with a high count of 45. Counts of sea lions at beaches and pupping areas of the island were not conducted in 2021. No branded individuals were observed.

Harbor seal (*Phoca vitulina*). Uncommon breeder. Harbor seals were seen on 45 days in 2021; most sightings outside of regular haul-out areas were of lone individuals or females with pups.

Fin whale (*Balaenoptera physalus*). Uncommon non-breeder. Fin whales were seen on 19 days in 2021. The majority of observations came in June from the ledgenester cliffs but whales were mostly absent in July with only one observation in August. Groups of two to nine were seen regularly below the ledgenester cliffs and a high count of 20 individuals was observed on 1 June.

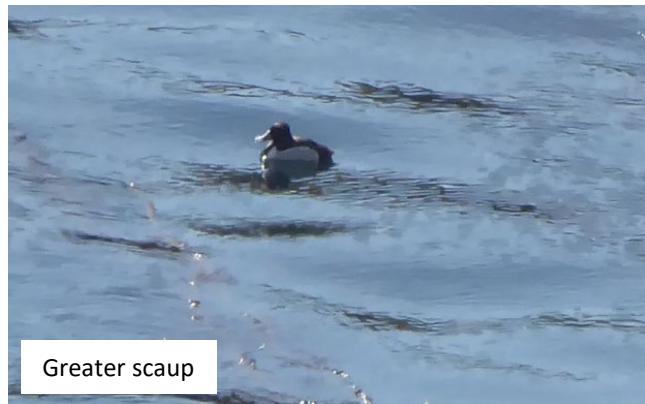
Humpback whale (*Megaptera novaeangliae*). Uncommon non-breeder. Humpbacks were seen only once in 2021. One individual was observed swimming close to shore in Landing Cove on 21 August.

FISH

Dolly varden (*Salvelinus malma*). A total of 43 individuals was counted in the South Bay stream in early June. In late June, a fish survey documented young of the year fish present all the way up to the high valley while adult fish were mostly found low near where the stream dives under the log jam before the sea. One individual was observed swimming close to shore in Landing Cove on 21 August.



Pribilof rock sandpiper



Greater scaup



Alder flycatcher



Red-breasted nuthatch



Red crossbill



White-winged crossbill



White-crowned sparrow

Table 100. Observations and breeding status of birds, selected mammals, and fish at Chowiet Island, Alaska. Dashes indicate species not recorded that year but may not necessarily indicate absence from the island during the time period (e.g., species not observed although present, or species not recorded although observed). Data represent observations made each year and therefore may not necessarily match general breeding status categories reported in the annotated list. Historic Information comes from annotated lists annual refuge monitoring reports; these were not included in all reports, although incidental observations of wildlife were undoubtedly made in all years. No data were collected in 2003, 2008, or 2020.

Species	Codes: B=confirmed breeder, P=probable/possible breeder, X=observed non-breeder X/B?=bred in other years but not specified in current year																		
	2002	2004	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021		
Emperor goose	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	
Greater white-fronted goose	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	
Brant	-	-	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	
Aleutian cackling goose	X	-	-	X	X	X	X	X	X	B	B	B	P	B	B	B	B	P	
Tundra swan	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	
Northern shoveler	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Gadwall	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
American widgeon	-	-	-	-	X	-	-	-	X	X	-	-	-	-	-	-	-	-	
Mallard	-	-	X	-	X	X	-	-	-	X	-	-	-	-	-	-	-	X	
Northern pintail	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	
Green-winged teal (unspecified ssp.)	X	-	X	X	-	X	-	X	-	X	-	-	-	-	X	-	-	X	
Greater scaup	X	-	X	X	X	X	X	-	-	X	-	-	-	-	-	-	-	X	
Common eider	B	B	B	P	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Harlequin duck	X	X	X	X	X	X	P	X	X	X	X	X	X	X	X	X	X	X	
White-winged scoter	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	
American (formerly black) scoter	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	
Bufflehead	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	
Red-breasted merganser	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Horned grebe	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Red-necked grebe	-	-	-	-	-	X	X	-	X	-	-	-	-	-	-	X	-	X	
Rufous hummingbird	-	-	X	-	-	-	-	-	X	-	X	X	-	-	-	-	-	X	
Sandhill crane	-	-	X	-	X	X	X	-	X	-	X	-	X	X	X	X	X	X	
Black oystercatcher	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
American golden-plover	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	-	
Pacific golden-plover	-	-	-	X	-	-	X	-	-	-	-	-	-	-	X	X	X	X	
Semipalmated plover	-	X	X	-	X	X	X	X	X	X	X	-	X	-	X	X	X	-	
Bristle-thighed curlew	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	X	-	
Whimbrel	-	X	-	-	-	X	-	X	X	-	X	-	-	-	-	-	X	-	
Ruddy turnstone	-	-	-	-	-	-	-	-	X	X	-	-	X	X	-	-	-	-	
Black turnstone	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	
Dunlin	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	
Aleutian rock sandpiper (<i>C. p. couesi</i>)	X	X	X	X	X	X	-	-	X	X	X	X	X	X	X	X	X	X	
Pribilof rock sandpiper (<i>C. p. ptilocnemis</i>)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	
Least sandpiper	X	X	-	-	X	X	P	P	P	P	P	P	P	P	P	P	P	P	
Pectoral sandpiper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	
Western sandpiper	-	X	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	
Short-billed dowitcher	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	
Wilson's (formerly common) snipe	X	-	-	-	-	X	X	-	-	-	-	-	X	X	-	X	X	X	

Table 100 (continued). Observations and breeding status of birds, selected mammals, and fish at Chowiet Island, Alaska. Dashes indicate species not recorded that year but may not necessarily indicate absence from the island during the time period (e.g., species not observed although present, or species not recorded although observed). Data represent observations made each year and therefore may not necessarily match general breeding status categories reported in the annotated list. Historic Information comes from annotated lists annual refuge monitoring reports; these were not included in all reports, although incidental observations of wildlife were undoubtedly made in all years. No data were collected in 2003, 2008, or 2020.

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	2002	2004	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021		
Spotted sandpiper	-	-	X	-	X	-	X	-	-	-	X	-	-	-	-	-	X	-	
Solitary sandpiper	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Wandering tattler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lesser yellowlegs	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	
Greater yellowlegs	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	
Red-necked phalarope	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	
Red phalarope	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	
Parasitic jaeger	B	B	B	B	B	P	B	P	B	B	P	B	B	P	B	B	B	B	
Common murre	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Thick-billed murre	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Pigeon guillemot	B	B	B	P	B	B	B	B	B	B	B	B	B	B	B	B	B	P	
Marbled murrelet	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	
Ancient murrelet	B	X	B	-	B	B	P	B	B	B	B	B	B	B	B	B	B	B	
Cassin's auklet	X	X	X	-	-	-	X	X	-	-	X	-	-	-	-	-	-	-	
Parakeet auklet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Least auklet	X	-	-	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	
Crested auklet	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	
Rhinoceros auklet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Horned puffin	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Tufted puffin	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Black-legged kittiwake	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Sabine's gull	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	
Franklin's gull	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Mew gull	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Herring gull	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	
Glaucous-winged gull	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Red-throated loon	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Pacific loon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	
Common loon	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	
Black-footed albatross	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Fork-tailed storm-petrel	-	X	-	-	X	X	-	-	-	X	-	-	X	X	-	-	-	-	
Leach's storm-petrel	X	X	X	-	X	P	P	P	P	P	P	P	P	P	P	P	P	P	
Northern fulmar	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Short-tailed shearwater	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sooty shearwater	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Red-faced cormorant	B	B	P	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Pelagic cormorant	X	X	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Double-crested cormorant	-	-	-	-	-	-	X	-	X	X	-	-	-	-	X	-	X	-	

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	2002	2004	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021		
Northern harrier	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	X	-	-	
Golden eagle	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Bald eagle	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Rough-legged hawk	-	B	B	B	B	B	P	-	-	X	-	X	X	X	X	-	-	-	
Short-eared owl	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	X	-	-	
Belted kingfisher	-	-	X	-	-	X	-	-	-	-	-	-	X	-	-	-	X	-	
Downy woodpecker	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	
Merlin	-	-	-	-	-	X	X	-	-	X	X	-	-	-	-	-	-	-	
Gyrfalcon	-	X	-	X	-	-	-	X	X	-	X	X	-	-	X	X	X	X	
Peregrine falcon	-	P	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Alder flycatcher	-	-	-	-	-	X	-	-	X	X	X	X	-	-	-	-	-	X	
Black-billed magpie	-	-	-	-	-	X	B	X/B?	X	X	X	-	-	-	-	-	-	-	
Common raven	B	B	B	B	X	B	B	B	B	B	B	B	B	B	B	B	B	B	
Horned lark	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	
Bank swallow	P	B	B	X	X	P	P	X/B?	P	P	P	P	P	P	P	P	P	P	
Tree swallow	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X	
Violet-green swallow	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	
Barn swallow	-	-	X	-	-	-	X	-	X	X	-	X	-	-	-	-	-	-	
Cliff swallow	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Pacific (formerly winter) wren	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Golden-crowned kinglet	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X	-	X	-	
Ruby-crowned kinglet	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	
Red-breasted nuthatch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	
Gray-cheeked thrush	-	-	-	-	-	X	X	-	-	-	-	-	X	-	-	X	-	-	
Hermit thrush	-	-	P	X	-	P	B	B	B	P	B	P	P	P	P	B	B	P	
American robin	-	-	-	-	-	X	-	-	X	-	-	X	-	-	-	-	-	-	
Varied thrush	-	X	-	-	X	X	X	-	-	X	-	-	-	-	-	-	-	-	
Cedar waxwing	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Eastern yellow wagtail	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	
American pipit	-	B	B	X	X	B	B	X/B?	B	B	B	P	B	B	P	P	B	B	
Brambling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	
Gray-crowned rosy-finch	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Common redpoll	-	-	-	-	-	X	-	-	X	-	P	X	X	B	B	P	-	B	
Red crossbill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	
White-winged crossbill	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	
Pine siskin	-	-	-	-	-	X	-	-	X	X	X	-	-	-	-	-	X	-	
Lapland longspur	X	X	P	X	X	B	P	P	P	B	P	B	B	P	P	P	P	X	
Snow bunting	X	B	X	-	X	-	X	-	-	X	-	-	-	-	-	-	-	-	
Fox sparrow	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
American tree sparrow	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	
Dark-eyed junco	-	-	-	-	-	-	X	X	-	X	-	-	X	-	-	-	X	-	
White-crowned sparrow	-	-	-	-	-	-	X	-	-	X	-	X	X	-	-	-	-	X	

Table 100 (continued). Observations and breeding status of birds, selected mammals, and fish at Chowiet Island, Alaska. Dashes indicate species not recorded that year but may not necessarily indicate absence from the island during the time period (e.g., species not observed although present, or species not recorded although observed). Data represent observations made each year and therefore may not necessarily match general breeding status categories reported in the annotated list. Historic Information comes from annotated lists annual refuge monitoring reports; these were not included in all reports, although incidental observations of wildlife were undoubtedly made in all years. No data were collected in 2003, 2008, or 2020.

Species	Codes: B=confirmed breeder, P=probable/possible breeder, X=observed non-breeder X/B?=bred in other years but not specified in current year																	
	2002	2004	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	
Golden-crowned sparrow	P	B	B	P	B	B	B	B	B	B	B	B	B	B	B	B	B	
Savannah sparrow	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Song sparrow	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Red-winged blackbird	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Rusty blackbird	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Orange-crowned warbler	-	-	-	-	-	X	X	-	X	X	X	-	-	-	X	-	-	
Yellow warbler	X	P	P	B	-	B	B	P	B	B	B	-	X	B	B	B	B	
Yellow-rumped warbler	-	-	-	-	-	-	-	-	X	X	-	-	X	-	X	-	-	
Townsend's warbler	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	
Wilson's warbler	X	P	P	P	-	B	B	P	B	B	P	B	B	B	P	B	B	
Arctic ground squirrel	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Sea otter	B	B	B	-	B	B	B	B	B	P	B	B	B	B	B	B	B	
Northern fur seal	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	
Steller sea lion	B	B	B	-	B	B	B	B	B	B	B	B	B	B	B	B	B	
Northern elephant seal	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	
Harbor seal	X	X	B	X	B	B	B	B	B	B	B	B	B	B	B	B	B	
Fin whale	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	
Humpback whale	X	-	-	X	-	-	X	-	X	X	X	-	X	X	X	X	X	
Orca	-	X	-	-	-	X	X	-	-	-	X	X	X	-	X	-	-	
Porpoise	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	
Dolly varden	-	-	-	-	-	-	-	P	P	B	B	B	-	-	-	-	B	
Observation dates	6 May-	8 May-	13 May-	14 May-	20 May-	17 May-	19 May-	20 May-	19 May-	20 May-	20 May-	21 May-	21 May-	15 May-	20 May-	26 May-	11 May-	
	12 Sep	16 Aug	2 Sep	5 Sep	3 Sep	5 Sep	7 Sep	7 Sep	4 Sep	31 Aug	1 Sep	2 Sep	3 Sep	3 Sep	3 Sep	2 Sep	31 Aug	

Table 101. First flowering dates of plants identified on Chowiet Island, Alaska. Data represent the day a fully-opened flower was first observed on the island each year. Dates may be poor indicators of actual phenology because observations of initial flowering events for uncommon or inconspicuous plants may be missed or depend on timing of field crew activities. Species in bold are considered conspicuous, easy to identify, and fairly widespread and flowering dates of these species are probably recorded within a few days. Species found, but for which no flowering data are available, are denoted by an "X". Families and species are presented alphabetically. Identifications are made by field personnel on-island and have not been confirmed by other authorities. Asterisks denote species not found by (Hatch 1978), who conducted vegetative surveys on Chowiet and collected plants that were later identified by staff at the University of Alaska Herbarium, Fairbanks, Alaska. For further information on plants in specific years, see table comments in previous reports. No data collected before 2004 or in 2006-2008 or 2020.

Family	Species	Common name	2004	2005	2009	2010	2011	2012	2013
Apiaceae	<i>Angelica lucida</i>	angelica	21 Jun	13 Jun	8 Jul	1 Jul	<4 Jul	24 Jun	24 Jun
	<i>Conioselinum chinense</i>	hemlock parsley	late Jul	-	26 Jul	-	X	X	21 Jul
	<i>Heracleum lanatum</i>	putchki, cow parsnip	20 Jun	8 Jun	2 Jul	28 Jun	24 Jun	25 Jun	28 Jun
	<i>Ligusticum latifolium</i>	petruski, beach lovage	5 Jul	26 Jun	29 Jun	8Jul	X	6 Jul	24 Jun
Asteraceae	<i>Achillia borealis</i>	yarrow	5 Jul	27 Jun	26 Jun	22 Jun	10 Jul	14 Jun	18 Jun
	<i>Antennaria monocephala</i>	pussytoes	-	9 Jun	9 Jun	29 Jun	15 Jun	7 Jun	8 Jun
	<i>Artemisia arctica</i>	mountain sage	-	1 Jul	X	-	20 Jul	X	24 Jul
	<i>Artemisia tilesii</i>	wormwood	14 Jul	1 Jul	21 Jul	10 Aug	14 Jul	21 Jul	19 Jul
	<i>Chrysanthemum arcticum</i>	Arctic daisy	-	16 Jun	21 Jun	2 Jul	29 Jun	25 Jun	2 Jul
	<i>Petasites frigidus</i>	coltsfoot	20 Jun	13 May	7 Jun	X	29 May	22 Jun	30 May
	<i>Prenanthes alata</i>	rattlesnake root	-	-	5 Aug	17 Aug	X	X	15 Aug
	<i>Senecio pseudo-arnica</i>	seashore sunflower	9 Jul	1 Jul	12 Jul	14 Jul	10 Jul	6 Jul	28 Jun
	<i>Senecio resedifolius</i>	ragwort	-	26 Jun	2 Jul	3 Jul	14 Jul	25 Jun	28 Jun
	<i>Solidago mutiradiata</i>	northern goldenrod	5 Jul	26 Jun	12 Jul	7 Jul	3 Jul	29 Jun	10 Jul
	<i>Taraxacum sp.</i>	dandelion	-	-	14 Jun	-	-	X	<2 Jul
Brassicaceae	<i>Barbarea orthoceras</i>	winter cress	8 Jun	22 May	10 Jun	-	X	26 Jun	15 Jun
	<i>Cardamine umbellata</i>	bitter cress	-	14 May	8 Jun	-	15 Jun	30 May	30 May
	<i>Draba borealis</i>	northern rock cress	-	30 May	3 Jun	X	19 May	31 May	31 May
Campanulaceae	<i>Draba hyperborea</i>	cliff hanger	-	-	7 Jun	X	1 Jun	2 Jun	-
	<i>Campanula lasiocarpa</i>	bluebell, harebell	18 Jul	1 Jul	12 Jul	22 Jul	29 Jul	11 Jul	19 Jul
Caryophyllaceae	<i>Cerastium beerlingianum</i>	mouse-eared chickweed	-	-	X	-	X	14 Jun	-
Cornaceae	<i>Honckenya peploides</i>	beach greens	23 Jul	27 Jun	14 Jun	8 Jul	2 Jun	25 Jun	28 Jun
	<i>Minuartia macrocarpa</i>	sandwort	-	16 Jun	-	-	-	29 Jun	2 Jul
	<i>Moehringia lateriflora</i>	grove sandwort	24 Jun	6 Jun	17 Jul	-	-	11 Jun	12 Jun
	<i>Sagina saginoides</i>	pearlwort	-	-	late Jun	-	-	X	18 Jun
	<i>Silene acaulis</i>	moss campion	5 Jun	10 Jun	1 Jul	19 Jul	21 Jun	<29 Jun	8 Jun
	<i>Stellaria crispa</i>	chickweed	-	-	<26 Jul	-	-	<29 Jun	12 Jun
	<i>Cornus suecica</i>	dwarf dogwood	<5 Jun	22 May	3 Jun	23 May	29 May	3 Jun	31 May
Crassulaceae	<i>Sedum rosea</i>	roseroot	<5 Jun	22 May	29 May	27 May	<26 May	30 May	22 May
Cruciferae	<i>Cochlearia officinalis</i>	scurvy grass	-	-	-	-	-	-	29 May
Ericaceae	<i>Arctostaphylos alpina</i>	bearberry	-	30 May	X	29 May	8 Jun	27 May	X
	<i>Empetrum nigrum</i>	crowberry	X	X	X	X	X	X	X
Fabaceae	<i>Ledum palustre</i>	Labrador tea	20 Jun	2 Jun	20 Jun	20 Jun	X	20 Jun	14 Jun
	<i>Loiseleuria procumbens</i>	alpine azalea	-	18 May	23 May	23 May	27 May	26 May	24 May
	<i>Rhododendron camtschaticum</i>	Kamchatka rhododendron	1 Jul	16 Jun	1 Jul	3 Jul	10 Jul	29 Jun	29 Jun
	<i>Vaccinium uliginosum</i>	alpine blueberry	-	16 Jun	7 Jul	29 Jul	-	25 Jun	2 Jul
	<i>Vaccinium vitis-idaea</i>	cranberry	-	24-May	8 Jun	X	-	7 Jun	29 May
Fabaceae	<i>Lupinus nootkatensis</i>	lupine	4 Jul	7 Jun	20 Jun	15 Jun	-	29 Jun	-

Table 101 (continued). First flowering dates of plants identified on Chowiet Island, Alaska. Data represent the day a fully-opened flower was first observed on the island each year. Dates may be poor indicators of actual phenology because observations of initial flowering events for uncommon or inconspicuous plants may be missed or depend on timing of field crew activities. Species in bold are considered conspicuous, easy to identify, and fairly widespread and flowering dates of these species are probably recorded within a few days. Species found, but for which no flowering data are available, are denoted by an "X". Families and species are presented alphabetically. Identifications are made by field personnel on-island and have not been confirmed by other authorities. Asterisks denote species not found by (Hatch 1978), who conducted vegetative surveys on Chowiet and collected plants that were later identified by staff at the University of Alaska Herbarium, Fairbanks, Alaska. For further information on plants in specific years, see table comments in previous reports. No data collected before 2004 or in 2006-2008 or 2020.

Family	Species	Common name	2014	2015	2016	2017	2018	2019	2021
Apiaceae	<i>Angelica lucida</i>	angelica	6 Jun	13 Jun	23 May	13 Jun	29 Jun	9 Jun	18 Jun
	<i>Conioselinum chinense</i>	hemlock parsley	2 Jul	<14 Jul	-	-	-	-	25 Jul
	<i>Heracleum lanatum</i>	putchki, cow parsnip	6 Jun	8 Jun	22 May	21 Jun	13 Jun	6 Jun	8 Jun
	<i>Ligusticum latifolium</i>	petruski, beach lovage	7 Jun	19 Jun	6 Jun	19 Jun	26 Jun	17 Jun	29 Jun
Asteraceae	<i>Achillia borealis</i>	yarrow	7 Jun	22 Jun	19 Jun	19 Jun	29 Jun	17 Jun	10 Jun
	<i>Antennaria monocephala</i>	pussytoes	<22 May	12 Jun	23 May	27 May	11 Jun	<28 May	29 May
	<i>Artemisia arctica</i>	mountain sage	18 Jun	24 Jul	11 Jun	10 Jul	X	X	X
	<i>Artemisia tilesii</i>	wormwood	22 Jun	15 Jul	X	1 Jul	X	14 Jul	23 Jul
	<i>Chrysanthemum arcticum</i>	Arctic daisy	2 Jun	27 Jun	6 Jun	10 Jun	13 Jun	16 Jun	19 Jun
	<i>Petasites frigidus</i>	coltsfoot	25 May	-	-	-	-	X	15 May
	<i>Prenanthes alata</i>	rattlesnake root	-	-	-	-	7 Aug	<29 Jul	<4 Jul
	<i>Senecio pseudo-arnica</i>	seashore sunflower	22 Jun	7 Jul	X	3 Jul	21 Jun	11 Jun	18 Jul
	<i>Senecio resedifolius</i>	ragwort	30 May	16 Jun	25 Jun	13 Jun	21 Jun	28 May	13 Jun
	<i>Solidago mutiradiata</i>	northern goldenrod	27 May	1 Jul	12 Jun	13 Jun	13 Jun	13 Jun	24 Jun
	<i>Taraxacum sp.</i>	dandelion	<2 Jun	-	-	-	-	-	-
Brassicaceae	<i>Barbarea orthoceras</i>	winter cress	<23 May	16 Jun	26 May	29 May	26 May	-	27 Jun
Campanulaceae	<i>Cardamine umbellata</i>	bitter cress	21 May	30 May	29 May	29 May	4 Jun	31 May	26 May
	<i>Draba borealis</i>	northern rock cress	22 May	-	23 May	29 May	11 Jun	<27 May	21 May
	<i>Draba hyperborea</i>	cliff hanger	-	-	12 Jun	2 Jul	-	X	X
	<i>Campanula lasiocarpa</i>	bluebell, harebell	28 Jun	24 Jul	30 Jun	16 Jul	9 Jul	24 Jun	18 Jul
Caryophyllaceae	<i>Cerastium Beeringianum</i>	mouse-eared chickweed	-	-	-	3 Jun	-	-	-
Cornaceae	<i>Honckenya peploides</i>	beach greens	8 Jul	16 Jun	12 Jun	3 Jun	2 Jun	13 Jun	28 Jun
	<i>Minuartia macrocarpa</i>	sandwort	8 Jun	-	6 Jun	-	-	-	-
	<i>Moehringia lateriflora</i>	grove sandwort	22 Jun	-	-	-	13 Jun	-	11 Jun
	<i>Sagina saginoides</i>	pearlwort	13 Jun	4 Jun	-	-	-	-	<28 Jul
	<i>Silene acaulis</i>	moss campion	<23 May	6 Jun	26 May	5 Jun	2 Jun	<28 Jun	4 Jul
	<i>Stellaria crispa</i>	chickweed	13 Jun	<19 Jul	X	3 Jun	-	24 Jun	27 Jul
	<i>Cornus suecica</i>	dwarf dogwood	<22 May	30 May	23 May	25 May	<22 May	<26 May	21 May
	<i>Sedum rosea</i>	roseroot	<22 May	22 May	<21 May	<15 May	<22 May	<26 May	23 May
Crassulaceae	<i>Cochlearia officinalis</i>	scurvy grass	30 May	<16 Jun	24 May	25 May	5 Jun	<28 May	23 May
Ericaceae	<i>Arctostaphylos alpina</i>	bearberry	X	25 May	-	29 May	2 Jun	-	22 May
	<i>Empetrum nigrum</i>	crowberry	X	25 May	<21 May	27 May	X	X	22 May
	<i>Ledum palustre</i>	Labrador tea	22 May	1 Jun	26 May	25 May	2 Jun	<28 May	6 Jun
	<i>Loiseleuria procumbens</i>	alpine azalea	<22 May	<23 May	26 May	19 May	<22 May	<28 May	21 May
Fabaceae	<i>Rhododendron camtschaticum</i>	Kamchatka rhododendron	<18 Jun	25 Jun	11 Jun	3 Jun	26 Jun	13 Jun	29 Jun
	<i>Vaccinium uliginosum</i>	alpine blueberry	30 May	1 Jun	X	1 Jul	2 Jun	3 Jun	13 Jun
	<i>Vaccinium vitis-idaea</i>	cranberry	<22 May	4 Jun	26 May	X	2 Jun	<28 May	9 Jun
	<i>Lupinus nootkatensis</i>	lupine	1 Jun	16 Jun	27 May	27 May	X	2 Jun	1 Jun

Table 101 (continued). First flowering dates of plants identified on Chowiet Island, Alaska. Data represent the day a fully-opened flower was first observed on the island each year. Dates may be poor indicators of actual phenology because observations of initial flowering events for uncommon or inconspicuous plants may be missed or depend on timing of field crew activities. Species in bold are considered conspicuous, easy to identify, and fairly widespread and flowering dates of these species are probably recorded within a few days. Species found, but for which no flowering data are available, are denoted by an "X". Families and species are presented alphabetically. Identifications are made by field personnel on-island and have not been confirmed by other authorities. Asterisks denote species not found by (Hatch 1978), who conducted vegetative surveys on Chowiet and collected plants that were later identified by staff at the University of Alaska Herbarium, Fairbanks, Alaska. For further information on plants in specific years, see table comments in previous reports. No data collected before 2004 or in 2006-2008 or 2020.

Family	Species	Common name	2004	2005	2009	2010	2011	2012	2013
Gentianaceae	<i>Gentiana algida</i>	Arctic gentian	mid Aug	early Aug	-	25 Aug	-	-	17 Aug
	<i>Gentiana amarella</i>	northern gentian	18 Jul	late Jun	30 Jul	9 Aug	29 Jul	6 Aug	3 Aug
	<i>Swertia perennis</i>	star gentian	-	-	-	-	-	-	-
Geraniaceae	<i>Geranium erianthum</i>	wild geranium	9 Jun	28 May	3 Jun	11 Jun	1 Jun	7 Jun	7 Jun
Iridaceae	<i>Iris setosa</i>	wild iris	5 Jul	20 Jun	18 Jul	14 Jul	17 Jul	<6 Jul	< 28 Jul
Liliaceae	<i>Fritillaria camschatensis</i>	chocolate lily	12 Jun	3 Jun	15 Jun	18 Jun	10 Jun	17 Jun	12 Jun
Onagraceae	<i>Chamerion angustifolium</i>	fireweed	25 Jul	10 Jul	26 Jul	2 Aug	21 Jul	X	28 Jul
	<i>Epilobium hornemannii ssp behr</i>	willow herb	5 Jul	6 Jun	early Jul	X	14 Jul	X	24 Jun
	<i>Epilobium ciliatum ssp glandul</i>	willow herb	6 Jul	-	early Jul	10 Jul	X	21 Jun	2 Jul
	<i>Epilobium sertulatum*</i>	willow herb	-	25 Jun	-	-	-	-	-
	<i>Epilobium palustre</i>	willow herb	-	-	-	-	-	-	<3 Aug
	<i>Botrychium lunaria</i>	moonwort	-	-	-	-	-	-	-
Ophioglossace	<i>Coeloglossum viride</i>	frog orchid	-	16 Jun	16 Jul	-	-	13 Jul	-
	<i>Cypripedium guttatum*</i>	lady's slipper	-	-	26 Jun	27 Jun	10 Jul	-	24 Jun
Orchidaceae	<i>Dactylorhiza aristata*</i>	purple orchid	12 Jun	6 Jun	10 Jun	21 Jun	13 Jun	<11 Jul	24 Jun
	<i>Malaxis monophylla</i>	white adder's tongue	-	-	24 Jul	-	-	<24 Jul	-
	<i>Platanthera dilatata</i>	bog orchid	20 Jun	11 Jun	20 Jun	17 Jun	26 Jun	24 Jun	12 Jun
Orobanchaceae	<i>Orobanche fasciculata</i>	broomrape	early Aug	mid Jul	X	-	-	-	28 Jul
Plantaginaceae	<i>Plantago maritima</i>	seashore plantain	-	26 Jun	18 Jul	X	X	20 Jun	28 Jun
Polemoniaceae	<i>Polemonium acutiflorum</i>	Jacob's ladder	1 Aug	-	X	29 Jul	10 Jul	-	28 Jul
Polygonaceae	<i>Polygonum viviparum</i>	buckwheat	10 Jul	8 Jul	15 Jul	-	1 Aug	2 Jul	14 Jul
	<i>Rumex arctica/transitorius</i>	dock	-	19 Jun	~1 Jul	7 Jul	X	X	18 Jun
	<i>Rumex fenestratus</i>	wild rhubarb, dock	15 Jun	6 Jun	1 Jul	1 Jul	13 Jun	20 Jun	18 Jun
Portulacaceae	<i>Claytonia sibirica</i>	spring beauty	12 Jun	14 May	22 May	30 May	<27 May	30 May	28 May
Primulaceae	<i>Montia fontana</i>	water blinks	-	-	-	-	-	-	14 Jun
	<i>Androsace charmaejasme</i>	rock jasmine	-	18 May	29 May	24 May	27 May	<26 May	22 May
	<i>Dodecatheon pulchellum</i>	shooting star	8 Jun	22 May	26 May	29 May	29 May	<24 May	24 May
Ranunculaceae	<i>Primula cuneifolia</i>	wedge-leaved primrose	-	-	9 Jun	8 Jun	15 Jun	<5 Jun	11 Jun
	<i>Trientalis europaea</i>	Arctic starflower	15 Jun	6 Jun	8 Jun	10 Jun	29 May	7 Jun	8 Jun
	<i>Aconitum delphinium</i>	monkshood	23 Jul	12 Jul	23 Jul	25 Jul	21 Jul	18 Jul	15 Jul
	<i>Anemone narcissiflora</i>	anemone	-	16 Jun	-	<19 Jun	29 Jun	<29 Jun	14 Jun
	<i>Caltha palustris</i>	marsh marigold	4 Jun	19 May	26 May	29 May	28 May	31 May	24 May
Rosaceae	<i>Ranunculus occidentalis</i>	buttercup	<5 Jun	13 May	<17 May	<19 May	<23 May	<20 May	<20 May
	<i>Geum macrophyllum</i>	large-leaved avens	20 Jun	6 Jun	late Jun	22 Jun	X	22 Jun	15 Jun
	<i>Potentilla egedii</i>	Pacific silverweed	21 Jun	6 Jun	26 Jun	22 Jun	9 Jul	25 Jun	24 Jun
	<i>Potentilla palustris</i>	marsh five-fingers	-	9 Jul	18 Jul	22 Jun	-	22 Jul	< 28 Jul
	<i>Potentilla villosa</i>	cinquefoil	-	22 May	26 May	4 Jun	29 May	<24 May	24 May
	<i>Rubus arcticus</i>	nagoon berry	9 Jun	22 May	26 May	23 May	5 Jun	<24 May	31 May
	<i>Rubus chamaemorus</i>	cloudberry	-	2 Jun	7 Jun	9 Jun	6 Jun	3 Jun	31 May

Table 101 (continued). First flowering dates of plants identified on Chowiet Island, Alaska. Data represent the day a fully-opened flower was first observed on the island each year. Dates may be poor indicators of actual phenology because observations of initial flowering events for uncommon or inconspicuous plants may be missed or depend on timing of field crew activities. Species in bold are considered conspicuous, easy to identify, and fairly widespread and flowering dates of these species are probably recorded within a few days. Species found, but for which no flowering data are available, are denoted by an "X". Families and species are presented alphabetically. Identifications are made by field personnel on-island and have not been confirmed by other authorities. Asterisks denote species not found by (Hatch 1978), who conducted vegetative surveys on Chowiet and collected plants that were later identified by staff at the University of Alaska Herbarium, Fairbanks, Alaska. For further information on plants in specific years, see table comments in previous reports. No data collected before 2004 or in 2006-2008 or 2020.

Family	Species	Common name	2014	2015	2016	2017	2018	2019	2021
Gentianaceae	<i>Gentiana algida</i>	Arctic gentian	<20 Aug	11 Aug	-	-	<9 Aug	-	19 Aug
	<i>Gentiana amarella</i>	northern gentian	17 Jul	26 Jul	10 Jul	25 Jul	-	19 Jul	18 Jul
	<i>Swertia perennis</i>	star gentian	-	-	-	-	-	-	27 Jul
Geraniaceae	<i>Geranium erianthum</i>	wild geranium	<22 May	31 May	23 May	25 May	24 May	<23 May	1 Jun
Iridaceae	<i>Iris setosa</i>	wild iris	17 Jun	26 Jun	16 Jun	19 Jun	X	X	X
Liliaceae	<i>Fritillaria camschatensis</i>	chocolate lily	27 May	10 Jun	30 May	7 Jun	30 May	<28 May	8 Jun
Onagraceae	<i>Chamerion angustifolium</i>	fireweed	3 Jul	28 Jun	26 Jun	28 Jun	>4 Aug	9 Jul	22 Jul
	<i>Epilobium behringianum</i>	willow herb	22 Jun	17 Jun	18 Jun	18 Jun	-	-	-
	<i>Epilobium glandulosum</i>	willow herb	13 Jun	<17 Jul	X	X	4 Jul	28 Jun	4 Jul
	<i>Epilobium sertulatum*</i>	willow herb	-	-	-	-	-	-	-
	<i>Epilobium palustre</i>	willow herb	3 Jul	<14 Jul	X	X	-	-	-
Ophioglossace	<i>Botrychium lunaria</i>	moonwort	-	20 Jul	-	-	-	-	26 Jul
Orchidaceae	<i>Coeloglossum viride</i>	frog orchid	26 Jun	-	-	30 Jun	-	16 Jun	16 Jun
	<i>Cypripedium guttatum*</i>	lady's slipper	-	26 Jun	16 Jun	23 Jun	-	23 Jun	18 Jun
	<i>Dactylorhiza aristata*</i>	purple orchid	-	-	-	-	-	-	13 Jun
Orobanchaceae	<i>Malaxis monophylla</i>	white adder's tongue	-	-	-	-	-	-	<27 Jul
	<i>Platanthera dilatata</i>	bog orchid	2 Jun	12 Jun	9 Jun	19 Jun	15 Jun	10 Jun	12 Jun
	<i>Orobanche fasciculata</i>	broomrape	-	-	-	23 Jul	-	19 Jun	27 Jul
Plantaginaceae	<i>Plantago maritima</i>	seashore plantain	1 Jun	22 Jun	10 Jun	12 Jun	15 Jun	13 Jun	29 Jun
Polemoniaceae	<i>Polemonium acutiflorum</i>	Jacob's ladder	28 Jun	1 Aug	14 Jul	23 Jul	-	-	8 Aug
Polygonaceae	<i>Polygonum viviparum</i>	buckwheat	22 Jun	<14 Jul	X	16 Jul	16 Jul	19 Jun	<28 Jun
	<i>Rumex arctica/transitorius</i>	dock	27 May	<26 Jun	<30 Jun	X	21 Jun	X	24 Jun
	<i>Rumex fenestratus</i>	wild rhubarb, dock	4 Jun	13 Jun	3 Jun	<15 May	-	8 Jun	24 Jun
Portulacaceae	<i>Claytonia sibirica</i>	spring beauty	<20 May	<22 May	<21 May	22 May	<22 May	<26 May	<12 May
Primulaceae	<i>Montia fontana</i>	water blinks	29 May	-	24 May	29 May	-	-	14 Jun
	<i>Androsace chamaejasme</i>	rock jasmine	<22 May	<23 May	23 May	25 May	<22 May	<26 May	29 May
	<i>Dodecatheon pulchellum</i>	shooting star	<22 May	<23 May	27 May	17 May	<22 May	<28 May	21 May
Ranunculaceae	<i>Primula cuneifolia</i>	wedge-leaved primrose	25 May	7 Jun	29 May	28 May	-	9 Jun	3 Jun
	<i>Trifentalis europaea</i>	Arctic starflower	<22 May	11 Jun	27 May	3 Jun	4 Jun	<28 May	6 Jun
	<i>Aconitum delphinium</i>	monkshood	8 Jul	14 Jul	12 Jul	23 Jul	17 Jul	29 Jun	23 Jul
Rosaceae	<i>Anemone narcissiflora</i>	anemone	<23 May	13 Jun	-	-	-	-	-
	<i>Caltha palustris</i>	marsh marigold	<20 May	22 May	<21 May	21 May	<22 May	<28 May	24 May
	<i>Ranunculus occidentalis</i>	buttercup	<20 May	<21 May	<21 May	<15 May	<21 May	<26 May	<12 May
	<i>Geum macrophyllum</i>	large-leaved avens	24 May	<24 Jun	7 Jun	10 Jun	15 Jun	X	14 Jun
	<i>Potentilla egedii</i>	Pacific silverweed	13 Jun	26 Jun	10 Jun	23 Jun	<22 May	<28 May	10 Jun
	<i>Potentilla palustris</i>	marsh five-fingers	22 Jun	X	27 May	18 Jul	-	-	8 Aug
	<i>Potentilla villosa</i>	cinquefoil	<22 May	30 May	X	20 May	<22 May	<28 May	1 Jun
	<i>Rubus arcticus</i>	nagoon berry	<22 May	30 May	24 May	17 May	<22 May	<26 May	26 May
	<i>Rubus chamaemorus</i>	cloudberry	24 May	4 Jun	26 May	3 Jun	24 May	-	21 May

Table 101 (continued). First flowering dates of plants identified on Chowiet Island, Alaska. Data represent the day a fully-opened flower was first observed on the island each year. Dates may be poor indicators of actual phenology because observations of initial flowering events for uncommon or inconspicuous plants may be missed or depend on timing of field crew activities. Species in bold are considered conspicuous, easy to identify, and fairly widespread and flowering dates of these species are probably recorded within a few days. Species found, but for which no flowering data are available, are denoted by an "X". Families and species are presented alphabetically. Identifications are made by field personnel on-island and have not been confirmed by other authorities. Asterisks denote species not found by (Hatch 1978), who conducted vegetative surveys on Chowiet and collected plants that were later identified by staff at the University of Alaska Herbarium, Fairbanks, Alaska. For further information on plants in specific years, see table comments in previous reports. No data collected before 2004 or in 2006-2008 or 2020.

Family	Species	Common name	2004	2005	2009	2010	2011	2012	2013
Rosaceae	<i>Rubus spectabilis</i>	salmonberry	-	-	-	-	-	-	-
	<i>Sanguisorba stipulata</i>	Sitka burnet	6 Jun	1 Jul	15 Jul	22 Jul	14 Jul	13 Jul	6 Jul
Rubiaceae	<i>Galium trifidum</i>	bedstraw	17 Jul	16 Jul	X	-	X	29 Jun	28 Jul
	<i>Galium triflorum</i>	bedstraw	-	-	16 Jul	-	X	30 Jun	-
	<i>Galium aparine</i>	bedstraw	-	-	-	-	-	-	-
Salicaceae	<i>Salix arctica</i>	dwarf willow	-	18 May	-	-	X	-	23 May
	<i>Salix pulchra</i>	diamondleaf willow	-	26 May	-	-	X	-	< 8 Jun
	<i>Salix rotundifolia</i>	dwarf willow	-	30 May	-	-	X	-	X
	<i>Salix stolonifera</i> *	dwarf willow	-	30 May	-	-	X	-	X
Saxifragaceae	<i>Parnassia palustris</i>	grass-of-Parnassus	18 Jul	1 Jul	12 Jul	19 Jul	17 Jul	18 Jul	19 Jul
	<i>Saxifraga bracteata</i>	bracted saxifrage	mid Jul	25 May	3 Jun	4 Jun	3 Jun	31 May	3 Jun
Scrophulariaceae	<i>Castilleja unalaschensis</i>	coastal paintbrush	12 Jun	6 Jun	12 Jun	10 Jun	19 Jun	20 Jun	18 Jun
	<i>Pedicularis verticillata</i>	lousewort	20 Jun	22 May	14 Jun	17 Jun	2 Jun	20 Jun	9 Jun
	<i>Veronica americana</i>	brooklime	11 Jul	25 Jun	24 Jun	7 Jul	X	16 Jul	9 Jul
	<i>Mimulus guttatus</i>	monkeyflower	-	-	-	-	-	-	-
Urticaceae	<i>Urtica lyallii</i>	nettle	5 Aug	25 Jun	X	X	X	X	X
	<i>Viola langsdorffii</i>	Alaska violet	late May	14 May	24 May	23 May	<22 May	<24 May	24 May

Table 101 (continued). First flowering dates of plants identified on Chowiet Island, Alaska. Data represent the day a fully-opened flower was first observed on the island each year. Dates may be poor indicators of actual phenology because observations of initial flowering events for uncommon or inconspicuous plants may be missed or depend on timing of field crew activities. Species in bold are considered conspicuous, easy to identify, and fairly widespread and flowering dates of these species are probably recorded within a few days. Species found, but for which no flowering data are available, are denoted by an "X". Families and species are presented alphabetically. Identifications are made by field personnel on-island and have not been confirmed by other authorities. Asterisks denote species not found by (Hatch 1978), who conducted vegetative surveys on Chowiet and collected plants that were later identified by staff at the University of Alaska Herbarium, Fairbanks, Alaska. For further information on plants in specific years, see table comments in previous reports. No data collected before 2004 or in 2006-2008 or 2020.

Family	Species	Common name	2014	2015	2016	2017	2018	2019	2021
Rosaceae	<i>Rubus spectabilis</i>	salmonberry	-	<4 Aug	11 Jun	X	30 Jun	-	-
	<i>Sanguisorba stipulata</i>	Sitka burnet	28 Jun	<8 Jul	30 Jun	1 Jul	30 Jun	1 Jul	14 Jul
Rubiaceae	<i>Galium trifidum</i>	bedstraw	X	-	-	-	-	-	26 Jul
	<i>Galium triflorum</i>	bedstraw	20 Jul	-	-	-	-	-	<26 Jul
	<i>Galium aparine</i>	bedstraw	-	-	-	-	-	-	<12 Aug
Salicaceae	<i>Salix arctica</i>	dwarf willow	X	X	X	X	-	X	21 May
	<i>Salix pulchra</i>	diamondleaf willow	X	X	X	X	-	X	X
	<i>Salix rotundifolia</i>	dwarf willow	X	X	X	X	-	X	X
	<i>Salix stolonifera</i> *	dwarf willow	X	X	X	X	-	X	X
Saxifragaceae	<i>Parnassia palustris</i>	grass-of-Parnassus	8 Jul	16 Jul	28 Jun	8 Jul	26 Jun	28 Jun	12 Jul
	<i>Saxifraga bracteata</i>	bracted saxifrage	<24 May	30 May	31 May	30 May	4 Jun	5 Jun	26 May
Scrophulariaceae	<i>Castilleja unalaschensis</i>	coastal paintbrush	27 May	4 Jun	3 Jun	10 Jun	4 Jun	<28 May	1 Jun
	<i>Pedicularis verticillata</i>	lousewort	27 May	30 May	27 May	10 Jun	29 May	31 May	6 Jun
	<i>Veronica americana</i>	brooklime	22 Jun	18 Jun	30 Jun	19 Jun	-	-	12 Jul
Urticaceae	<i>Mimulus guttatus</i>	monkeyflower	20 Jul	-	-	-	-	17 Jun	7 Aug
	<i>Urtica lyallii</i>	nettle	<16 Jul	20 Jul	X	10 Jun	Jul	X	18 Jul
Violaceae	<i>Viola langsdorffii</i>	Alaska violet	<20 May	22 May	<21 May	<15 May	<21 May	<26 May	22 May

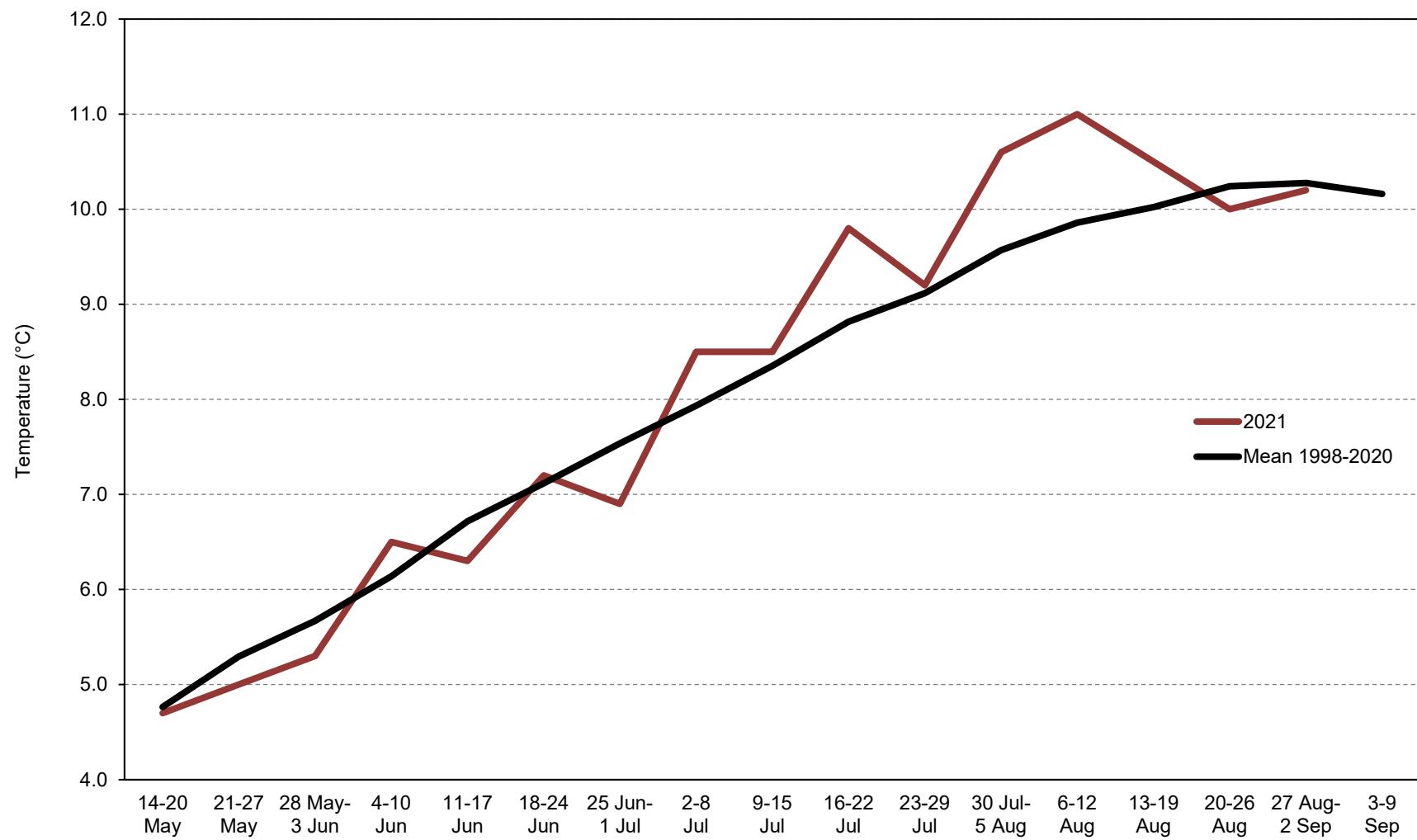


Figure 61. Mean weekly sea surface temperatures (°C) in Chowiet Bay, Chowiet Island, Alaska. No data were collected in 1999-2001, 2003, or 2020.

Table 102. Mean weekly sea surface temperatures (°C)^a in Chowiet Bay, Chowiet Island, Alaska. No data were collected in 1999–2001, 2003, or 2020.

Week	1998	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
1 - 7 Jan	-	-	-	-	-	-	4.2	-	-	-	-	-	-	-	-	-	-	-	
8 - 14 Jan	-	-	-	-	-	-	3.5	-	-	-	-	-	-	-	-	-	-	-	
15 - 21 Jan	-	-	-	-	-	-	3.4	-	-	-	-	-	-	-	-	-	-	-	
22 - 28 Jan	-	-	-	-	-	-	3.4	-	-	-	-	-	-	-	-	-	-	-	
29 Jan - 4 Feb	-	-	-	-	-	-	3.2	-	-	-	-	-	-	-	-	-	-	-	
5 - 11 Feb	-	-	-	-	-	-	3.0	-	-	-	-	-	-	-	-	-	-	-	
12 - 18 Feb	-	-	-	-	-	-	2.9	-	-	-	-	-	-	-	-	-	-	-	
19 - 25 Feb	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	-	-	-	-	
26 Feb - 4 Mar	-	-	-	-	-	-	2.7	-	-	-	-	-	-	-	-	-	-	-	
5 - 11 Mar	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	-	-	-	-	
12 - 18 Mar	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	-	-	-	-	
19 - 25 Mar	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	
26 Mar - 1 Apr	-	-	-	-	-	-	2.6	-	-	-	-	-	-	-	-	-	-	-	
2 - 8 Apr	-	-	-	-	-	-	2.7	-	-	-	-	-	-	-	-	-	-	-	
9 - 15 Apr	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	-	-	-	-	
16 - 22 Apr	-	-	-	-	-	-	2.9	-	-	-	-	-	-	-	-	-	-	-	
23 - 29 Apr	-	-	-	-	-	-	3.1	-	-	-	-	-	-	-	-	-	-	-	
30 Apr - 6 May	-	-	-	-	-	-	3.1	-	-	-	-	-	-	-	-	-	-	-	
7 - 13 May	-	4.4	4.7	5.1	-	-	3.4	-	-	-	-	-	-	-	-	-	-	4.5	
14 - 20 May	6.0	4.8	5.0	5.4	4.6	3.9	3.8	4.2	4.8	4.7	4.0	4.0	5.7	-	-	5.3	5.3	-	4.7
21 - 27 May	6.0	5.1	5.3	5.8	5.0	4.0	4.0	4.2	5.1	4.7	4.4	4.2	6.0	6.2	7.3	5.8	5.4	6.8	5.0
28 May - 3 Jun	6.3	5.5	5.7	6.0	5.4	4.7	4.5	4.2	5.5	5.5	5.0	4.4	6.1	6.8	7.7	5.9	5.7	7.1	5.3
4 - 10 Jun	6.6	6.0	6.2	6.9	6.1	5.1	4.8	4.5	5.9	5.6	5.4	4.8	6.7	7.5	7.8	6.3	6.6	7.7	6.5
11 - 17 Jun	6.9	6.9	6.7	8.3	6.2	5.6	5.6	4.8	6.3	5.9	6.5	5.4	6.9	7.7	9.0	7.0	6.9	8.3	6.3
18 - 24 Jun	7.3	7.2	7.0	8.4	6.4	6.0	6.1	5.6	6.8	6.3	7.0	5.8	7.2	8.0	9.1	7.9	7.3	8.7	7.2
25 Jun - 1 Jul	7.3	7.8	7.5	8.0	7.5	6.7	6.4	6.1	7.4	7.0	7.2	5.9	7.6	8.8	9.5	7.8	7.4	9.8	6.9
2 - 8 Jul	8.4	9.3	7.8	8.1	8.3	6.4	6.2	6.9	7.5	6.6	7.0	6.3	8.7	8.6	9.9	9.2	8.2	9.4	8.5
9 - 15 Jul	8.1	8.6	8.6	8.4	8.1	7.4	7.3	7.8	7.7	7.2	8.3	7.0	8.6	9.4	11.0	8.9	8.1	9.8	8.5
16 - 22 Jul	8.8	9.6	8.6	9.2	8.2	7.4	-	8.5	8.4	7.2	8.2	7.9	8.8	9.8	11.4	9.7	8.3	9.9	9.8
23 - 29 Jul	8.9	9.7	8.7	9.0	8.9	8.4	-	6.9	8.6	8.7	8.3	7.5	9.8	11.6	11.2	8.9	9.0	10.9	9.2
30 Jul - 5 Aug	9.7	10.7	8.5	10.1	10.1	8.5	-	8.3	9.2	7.9	8.4	8.5	10.2	10.2	11.4	10.6	9.8	10.6	10.6
6 - 12 Aug	9.9	10.4	9.4	10.3	10.2	9.1	-	8.5	8.9	8.7	9.0	8.7	10.7	11.0	11.0	9.8	10.3	11.7	11.0
13 - 19 Aug	10.2	10.3	9.9	11.5	10.1	9.1	-	9.3	8.6	8.6	9.4	9.0	9.7	11.1	11.6	10.3	9.9	11.8	10.5
20 - 26 Aug	10.2	10.2	9.9	11.2	10.3	10.6	-	8.9	9.5	10.0	9.1	8.7	11.3	11.5	10.8	9.9	10.4	11.6	10.0
27 Aug - 2 Sep	10.3	10.5	10.1	11.9	10.5	9.8	-	9.5	10.1	8.3	9.4	10.0	10.7	10.8	11.8	10.3	10.1	10.6	10.2
3 - 9 Sep	9.6	11.0	10.8	-	10.9	10.3	-	9.2	10.3	8.7	9.6	-	-	-	10.8	10.2	10.6	10.1	-
10 - 16 Sep	-	9.1	-	-	-	10.1	-	-	-	-	-	-	-	-	-	-	-	-	-
17 - 23 Sep	-	-	-	-	-	10.4	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 102 (continued). Mean weekly sea surface temperatures ($^{\circ}\text{C}$)^a in Chowiet Bay, Chowiet Island, Alaska. No data were collected in 1999-2001, 2003, or 2020.

Week	1998	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
24 - 30 Sep	-	-	-	-	-	9.5	-	-	-	-	-	-	-	-	-	-	-	-	
1 - 7 Oct	-	-	-	-	-	9.2	-	-	-	-	-	-	-	-	-	-	-	-	
8 - 14 Oct	-	-	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	
15 - 21 Oct	-	-	-	-	-	8.1	-	-	-	-	-	-	-	-	-	-	-	-	
22 - 28 Oct	-	-	-	-	-	7.8	-	-	-	-	-	-	-	-	-	-	-	-	
29 Oct - 4 Nov	-	-	-	-	-	7.5	-	-	-	-	-	-	-	-	-	-	-	-	
5 - 11 Nov	-	-	-	-	-	7.2	-	-	-	-	-	-	-	-	-	-	-	-	
12 - 18 Nov	-	-	-	-	-	6.7	-	-	-	-	-	-	-	-	-	-	-	-	
19 - 25 Nov	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	
26 Nov - 2 Dec	-	-	-	-	-	6.3	-	-	-	-	-	-	-	-	-	-	-	-	
3 - 9 Dec	-	-	-	-	-	6.2	-	-	-	-	-	-	-	-	-	-	-	-	
10 - 16 Dec	-	-	-	-	-	5.9	-	-	-	-	-	-	-	-	-	-	-	-	
17 - 23 Dec	-	-	-	-	-	5.4	-	-	-	-	-	-	-	-	-	-	-	-	
24 - 30 Dec	-	-	-	-	-	4.9	-	-	-	-	-	-	-	-	-	-	-	-	

^aData loggers are anchored in 6-10 meters of water.

Table 103. Weather observations at Chowiet Island, Alaska in 2021.

Dates	Daily High Temperature °C		Daily Low Temperature °C		Total Precipitation (cm)
	Mean	Max.	Mean	Min.	
12-31 May	58.0	61.0	42.1	38.0	5.0
June	59.1	68.0	45.8	43.0	7.6
July	64.5	76.0	49.9	46.0	8.0
1-30 August	65.0	74.0	50.8	47.0	8.0
All (12 May - 30 Aug)	62.2	55.8	48.1	34.8	25.9

Appendix A. Diet datasets in the AMNWR diet database from Chowiet Island, Alaska. Years in parentheses are pending analysis.

Species	Recipient	Diet type	Years	In 2021 annual report
Black oystercatcher	Adult	Stomach	1995	N
Common murre	Adult	Stomach	1995, 1998	N
Common murre	Chick	Bill-load	1998, 2002, 2004-2006	Y
Thick-billed murre	Chick	Bill-load	1998, 2002, 2004	Y
Pigeon guillemot	Adult	Stomach	1995	N
Parakeet auklet	Adult	Stomach	1995	N
Parakeet auklet	Chick	Regurgitation	2015-2019, (2021)	Y
Rhinoceros auklet	Adult	Stomach	1998	N
Rhinoceros auklet	Chick	Bill-load	1979, 1993, 1995, 1998, 2002, 2004-2005, 2007, 2009-2019, 2021	Y
Horned puffin	Adult	Stomach	1995	N
Horned puffin	Chick	Bill-load	2014-2016, 2018-2019, 2021	Y
Tufted puffin	Adult	Stomach	1995	N
Tufted puffin	Chick	Bill-load	2014-2015, 2018-2019, 2021	Y
Black-legged kittiwake	Adult	Stomach	1995, 1998	N
Glaucous-winged gull	Adult	Stomach	1995	Y
Glaucous-winged gull	Adult	Pellet	2004-2007, 2009-2019, 2021	Y
Glaucous-winged gull	Chick	Regurgitation	2002, 2004	N
Leach's storm-petrel	Chick	Regurgitation	2014	N
Northern fulmar	Adult	Stomach	1995	N
Northern fulmar	Chick	Regurgitation	2002	N

Appendix B. Diet datasets in the AMNWR diet database from other sites in the Semidis Islands, Alaska.

Species	Recipient	Diet type	Years	In 2021 annual report
Kateekuk				
Common murre	Adult	Stomach	1995	N
Tufted puffin	Chick	Bill-load	2021	Y
Black-legged kittiwake	Chick	Stomach	1998	N
Suklik				
Black oystercatcher	Adult	Stomach	1994	N
Common murre	Adult	Stomach	1993-1994	N
Pigeon guillemot	Adult	Stomach	1994	N
Parakeet auklet	Adult	Stomach	1994	N
Horned puffin	Adult	Stomach	1993-1994	N
Horned puffin	Chick	Bill-load	1979, 1985-1987, 1991-1995, 2014, 2016	Y
Tufted puffin	Adult	Stomach	1993-1994	N
Tufted puffin	Chick	Bill-load	1979, 1985-1987, 1991-1995, 2014-2016, 2018-2019, 2021	Y
Black-legged kittiwake	Adult	Stomach	1993-1994	N
Northern fulmar	Adult	Stomach	1994	N
Red-faced cormorant	Adult	Stomach	1994	N
Pelagic cormorant	Adult	Stomach	1994	N
Semidis (unspecified)				
Harlequin duck	Adult	Stomach	1992	N
Black oystercatcher	Adult	Stomach	1992	N
Common murre	Adult	Stomach	1992, 1995	N
Thick-billed murre	Adult	Stomach	1990	N
Pigeon guillemot	Adult	Stomach	1990, 1992	N
Cassin's auklet	Adult	Stomach	1992	N
Parakeet auklet	Adult	Stomach	1990, 1992	N
Horned puffin	Adult	Stomach	1992	N
Tufted puffin	Adult	Stomach	1990, 1992	N
Black-legged kittiwake	Adult	Stomach	1990, 1992	N
Glaucous-winged gull	Adult	Stomach	1990, 1992	N
Leach's storm-petrel	Adult	Stomach	1990	N
Northern fulmar	Adult	Stomach	1990, 1992	N
Short-tailed shearwater	Adult	Stomach	1990	N
Red-faced cormorant	Adult	Stomach	1992	N