

## BIOLOGICAL MONITORING AT AIKTAK ISLAND, ALASKA IN 2021



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Key words: Aiktak Island, Alaska, Aleutian Islands, ancient murrelet, *Cepphus columba*, common murre, double-crested cormorant, fork-tailed storm-petrel, *Fratercula cirrhata*, *Fratercula corniculata*, glaucous-winged gull, horned puffin, *Hydrobates furcatus*, *Hydrobates leucorhous*, *Larus glaucescens*, Leach's storm-petrel, *Nannopterum auritus*, pelagic cormorant, pigeon guillemot, population trends, productivity, red-faced cormorant, *Synthliboramphus antiquus*, thick-billed murre, tufted puffin, *Uria aalge*, *Uria lomvia*, *Uria pelagicus*, *Uria urile*.

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Tufted puffins swirl on the south side of Aiktak island (Youngren 2018).

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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 near shore 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.

Aikta Island, in the eastern Aleutian Islands, has been an annual monitoring site since 1995, with additional seabird data collected on the island since 1981. Brief visits were first made to Aikta to monitor populations of puffins and storm-petrels from 1981 to 1983 and in 1989 (DeGange et al. 1981; Forsell 1983a,b; Blomstrom and Nault 1989). In 1990, data collection also included counting murres and conducting circumnavigation surveys of the island (O'Daniel et al. 1990). Since 1995, intensive season-long monitoring of most seabird populations at Aikta has been conducted each year except 2020 (Dragoo and Woodward 1996; Woodward 1997; Howard and Woodward 1999; Thomson and Smith 2000; Sztukowski and Oleszczuk 2001; Dykstra and Wynn 2002; Helm and Zeman 2005, 2006; Helm et al. 2007; Drummond 2008; Sapora et al. 2009; Hand et al. 2010; Bechaver and Gehrig 2011; Gladics et al. 2013; Howie et al. 2014; Boyd et al. 2015; Youngren et al. 2015, 2017, 2018, 2019a,b).

The specific monitoring goals in 2021 were to estimate productivity and/or population parameters for 11 indicator species representing three major feeding guilds: 1) diving fish-feeders (common and thick-billed murres [*Uria aalge* and *U. lomvia*], pigeon guillemots [*Cephus columba*], horned and tufted puffins [*Fratercula corniculata* and *F. cirrhata*]), and red-faced, pelagic and double-crested cormorants [*Urile urile*, *U. pelagicus*, and *Nannopterum auritum*]), 2) diving plankton feeders (ancient murrelets [*Synthliboramphus antiquus*]), and 3) surface plankton feeders (Leach's and fork-tailed storm-petrels [*Hydrobates furcatus* and *H. leucorhous*]). Similar data were also collected for intertidal-foraging black oystercatchers (*Haematopus bachmani*) and flexible-foraging glaucous-winged gulls (*Larus glaucescens*). Additional monitoring goals include the description of breeding chronology, food habits, and chick growth 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

Aikta Island (54.1865° N 164.8307° W) is located in the Krenitzin Islands in the eastern Aleutian Islands, Alaska. Aikta is on the west side of Unimak Pass, with Ugamak Island directly to the north across a 0.8 km channel and Tigalda Island about 5 km to the west. Unimak Pass is the main shipping route between the North Pacific Ocean and the Bering Sea and transiting container ships are often seen on the horizon from the east side of the island.

Aikta is a small island approximately 2 km long and 1 km wide, encompassing 155 ha and with a circumference of 7.3 km (see Figures 1-3). The low-lying north shore consists of alternating grassy slopes and low rock cliffs (10-15 m) that back a number of small coves with cobble beaches. The south side of the island rises to high, sheer bluffs, the tops of which approach the highest parts of the island. Maximum elevation is 170 m. Several small *Leymus*-covered islets lie just offshore the eastern and western ends of the island. Vegetation is composed of maritime tundra: *Leymus* and *Heracleum* dominate the near-shore edges, while the island's interior is about half covered by *Poa* and *Calamagrostis*, and a quarter composed of a short tundra community of *Empetrum*, lichens, mosses, and *Anemone*. Intermixed within these communities around the island are *Angelica*, *Claytonia*, *Fritillaria*, *Equisetum*, *Rumex*, *Conioselinum*, *Ranunculus*, *Viola*, *Pedicularis*, *Sanguisorba*, *Geranium*, *Acontium*, *Epilobium*, ferns, and several other herbaceous plants.

Arctic foxes were introduced to Aikta in 1921 and were trapped for pelts (Bureau of Biological Survey 1940) but eventually died off. With no foxes present on the island today, Aikta has a breeding bird community that is one of the most diverse of any island in the eastern Aleutian Islands. The tufted puffin colony that exists at Aikta is one of the largest in Alaska, supporting hundreds of thousands of birds. For these reasons, Aikta Island has been designated as the annual monitoring site in the eastern Aleutian Island portion of the Alaska Maritime National Wildlife Refuge seabird monitoring system.

## METHODS

**Personnel:** The U.S. Fish and Wildlife Service field crew at Aikta Island in 2021 consisted of Sarah Youngren and Dan Rapp (23 May to 29 August). On 14 July, during the resupply, a boat-based circumnavigation survey was completed with assistance from Nora Rojek, Brie Drummond, Aaron Christ, Sarah Guitart, and Erin Lefkowitz.

**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:

### Black oystercatcher

- Nest statuses were checked and recorded more frequently than the protocol specifications when incubating birds were observed off active nests due to being passed in route to other monitoring tasks (e.g., passerine transects, COASST).

### Murre

- We tested a pilot protocol to quantify early breeding effort and success, and to obtain some absolute measures of success of murre in 2019 and 2021. Within fixed-border plots and subplots, we periodically counted adults and nesting attempts (eggs laid) 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 Aikta, we implemented this new protocol in two common murre plots and two thick-billed murre plots, beginning on 26 June 2021. In 2021 we moved the thick-billed murre subplot on Sail Rock (Plot 5) to a new and better location within the plot. We are still analyzing these data; results will be summarized in a separate report.

### **Pigeon guillemot**

- Raft counts at pole 77 were conducted from Upland Access Trail due to aggressive bald eagles (*Haliaeetus leucocephalus*) nesting on first sister of Four Sister formation. All of the count area could be observed as well as from pole 77. This occurred in other years (2015-2018) when bald eagles nested in this area.

### **Ancient murrelet**

- We continued a study on the distribution of ancient murrelets during the non-breeding season by recapturing and removing geolocator loggers from one additional bird of the original 24 adult birds that were tagged in 2018 (19 loggers were recovered in 2019). Four loggers remain on birds; three of the four burrows were active this season (had eggs) but not by a tagged bird (unless the tags and FWS bands fell off); the fourth burrow was not active. Birds that were handled or disturbed at a rate higher than defined in the protocol were not included in the overall summary of chronology and reproductive success in this report. We included an additional table (Table 26) that compares the reproductive success of nest sites with handled birds to nest sites that were monitored following the standard protocol.
- A new area to monitor ancient murrelets was found in the low bluffs adjacent to Old Camp Beach (54.18508° N 164.84598° W); more burrows could likely be found here.

### **Horned puffin**

- Raft counts at pole 77 were conducted from Upland Access Trail due to aggressive bald eagles nesting on first sister of Four Sister formation. All of the count area could be observed as well as from pole 77. This occurred in other years (2015-2018) when bald eagles nested in this area.
- Due to the small number of nests monitored and the inaccessibility of many of the nests, chick growth data were not collected in 2021.

### **Tufted puffin**

- In addition to conducting the normal tufted puffin burrow-nester population surveys (density and apparent occupancy within plots), we continued testing a protocol being developed to track changes in puffin populations, using the presence/absence of occupied burrows (i.e., the presence of fish, guano, feathers, shell fragments, egg(s), and chick(s) inside a burrow) within randomly placed 1m<sup>2</sup> plots as a surrogate for annual breeding population and colony attendance. We conducted only one replicate of sampling, consisting of a total of 20 quadrats arranged along transect lines within these colonies. Details of this survey will be described in a special report on the new puffin protocol.
- In 2021 we initiated a study on the distribution of tufted puffins during the non-breeding season by tagging 19 adult nesting birds with geolocator tags attached to leg bands. Birds were captured from active nest sites being monitored within productivity plots during the mid-chick rearing period. Retrieval will be attempted during 2022. Birds that were tagged were not included in the overall summary of chronology and reproductive success in this report but are included in an additional table that compares the reproductive success of nest sites with tagged birds to those that were monitored following the standard protocol (Table 40). At last check, just prior to departure from the island, all chicks from burrows with tagged adults were still alive.

### **Storm-petrels**

- For populations, we recorded burrow entrance size but for analysis included all burrows found in storm-petrel plots. Large burrows were not excluded because on Aiktaq Island large burrows in the storm-petrel plots have resulted from enlargement from original size due to intensive monitoring over the years.

- To boost chronology and chick growth sample sizes, we followed 12 active burrows outside chronology plots weekly including burrows found just outside typical plots, in artificial burrows, and burrows found in ancient murrelet, tufted puffin, and horned puffin colonies. Burrows not associated with numbered chronology or artificial plots were lumped in a plot called 'off plot' and designated for chronology use in the database.

## **Cormorants**

- Boom-or-bust counts were conducted in 2021 for double-crested cormorants.

## **Additional sampling**

- We collected glaucous-winged gull and black oystercatcher eggshells membranes for Environment and Climate Change Canada as part of a project to better understand each species genetic population structure.
- We collected sets of feathers from six opportunistically collected dead tufted puffin adults for the ARCTOX contamination project (P.I. Jerome Fort, Universite de La Rochelle, France).
- We collected ticks for the Alaska Submit-A-Tick Program, which aims to document ticks in order to better understand the potential impacts of ticks in Alaska.
- Seven COASST survey replicates were completed on Old-New Camp Beach.
- One early season oil survey was conducted.

To abide by recent American Ornithological Union classification and nomenclature revisions, taxonomic order and scientific names within tables and in the annotated list in this report were adjusted. Of particular note from the 62<sup>nd</sup> supplement to the American Ornithological Society's checklist of North American birds is the revision of genus names and taxonomic order for cormorants.

Reproductive success and chronology data for murres and puffins in all years, and storm-petrels in 2017-2021, 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, black oystercatchers, ancient murrelets and gulls in all years, and storm-petrels prior to 2017, were summarized by hand (these data will be added to and summarized by the database in the future).

Population data for murres in 2014-2021 were summarized using the AMNWR population database. Population data for murres in 1995-2013 and all other species in all years have not yet been added to the database and were hand-summarized (these data will be added to and summarized by the database in the future).

This report corrects diet data in figures and tables for all species at Aikta that were presented in previous reports. Diet data for all species in all years were summarized using the AMNWR diet database (only ongoing diet datasets are presented here; additional diet datasets exist [Appendix A]). Diet is summarized for frequency of occurrence, percent composition, and percent biomass for puffins; frequency of occurrence, percent composition, and percent volume for gulls; and frequency of occurrence and percent composition for all 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 Aikta 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.



## INTERESTING OBSERVATIONS

- In 2021 black oystercatchers, ancient murrelets, and horned puffins exhibited earlier than average hatch dates. Ancient murrelets had the earliest mean hatch recorded for the island (eight days earlier than long-term mean). Fork-tailed storm-petrels were average, while tufted puffins, glaucous-winged gulls and Leach's storm-petrel were later than average.
- Reproductive success was above average for most species monitored at Aiktak Island in 2021, including common and thick-billed murres, ancient murrelets, horned and tufted puffins, and fork-tailed storm-petrels; average for glaucous-winged gulls, and below average for black oystercatchers and Leach's storm-petrels.
- Chick growth was higher than the long-term mean for tufted puffins and Leach's storm-petrels while it was lower for fork-tailed storm-petrels.

### Black oystercatcher

- Upon our arrival on 23 May we observed evidence that a high-water event may have occurred relatively recently, this could explain the lack of usual nests used for productivity and chronology. There were three weather events during the season that directly impacted active oystercatcher nests through heavy rainfall and/or over washing from storm-surge.
- The Spire contained an oystercatcher territory and likely an active nest, viewable from pole 04, but this was never confirmed (this may have been a territory in past seasons too).

### Murre

- Significantly larger numbers of murres were present on Aiktak in 2021 compared to recent years with successful breeding by both common and thick-billed murres. Land-based population counts for murres were the highest recorded since 1997 and the boat-based count during the circumnavigation survey on 14 July was the highest since 1998.
- The absence of the usual bald eagle nest atop The Fin (below Pole 89) in 2021 (and 2019) may have contributed to the increased attendance, nest initiation, and reproductive success of thick-billed murres on Sail Rock and adjacent cliff faces. Subplot A, on Sail Rock, an area where common murre productivity typically conducted, was completely empty in 2021, which was the first time we have seen this; outside of Subplot 5, common murres were in their normal areas. Thick-billed murres were observed standing on cliffs east of Pole 51 and The Fin (Population Plot 10), these areas are typically devoid of murres.

### Ancient murrelet

- Between 4 July and 8 July four living and three dead adult birds (assumed breeding) were found at New Camp Beach, Cabin, and the Petrel Valley and Two-Crik drainages. Two dead birds found on New Camp Beach were predated or scavenged. Living birds were generally skinny (had prominent keels), lethargic, and wet; the one intact dead bird was also skinny. Living birds not already on New Camp Beach were captured and released there.

### Tufted puffin

- Between 23 June and 26 August, we found 29 downed birds in island drainages and trails and subsequently captured and released them in colonies or on beaches; seven dead birds were found in the same locations.

### **Cormorants**

- Three double-crested cormorant nests were initiated in early June on the cliffs east of Pole 51 and then disappeared. Small numbers of red-faced and pelagic cormorants (three nests for each species) were observed nesting on the south side of Sail Rock during a circumnavigation survey on 14 July (area not visible from on the island).

### **Non-monitored avian species and miscellaneous**

- Bald eagles, common ravens (*Corvus corax*), and peregrine falcons (*Falco peregrinus*) all fledged chicks in 2021.
- A gyrfalcon (*Falco rusticolus*) was observed 18 August. This is the first known record of this species on Aikta. Gibson and Byrd (2007) described gyrfalcon in the eastern Aleutians as probably a rare resident, with most observations known in fall and winter.
- On 14 June a unique gull was observed, it was likely a lesser black-backed gull, but we were not able to positively identify the gull nor could a positive identification be made from photos viewed by gull experts.
- Large flying swarms of March flies (*Bibio* sp.) were observed from late June through early July. Typically, these insects were only observed in good numbers on warm, sunny, low wind days. Male flies were especially prevalent on angelica (*Angelica lucida*) and putchki (*Heracleum lanatum*) flowers.
- Vegetation was beginning to green up upon our arrival to the island (23 May). Further, there were developed flowers among the flowering plants and putchki plants were already getting large. Ugamak Island, across the channel from Aikta, was also noticeably green upon our deployment.
- Fireweed (*Epilobium angustifolium*) was more numerous than during the 2015-2019 seasons, especially in Petrel Valley. Ugamak Island appeared to have increased numbers of flowering yellow monkey flower (*Mimulus guttatus*). Flowering dandelions (*Taraxacum trigonolobum*) seemed more common, especially in patches in Ivory Cove, Tower Cove, and Petrel Valley. None of these plants appear to be the invasive common dandelion (*Taraxacum officinale*). It appears that the invasive annual bluegrass (*Poa annua*) that is found near the cabin is also present in many traveled areas around the island, but *Poa* species are difficult to identify and further investigation is needed.
- The mean weekly sea surface temperature in 2021 exceeded the long-term mean throughout the season.
- When we arrived (23 May) the creek and trail by camp were very full. June was a very wet month (6.2" of accumulated rain) as was August (7" accumulated rain).
- We experienced an earthquake on 28 July that generated a tsunami warning resulting in the crew heading up the hill. The earthquake caused no damage and caused nothing to fall in the cabin. No damage appears to have occurred from a large earthquake that occurred in the summer of 2020.

### **Cabin maintenance**

- This season's cabin maintenance included: repainted the exterior of the cabin, replacing rotten framing on the front deck (east side), removing two rotten patches of wood on the cabin and patching, and recaulking around the front door. Instead of replacing additional deck pieces, it's recommended to replace the front portion of the deck in 2022.

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Figure 2. Aerial view of Aiktak Island from the west.



Figure 3. Aerial view of Aiktak Island from the east.

## FIGURES AND TABLES



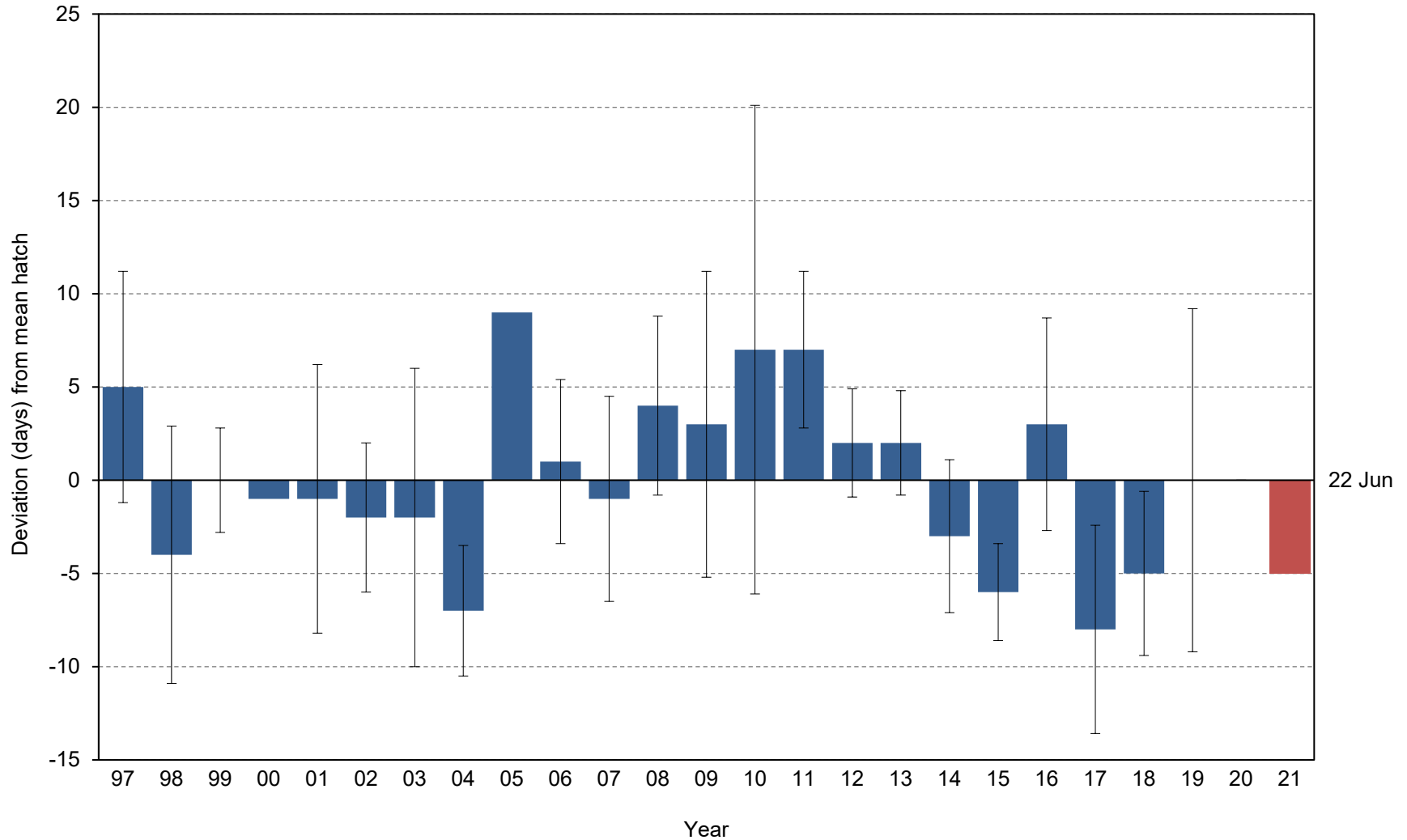


Figure 4. Yearly hatch date deviation (from the 1997-2020 average of 22 June) for black oystercatchers at Aiktak Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date (years without error bars have sample size of one); red highlights the current year. No data were collected in 2020.



Table 1. Breeding chronology of black oystercatchers at Aiktak Island, Alaska. Data represent the date of the first chick hatched in each nest. No data were collected in 2020.

Year	Mean hatch	SD	$n^a$	First hatch	Last hatch
1997	27 Jun	6.2	7	18 Jun	5 Jul
1998	18 Jun	6.9	4	11 Jun	27 Jun
1999	22 Jun	2.8	4	19 Jun	25 Jun
2000	20 Jun	-	1	20 Jun	-
2001	21 Jun	7.2	9	15 Jun	6 Jul
2002	20 Jun	4.0	4	14 Jun	22 Jun
2003	20 Jun	8.0	6	13 Jun	5 Jul
2004	14 Jun	3.5	8	10 Jun	19 Jun
2005	1 Jul	-	1	1 Jul	-
2006	23 Jun	4.4	10	15 Jun	1 Jul
2007	21 Jun	5.5	5	17 Jun	27 Jun
2008	25 Jun	4.8	10	17 Jun	1 Jul
2009	25 Jun	8.2	9	13 Jun	5 Jul
2010	29 Jun	13.1	3	15 Jun	11 Jul
2011	29 Jun	4.2	3	26 Jun	4 Jul
2012	23 Jun	2.9	3	20 Jun	25 Jun
2013	24 Jun	2.8	5	21 Jun	27 Jun
2014	19 Jun	4.1	10	13 Jun	26 Jun
2015	16 Jun	2.6	7	13 Jun	21 Jun
2016	24 Jun	5.7	7	18 Jun	2 Jul
2017	14 Jun	5.6	10	5 Jun	23 Jun
2018	17 Jun	4.4	3	12 Jun	20 Jun
2019	22 Jun	9.2	7	10 Jun	5 Jul
2021	17 Jun	-	1	17 Jun	-

<sup>a</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is  $\leq 5$  days.

Table 2. Frequency distribution of hatch dates for black oystercatchers at Aikta 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  $\leq 5$  days. No data were collected in 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date																							
	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	21
156	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
157	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
158	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
159	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
161	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
162	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
163	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-
164	-	-	-	-	-	-	1	2	-	-	-	-	1	-	-	-	-	1	1	-	-	-	1	-
165	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
166	-	1	-	-	2	-	-	-	-	1	-	-	-	1	-	-	-	1	4	-	-	-	-	-
167	-	-	-	-	1	-	2	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-
168	-	-	-	-	1	-	1	1	-	-	3	-	-	-	-	-	-	-	-	-	2	-	-	1
169	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	1	-	-	-	1	-
170	-	-	1	-	-	-	-	1	-	1	-	-	1	-	-	-	-	1	-	2	-	1	-	-
171	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-
172	1	-	1	1	-	-	-	-	-	-	-	1	-	-	-	1	2	1	1	-	-	-	-	-
173	-	-	-	-	-	3	-	-	-	3	-	1	1	-	-	-	-	-	-	-	-	-	1	-
174	-	-	-	-	1	-	1	-	-	2	-	-	-	-	-	-	-	-	-	2	1	-	-	-
175	-	-	1	-	-	-	-	-	-	1	-	-	1	-	-	-	-	2	-	-	-	-	-	-
176	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-
177	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	2	1	1	-	-	-	-	-	-
178	1	1	-	-	2	-	-	-	-	-	2	1	-	-	-	-	1	-	-	1	-	-	-	-
179	1	-	-	-	-	-	-	-	-	1	-	2	-	-	1	-	-	-	-	-	-	-	1	-
180	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-
182	-	-	-	-	-	-	-	-	1	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-
183	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	-
184	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
185	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
186	1	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	1	-
187	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>n</i>	7	4	4	1	9	4	6	8	1	10	5	10	9	3	3	3	5	10	7	7	10	3	7	1

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

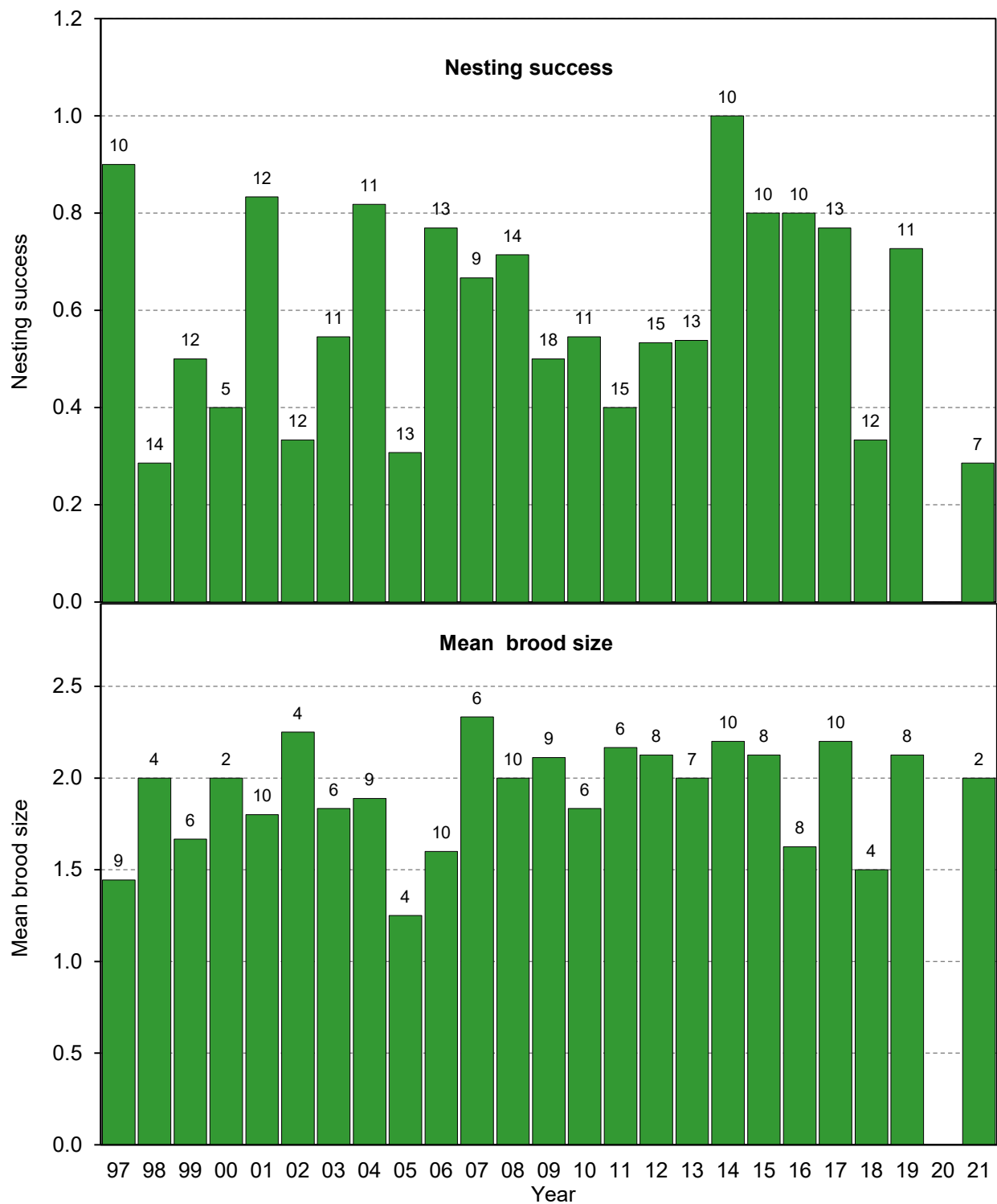


Figure 5. Reproductive performance of black oystercatchers at Aiktak Island, Alaska. Nesting success= $D/B$ ; Mean brood size= $E/D$ ; where  $B$ =nest sites with eggs,  $D$ =nest sites with chicks;  $E$ =total chicks. Numbers above columns indicate sample sizes ( $[B]$  for nesting success,  $[D]$  for brood size). No data were collected in 2020.

Table 3. Reproductive performance of black oystercatchers at Aiktak Island, Alaska. No data were collected in 2020.

Year	Nest sites w/ eggs	Nest sites w/ x eggs:			Total eggs	Nest sites w/ chicks	Total chicks	Nest sites w/ chicks fledged	Total chicks fledged	Mean clutch size	Mean brood size	Nesting success	Hatching success	Chick success	Egg success	Fledging success	Reprod. success
		1	2	3													
	(B)				(C)	(D)	(E)	(F)	(G)	(C/B)	(E/D)	(D/B)	(E/C)	(G/E)	(G/C)	(F/D)	(F/B)
1997	10	0	7	3	23	9	13	-	-	2.3	1.4	0.90	0.57	-	-	-	-
1998	14	4	2	8	32	4	8	-	-	2.3	2.0	0.29	0.25	-	-	-	-
1999	12	0	5	7	31	6	10	-	-	2.6	1.7	0.50	0.32	-	-	-	-
2000	5	1	1	3	12	2	4	-	-	2.4	2.0	0.40	0.33	-	-	-	-
2001	12	2	5	5	27	10	18	-	-	2.3	1.8	0.83	0.67	-	-	-	-
2002	12	1	2	9	32	4	9	-	-	2.7	2.3	0.33	0.28	-	-	-	-
2003	11	1	4	6	27	6	11	-	-	2.5	1.8	0.55	0.41	-	-	-	-
2004	11	1	2	8	29	9	17	-	-	2.6	1.9	0.82	0.59	-	-	-	-
2005 <sup>a</sup>	13	2	7	4	28	4	5	-	-	2.2	1.3	0.31	0.18	-	-	-	-
2006	13	0	6	7	33	10	16	-	-	2.5	1.6	0.77	0.48	-	-	-	-
2007	9	0	4	5	23	6	14	-	-	2.6	2.3	0.67	0.61	-	-	-	-
2008	14	1	5	8	35	10	20	-	-	2.5	2.0	0.71	0.57	-	-	-	-
2009	18	3	8	7	40	9	19	-	-	2.2	2.1	0.50	0.48	-	-	-	-
2010	11	1	8	2	23	6	11	-	-	2.1	1.8	0.55	0.48	-	-	-	-
2011	15	1	6	8	37	6	13	-	-	2.5	2.2	0.40	0.35	-	-	-	-
2012	15	1	8	6	35	8	17	-	-	2.3	2.1	0.53	0.48	-	-	-	-
2013	13	0	5	8	34	7	14	-	-	2.6	2.0	0.54	0.38	-	-	-	-
2014	10	1	3	6	25	10	22	-	-	2.5	2.2	1.00	0.88	-	-	-	-
2015	10	1	2	7	26	8	17	6	9	2.6	2.1	0.80	0.65	0.53	0.35	0.75	0.60
2016	10	1	6	3	22	8	13	2	3	2.2	1.6	0.80	0.59	0.23	0.14	0.25	0.20
2017	13	0	3	10	36	10	22	6	9	2.8	2.2	0.77	0.61	0.41	0.25	0.60	0.46
2018	12	0	4	8	32	4	6	2	2	2.7	1.5	0.33	0.19	0.33	0.06	0.50	0.17
2019	11	0	7	4	26	8	17	4	5	2.4	2.1	0.73	0.65	0.29	0.19	0.50	0.36
2021	7	1	5	1	14	2	4	2	4	2.0	2.0	0.29	0.29	1.00	0.29	1.00	0.29

<sup>a</sup>In 2005, an early-season storm on 27 May pushed kelp over many nests, causing a large number of pairs to relay.

Table 4. Standard deviation in reproductive performance parameters of black oystercatchers at Aiktak Island, Alaska. No data were collected in 2020.

Year	Nest sites w/ eggs	Sampling design <sup>a</sup>	Mean clutch size	Mean brood size	Nesting success	Hatching success	Chick success	Egg success	Fledging success	Reprod. success
1997	10	Simple random	xx <sup>b</sup>	xx	0.09	0.10	-	-	-	-
1998	14	Simple random	xx	xx	0.12	0.08	-	-	-	-
1999	12	Simple random	xx	xx	0.14	0.08	-	-	-	-
2000	5	Simple random	xx	xx	0.22	0.14	-	-	-	-
2001	12	Simple random	xx	xx	0.11	0.09	-	-	-	-
2002	12	Simple random	xx	xx	0.14	0.08	-	-	-	-
2003	11	Simple random	xx	xx	0.15	0.09	-	-	-	-
2004	11	Simple random	xx	xx	0.12	0.09	-	-	-	-
2005	13	Simple random	xx	xx	0.13	0.07	-	-	-	-
2006	13	Simple random	xx	xx	0.12	0.09	-	-	-	-
2007	9	Simple random	xx	xx	0.16	0.10	-	-	-	-
2008	14	Simple random	xx	xx	0.12	0.08	-	-	-	-
2009	18	Simple random	xx	xx	0.12	0.08	-	-	-	-
2010	11	Simple random	xx	xx	0.15	0.10	-	-	-	-
2011	15	Simple random	xx	xx	0.13	0.08	-	-	-	-
2012	15	Simple random	xx	xx	0.13	0.08	-	-	-	-
2013	13	Simple random	xx	xx	0.14	0.08	-	-	-	-
2014	10	Simple random	xx	xx	0.00	0.06	-	-	-	-
2015	10	Simple random	xx	xx	0.13	0.09	0.12	0.09	0.15	0.15
2016	10	Simple random	xx	xx	0.13	0.10	0.12	0.07	0.15	0.13
2017	13	Simple random	xx	xx	0.12	0.08	0.10	0.07	0.15	0.14
2018	12	Simple random	xx	xx	0.14	0.07	0.19	0.04	0.25	0.11
2019	11	Simple random	xx	xx	0.13	0.09	0.11	0.08	0.18	0.14
2021	7	Simple random	xx	xx	0.17	0.12	0.00	0.12	0.00	0.17

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

<sup>b</sup>xx indicates data potentially exist but have not yet been summarized.

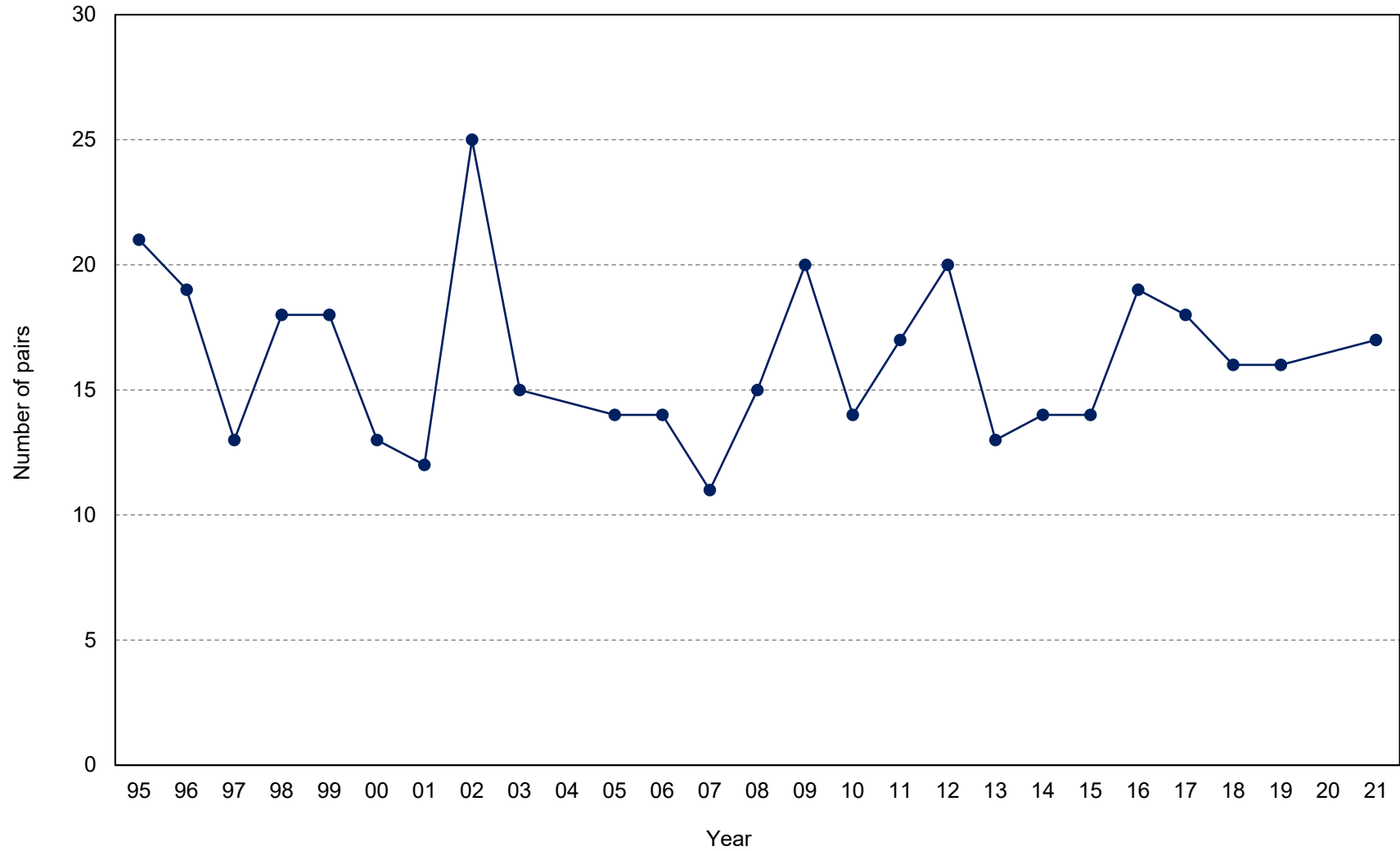


Figure 6. Numbers of black oystercatcher breeding pairs at Aiktak Island, Alaska. Values are based on the total number of nests, territories, and/or breeding pairs counted on the island throughout the year. No data were collected in 2020.

Table 5. Numbers of black oystercatchers breeding at Aiktak Island, Alaska. Values are based on the total number of nests, territories, and/or breeding pairs counted on the island throughout the year; numbers of breeding birds are estimated by doubling territory numbers. Data do not include flocks of migratory birds passing through the area in the fall. No data were collected in 2020.

Year	No. nests/ territories	Estimated no. breeding birds
1995	21	42
1996	19	38
1997	13	26
1998	18	36
1999	18	36
2000	13	26
2001	12	24
2002	25	50
2003	15	30
2004 <sup>a</sup>	≥10	≥20
2005	14	28
2006	14	28
2007	11	22
2008	15	30
2009	20	40
2010	14	28
2011	17	34
2012	20	40
2013	13	26
2014	14	28
2015	14	28
2016	19	38
2017	18	36
2018	16	32
2019	16	32
2021	17	34

<sup>a</sup>No data on the total number or distribution of breeding pairs were recorded for 2004; numbers represents minimum number of breeding pairs and birds from those nests monitored for productivity.

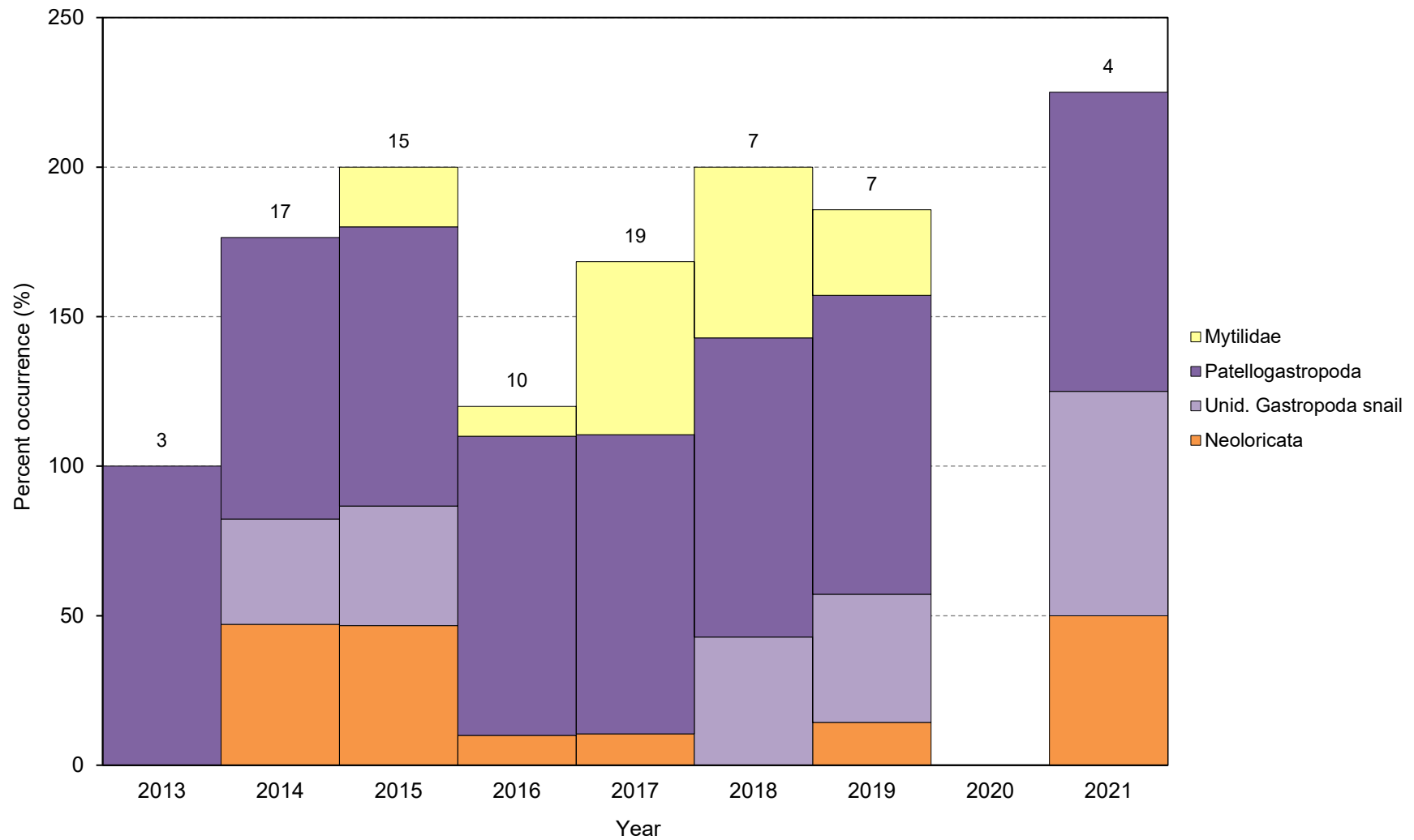


Figure 7. Frequency of occurrence of major prey items in diets of black oystercatcher chicks at Aiktak Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of prey piles collected at nests at the colony. Numbers above columns indicate sample sizes. No diet samples were collected before 2013 or in 2020.



Table 6. Frequency of occurrence of major prey items in diets of black oystercatcher chicks at Aiktak 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 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 prey piles collected at nests at the colony. No diet samples were collected before 2013 or in 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	3	17	15	10	19	7	7	4
<b>Invertebrates</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Bivalvia</b>	-	<b>5.9</b>	<b>20.0</b>	<b>10.0</b>	<b>57.9</b>	<b>57.1</b>	<b>28.6</b>	-
<b>Mytilidae</b>	-	-	<b>20.0</b>	<b>10.0</b>	<b>57.9</b>	<b>57.1</b>	<b>28.6</b>	-
Unid. Mytilidae	-	-	20.0	10.0	57.9	57.1	28.6	-
Other Bivalvia	-	5.9	-	-	-	-	-	-
<b>Gastropoda</b>	<b>100.0</b>	<b>94.1</b>	<b>93.3</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Patellogastropoda	100.0	94.1	93.3	100.0	100.0	100.0	100.0	100.0
Unid. Gastropoda snail	-	35.3	40.0	-	-	42.9	42.9	75.0
Other Gastropoda	-	-	-	-	15.8	-	-	-
<b>Polyplacophora</b>	-	<b>47.1</b>	<b>46.7</b>	<b>10.0</b>	<b>10.5</b>	-	<b>14.3</b>	<b>50.0</b>
Neoloricata	-	47.1	46.7	10.0	10.5	-	14.3	50.0
Other Invertebrates	-	5.9	-	10.0	-	-	-	-

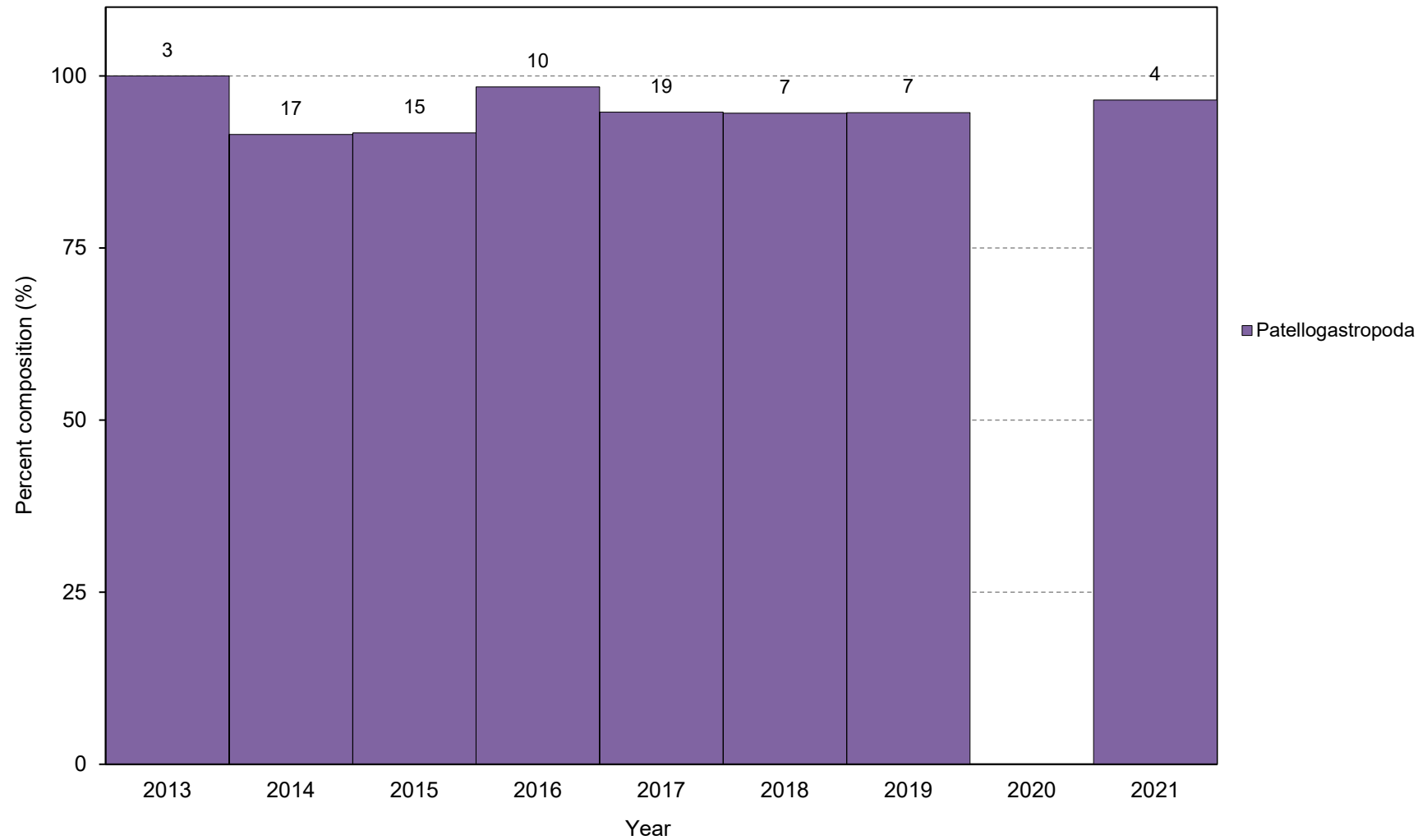


Figure 8. Percent composition of major prey items in diets of black oystercatcher chicks at Aiktak Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of prey piles collected at nests at the colony. Numbers above columns indicate sample sizes. No diet samples were collected before 2013 or in 2020.

Table 7. Percent composition of major prey items in diets of black oystercatcher chicks at Aiktak 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 prey piles collected at nests at the colony. No diet samples were collected before 2013 or in 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	3	17	15	10	19	7	7	4
No. individuals	10	658	1186	499	687	774	655	486
<b>Invertebrates</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Gastropoda</b>	<b>100.0</b>	<b>95.0</b>	<b>97.7</b>	<b>98.4</b>	<b>94.8</b>	<b>95.1</b>	<b>98.8</b>	<b>99.2</b>
Patellogastropoda	100.0	91.5	91.7	98.4	94.8	94.6	94.7	96.5
Other Gastropoda	-	3.5	6.0	-	0.4	0.5	4.1	2.7
Other Invertebrates	-	5.0	2.3	1.6	5.2	4.9	1.2	0.8

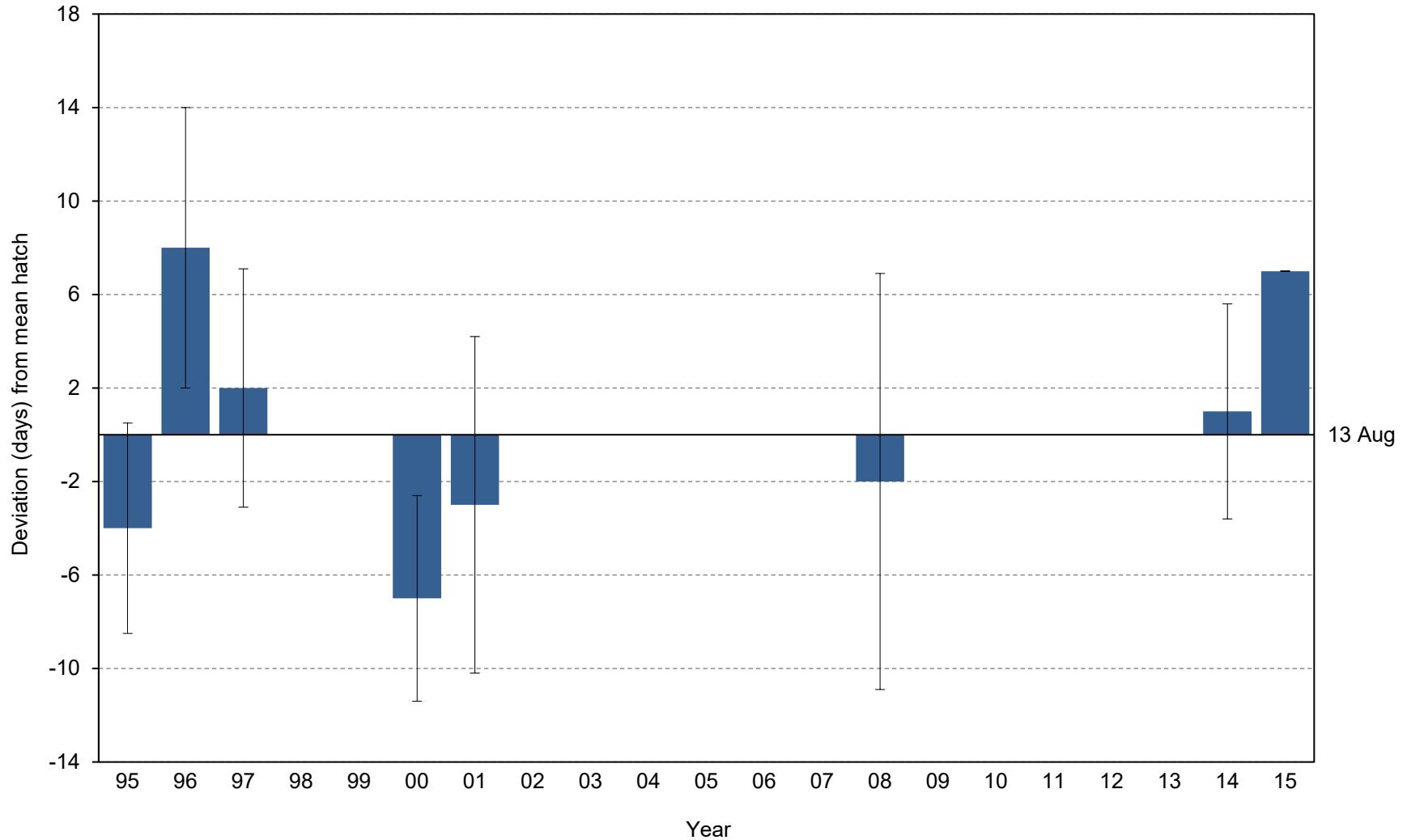


Figure 9. Yearly hatch date deviation (from the 1995-2015 average of 13 August) for common murrelets at Aikta Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date. No data were collected in 2003 or 2020; no hatch dates were recorded with the appropriate egg to chick interval ( $\leq 7$  days) in 2006, 2016, 2019, or 2021 and no eggs hatched in plots in 1998-1999, 2002, 2004-2005, 2007, 2009-2013, or 2017-2018.

Table 8. Breeding chronology of common murres at Aikta Island, Alaska. No data were collected in 2003 or 2020; no hatch dates were recorded with the appropriate egg to chick interval ( $\leq 7$  days) in 2006, 2016, 2019, or 2021 and no eggs hatched in plots in 1998-1999, 2002, 2004-2005, 2007, 2009-2013, or 2017-2018.

Year	Mean hatch	SD	$n^a$	First hatch	Last hatch	First "jump" <sup>b</sup>
1995	9 Aug	4.5	13	31 Jul	14 Aug	22 Aug
1996	20 Aug	6.0	45	5 Aug	8 Sep	25 Aug
1997	15 Aug	5.1	39	4 Aug	26 Aug	22 Aug
2000	7 Aug	4.4	10	2 Aug	15 Aug	17 Aug
2001	10 Aug	7.2	13	2 Aug	23 Aug	11 Aug
2008	10 Aug	8.9	4	30 Jul	24 Aug	>26 Aug
2014	14 Aug	4.6	8	8 Aug	24 Aug	>28 Aug
2015	20 Aug	0.0	2	20 Aug	20 Aug	24 Aug
2019	-	-	-	-	-	25 Aug
2021	-	-	-	-	-	21 Aug

<sup>a</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is  $\leq 7$  days.

<sup>b</sup>In 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 9. Frequency distribution of hatch dates for common murrelets at Aikta Island, Alaska. Data include only nests in which observations of egg to chick  $\leq 7$  days. No data were collected in 2003 or 2020; no hatch dates were recorded with the appropriate egg to chick interval in 2006, 2016, 2019, or 2021 and no eggs hatched in plots in 1998-1999, 2002, 2004-2005, 2007, 2009-2013, 2017-2018.

Julian date <sup>a</sup>	No. nests hatching on Julian date							
	95	96	97	00	01	08	14	15
212	1	-	-	-	-	1	-	-
213	-	-	-	-	-	-	-	-
214	-	-	-	-	3	-	-	-
215	-	-	-	4	-	-	-	-
216	-	-	3	-	2	-	-	-
217	-	-	-	-	-	-	-	-
218	6	2	-	-	-	-	-	-
219	-	-	2	-	-	-	-	-
220	-	-	-	-	3	-	1	-
221	-	-	1	-	-	-	-	-
222	1	-	2	4	-	2	2	-
223	-	-	-	-	-	-	-	-
224	-	-	1	1	-	-	-	-
225	-	1	-	-	-	-	-	-
226	5	2	8	-	1	-	4	-
227	-	-	2	-	1	-	-	-
228	-	6	2	1	-	-	-	-
229	-	-	-	-	-	-	-	-
230	-	1	9	-	-	-	-	-
231	-	1	2	-	1	-	-	-
232	-	3	5	-	1	-	-	2
233	-	-	-	-	-	-	-	-
234	-	18	1	-	-	-	-	-
235	-	-	-	-	1	-	-	-
236	-	1	-	-	-	-	1	-
237	-	-	-	-	-	1	-	-
238	-	4	1	-	-	-	-	-
239	-	-	-	-	-	-	-	-
240	-	2	-	-	-	-	-	-
241	-	2	-	-	-	-	-	-
242	-	-	-	-	-	-	-	-
243	-	-	-	-	-	-	-	-
244	-	1	-	-	-	-	-	-
245	-	-	-	-	-	-	-	-
246	-	-	-	-	-	-	-	-
247	-	-	-	-	-	-	-	-
248	-	-	-	-	-	-	-	-
249	-	-	-	-	-	-	-	-
250	-	-	-	-	-	-	-	-
251	-	-	-	-	-	-	-	-
252	-	1	-	-	-	-	-	-
<i>n</i>	13	45	39	10	13	4	8	2

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

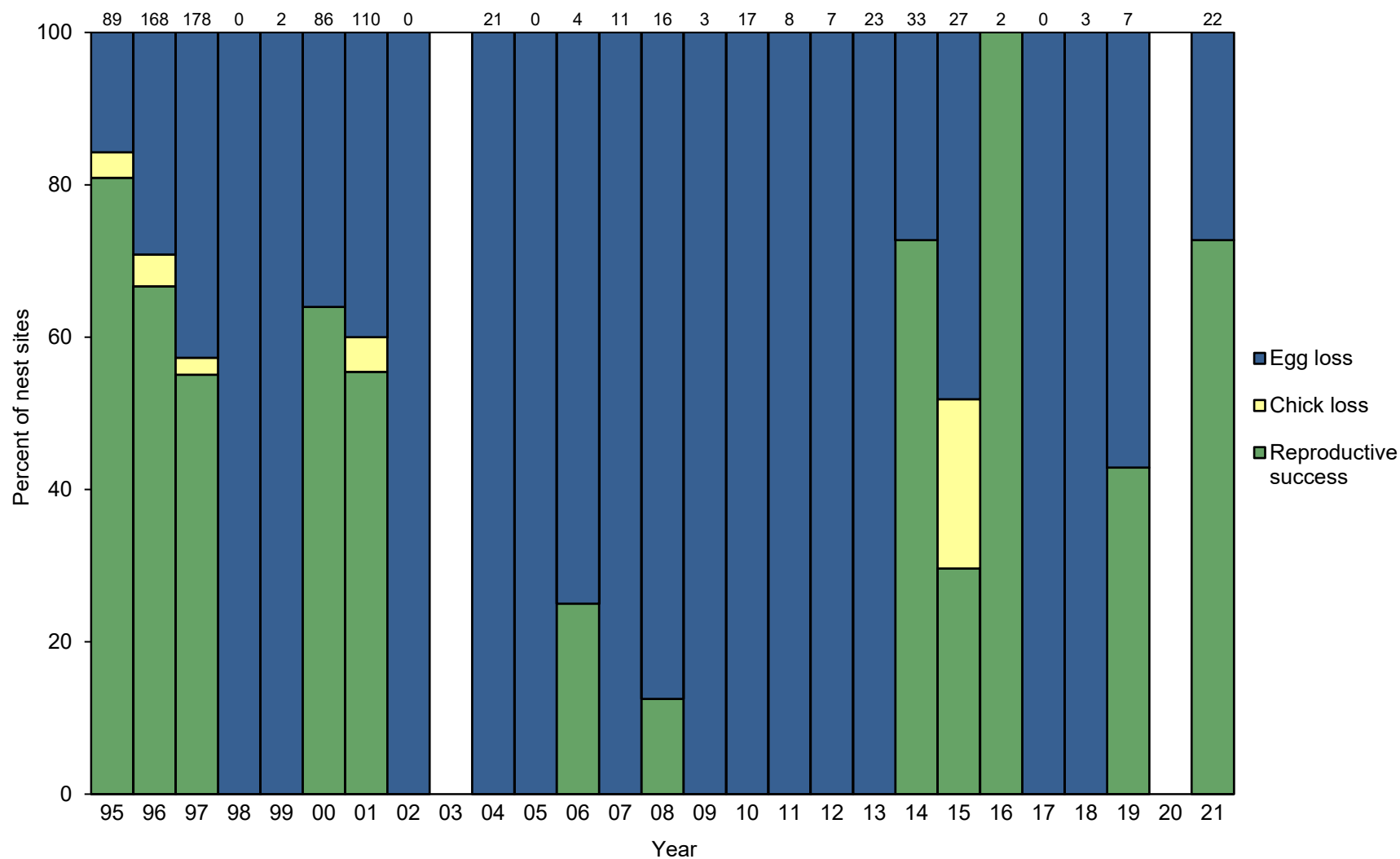


Figure 10. Reproductive performance of common murrelets at Aiktak Island, Alaska.  $\text{Egg loss} = (B - D) / B$ ;  $\text{Chick loss} = (D - F) / B$ ;  $\text{Reproductive success} = F / B$ , where  $B$  = nest sites with eggs;  $D$  = nest sites with chicks;  $F$  = nest sites with chicks fledged. Failure in years when no eggs were laid is considered 100% egg loss. Numbers above columns indicate sample sizes ( $B$ ). No data were collected in 2003 or 2020.

Table 10. Reproductive performance of common murrelets at Aikta Island, Alaska. No data were collected in 2003 or 2020.

Year	Nest sites w/ eggs	Nest sites w/ chicks	Nest sites w/ chicks fledged	Nest sites w/ young chicks still present <sup>a</sup>	Nesting success (D/B) <sup>b</sup>		Fledging success (F/D) <sup>c</sup>		Reproductive success (F/B)		Max. potential reproductive success <sup>d</sup> [(F+H)/(B+H)]		No. plots <sup>e</sup>	Sampling design <sup>f</sup>
	(B)	(D)	(F)	(H)	Total	SD	Total	SD	Total	SD	Total	SD		
1995	89	75	72	10	0.84	0.02	0.96	0.02	0.81	0.03	0.83	0.03	5	Cluster by plot
1996	168	119	112	4	0.71	0.10	0.94	0.04	0.67	0.08	0.67	0.08	7	Cluster by plot
1997	178	102	98	25	0.57	0.12	0.96	0.02	0.55	0.11	0.61	0.11	9	Cluster by plot
1998	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
1999	2	0	0	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	2	Simple random
2000	86	55	55	2	0.64	0.14	1.00	0.00	0.64	0.14	0.65	0.13	6	Cluster by plot
2001	110	66	61	8	0.60	0.12	0.92	0.04	0.55	0.12	0.58	0.11	7	Cluster by plot
2002	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
2004	21	0	0	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	1	Simple random
2005	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
2006	4	1	1	1	0.25	0.22	1.00	0.00	0.25	0.22	0.40	0.22	1	Simple random
2007	11	0	0	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	4	Simple random
2008	16	2	2	3	0.13	0.08	1.00	0.00	0.13	0.08	0.26	0.10	5	Simple random
2009	3	0	0	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	1	Simple random
2010	17	0	0	2	0.00	0.00	-	-	0.00	0.00	0.11	0.07	4	Simple random
2011	8	0	0	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	3	Simple random
2012	7	0	0	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	3	Simple random
2013	23	0	0	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	1	Simple random
2014	33	24	24	7	0.73	0.08	1.00	0.00	0.73	0.08	0.78	0.07	6	Simple random
2015	27	14	8	0	0.52	0.10	0.57	0.13	0.30	0.09	0.30	0.09	2	Simple random
2016	2	2	2	0	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1	Simple random
2017	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
2018	3	0	0	0	0.00	0.00	-	-	0.00	0.00	0.00	0.00	1	Simple random
2019	7	3	3	6	0.43	0.19	1.00	0.00	0.43	0.19	0.69	0.13	1	Simple random
2021	22	16	16	6	0.73	0.09	1.00	0.00	0.73	0.09	0.79	0.08	1	Simple random

<sup>a</sup>Chicks still present at last check but too young to consider successfully fledged by fledging age conventions (still present  $\geq 13$  d for murrelets). 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.

<sup>b</sup>For 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).

<sup>c</sup>For 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).

<sup>d</sup>Values 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.

<sup>e</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>f</sup>Sampling for murrelets 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  $\sqrt{p * (1 - p) / n}$ , where  $p$  is the success rate and  $n$  is the sample size of individual nests.



Table 11. Reproductive performance of common murrelets at Aikta Island, Alaska in 2021.

Parameter	Plot	Total	SD <sup>a</sup>
	5		
Nests w/ eggs (B)	22	22	-
Nests w/ chicks (D)	16	16	-
Nests w/ chicks fledged (F)	16	16	-
Nest sites w/ young chicks still present (H) <sup>b</sup>	6	6	-
Nesting success (D/B) <sup>c</sup>	0.73	0.73	0.09
Fledging success (F/D) <sup>d</sup>	1.00	1.00	0.00
Reproductive success (F/B)	0.73	0.73	0.09
Max. potential reproductive success [(F+H)/(B+H)]	0.79	0.79	0.08

<sup>a</sup>Due to small sample sizes per plot, standard deviations are calculated based on simple random sampling rather than cluster sampling. For simple random sampling, values are calculated using  $\sqrt{\rho * (1 - \rho) / n}$ , where  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

<sup>b</sup>Chicks still present at last check but too young to consider successfully fledged by fledging age conventions (still present  $\geq 13$  d for common murrelets). 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.

<sup>c</sup>For 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).

<sup>d</sup>For 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).

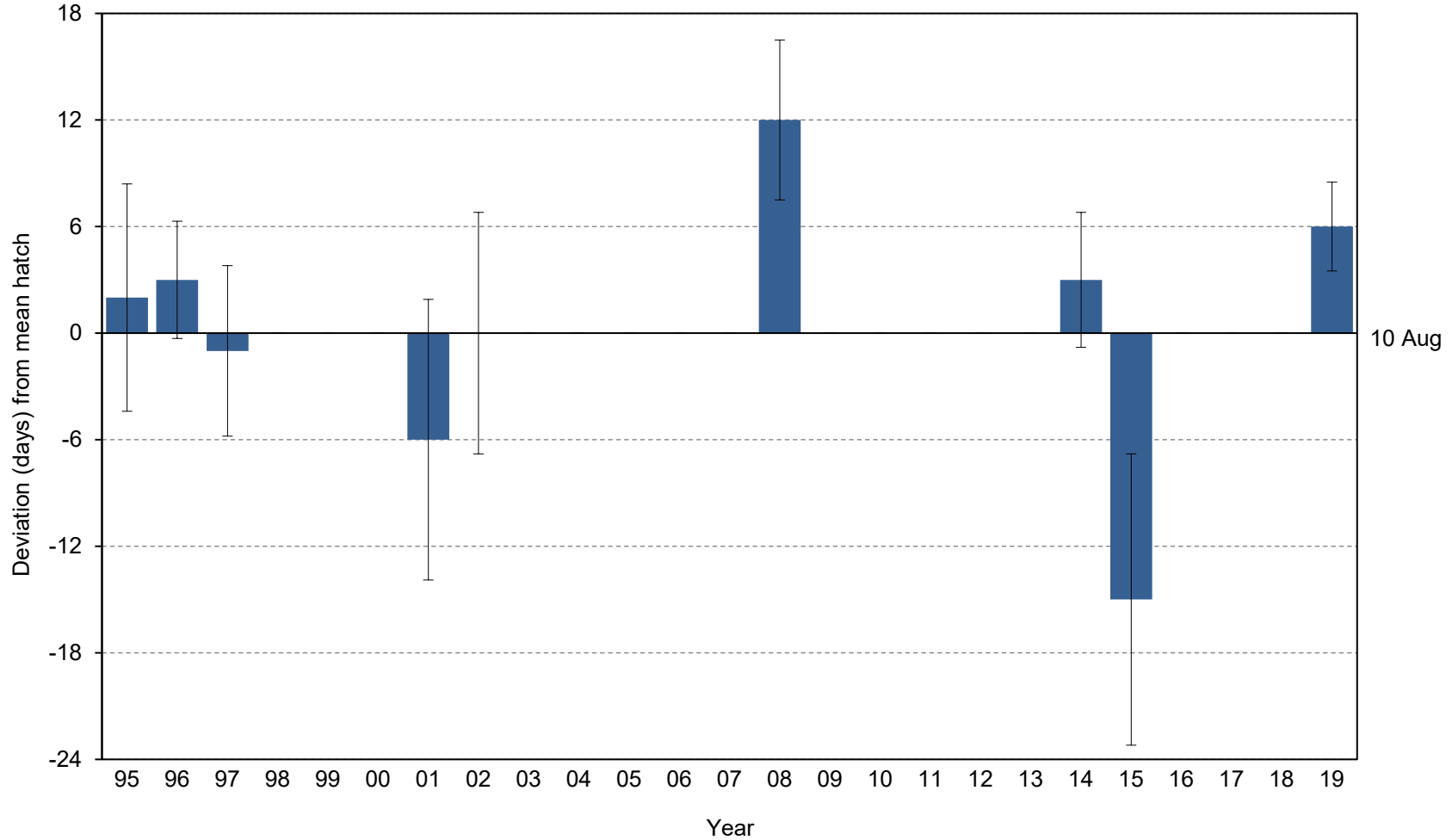


Figure 11. Yearly hatch date deviation (from the 1995-2015 average of 10 August) for thick-billed murres at Aiktak Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date. No data were collected in 2003 or 2020; no hatch dates were recorded with the appropriate egg to chick interval ( $\leq 7$  days) in 2006-2007, 2016, or 2021 and no eggs hatched in plots in 1998-1999, 2002, 2004-2005, 2009-2013, or 2017-2018.

Table 12. Breeding chronology of thick-billed murres at Aiktak Island, Alaska. No data were collected in 2003 or 2020; no hatch dates were recorded with the appropriate egg to chick interval ( $\leq 7$  days) in 2006-2007, 2016, or 2021 and no eggs hatched in plots in 1998-1999, 2002, 2004-2005, 2009-2013, or 2017-2018.

Year	Mean hatch	SD	$n^a$	First hatch	Last hatch	First "jump" <sup>b</sup>
1995	12 Aug	6.4	8	6 Aug	27 Aug	26 Aug
1996	12 Aug	3.3	9	5 Aug	17 Aug	25 Aug
1997	9 Aug	4.8	15	4 Aug	22 Aug	22 Aug
2000	3 Aug	7.9	9	23 Jul	11 Aug	11 Aug
2001	10 Aug	6.8	6	2 Aug	23 Aug	11 Aug
2008	21 Aug	4.5	2	16 Aug	25 Aug	-
2014	13 Aug	3.8	4	8 Aug	18 Aug	>28 Aug
2015	26 Jul	8.2	4	19 Jul	8 Aug	24 Aug
2019	16 Aug	2.5	2	13 Aug	18 Aug	25 Aug
2021	-	-	-	-	-	21 Aug

<sup>a</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is  $\leq 7$  days.

<sup>b</sup>In 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 13. Frequency distribution of hatch dates for thick-billed murres at Aiktak Island, Alaska. Data include only nests in which observations of egg to chick  $\leq 7$  days. No data were collected in 2003 or 2020; no hatch dates were recorded with the appropriate egg to chick interval in 2006-2007, 2016, or 2021 and no eggs hatched in plots in 1998-1999, 2002, 2004-2005, 2009-2013, or 2017-2018.

Julian date <sup>a</sup>	No. nests hatching on Julian date								
	95	96	97	00	01	08	14	15	19
200	-	-	-	-	-	-	-	2	-
201	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	-
205	-	-	-	3	-	-	-	-	-
206	-	-	-	-	-	-	-	1	-
207	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	-
211	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	-	-	-
213	-	-	-	-	-	-	-	-	-
214	-	-	-	-	1	-	-	-	-
215	-	-	-	-	-	-	-	-	-
216	-	-	4	-	1	-	-	-	-
217	-	-	-	-	-	-	-	-	-
218	2	1	1	-	-	-	-	-	-
219	-	-	3	1	-	-	-	-	-
220	-	-	-	1	2	-	1	1	-
221	-	-	3	-	-	-	-	-	-
222	3	2	-	3	-	-	1	-	-
223	-	-	-	-	-	-	-	-	-
224	-	-	1	1	1	-	-	-	-
225	-	-	-	-	-	-	-	-	1
226	1	5	2	-	-	-	1	-	-
227	-	-	-	-	-	-	-	-	-
228	1	-	-	-	-	1	-	-	-
229	-	-	-	-	-	-	-	-	-
230	-	1	-	-	-	-	1	-	1
231	-	-	-	-	-	-	-	-	-
232	-	-	-	-	-	-	-	-	-
233	-	-	-	-	-	-	-	-	-
234	-	-	1	-	-	-	-	-	-
235	-	-	-	-	1	-	-	-	-
236	-	-	-	-	-	-	-	-	-
237	-	-	-	-	-	1	-	-	-
238	-	-	-	-	-	-	-	-	-
239	1	-	-	-	-	-	-	-	-
<i>n</i>	8	9	15	9	6	2	4	4	2

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

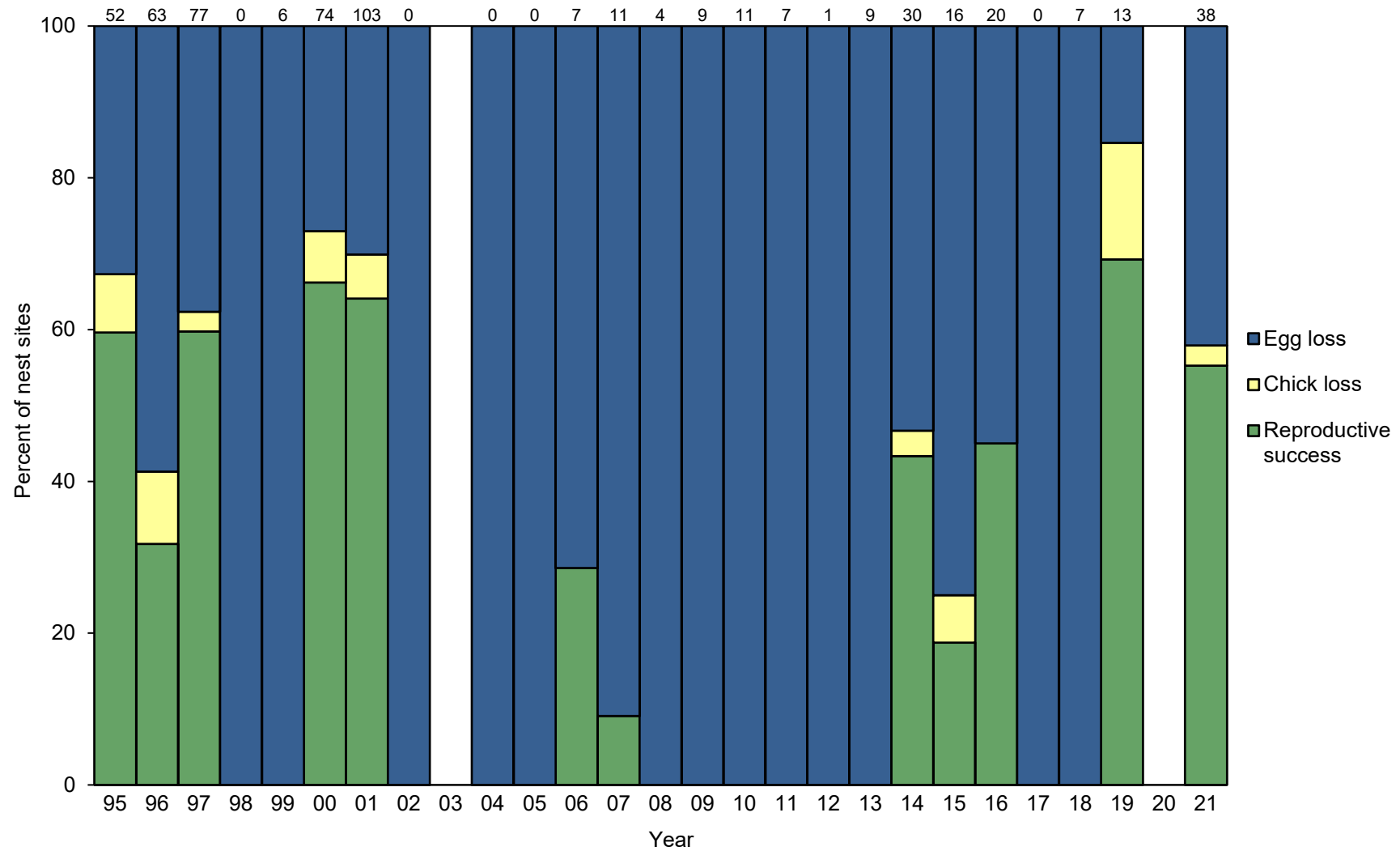


Figure 12. Reproductive performance of thick-billed murres at Aiktak Island, Alaska. Egg loss= $(B-D)/B$ ; Chick loss= $(D-F)/B$ ; Reproductive success= $F/B$ , where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Failure in years when no eggs were laid is considered 100% egg loss. Numbers above columns indicate sample sizes (B). No data were collected in 2003 or 2020.

Table 14. Reproductive performance of thick-billed murres at Aikta Island, Alaska. No data were collected in 2003 or 2020.

Year	Nest sites w/ eggs	Nest sites w/ chicks	Nest sites w/ chicks fledged	Nest sites w/ young chicks still present <sup>a</sup>	Nesting success (D/B) <sup>b</sup>		Fledging success (F/D) <sup>c</sup>		Reproductive success (F/B)		Max. potential reproductive success <sup>d</sup> [(F+H)/(B+H)]		No. plots <sup>e</sup>	Sampling design <sup>f</sup>
	(B)	(D)	(F)	(H)	Total	SD	Total	SD	Total	SD	Total	SD		
1995	52	35	31	5	0.67	0.06	0.89	0.04	0.60	0.04	0.63	0.02	6	Cluster by plot
1996	63	26	20	0	0.41	0.11	0.77	0.03	0.32	0.09	0.32	0.09	5	Cluster by plot
1997	77	48	46	7	0.62	0.06	0.96	0.02	0.60	0.06	0.63	0.06	5	Cluster by plot
1998	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
1999	6	0	0	0	0.00	0.00	-	-	0.00	-	0.00	0.00	3	Simple random
2000	74	54	49	0	0.73	0.06	0.91	0.03	0.66	0.06	0.66	0.06	3	Cluster by plot
2001	103	72	66	0	0.70	0.11	0.92	0.05	0.64	0.13	0.64	0.13	6	Cluster by plot
2002	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
2004	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
2005	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
2006	7	2	2	1	0.29	0.17	1.00	0.00	0.29	0.17	0.38	0.17	1	Simple random
2007	11	1	1	0	0.09	0.09	1.00	0.00	0.09	0.09	0.09	0.09	2	Simple random
2008	4	0	0	2	0.00	0.00	-	-	0.00	-	0.33	0.19	3	Simple random
2009	9	0	0	0	0.00	0.00	-	-	0.00	-	0.00	0.00	1	Simple random
2010	11	0	0	1	0.00	0.00	-	-	0.00	-	0.08	0.08	3	Simple random
2011	7	0	0	0	0.00	0.00	-	-	0.00	-	0.00	0.00	3	Simple random
2012	1	0	0	0	0.00	0.00	-	-	0.00	-	0.00	0.00	1	Simple random
2013	9	0	0	0	0.00	0.00	-	-	0.00	-	0.00	0.00	4	Simple random
2014	30	14	13	5	0.47	0.09	0.93	0.07	0.43	0.09	0.51	0.08	3	Simple random
2015	16	4	3	0	0.25	0.11	0.75	0.22	0.19	0.10	0.19	0.10	2	Simple random
2016	20	9	9	2	0.45	0.11	1.00	0.00	0.45	0.11	0.50	0.11	2	Simple random
2017	0	0	0	0	0.00	-	-	-	0.00	-	0.00	-	-	-
2018	7	0	0	0	0.00	0.00	-	-	0.00	-	0.00	0.00	1	Simple random
2019	13	11	9	13	0.85	0.10	0.82	0.12	0.69	0.15	0.85	0.07	2	Simple random
2021	38	22	21	6	0.58	0.08	0.95	0.05	0.55	0.11	0.61	0.07	2	Simple random

<sup>a</sup>Chicks still present at last check but too young to consider successfully fledged by fledging age conventions (still present  $\geq 13$  d for murres). 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.

<sup>b</sup>For 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).

<sup>c</sup>For 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).

<sup>d</sup>Values 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.

<sup>e</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>f</sup>Sampling 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  $\sqrt{p * (1 - p) / n}$ , where  $p$  is the success rate and  $n$  is the sample size of individual nests.

Table 15. Reproductive performance of thick-billed murres at Aikta Island, Alaska in 2021.

Parameter	Plot		Total	SD <sup>a</sup>
	3	5		
Nests w/ eggs (B)	7	31	38	-
Nests w/ chicks (D)	3	19	22	-
Nests w/ chicks fledged (F)	3	18	21	-
Nest sites w/ young chicks still present (H) <sup>b</sup>	0	6	6	-
Nesting success (D/B) <sup>c</sup>	0.43	0.61	0.58	0.08
Fledging success (F/D) <sup>d</sup>	1.00	0.95	0.95	0.05
Reproductive success (F/B)	0.43	0.58	0.55	0.11
Max. potential reproductive success [(F+H)/(B+H)]	0.43	0.65	0.61	0.07

<sup>a</sup>Due to small sample sizes per plot, standard deviations are calculated based on simple random sampling rather than cluster sampling. For simple random sampling, values are calculated using  $\sqrt{\rho * (1 - \rho) / n}$ , where  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

<sup>b</sup>Chicks still present at last check but too young to consider successfully fledged by fledging age conventions (still present  $\geq 13$  d for thick-billed murres). 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.

<sup>c</sup>For 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).

<sup>d</sup>For 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).

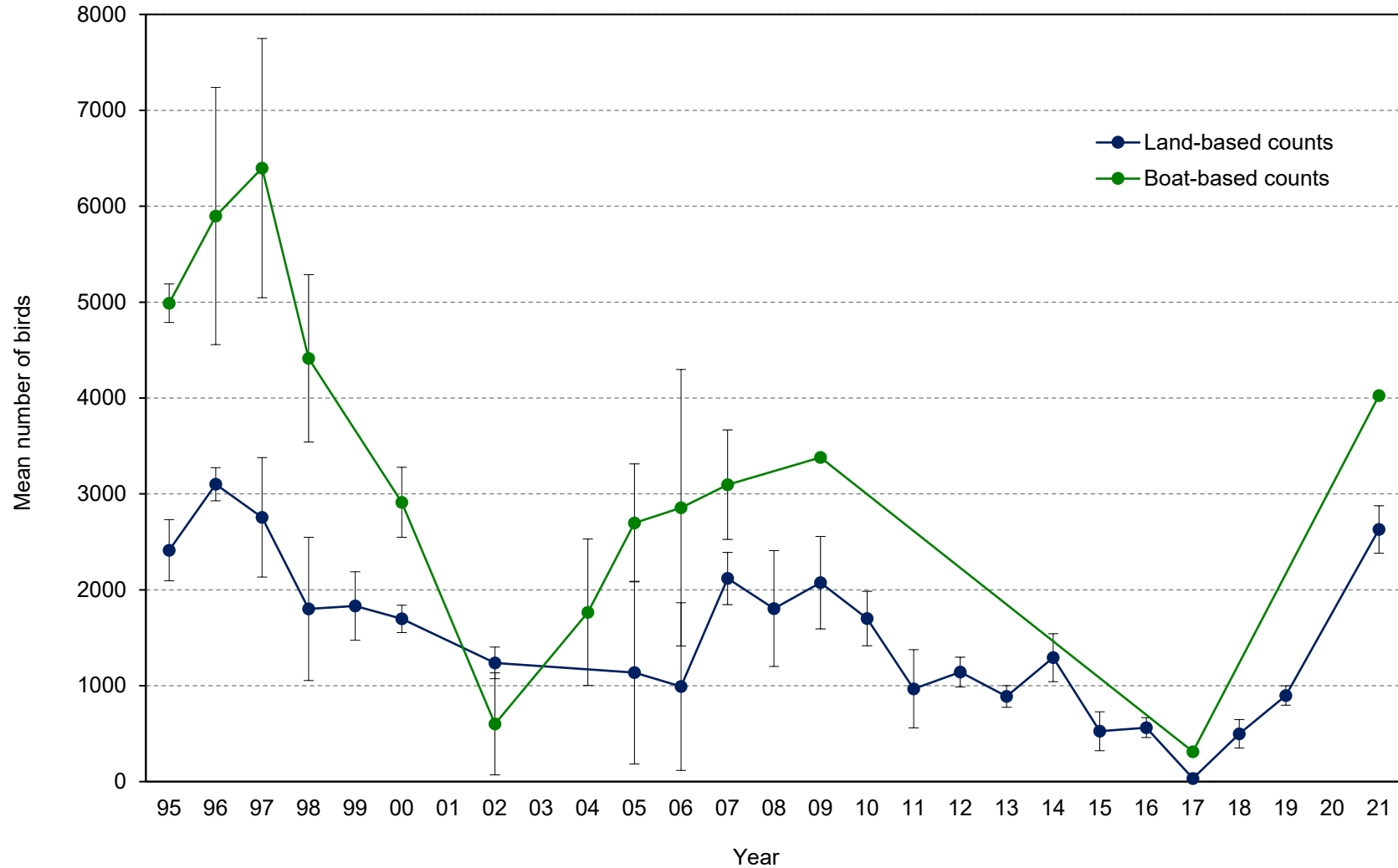


Figure 13. Mean numbers of murre (includes common, thick-billed, and unknown murre) counted on land-based index plots and during boat-based circumnavigations at Aiktak Island, Alaska. Land-based counts represent the number of murre attending cliffs and do not include rafting birds; boat based-counts include all murre attending cliffs and rafting on the water. Error bars represent standard deviation. No land-based counts were conducted in 2001, 2003-2004, or 2020; no boat-based counts were conducted in 1999, 2001, 2003, 2008, 2010-2016, or 2018-2020.



Table 16. Numbers of murres (includes common, thick-billed, and unknown murres) counted on land-based index plots at Aikta Island, Alaska. No counts were conducted in 2001, 2003-2004, or 2020.

Replicate	1995	1996	1997	1998	1999	2000	2002	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
1	2597	2873	2553	1840	1566	1761	1240	370	511	1775	1117	2498	1283	1031	959	881	913	324	585	15	591	975	2347
2	2591	2897	1836	581	1518	1726	1471	276	837	1944	1215	1441	1899	763	1243	701	1166	398	666	0	238	761	2798
3	1937	3190	2310	894	2272	1601	1115	2147	1966	2222	2293	2396	1767	1351	1296	1000	1445	431	587	115	521	890	2423
4	2528	3168	3148	1335	1969	1819	1127	1749	268	2403	2419	1965	1854	236	1071	927	1422	491	588	0	561	848	2935
5	-	3193	3414	1617	-	1841	-	-	178	2454	1975	-	-	1423	-	929	1516	889	388	-	581	1015	2644
6	-	3286	3273	2581	-	1426	-	-	2186	2332	-	-	-	1163	-	-	-	614	-	-	-	-	-
7	-	-	-	2554	-	1702	-	-	-	-	-	-	-	812	-	-	-	-	-	-	-	-	-
8	-	-	-	2350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	2455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	2413	3101	2756	1801	1831	1697	1238	1136	991	2118	1805	2075	1701	968	1142	888	1292	525	563	33	498	898	2629
n	4	6	6	9	4	7	4	4	6	6	5	4	4	7	4	5	5	6	5	4	5	5	5
SD	319	173	623	747	357	143	165	953	874	272	604	482	284	408	155	113	250	203	104	55	148	101	247
First count	17 Jul	17 Jul	21 Jul	22 Jul	24 Jul	10 Jul	10 Jul	10 Jul	14 Jul	28 Jul	16 Jul	24 Jul	22 Jul	17 Jul	27 Jul	2 Aug	16 Jul	17 Jul	22 Jul	1 Aug	1 Aug	27 Jul	16 Jul
Last count	28 Jul	7 Aug	12 Aug	11 Aug	20 Aug	22 Aug	5 Aug	1 Aug	5 Aug	18 Aug	6 Aug	6 Aug	10 Aug	5 Aug	8 Aug	25 Aug	14 Aug	11 Aug	8 Aug	20 Aug	23 Aug	15 Aug	7 Aug

Table 17. Numbers of murres counted on land-based index plots at Aiktak Island, Alaska in 2021.

Plot	Species	Date					Mean	SD
		16 Jul	21 Jul	26 Jul	4 Aug	7 Aug		
1	COMU	0	0	0	0	0	-	-
	TBMU	0	0	0	0	0	-	-
	UNMU	0	0	0	0	0	-	-
2	COMU	0	0	0	0	0	-	-
	TBMU	0	0	0	0	0	-	-
	UNMU	0	0	0	0	0	-	-
3	COMU	3	6	5	10	5	-	-
	TBMU	21	16	19	28	25	-	-
	UNMU	0	0	0	0	0	-	-
4	COMU	0	0	0	0	0	-	-
	TBMU	0	0	0	0	0	-	-
	UNMU	0	0	0	0	0	-	-
5	COMU	126	115	122	131	139	-	-
	TBMU	425	428	428	510	506	-	-
	UNMU	0	0	0	0	0	-	-
6	COMU	0	0	0	0	0	-	-
	TBMU	0	0	0	0	0	-	-
	UNMU	1772	2222	1849	2241	1966	-	-
7	COMU	0	0	0	0	0	-	-
	TBMU	0	0	0	0	0	-	-
	UNMU	0	0	0	0	0	-	-
8	COMU	0	0	0	0	0	-	-
	TBMU	0	0	0	0	0	-	-
	UNMU	0	0	0	0	0	-	-
9	COMU	0	0	0	0	0	-	-
	TBMU	0	0	0	0	0	-	-
	UNMU	0	0	0	0	0	-	-
10	COMU	0	0	0	0	0	-	-
	TBMU	0	11	0	15	3	-	-
	UNMU	0	0	0	0	0	-	-
Rafts <sup>a</sup>	UNMU	-	-	-	-	-	-	-
Total <sup>a</sup>	COMU	129	121	127	141	144	132	10
	TBMU	446	455	447	553	534	487	52
	UNMU	1772	2222	1849	2241	1966	2010	214
	ALL	2347	2798	2423	2935	2644	2629	247

<sup>a</sup>Murres rafting below cliffs were not counted (NC) in 2020.

Table 18. Numbers of murres (includes common, thick-billed, and unknown murres) counted during boat-based circumnavigation surveys at Aikta Island, Alaska. No counts were conducted in 1999, 2001, 2003, 2008, 2010-2016, or 2018-2020.

Replicate	1995	1996	1997	1998	2000	2002	2004	2005	2006	2007	2009	2017	2021
1	4800	6124	7095	5031	2790	81	2756	2619	1836	2486	3380 <sup>a</sup>	312	4026
2	5200	3752	4839	3796	2307	73	1234	3348	3875	3617	-	-	-
3	4968	6022	7259	-	3023	998	2116	2126	-	3187	-	-	-
4	-	7692	-	-	3142	1256	957	-	-	-	-	-	-
5	-	-	-	-	3304	-	-	-	-	-	-	-	-
Mean	4989	5898	6398	4414	2913	602	1766	2698	2856	3097	3380 <sup>a</sup>	312	4026
n	3	4	3	2	5	4	4	3	2	3	1	1	1
SD	201	1341	1352	873	365	532	764	615	1442	571	-	-	-
First count	25 Jun	21 Jul	23 Jul	27 Jul	9 Jul	26 May	22 Jul	22 Jul	21 Jul	22 Jul	25 Jul	6 Aug	14 Jul
Last count	5 Aug	15 Aug	9 Aug	3 Aug	11 Aug	18 Jul	10 Aug	14 Aug	27 Aug	20 Aug	-	-	-

<sup>a</sup>Murres rafting below cliffs were not counted in 2009 due to rough sea-conditions.

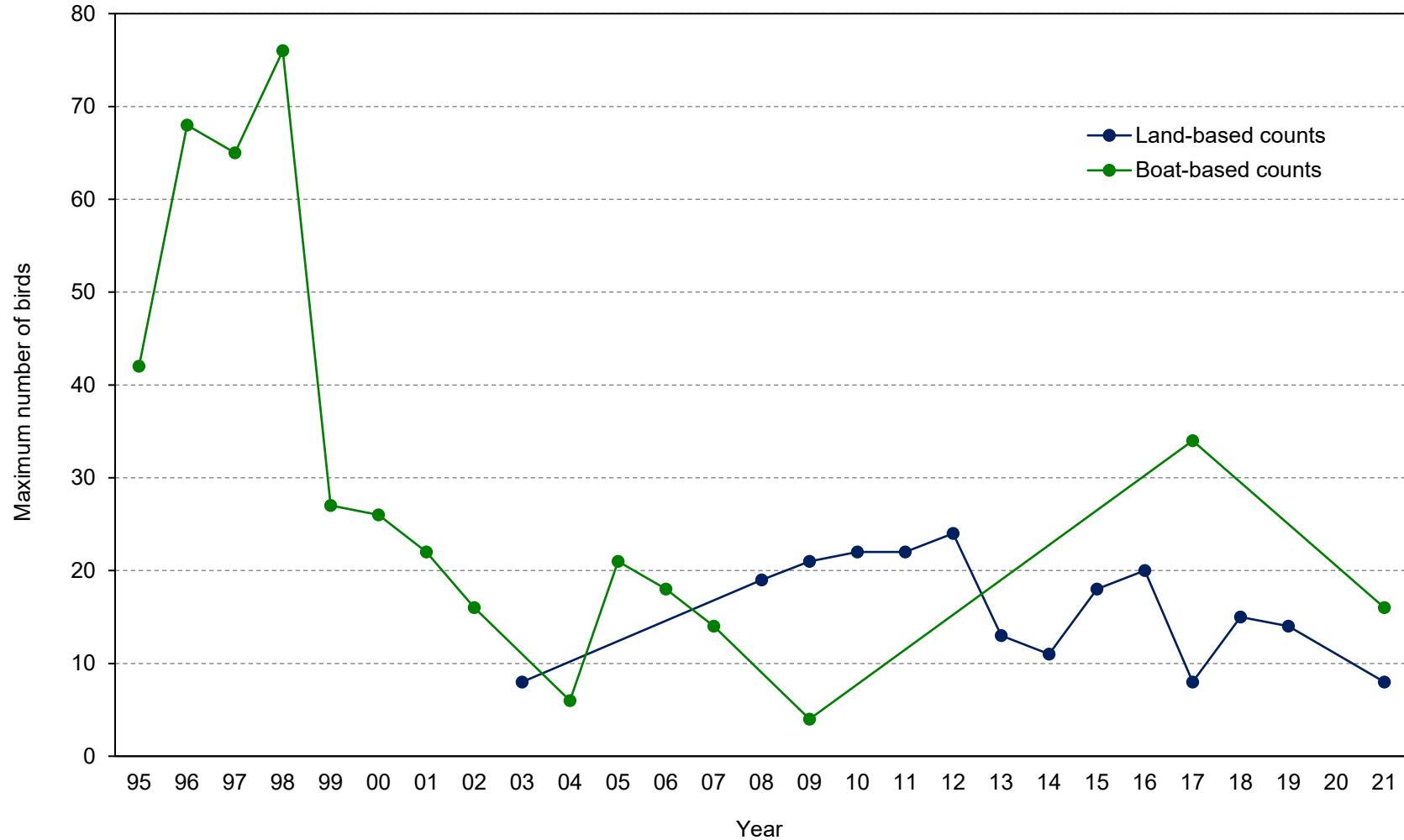


Figure 14. Maximum numbers of pigeon guillemots counted from land-based observation points and during boat-based circumnavigation surveys at Aiktak Island, Alaska. Values represent the highest count of individuals each year. Land-based counts all occurred during a standardized count window but times of day and seasons of boat-based counts vary (see circumnavigation tables for exact times). No land-based counts were conducted in 2004-2006 or 2020; land-based data do not include counts in 2000-2002 or 2004-2007 due to differences in observation points, times of day, and times of season. No boat-based counts were conducted in 2003, 2008, 2010-2016, or 2019-2020.

Table 19. Maximum numbers of pigeon guillemots counted from land-based observation points at Aiktak Island, Alaska. Data represent the highest single daily count of individuals each year. No counts were conducted in 2004-2006 or 2020; data do not include counts made in 2000-2002 or 2004-2007 due to differences in observation points, times of day, and times of season.

Observation point	2003	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
Pleasure Cove	2	1	0	0	0	2	0	2	0	0	0	0	0	0
Old Camp Beach	1	5	5	0	3	5	0	1	0	0	0	0	0	1
New Camp Beach	2	3	0	0	2	0	0	0	0	0	0	0	0	1
4 Sisters	2	0	0	0	0	0	0	1	0	0	0	0	1	0
Ivory Cove	0	0	0	0	0	0	0	1	2	0	0	2	1	0
Tower Cove	1	0	0	0	0	1	1	0	2	0	2	0	1	4
Arch's Cove	0	6	15	22	17	1	12	5	14	20	6	13	11	2
Petrel Valley Cove	0	4	1	0	0	15	0	1	0	0	0	0	0	0
Total	8	19	21	22	22	24	13	11	18	20	8	15	14	8
Date of max. count	21 Jun	19 Jun	12 Jun	5 Jun	13 Jun	28 Jun	1 Jul <sup>a</sup>	16 Jun	1 Jul	17 Jun	26 Jun <sup>a</sup>	20 Jun <sup>a</sup>	19 Jun	18 Jun
Start time (ALDT) <sup>b</sup>	0845	0930	0830	0800	0620	0704	0808	0717	0700	0700	0818	0838	0738	0737
End time (ALDT) <sup>b</sup>	1110	1045	1030	1005	0811	0850	1100	0830	0840	0855	0954	0959	0926	0919

<sup>a</sup>Maximum count occurred on two days in 2013 (13 birds), 2017 (8 birds), and 2018 (15 birds); by convention, plot data from the earlier date are reported.

<sup>b</sup>Times are Aleutian Daylight Time (-1 hr from Alaska Daylight Time).

Table 20. Numbers of pigeon guillemots counted from land-based observation points at Aiktak Island, Alaska in 2021.

Observation point	Date					Mean	SD	Max.
	18 Jun	19 Jun	20 Jun	25 Jun	26 Jun			
Pleasure Cove	0	0	0	0	0	-	-	-
Old Camp Beach	1	0	0	0	0	-	-	-
New Camp Beach	1	0	0	0	0	-	-	-
4 Sisters	0	0	0	0	0	-	-	-
Ivory Cove	0	0	1	1	0	-	-	-
Tower Cove	4	0	0	1	0	-	-	-
Arch's Cove	2	7	0	3	5	-	-	-
Petrel Valley Cove	0	0	0	0	0	-	-	-
Total	8	7	1	5	5	5	3	8
Start time (ALDT) <sup>a</sup>	0737	0748	0817	0807	0759	-	-	-
End time (ALDT) <sup>a</sup>	0919	0921	0935	0946	0937	-	-	-

<sup>a</sup>Times are Aleutian Daylight Time (-1 hr from Alaska Daylight Time).

Table 21. Maximum numbers of pigeon guillemots counted during boat-based circumnavigation surveys at Aikta Island, Alaska. Data represent the highest single daily count of individuals each year. Count time varied among years; morning counts may not be comparable with afternoon counts. No counts were conducted in 2003, 2008, 2010-2016, or 2018-2020.

Segment	1995	1996	1997	1998	1999	2000	2001	2002	2004	2005	2006	2007	2009	2017	2021
1-2	-	2	6	14	3	4	12	12	2	4	2	0	1	4	1
3-5	-	8	0	0	0	2	0	0	0	2	0	2	1	5	0
6	-	8	20	19	4	2	0	2	0	3	1	5	0	0	0
7-10	-	3	0	0	2	0	0	0	2	0	7	0	1	0	2
11-12	-	25	21	22	11	13	0	0	0	10	3	6	1	19	12
13	-	13	17	12	4	4	8	2	1	1	0	0	0	0	0
14	-	9	1	9	3	0	2	0	1	1	5	1	0	6	1
Total	42	68	65	76	27	26	22	16	6	21	18	14	4	34	16
Date of max. count	5 Aug	22 Jul	26 Jul	28 Jun	5 Jul	19 Jul	18 Jun	26 May	22 Jul	22 Jul	21 Jul	8 Aug	25 Jul	6 Aug	14 Jul
Start time <sup>a</sup>	1230	0640	0659	0625	0726	0700	0550	1200	1000	1100	1500	1430	1300	0830	0903
End time <sup>a</sup>	1630	0830	0800	0755	0844	0810	0650	1730	1400	1330	1640	1630	1800	1021	1002

<sup>a</sup>Times are Aleutian Daylight Time (-1 hr from Alaska Daylight Time).

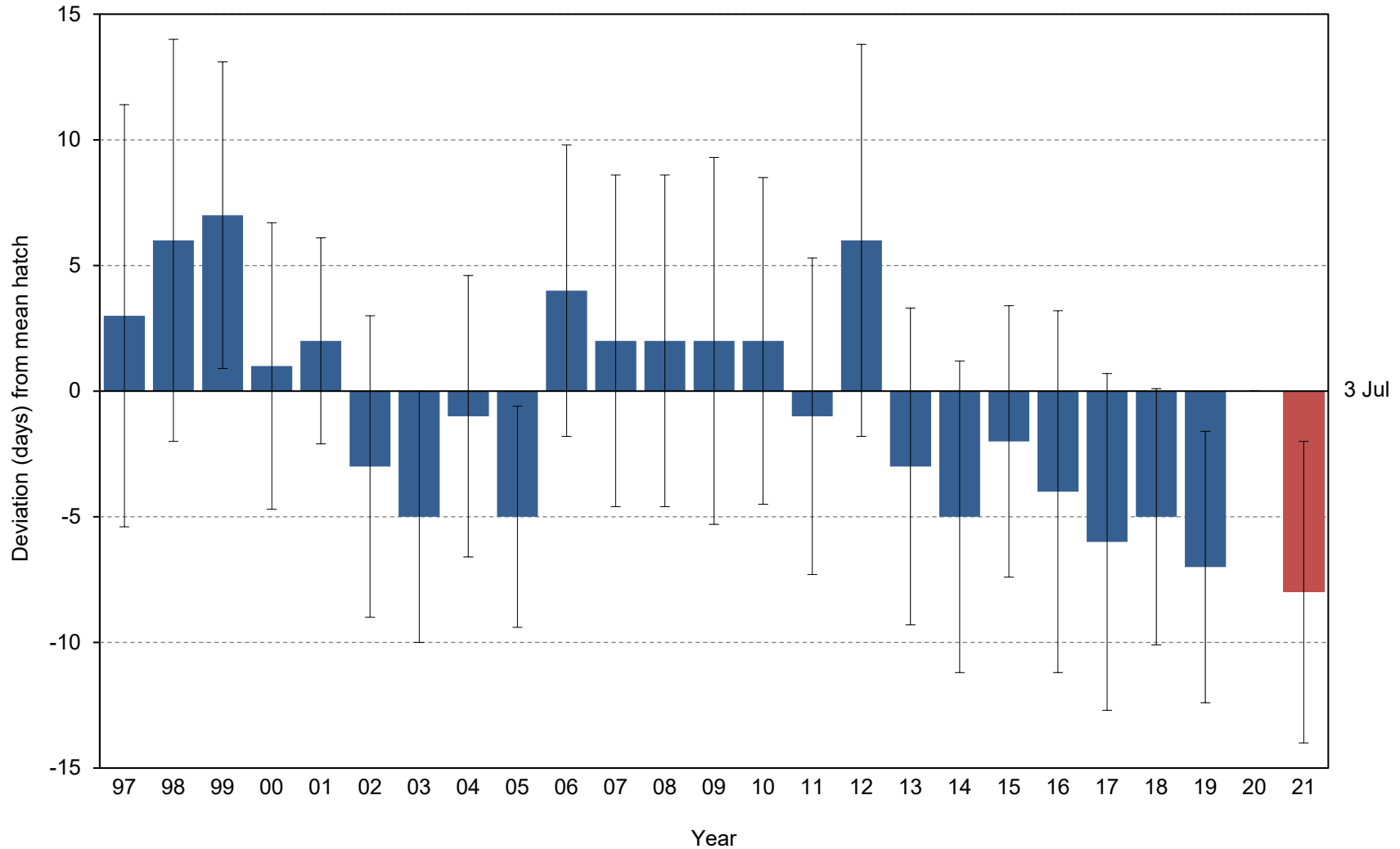


Figure 15. Yearly hatch date deviation (from the 1997-2020 average of 3 July) for ancient murrelets at Aiktak Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year. In 2018, 2019, and 2021 data do not include nest sites with adult birds that were handled during a geolocator study. No data were collected in 2020.



Table 22. Breeding chronology of ancient murrelets at Aikta Island, Alaska. Data represent the date of the first chick hatched in each nest. No data were collected in 2020.

Year	Mean hatch	SD	<i>n</i> <sup>a</sup>	First hatch	Last hatch
1997	6 Jul	8.4	8	29 Jun	22 Jul
1998	10 Jul	8.0	12	27 Jun	25 Jul
1999	11 Jul	6.1	21	29 Jun	23 Jul
2000	3 Jul	5.7	23	26 Jun	14 Jul
2001	29 Jun	4.1	22	26 Jun	14 Jul
2002	1 Jul	6.0	33	25 Jun	16 Jul
2003	27 Jun	5.0	21	19 Jun	5 Jul
2004	30 Jun	5.6	23	20 Jun	12 Jul
2005	28 Jun	4.4	27	19 Jun	5 Jul
2006	7 Jul	5.8	41	29 Jun	23 Jul
2007	5 Jul	6.6	41	23 Jun	23 Jul
2008	4 Jul	6.6	37	20 Jun	21 Jul
2009	5 Jul	7.3	83	18 Jun	22 Jul
2010	5 Jul	6.5	50	21 Jun	25 Jul
2011	2 Jul	6.3	43	21 Jun	19 Jul
2012	8 Jul	7.8	60	24 Jun	26 Jul
2013	30 Jun	6.3	36	22 Jun	21 Jul
2014	28 Jun	6.2	74	17 Jun	20 Jul
2015	1 Jul	5.4	77	15 Jun	9 Jul
2016	28 Jun	7.2	89	16 Jun	24 Jul
2017	27 Jun	6.7	89	17 Jun	17 Jul
2018 <sup>b</sup>	28 Jun	5.1	76	17 Jun	7 Jul
2019 <sup>b</sup>	26 Jun	5.4	88	15 Jun	21 Jul
2021	25 Jun	6.0	101	13 Jun	15 Jul

<sup>a</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is  $\leq 7$  days.

<sup>b</sup>In 2018, 2019, and 2021 data do not include nest sites with adult birds that were handled during a geolocator study.

Table 23. Frequency distribution of hatch dates for ancient murrelets at Aikta 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  $\leq 7$  days. No data were collected in 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date																							
	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18 <sup>b</sup>	19 <sup>b</sup>	21
164	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
165	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
166	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-
167	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
168	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	1	10	5	-	-
169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	-	-	-	-	-	-	3	-	1	-	-	-	3	-	1	-	-	-	-	-	4	-	4	32
171	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	5	-
172	-	-	-	-	1	-	-	1	-	-	-	1	-	1	-	-	-	-	-	23	-	-	-	9
173	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
174	-	-	-	-	-	-	-	1	5	-	2	-	-	-	-	-	1	2	5	4	24	18	24	-
175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-	-	-
176	-	-	-	-	1	10	9	-	-	-	-	-	12	-	10	6	-	-	4	6	11	5	17	26
177	-	-	-	-	1	-	-	3	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
178	-	1	-	6	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	18	-	-	16	-
179	-	-	-	1	-	8	-	5	-	-	-	-	-	-	2	-	-	-	-	-	-	4	-	-
180	1	1	1	-	10	-	5	-	-	6	11	-	-	13	-	-	27	1	7	6	-	12	9	13
181	1	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
182	1	-	-	-	-	-	-	5	8	-	-	-	-	-	17	12	-	21	28	4	-	22	1	11
183	1	1	-	2	-	4	-	-	-	-	-	-	-	5	-	-	1	-	1	-	-	-	-	-
184	1	-	1	-	6	1	-	3	-	-	1	14	33	-	-	-	-	-	5	5	8	-	5	-
185	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
186	1	-	-	5	-	-	4	-	4	18	13	1	-	7	1	-	-	-	7	13	-	5	-	2
187	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	1	6	-	1	1	-	-	-	1	-	1	-	8	-	-	-	1	8	-	7	5	3	-
189	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	19	-	-	6	-	-	-	-	-
190	-	-	1	3	-	-	-	-	-	-	2	9	22	-	9	-	-	4	2	-	3	-	-	3
191	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	4	3	-	-	-	-	-	12	8	-	-	9	-	-	-	-	-	3	-	-	-	1
193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	3	-	-	-	-	2	-	-	-	-	1	3	-	-	-	1	-	5	1	-	-	-
195	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	2	1	-	-	-	-	-	-	-	-	-	-	3	17	3	2	-	-	-	-	1	1
197	1	-	-	-	-	1	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	2	3	-	11	3	-	-	-	-	-	-	1	-	-	-
199	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
202	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	5	1	-	-	-	-	-	1	-
203	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	1	-	-	-	-	-	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
206	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
<i>n</i>	8	12	21	23	22	33	21	23	27	41	41	37	83	50	43	60	36	74	77	89	89	76	88	101

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

<sup>b</sup>In 2018, 2019, and 2021 data do not include nest sites with adult birds that were handled during a geolocator study.

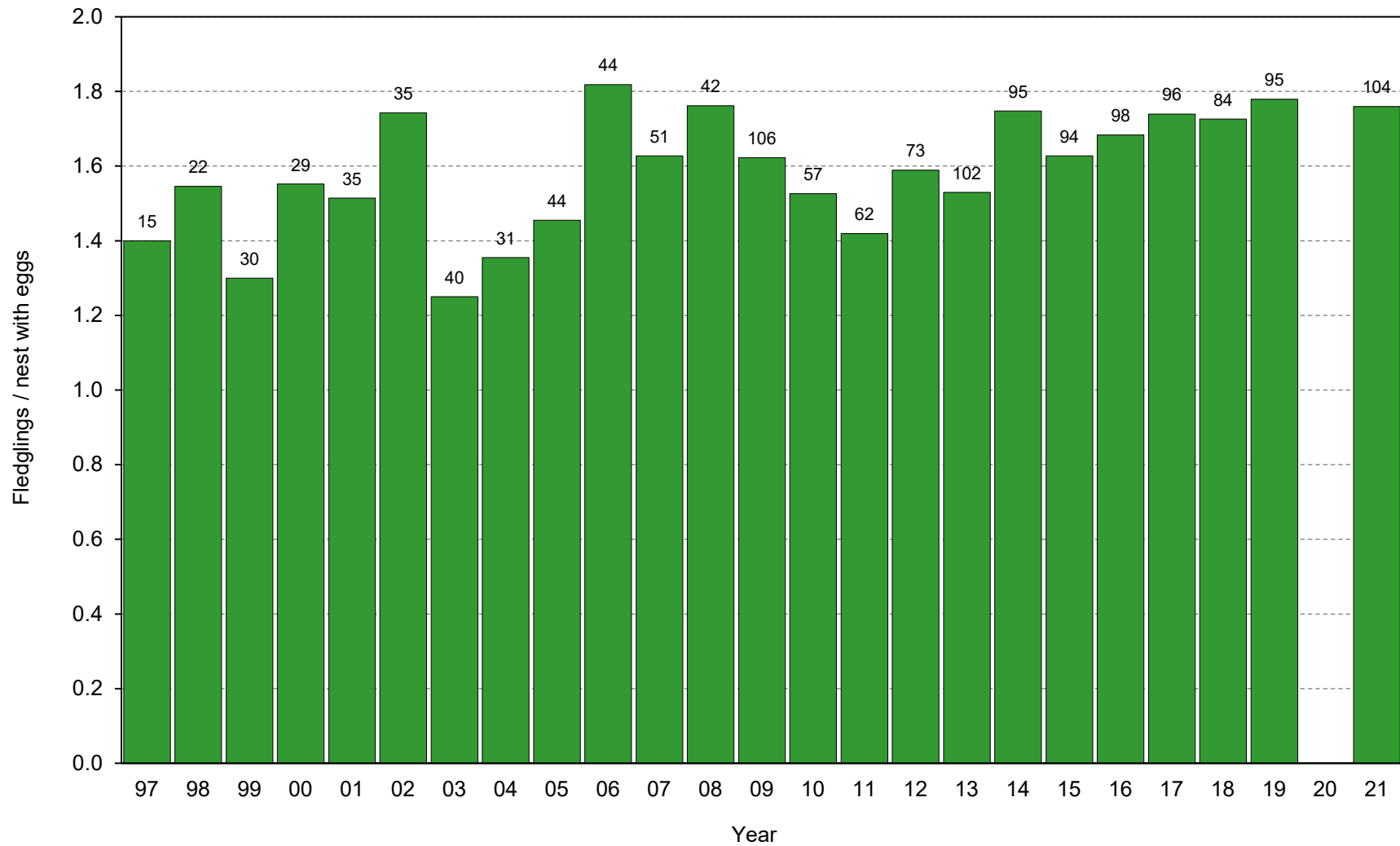


Figure 16. Reproductive performance of ancient murrelets at Aiktak Island, Alaska. Success is measured by the number of chicks fledged per nests with eggs ( $G/B$ ), where  $G$ =total chicks fledged and  $B$ =nest sites w/ eggs. Numbers above columns indicate sample sizes ( $B$ ). In 2018, 2019, and 2021 data do not include nest sites with adult birds that were handled during a geolocator study. No data were collected in 2020.

Table 24. Reproductive performance of ancient murrelets at Aikta Island. No data were collected in 2020.

Year	Nest sites w/ eggs (B)	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)	Fledglings/ nest w/ eggs (G/B)
1997	15	29	13	21	13	21	1.9	1.6	0.87	0.72	1.00	0.72	1.00	0.87	1.40
1998	22	44	19	35	19	34	2.0	1.8	0.86	0.80	0.97	0.77	1.00	0.86	1.55
1999	30	57	22	39	22	39	1.9	1.8	0.73	0.68	1.00	0.68	1.00	0.73	1.30
2000	29	58	24	45	24	45	2.0	1.9	0.83	0.78	1.00	0.78	1.00	0.83	1.55
2001	35	67	29	53	29	53	1.9	1.8	0.83	0.79	1.00	0.79	1.00	0.83	1.51
2002	35	70	33	61	33	61	2.0	1.8	0.94	0.87	1.00	0.87	1.00	0.94	1.74
2003	40	75	28	51	27	50	1.9	1.8 <sup>a</sup>	0.70 <sup>a</sup>	0.68 <sup>a</sup>	0.98 <sup>a</sup>	0.67 <sup>a</sup>	0.96 <sup>a</sup>	0.68 <sup>a</sup>	1.25 <sup>a</sup>
2004	31	60	23	42	23	42	1.9	1.8	0.74	0.70	1.00	0.70	1.00	0.74	1.35
2005	44	88	33	65	33	64	2.0	2.0	0.75	0.74	0.98	0.73	1.00	0.75	1.45
2006	44	88	41	80	41	80	2.0	2.0	0.93	0.91	1.00	0.91	1.00	0.93	1.82
2007	51	100	45	83	45	83	2.0	1.8	0.88	0.83	1.00	0.83	1.00	0.88	1.63
2008	42	84	37	74	37	74	2.0	2.0	0.88	0.88	1.00	0.88	1.00	0.88	1.76
2009	106	209	92	173	91	172	2.0	1.9	0.87	0.83	0.99	0.82	0.99	0.86	1.62
2010	57	108	48	87	48	87	1.9	1.8	0.84	0.81	1.00	0.81	1.00	0.84	1.53
2011	62	120	47	88	47	88	1.9	1.9	0.76	0.73	1.00	0.73	1.00	0.76	1.42
2012	73	143	61	116	61	116	2.0	1.9	0.84	0.81	1.00	0.81	1.00	0.84	1.59
2013	102	202	84	162	84	156	2.0	1.9	0.82	0.80	0.96	0.77	1.00	0.82	1.53
2014	95	189	89	169	88	166	2.0	1.9	0.94	0.89	0.98	0.88	0.99	0.93	1.75
2015	94	186	80	154	79	153	2.0	1.9	0.85	0.83	0.99	0.82	0.99	0.84	1.63
2016	98	192	90	166	90	165	2.0	1.8	0.92	0.86	0.99	0.86	1.00	0.92	1.68
2017	96	192	90	169	89	167	2.0	1.9	0.94	0.88	0.99	0.87	0.99	0.93	1.74
2018 <sup>b</sup>	84	167	76	146	76	145	2.0	1.9	0.90	0.87	0.99	0.87	1.00	0.90	1.73
2019 <sup>b</sup>	95	188	87	170	87	169	2.0	2.0	0.92	0.90	0.99	0.90	1.00	0.92	1.78
2021 <sup>b</sup>	104	205	96	183	96	183	2.0	1.9	0.92	0.89	1.00	0.89	1.00	0.92	1.76

<sup>a</sup>In 2003, values of success represent a maximum estimate because there were still burrows with eggs at the time of field crew departure in mid-July.

<sup>b</sup>In 2018, 2019, and 2021 data do not include nest sites with adult birds that were handled during a geolocator study.

Table 25. Standard deviation in reproductive performance parameters of ancient murrelets at Aiktak Island, Alaska. No data were collected in 2020.

Year	Nest sites w/ eggs	Sampling design <sup>a</sup>	Mean clutch size	Mean brood size	Nesting success	Hatching success	Chick success	Egg success	Fledging success	Reprod. success	Fledglings/ nest w/ eggs
1997	15	Simple random	xx <sup>b</sup>	xx	0.09	0.08	0.00	0.08	0.00	0.09	xx
1998	22	Simple random	xx	xx	0.07	0.06	0.03	0.06	0.00	0.07	xx
1999	30	Simple random	xx	xx	0.08	0.06	0.00	0.06	0.00	0.08	xx
2000	29	Simple random	xx	xx	0.07	0.05	0.00	0.05	0.00	0.07	xx
2001	35	Simple random	xx	xx	0.06	0.05	0.00	0.05	0.00	0.06	xx
2002	35	Simple random	xx	xx	0.04	0.04	0.00	0.04	0.00	0.04	xx
2003	40	Simple random	xx	xx	0.07	0.05	0.02	0.05	0.04	0.07	xx
2004	31	Simple random	xx	xx	0.08	0.06	0.00	0.06	0.00	0.08	xx
2005	44	Simple random	xx	xx	0.07	0.05	0.02	0.05	0.00	0.07	xx
2006	44	Simple random	xx	xx	0.04	0.03	0.00	0.03	0.00	0.04	xx
2007	51	Simple random	xx	xx	0.05	0.04	0.00	0.04	0.00	0.05	xx
2008	42	Simple random	xx	xx	0.05	0.04	0.00	0.04	0.00	0.05	xx
2009	106	Simple random	xx	xx	0.03	0.03	0.01	0.03	0.01	0.03	xx
2010	57	Simple random	xx	xx	0.05	0.04	0.00	0.04	0.00	0.05	xx
2011	62	Simple random	xx	xx	0.05	0.04	0.00	0.04	0.00	0.05	xx
2012	73	Simple random	xx	xx	0.04	0.03	0.00	0.03	0.00	0.04	xx
2013	102	Simple random	xx	xx	0.04	0.03	0.02	0.03	0.00	0.04	xx
2014	95	Simple random	xx	xx	0.02	0.02	0.01	0.02	0.01	0.03	xx
2015	94	Simple random	xx	xx	0.04	0.03	0.01	0.03	0.01	0.04	xx
2016	98	Simple random	xx	xx	0.03	0.03	0.01	0.03	0.00	0.03	xx
2017	96	Simple random	xx	xx	0.02	0.02	0.01	0.02	0.01	0.03	xx
2018	84	Simple random	xx	xx	0.03	0.03	0.01	0.03	0.00	0.03	xx
2019	95	Simple random	xx	xx	0.03	0.02	0.01	0.02	0.00	0.03	xx
2021	104	Simple random	xx	xx	0.03	0.02	0.00	0.02	0.00	0.03	xx

<sup>a</sup>Sampling for ancient murrelets is based on nests as the sample unit. For simple random sampling, values are calculated using  $\sqrt{\rho * (1 - \rho)/n}$ , where  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

<sup>b</sup>xx indicates data potentially exist but have not yet been summarized.

Table 26. Reproductive performance of handled and unhandled ancient murrelets at Aiktak Island, Alaska in 2021. Summaries are presented for nest sites monitored following the standard protocol (labeled “not handled, monitored only”; also presented in Table 24), as well as for nest sites with adult birds that were handled for a geolocator study. In 2021, a geolocator logger was removed from a recaptured adult bird that had been tagged in 2018; the sites labeled “handled, tag removed” refers to the sites where loggers were recovered. Of the handled birds, “no tag” sites in 2021 included three nest sites for which a non-tagged pair was using a site that had been used by tagged birds in 2018; thus they are excluded from regular “monitored only” summary due to the handling of adult birds to check for tags.

Parameter		Group			Total
		Not handled	Handled		
		Monitored only	No tag	Tag removed	
Nest sites w/ x eggs	1	3	0	0	3
	2	101	3	1	105
Nests with eggs (B)		104	3	1	108
Total eggs (C)		205	6	2	213
Nest sites w/ x chicks	1	9	1	0	10
	2	87	2	1	90
Nest sites w/ chicks (D)		96	3	1	100
Total chicks (E)		183	5	2	190
Nests w/ chicks fledged (F)		96	3	1	100
Total chicks fledged (G)		183	5	2	190
Mean clutch size (C/B)		2.0	2.0	2.0	2.0
Mean brood size (E/D)		1.9	1.7	2.0	1.9
Nesting success (D/B)		0.92	1.00	1.00	0.93
Hatching success (E/C)		0.89	0.83	1.00	0.89
Chick success (G/E)		1.00	1.00	1.00	1.00
Egg success (G/C)		0.89	0.83	1.00	0.89
Fledging success (F/D)		1.00	1.00	1.00	1.00
Reproductive success (F/B)		0.92	1.00	1.00	0.93
Fledglings/nest w/ eggs (G/B)		1.76	1.67	2.00	1.76

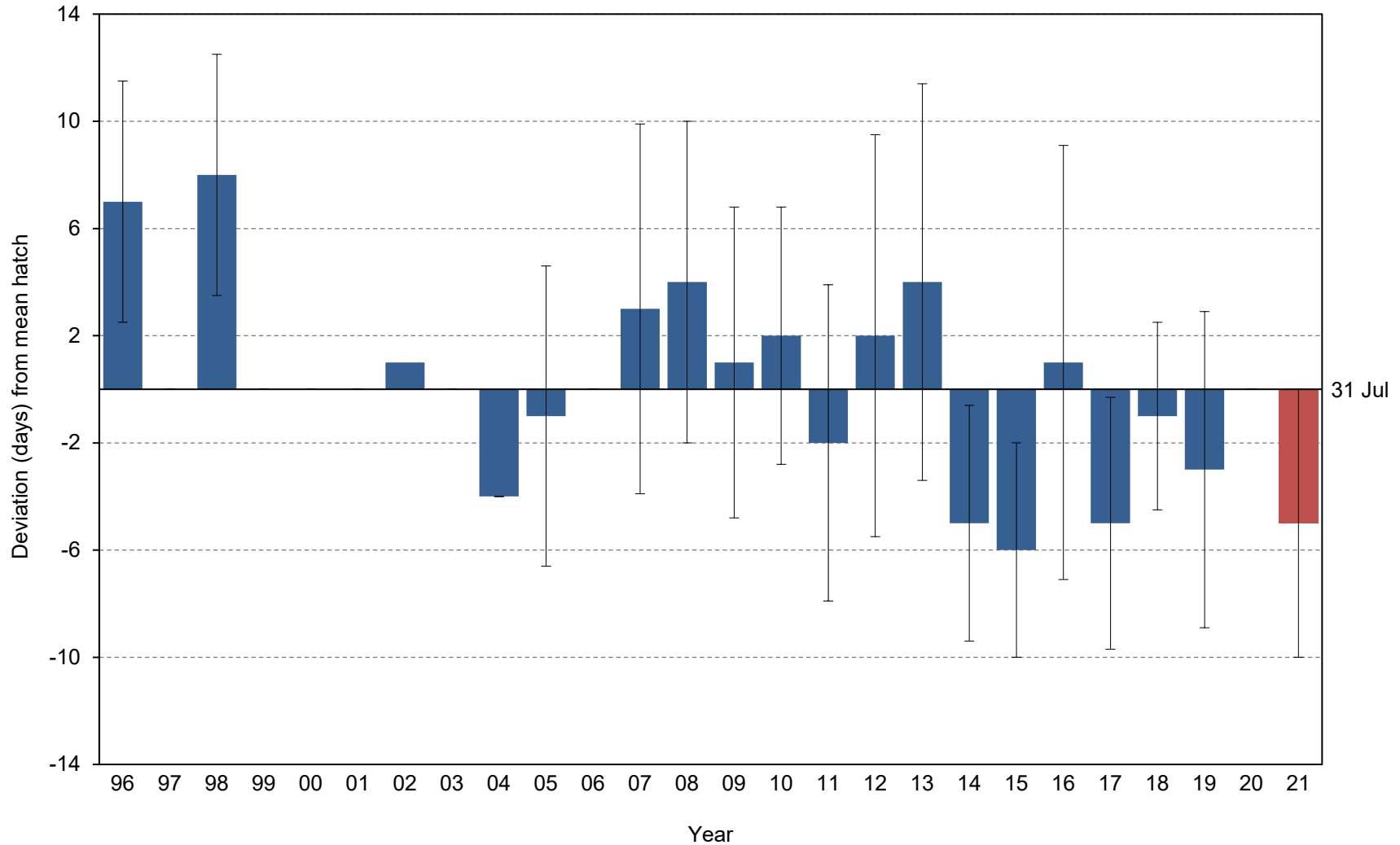


Figure 17. Yearly hatch date deviation (from the 1996-2020 average of 31 July) for horned puffins at Aiktak Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date (years without error bars have sample size of one); red highlights the current year. No data were collected in 1997, 1999, 2001, 2003, or 2020; no hatch dates were recorded with the appropriate egg to chick interval ( $\leq 7$  days) in 2000 or 2006.

Table 27. Breeding chronology of horned puffins at Aiktak Island, Alaska. No data were collected in 1997, 1999, 2001, 2003, or 2020; no hatch dates were recorded with the appropriate egg to chick interval ( $\leq 7$  days) in 2000 or 2006.

Year	Mean hatch	SD	$n^a$	First hatch	Last hatch	First fledge <sup>b</sup>
1996	6 Aug	4.5	2	1 Aug	10 Aug	>13 Aug
1998	8 Aug	4.5	2	3 Aug	12 Aug	>31 Aug
2002	1 Aug	-	1	1 Aug	-	-
2004	26 Jul	0.0	4	26 Jul	-	>27 Aug
2005	30 Jul	5.6	4	25 Jul	8 Aug	>30 Aug
2006	-	-	-	-	-	>2 Sep
2007	3 Aug	6.9	4	26 Jul	13 Aug	>28 Aug
2008	3 Aug	6.0	8	28 Jul	15 Aug	>29 Aug
2009	1 Aug	5.8	15	20 Jul	14 Aug	>3 Sep
2010	2 Aug	4.8	5	27 Jul	6 Aug	>1 Sep
2011	29 Jul	5.9	8	21 Jul	10 Aug	>2 Sep
2012	1 Aug	7.5	11	22 Jul	19 Aug	29 Aug
2013	4 Aug	7.4	6	27 Jul	18 Aug	29 Aug
2014	26 Jul	4.4	10	19 Jul	4 Aug	>28 Aug
2015	25 Jul	4.0	4	21 Jul	31 Jul	>28 Aug
2016	31 Jul	8.1	6	23 Jul	17 Aug	> 1 Sep
2017	26 Jul	4.7	3	19 Jul	29 Jul	>31 Aug
2018	30 Jul	3.5	5	25 Jul	2 Aug	>28 Aug
2019	28 Jul	5.9	8	21 Jul	12 Aug	>30 Aug
2021	26 Jul	5.0	3	21 Jul	2 Aug	>28 Aug

<sup>a</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is  $\leq 7$  days.

<sup>b</sup>In 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 28. Frequency distribution of hatch dates for horned puffins at Aiktak Island, Alaska. Data include only nests in which observations of egg to chick  $\leq 7$  days. No data were collected in 1997, 1999, 2001, 2003 or 2020; no hatch dates were recorded with the appropriate egg to chick interval in 2000 or 2006.

Julian date <sup>a</sup>	No. nests hatching on Julian date																			
	96	98	02	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	21
200	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
201	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1	1
203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
204	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
206	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1
207	-	-	-	-	-	-	1	-	-	-	4	-	-	-	-	1	-	-	-	-
208	-	-	-	4	2	-	-	-	-	2	1	3	2	3	1	-	-	1	6	-
209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	1	3	4	-	-	-	-	1	-	-	2	-	-	-
211	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	2	-	-	-	-
213	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
214	1	-	-	-	-	-	-	2	5	-	-	1	-	-	-	1	-	3	-	1
215	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	1	-	-	-	1	1	-	1	-	-	-	-	-	-
217	-	-	-	-	-	-	-	-	-	1	-	1	2	-	-	-	-	-	-	-
218	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-
219	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	1	-	-	2	2	-	-	2	-	-	-	-	-	-	-	-
221	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
223	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
224	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
225	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
229	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
231	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
232	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
<i>n</i>	2	2	1	4	4	-	4	8	15	5	8	11	6	10	4	6	3	5	8	3

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

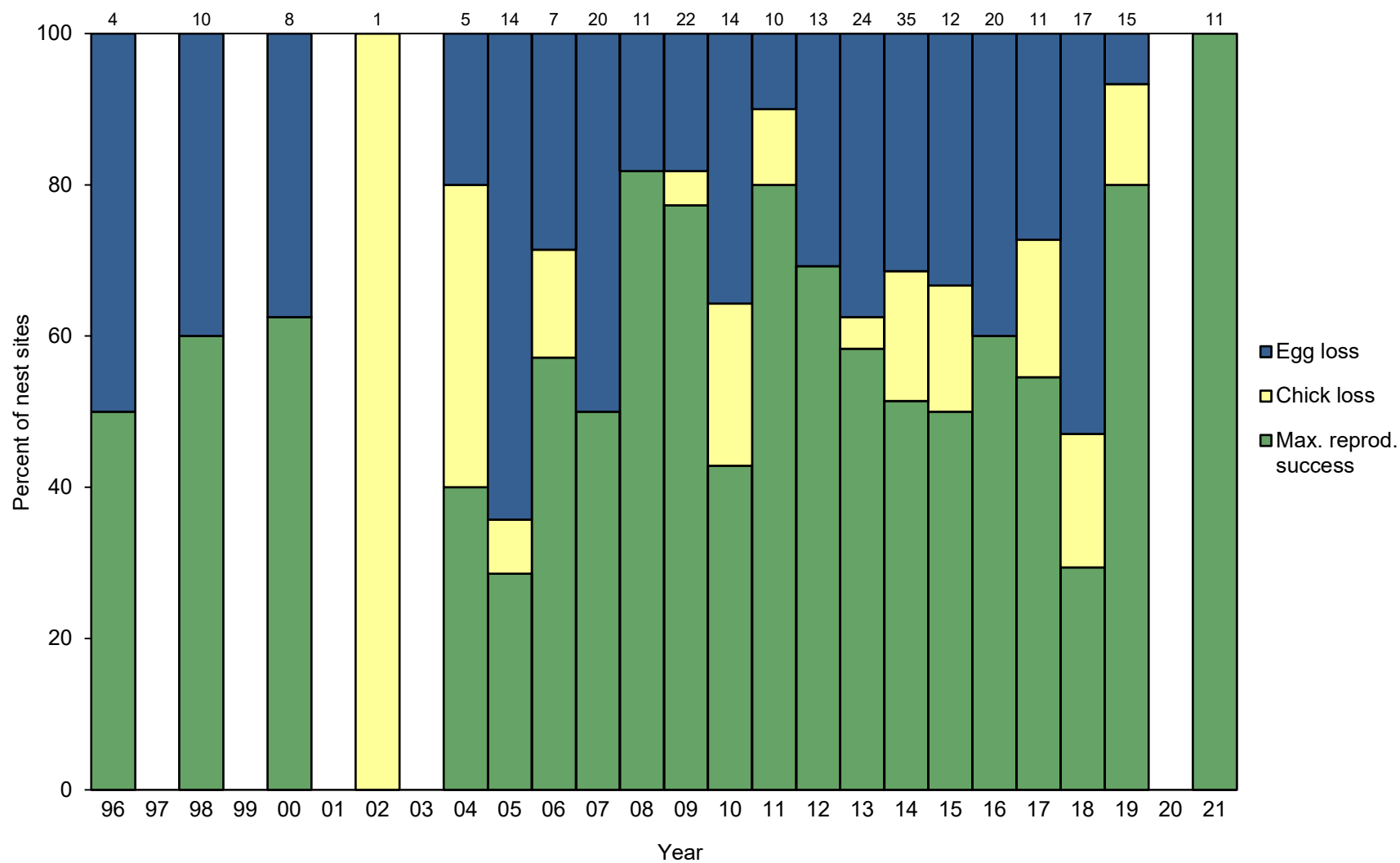


Figure 18. Maximum potential reproductive performance of horned puffins at Aiktak Island, Alaska. Values include nest sites with chicks still present but too young to consider fledged at the last check.  $\text{Egg loss} = [(B+H) - D + H] / (B+H)$ ;  $\text{Chick loss} = [(D+H) - F + H] / (B+H)$ ;  $\text{Maximum potential reproductive success} = [(F+H) / (B+H)]$ , where B=nest sites with eggs; D=nest site 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 1997, 1999, 2003, or 2020.

Table 29. Reproductive performance of horned puffins at Aikta Island, Alaska. No data were collected in 1997, 1999, 2003, or 2020.

Year	Nest sites w/ eggs	Nest sites w/ chicks	Nest sites w/ chicks fledged	Nest sites w/ young chicks still present <sup>a</sup>	Nesting success (D/B) <sup>b</sup>		Fledging success (F/D) <sup>c</sup>		Reproductive success (F/B)		Max. potential nesting success <sup>d</sup> [(D+H)/(B+H)]		Max. potential fledging success <sup>d</sup> [(F+H)/(D+H)]		Max. potential reproductive success <sup>d</sup> [(F+H)/(B+H)]		Sampling design <sup>e</sup>
	(B)	(D)	(F)	(H)	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	
1996	2	0	0	2	0.00	0.00	-	-	0.00	0.00	0.50	0.25	1.00	0.00	0.50	0.25	Simple random
1998	7	3	3	3	0.43	0.19	1.00	0.00	0.43	0.19	0.60	0.15	1.00	0.00	0.60	0.15	Simple random
2000	5	2	2	3	0.40	0.22	1.00	0.00	0.40	0.22	0.63	0.17	1.00	0.00	0.63	0.17	Simple random
2002	1	1	0	0	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	Simple random
2004	5	4	2	0	0.80	0.18	0.50	0.25	0.40	0.22	0.80	0.18	0.50	0.25	0.40	0.22	Simple random
2005	13	4	3	1	0.31	0.13	0.75	0.22	0.23	0.12	0.36	0.13	0.80	0.18	0.29	0.12	Simple random
2006	5	3	2	2	0.60	0.22	0.67	0.27	0.40	0.22	0.71	0.17	0.80	0.18	0.57	0.19	Simple random
2007	16	6	6	4	0.38	0.12	1.00	0.00	0.38	0.12	0.50	0.11	1.00	0.00	0.50	0.11	Simple random
2008	6	4	4	5	0.67	0.19	1.00	0.00	0.67	0.19	0.82	0.12	1.00	0.00	0.82	0.12	Simple random
2009	18	14	13	4	0.78	0.10	0.93	0.07	0.72	0.11	0.82	0.08	0.94	0.06	0.77	0.09	Simple random
2010	9	4	1	5	0.44	0.17	0.25	0.22	0.11	0.10	0.64	0.13	0.67	0.16	0.43	0.13	Simple random
2011	8	7	6	2	0.88	0.11	0.86	0.13	0.75	0.15	0.90	0.09	0.89	0.10	0.80	0.13	Simple random
2012	11	7	7	2	0.64	0.14	1.00	0.00	0.64	0.14	0.69	0.13	1.00	0.00	0.69	0.13	Simple random
2013	11	2	1	13	0.18	0.12	0.50	0.35	0.09	0.09	0.63	0.10	0.93	0.07	0.58	0.10	Simple random
2014	29	18	12	6	0.62	0.09	0.67	0.11	0.41	0.09	0.69	0.08	0.75	0.09	0.51	0.08	Simple random
2015	10	6	4	2	0.60	0.15	0.67	0.19	0.40	0.15	0.67	0.14	0.75	0.15	0.50	0.14	Simple random
2016	15	7	7	5	0.47	0.13	1.00	0.00	0.47	0.13	0.60	0.11	1.00	0.00	0.60	0.11	Simple random
2017	11	8	6	0	0.73	0.13	0.75	0.15	0.55	0.15	0.73	0.13	0.75	0.15	0.55	0.15	Simple random
2018	15	6	3	2	0.40	0.13	0.50	0.20	0.20	0.10	0.47	0.12	0.63	0.17	0.29	0.11	Simple random
2019	13	12	10	2	0.92	0.08	0.83	0.11	0.77	0.12	0.93	0.07	0.86	0.09	0.80	0.10	Simple random
2021	7	7	7	4	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	Simple random

<sup>a</sup>Chicks still present at last check but too young to consider successfully fledged by fledging age conventions (still present  $\geq 30$  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.

<sup>b</sup>For 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).

<sup>c</sup>For 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).

<sup>d</sup>Values 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.

<sup>e</sup>Sampling 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  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

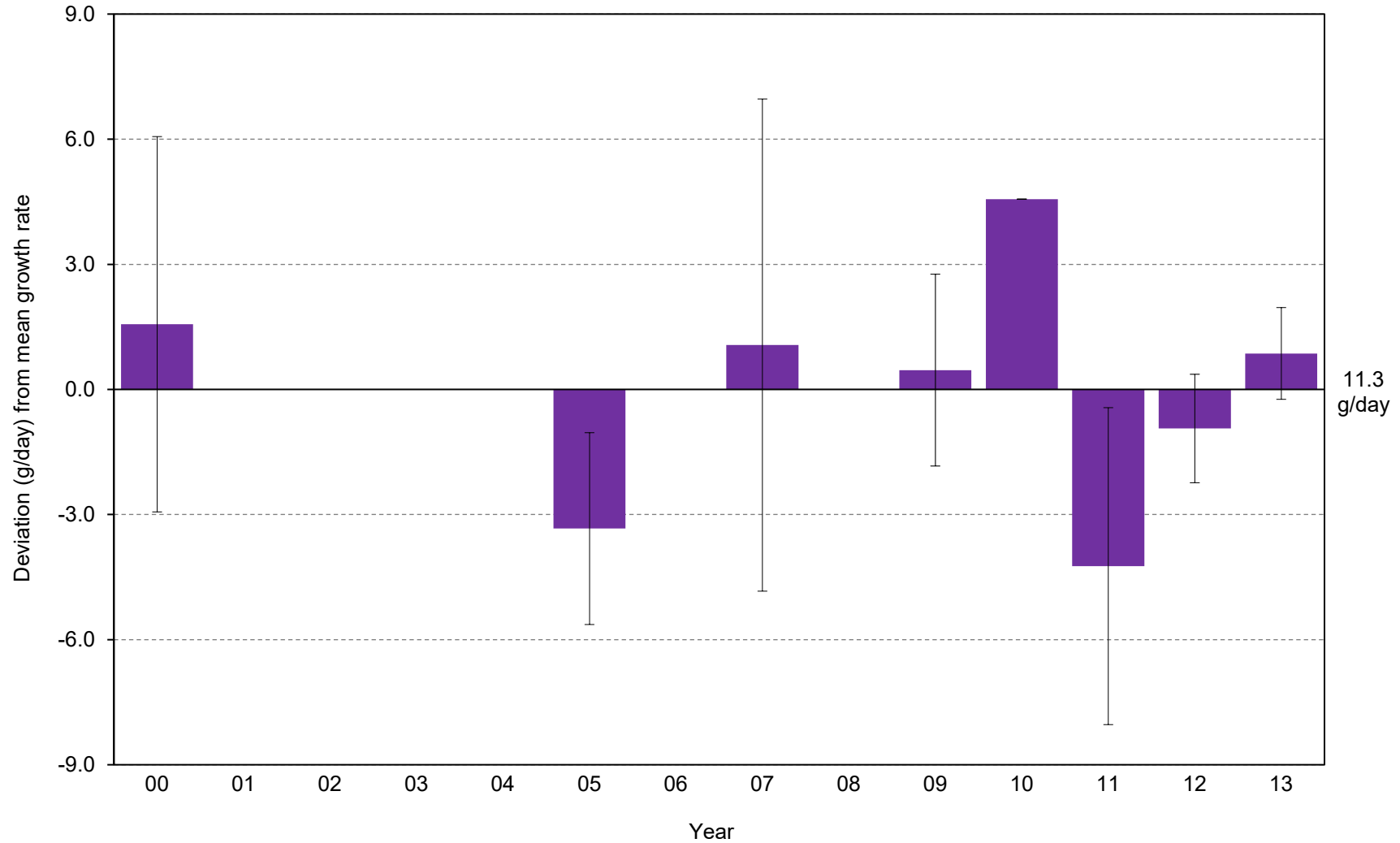


Figure 19. Yearly chick growth rate deviation (from the 1995-2013 average of 11.3 g/day) for horned puffins at Aikta Island, Alaska. Negative values indicate less than the mean growth rate, positive values exceed the mean growth rate. Error bars represent standard deviation around each year's mean growth rate. No chicks were measured in 2001-2004, 2006, 2008, or 2014-2021.

Table 30. Mean growth rates of horned puffin chicks at Aiktak Island, Alaska. Data include chicks measured at least two times during the linear phase of growth (up to approximately 450g); chicks that died were excluded. No chicks were measured in 2001-2004, 2006, 2008, or 2014-2021.

Year	Mass (g/day)				Wing chord (mm/day)			
	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>
2000	12.9	4.5	7.9 - 18.3	6	3.6	0.9	2.7 - 4.5	3
2005	8.0	2.3	5.7 - 10.2	3	3.4	0.2	3.2 - 3.6	3
2007	12.4	5.9	4.7 - 22.3	6	3.4	0.6	2.6 - 4.4	6
2009	11.8	2.3	9.6 - 15.5	5	4.0	0.6	3.3 - 5.0	5
2010	15.9	-	-	1	3.3	-	-	1
2011	7.1	3.8	4.4 - 11.4	3	2.8	0.1	2.8 - 2.9	3
2012	10.4	1.3	8.5 - 11.7	4	4.2	0.6	3.7 - 5.3	5
2013	12.2	1.1	11.4 - 12.9	2	4.0	0.3	3.8 - 4.2	2

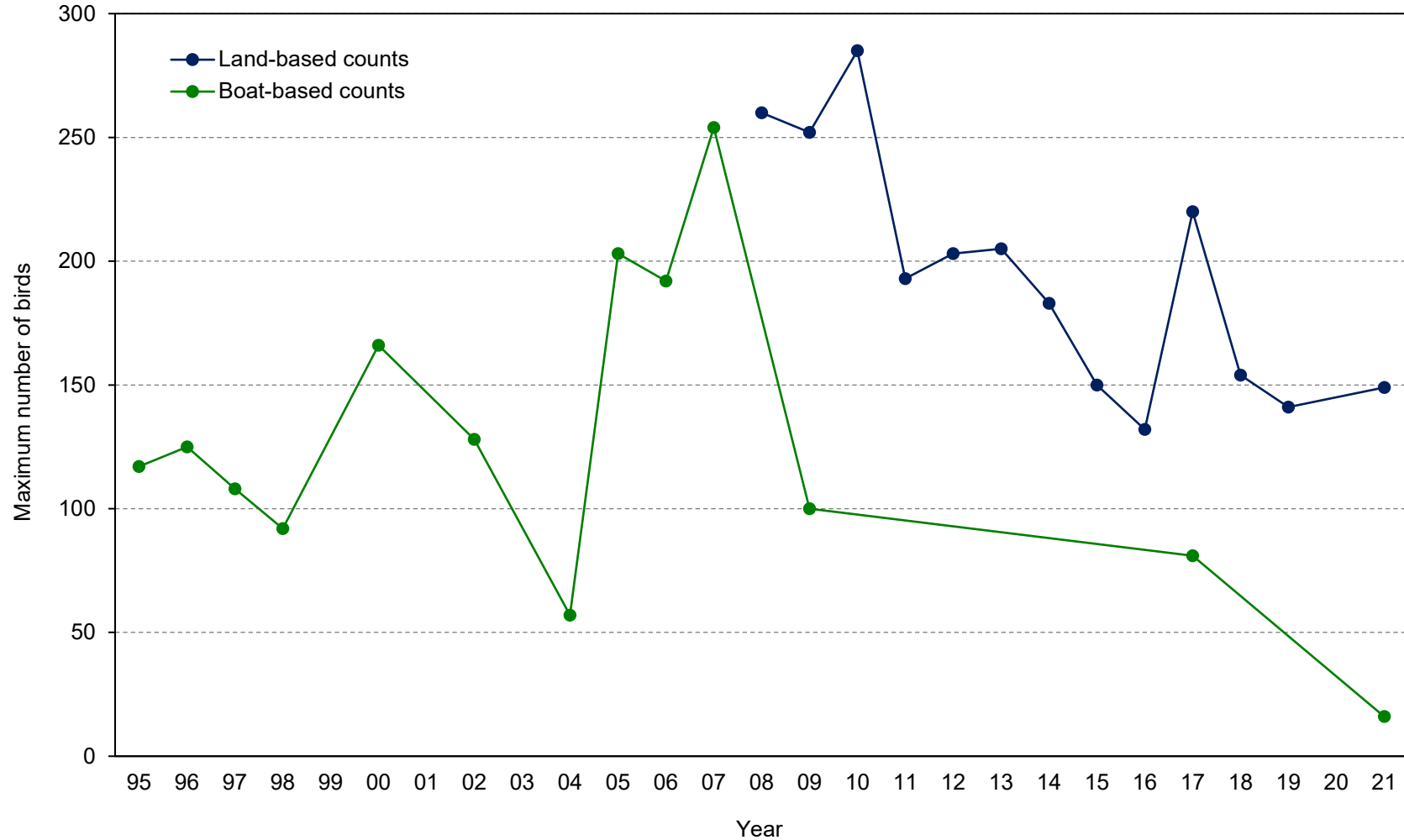


Figure 20. Maximum numbers of horned puffins counted from land-based observation points and during boat-based circumnavigation surveys at Aiktak Island, Alaska. Values represent the highest single daily count of individuals each year. Land-based counts all occurred during a standardized count window but times of day and seasons of boat-based counts vary (see Tables 31 and 33 for times). No land-based counts were conducted in 2020; land-based data do not include counts in 2000-2007 due to differences in observation points, times of day, and times of season. No boat-based counts were conducted in 1999, 2003, 2008, 2010-2016, or 2018-2020.

Table 31. Maximum numbers of horned puffins counted from land-based observation points at Aikta Island, Alaska. Data represent the highest single daily count of individuals each year. No counts were conducted in 2020; data do not include counts in 2000-2007 due to differences in observation points, times of day, and times of season.

Observation point	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
Pleasure Cove	4	10	0	0	4	2	4	0	1	0	4	9	0
Old Camp Beach	25	25	18	19	37	17	34	17	14	30	28	20	24
New Camp Beach	2	2	6	5	0	4	21	19	1	9	0	2	3
4 Sisters	42	47	49	33	24	32	5	22	19	15	16	9	6
Ivory Cove	6	18	10	6	6	14	8	10	7	9	0	5	2
Tower Cove	10	20	17	26	35	5	10	4	23	20	18	26	21
Arch's Cove	17	16	24	12	7	12	0	14	14	25	11	7	18
Petrel Valley Cove	154	119	161	92	90	119	101	64	53	112	77	63	75
Total	260	252	285	193	203	205	183	150	132	220	154	141	149
Date of max. count	7 Jul	19 Jul	20 Jul	16 Jul	5 Jul	8 Jul	10 Jul	27 Jul	11 Jul	11 Jul	5 Jul	4 Jul	15 Jul
Start time (ALDT) <sup>a</sup>	1550	1630	1600	1556	1530	1412	1510	1530	1506	1535	1528	1500	1500
End time (ALDT) <sup>a</sup>	1630	1800	1720	1739	1723	1748	1720	1825	1715	1815	1803	1628	1806

<sup>a</sup>Times are Aleutian Daylight Time (-1 hr from Alaska Daylight Time).

Table 32. Numbers of horned puffins counted from land-based observation points at Aiktak Island, Alaska in 2021.

Observation point	Date					Mean	SD	Max.
	3 Jul	9 Jul	11 Jul	15 Jul	16 Jul			
Pleasure Cove	0	5	7	0	4	-	-	-
Old Camp Beach	13	6	22	24	12	-	-	-
New Camp Beach	4	2	0	3	0	-	-	-
4 Sisters	13	6	3	6	10	-	-	-
Ivory Cove	7	2	1	2	6	-	-	-
Tower Cove	16	18	22	21	15	-	-	-
Arch's Cove	27	13	18	18	5	-	-	-
Petrel Valley Cove	68	49	57	75	37	-	-	-
Total	148	101	130	149	89	123	27	149
Start time (ALDT) <sup>a</sup>	1601	1523	1531	1500	1506	-	-	-
End time (ALDT) <sup>a</sup>	1825	1806	1828	1806	1731	-	-	-

<sup>a</sup>Times are Aleutian Daylight time (-1 hr from Alaska Daylight Time).



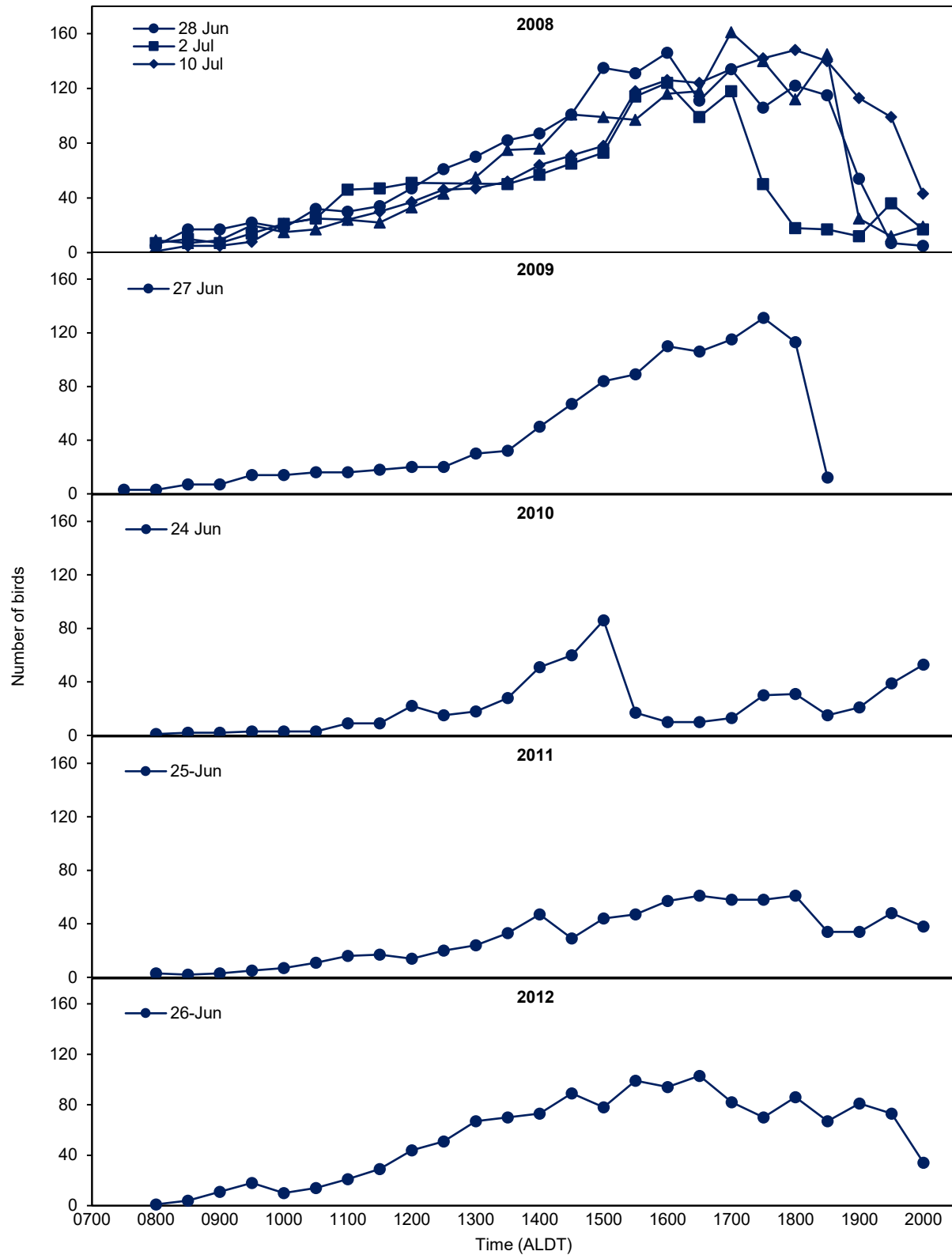


Figure 21. Attendance patterns of horned puffins on the water in Petrel Valley Cove during the incubation period at Aikta Island, Alaska. No all-day counts were conducted before 2008 or after 2012.

Table 33. Numbers of horned puffins counted during boat-based circumnavigation surveys at Aiktak Island, Alaska. Count time varied among years; morning counts may not be comparable with afternoon counts. No counts were conducted in 1999, 2003, 2008, 2010-2016, or 2018-2020.

Replicate	1995	1996	1997	1998	2000	2002	2004	2005	2006	2007	2009	2017	2021
1	99	113	108	11	89	67	36	63	191	165	100	81	16
2	59	62	88	92	166	48	30	203	192	254	85	-	-
3	117	125	24	-	161	119	57	156	-	167	-	-	-
4	-	65	-	-	85	128	38	-	-	-	-	-	-
5	-	-	-	-	74	-	-	-	-	-	-	-	-
Mean	92	91	73	52	115	91	40	141	192	195	93	81	16
Max.	117	125	108	92	166	128	57	203	192	254	100	81	16
n	3	4	3	2	5	4	4	3	2	3	2	1	1
SD	30	32	44	57	45	39	12	71	1	51	11	-	-
Date of max. count	5 Aug	2 Aug	23 Jul	3 Aug	4 Aug	18 Jul	4 Aug	4 Aug	21 Jul	8 Aug	25 Jul	6 Aug	14 Jul
Start time (ALDT) <sup>a</sup>	1230	1115	1100	1230	1230	1600	1500	1450	1500	1430	1400	0830	0903
End time (ALDT) <sup>a</sup>	1630	1330	1430	1545	1430	2000	1730	1900	1640	1630	1900	1021	1002

<sup>a</sup>Times are Aleutian Daylight Time (-1 hr from Alaska Daylight Time).

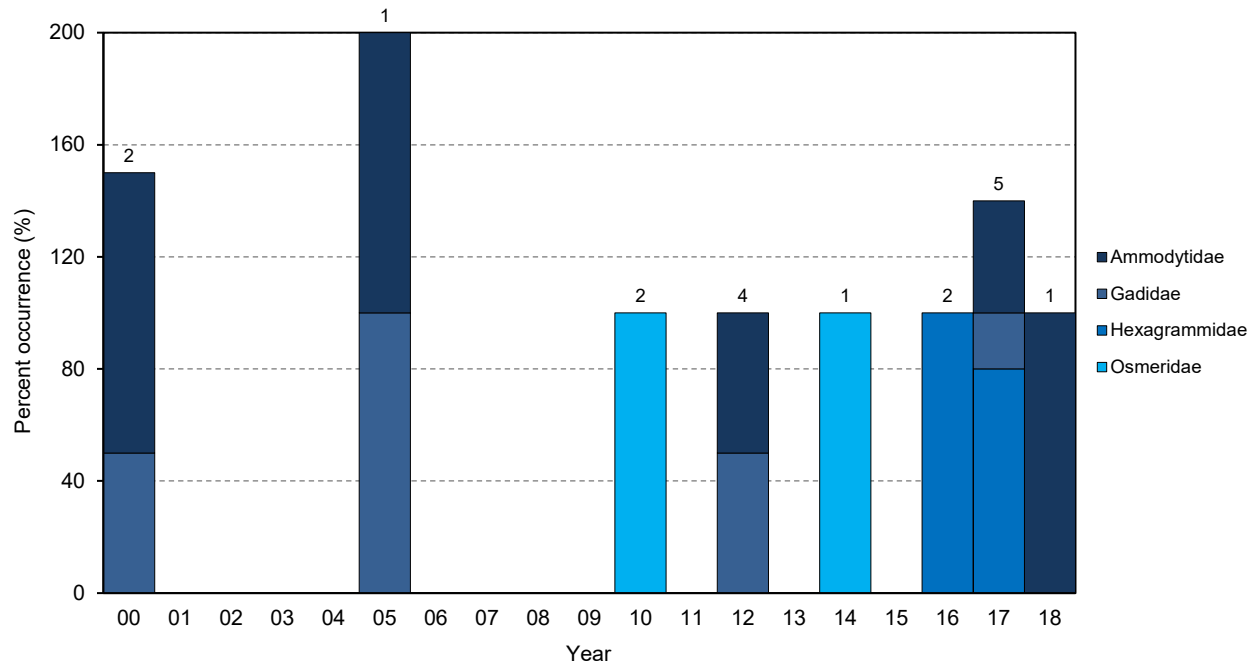


Figure 22. Frequency of occurrence of major prey items in diets of horned puffin chicks at Aiktak Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of 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 2001-2004, 2006-2009, 2011, 2013, 2015, or 2019-2021.

Table 34. Frequency of occurrence of major prey items in diets of horned puffin chicks at Aiktak 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 2001-2004, 2006-2009, 2011, 2013, 2015, or 2019-2021. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2000	2005	2010	2012	2014	2016	2017	2018
No. samples	2	1	2	4	1	2	5	1
<b>Fish</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Teleostei</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Ammodytidae</b>	<b>100.0</b>	<b>100.0</b>	-	<b>50.0</b>	-	-	<b>40.0</b>	<b>100.0</b>
<i>Ammodytes</i> spp.	100.0	100.0	-	50.0	-	-	40.0	100.0
<b>Gadidae</b>	<b>50.0</b>	<b>100.0</b>	-	<b>50.0</b>	-	-	<b>20.0</b>	-
<i>Gadus chalcogrammus</i>	-	100.0	-	50.0	-	-	20.0	-
<i>Microgadus proximus</i>	50.0	-	-	-	-	-	-	-
<b>Hexagrammidae</b>	-	-	-	-	-	<b>100.0</b>	<b>80.0</b>	-
<i>Pleurogrammus monopterygius</i>	-	-	-	-	-	100.0	80.0	-
<b>Osmeridae</b>	-	-	<b>100.0</b>	-	<b>100.0</b>	-	-	-
<i>Mallotus villosus</i>	-	-	100.0	-	100.0	-	-	-

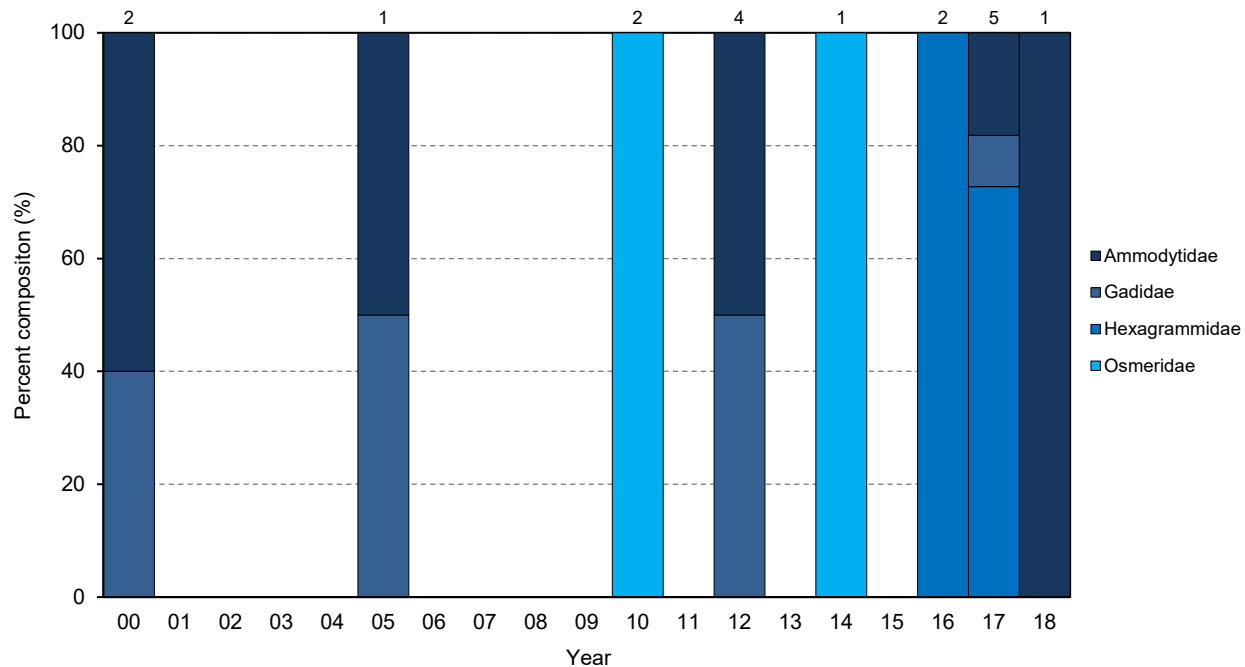


Figure 23. Percent composition of major prey items in diets of horned puffin chicks at Aiktak Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition 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 2001-2004, 2006-2009, 2011, 2013, 2015, or 2019-2021.

Table 35. Percent composition of major prey items in diets of horned puffin chicks at Aiktak 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 2001-2004, 2006-2009, 2011, 2013, 2015, or 2019-2021. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2000	2005	2010	2012	2014	2016	2017	2018
No. samples	2	1	2	4	1	2	5	1
No. individuals	5	4	2	8	1	6	11	1
<b>Fish</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Teleostei</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Ammodytidae</b>	<b>60.0</b>	<b>50.0</b>	-	<b>50.0</b>	-	-	<b>18.2</b>	<b>100.0</b>
<i>Ammodytes</i> spp.	60.0	50.0	-	50.0	-	-	18.2	100.0
<b>Gadidae</b>	<b>40.0</b>	<b>50.0</b>	-	<b>50.0</b>	-	-	<b>9.1</b>	-
<i>Gadus chalcogrammus</i>	-	50.0	-	50.0	-	-	9.1	-
<i>Microgadus proximus</i>	40.0	-	-	-	-	-	-	-
<b>Hexagrammidae</b>	-	-	-	-	-	<b>100.0</b>	<b>72.7</b>	-
<i>Pleurogrammus monopterygius</i>	-	-	-	-	-	100.0	72.7	-
<b>Osmeridae</b>	-	-	<b>100.0</b>	-	<b>100.0</b>	-	-	-
<i>Mallotus villosus</i>	-	-	100.0	-	100.0	-	-	-

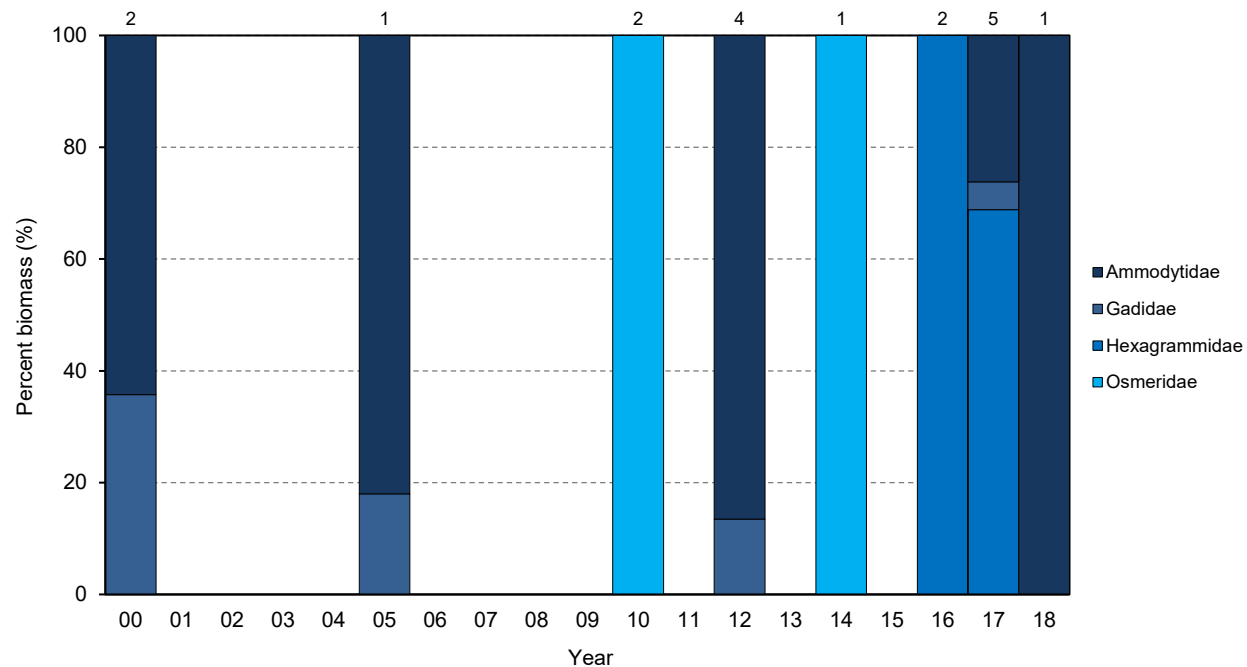


Figure 24. Relative biomass of major prey items in diets of horned puffin chicks at Aiktak Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average biomass of at least 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 2001-2004, 2006-2009, 2011, 2013, 2015, or 2019-2021.

Table 36. Relative biomass of major prey items in diets of horned puffin chicks at Aiktak 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 2001-2004, 2006-2009, 2011, 2013, 2015, or 2019-2021. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2000	2005	2010	2012	2014	2016	2017	2018
No. samples	2	1	2	4	1	2	5	1
Total mass (g)	22	17	23	36	2	14	26	1
<b>Fish</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Teleostei</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Ammodytidae</b>	<b>64.3</b>	<b>82.0</b>	-	<b>86.6</b>	-	-	<b>26.2</b>	<b>100.0</b>
<i>Ammodytes</i> spp.	64.3	82.0	-	86.6	-	-	26.2	100.0
<b>Gadidae</b>	<b>35.7</b>	<b>18.0</b>	-	<b>13.4</b>	-	-	<b>5.0</b>	-
<i>Gadus chalcogrammus</i>	-	18.0	-	13.4	-	-	5.0	-
Other Gadidae	35.7	-	-	-	-	-	-	-
<b>Hexagrammidae</b>	-	-	-	-	-	<b>100.0</b>	<b>68.8</b>	-
<i>Pleurogrammus monopterygius</i>	-	-	-	-	-	100.0	68.8	-
<b>Osmeridae</b>	-	-	<b>100.0</b>	-	<b>100.0</b>	-	-	-
<i>Mallotus villosus</i>	-	-	100.0	-	100.0	-	-	-

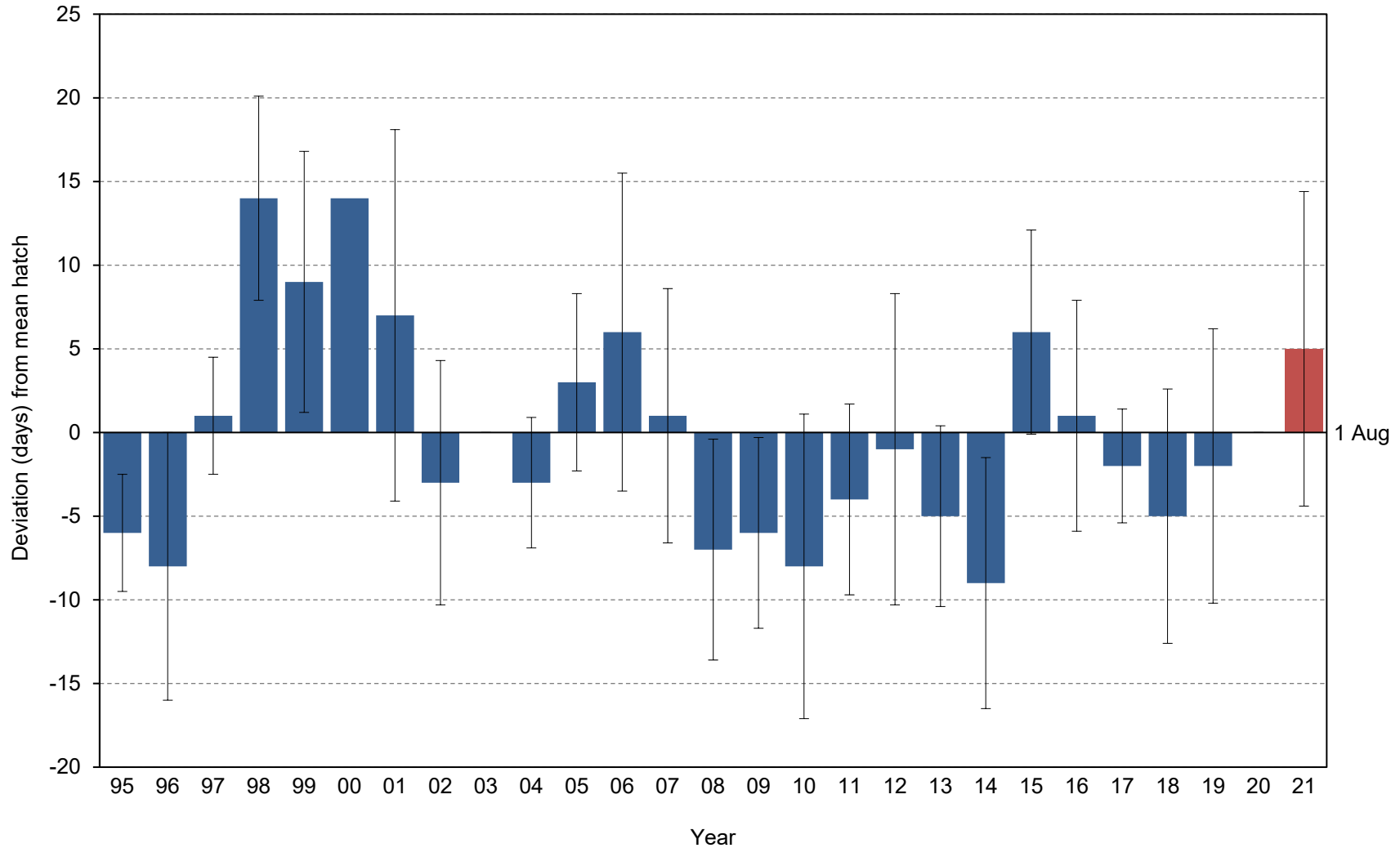


Figure 25. Yearly hatch date deviation (from the 1995-2020 average of 1 August) for tufted puffins at Aiktak Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date (years without error bars have sample size of one); red highlights the current year. No data were collected in 2003 or 2020.

Table 37. Breeding chronology of tufted puffins at Aiktak Island, Alaska. No data were collected in 2003 or 2020.

Year	Mean hatch	SD	<i>n</i> <sup>a</sup>	First hatch	Last hatch	First fledge <sup>b</sup>
1995	26 Jul	3.4	17	21 Jul	31 Jul	>31 Aug
1996	23 Jul	8.0	24	8 Jul	12 Aug	27 Aug
1997	2 Aug	3.5	24	27 Jul	8 Aug	>2 Sep
1998	15 Aug	6.1	5	8 Aug	24 Aug	>3 Sep
1999	10 Aug	7.8	6	3 Aug	27 Aug	>3 Sep
2000	14 Aug	-	1	14 Aug	-	27 Aug
2001	8 Aug	11.1	5	19 Jul	21 Aug	30 Aug
2002	29 Jul	7.3	16	21 Jul	18 Aug	1 Sep
2004	28 Jul	3.9	43	26 Jul	17 Aug	>27 Aug
2005	4 Aug	5.3	10	27 Jul	14 Aug	>30 Aug
2006	7 Aug	9.5	12	25 Jul	24 Aug	>2 Sep
2007	2 Aug	7.6	9	26 Jul	19 Aug	>27 Aug
2008	24 Jul	6.6	54	12 Jul	15 Aug	21 Aug
2009	26 Jul	5.7	53	18 Jul	11 Aug	31 Aug
2010	24 Jul	9.1	25	13 Jul	20 Aug	24 Aug
2011	28 Jul	5.7	15	21 Jul	10 Aug	>2 Sep
2012	30 Jul	9.3	16	18 Jul	17 Aug	28 Aug
2013	27 Jul	5.4	23	19 Jul	10 Aug	>29 Aug
2014	23 Jul	7.5	47	11 Jul	15 Aug	21 Aug
2015	7 Aug	6.1	11	31 Jul	16 Aug	>28 Aug
2016	1 Aug	6.9	25	20 Jul	13 Aug	>1 Sep
2017	30 Jul	3.4	4	27 Jul	5 Aug	>31 Aug
2018	27 Jul	7.6	32	18 Jul	16 Aug	28 Aug
2019	30 Jul	8.2	32	19 Jul	22 Aug	>30 Aug
2021	6 Aug	9.4	37	21 Jul	27 Aug	>28 Aug

<sup>a</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is  $\leq 7$  days.

<sup>b</sup>In 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 38. Frequency distribution of hatch dates for tufted puffins at Aikta Island, Alaska. Data include only nests in which observations of egg to chick  $\leq 7$  days. No data were collected in 2003 or 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date												
	95	96	97	98	99	00	01	02	04	05	06	07	08
190	-	1	-	-	-	-	-	-	-	-	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	1	-	-	-	-	-	-	-	-	-	-	1
195	-	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	-	-	-	-	-	-	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-	-
198	-	5	-	-	-	-	-	-	-	-	-	-	1
199	-	3	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	1	-	-	-	-	-	12
201	-	-	-	-	-	-	-	-	-	-	-	-	-
202	2	1	-	-	-	-	-	4	-	-	-	-	2
203	-	-	-	-	-	-	-	-	-	-	-	-	2
204	4	3	-	-	-	-	-	-	-	-	-	-	16
205	-	-	-	-	-	-	-	-	-	-	-	-	-
206	4	-	-	-	-	-	-	2	-	-	2	-	-
207	-	-	-	-	-	-	-	-	-	-	-	1	2
208	-	3	4	-	-	-	-	4	32	1	-	2	1
209	-	1	-	-	-	-	-	-	-	-	-	-	-
210	4	-	-	-	-	-	-	-	-	-	-	-	7
211	1	-	-	-	-	-	-	-	-	-	-	-	-
212	2	1	4	-	-	-	-	1	2	1	3	2	-
213	-	3	-	-	-	-	-	-	-	-	-	1	-
214	-	-	-	-	-	-	-	3	8	6	-	1	5
215	-	-	2	-	1	-	-	-	-	-	-	-	-
216	-	-	11	-	-	-	-	-	-	-	-	-	-
217	-	1	-	-	-	-	-	-	-	-	-	-	1
218	-	-	-	-	-	-	1	-	-	-	1	-	1
219	-	-	1	-	3	-	-	-	-	-	1	-	-
220	-	-	2	1	-	-	-	1	-	-	-	-	2
221	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	-	-	-	-	-	-
223	-	-	-	2	1	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	1	-	-	-	1	1	-
225	-	1	-	-	-	-	1	-	-	1	1	-	-
226	-	-	-	-	-	-	-	-	-	1	-	-	-
227	-	-	-	-	-	1	-	-	-	-	-	-	-
228	-	-	-	-	-	-	-	-	-	-	-	-	1
229	-	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	1	1	-	2	-	-
231	-	-	-	-	-	-	-	-	-	-	-	1	-
232	-	-	-	1	-	-	-	-	-	-	-	-	-
233	-	-	-	-	-	-	1	-	-	-	-	-	-
234	-	-	-	-	-	-	-	-	-	-	-	-	-
235	-	-	-	-	-	-	-	-	-	-	-	-	-
236	-	-	-	1	-	-	-	-	-	-	1	-	-
237	-	-	-	-	-	-	-	-	-	-	-	-	-
238	-	-	-	-	-	-	-	-	-	-	-	-	-
239	-	-	-	-	1	-	-	-	-	-	-	-	-
<i>n</i>	17	24	24	5	6	1	5	16	43	10	12	9	54

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.



Table 38 (continued). Frequency distribution of hatch dates for tufted puffins at Aikta Island, Alaska. Data include only nests in which observations of egg to chick  $\leq 7$  days. No data were collected in 2003 or 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date											
	09	10	11	12	13	14	15	16	17	18	19	21
190	-	-	-	-	-	-	-	-	-	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	1	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-
194	-	3	-	-	-	1	-	-	-	-	-	-
195	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	-	10	-	-	-	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-
198	-	2	-	-	-	-	-	-	-	-	-	-
199	1	-	-	-	-	1	-	-	-	2	-	-
200	-	7	-	1	4	3	-	-	-	3	1	-
201	18	-	-	1	-	1	-	-	-	-	-	-
202	-	2	1	-	-	-	-	3	-	4	1	1
203	-	-	2	-	-	1	-	-	-	-	3	2
204	-	2	-	2	-	1	-	-	-	5	-	-
205	-	-	1	2	-	5	-	-	-	-	1	-
206	13	-	-	-	11	13	-	-	-	2	3	-
207	-	-	5	-	-	-	-	-	-	4	7	-
208	1	6	1	-	-	2	-	4	1	1	-	2
209	2	-	-	-	-	-	-	-	-	-	-	1
210	5	-	-	4	3	1	-	-	2	2	-	-
211	-	-	-	-	-	-	-	1	-	-	-	5
212	-	-	1	-	2	-	1	4	-	-	10	4
213	2	-	-	-	-	1	2	2	-	1	-	-
214	8	-	-	1	-	2	-	-	-	2	-	1
215	1	-	-	-	-	-	-	-	-	-	-	-
216	-	-	3	-	2	-	4	3	-	-	-	-
217	-	-	-	-	-	1	-	-	1	-	-	-
218	-	-	-	-	-	1	-	-	-	1	1	6
219	1	-	-	2	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	3	-	2	-	1
221	-	-	-	-	-	-	-	2	-	1	-	-
222	-	-	1	-	1	-	-	-	-	1	-	-
223	1	2	-	1	-	-	-	1	-	-	-	1
224	-	-	-	-	-	1	-	-	-	-	1	2
225	-	-	-	-	-	-	1	-	-	-	1	-
226	-	-	-	-	-	-	1	2	-	-	-	6
227	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	-	1	2	-	-	1	2	-
229	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	2	-	-	-	-	-	-	-	1
231	-	-	-	-	-	-	-	-	-	-	-	-
232	-	1	-	-	-	-	-	-	-	-	-	2
233	-	-	-	-	-	-	-	-	-	-	-	-
234	-	-	-	-	-	-	-	-	-	-	1	-
235	-	-	-	-	-	-	-	-	-	-	-	-
236	-	-	-	-	-	-	-	-	-	-	-	-
237	-	-	-	-	-	-	-	-	-	-	-	-
238	-	-	-	-	-	-	-	-	-	-	-	-
239	-	-	-	-	-	-	-	-	-	-	-	2
<i>n</i>	53	25	15	16	23	47	11	25	4	32	32	37

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

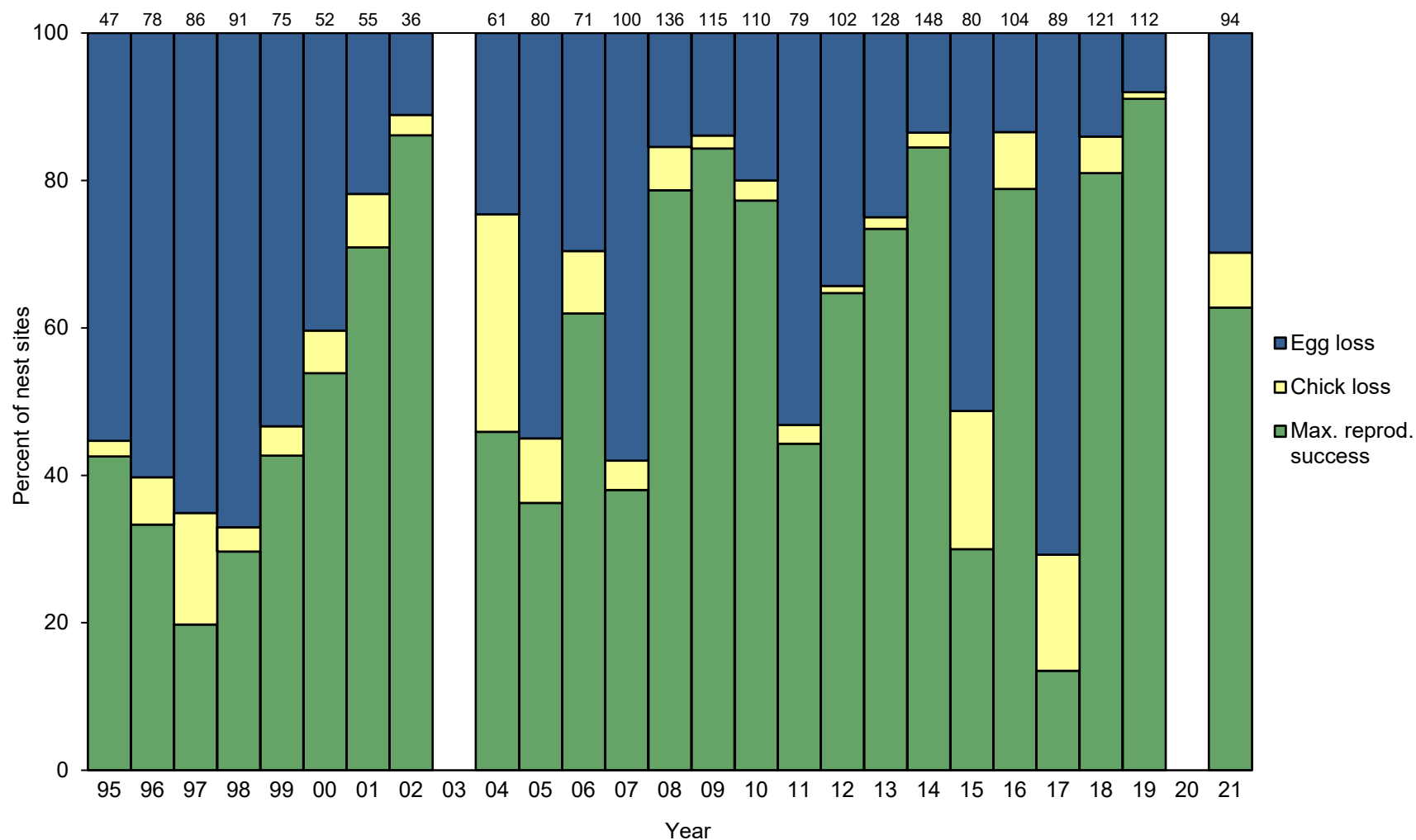


Figure 26. Maximum potential reproductive performance of tufted puffins at Aiktak Island, Alaska. Values include nest sites with chicks still present but too young to consider fledged at the last check. Egg loss= $[(B+H)-D+H]/(B+H)$ ; Chick loss= $[(D+H)-F+H]/(B+H)$ ; Maximum potential reproductive success= $[(F+H)/(B+H)]$ , where B=nest sites with eggs; D=nest site with chicks; F=nest sites with chicks fledged; H=nest sites with young chicks still present. Numbers above columns indicate sample sizes (B+H). In 2021 data do not include nest sites with adult birds that were handled during a geolocator study. No data were collected in 2003 or 2020.

Table 39. Reproductive performance of tufted puffins in artificial and natural burrows at Aikta Island, Alaska. No data were collected in 2003 or 2020.

Year	Nest sites w/ eggs	Nest sites w/ chicks	Nest sites w/ chicks fledged	Nest sites w/ young chicks still present <sup>a</sup>	Nesting success (D/B) <sup>b</sup>		Fledging success (F/D) <sup>c</sup>		Reproductive success (F/B)		Max. potential nesting success <sup>d</sup> [(D+H)/(B+H)]		Max. potential fledging success <sup>d</sup> [(F+H)/(D+H)]		Max. potential reproductive success <sup>d</sup> [(F+H)/(B+H)]		Sampling design <sup>e</sup>
	(B)	(D)	(F)	(H)	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	
1995	43	17	16	4	0.40	0.07	0.94	0.06	0.37	0.07	0.45	0.07	0.95	0.05	0.43	0.07	Simple random
1996	76	29	24	2	0.38	0.06	0.83	0.07	0.32	0.05	0.40	0.06	0.84	0.07	0.33	0.05	Simple random
1997	71	15	2	15	0.21	0.05	0.13	0.09	0.03	0.02	0.35	0.05	0.57	0.09	0.20	0.04	Simple random
1998	68	7	4	23	0.10	0.04	0.57	0.19	0.06	0.03	0.33	0.05	0.90	0.05	0.30	0.05	Simple random
1999	44	4	1	31	0.09	0.04	0.25	0.22	0.02	0.02	0.47	0.06	0.91	0.05	0.43	0.06	Simple random
2000	48	27	24	4	0.56	0.07	0.89	0.06	0.50	0.07	0.60	0.07	0.90	0.05	0.54	0.07	Simple random
2001	44	32	28	11	0.73	0.07	0.88	0.06	0.64	0.07	0.78	0.06	0.91	0.04	0.71	0.06	Simple random
2002	29	25	24	7	0.86	0.06	0.96	0.04	0.83	0.07	0.89	0.05	0.97	0.03	0.86	0.06	Simple random
2004	33	18	0	28	0.55	0.09	0.00	0.00	0.00	0.00	0.75	0.06	0.61	0.07	0.46	0.06	Simple random
2005	55	11	4	25	0.20	0.05	0.36	0.14	0.07	0.03	0.45	0.06	0.81	0.07	0.36	0.05	Simple random
2006	39	18	12	32	0.46	0.08	0.67	0.11	0.31	0.07	0.70	0.05	0.88	0.05	0.62	0.06	Simple random
2007	62	4	0	38	0.06	0.03	0.00	0.00	0.00	0.00	0.42	0.05	0.90	0.05	0.38	0.05	Simple random
2008	96	75	67	40	0.78	0.04	0.89	0.04	0.70	0.05	0.85	0.03	0.93	0.02	0.79	0.03	Simple random
2009	94	78	76	21	0.83	0.04	0.97	0.02	0.81	0.04	0.86	0.03	0.98	0.01	0.84	0.03	Simple random
2010	96	74	71	14	0.77	0.04	0.96	0.02	0.74	0.04	0.80	0.04	0.97	0.02	0.77	0.04	Simple random
2011	61	19	17	18	0.31	0.06	0.89	0.07	0.28	0.06	0.47	0.06	0.95	0.04	0.44	0.06	Simple random
2012	81	46	45	21	0.57	0.06	0.98	0.02	0.56	0.06	0.66	0.05	0.99	0.01	0.65	0.05	Simple random
2013	76	44	42	52	0.58	0.06	0.95	0.03	0.55	0.06	0.75	0.04	0.98	0.01	0.73	0.04	Simple random
2014	80	60	57	68	0.75	0.05	0.95	0.03	0.71	0.05	0.86	0.03	0.98	0.01	0.84	0.03	Simple random
2015	56	15	0	24	0.27	0.06	0.00	0.00	0.00	0.00	0.49	0.06	0.62	0.08	0.30	0.05	Simple random
2016	64	50	42	40	0.78	0.05	0.84	0.05	0.66	0.06	0.87	0.03	0.91	0.03	0.79	0.04	Simple random
2017	82	19	5	7	0.23	0.05	0.26	0.10	0.06	0.03	0.29	0.05	0.46	0.10	0.13	0.04	Simple random
2018	84	67	61	37	0.80	0.04	0.91	0.03	0.73	0.05	0.86	0.03	0.94	0.02	0.81	0.04	Simple random
2019	61	52	51	51	0.85	0.05	0.98	0.02	0.84	0.05	0.92	0.03	0.99	0.01	0.91	0.03	Simple random
2021 <sup>f</sup>	41	13	6	53	0.32	0.07	0.46	0.14	0.15	0.06	0.70	0.05	0.89	0.04	0.63	0.05	Simple random

<sup>a</sup>Chicks still present at last check but too young to consider successfully fledged by fledging age conventions (still present  $\geq 33$  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.

<sup>b</sup>For 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).

<sup>c</sup>For 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).

<sup>d</sup>Values 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.

<sup>e</sup>Sampling 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  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

<sup>f</sup>In 2021 data do not include nest sites with adult birds that were handled during a geolocator study.

Table 40. Reproductive performance of handled and unhandled tufted puffins at Aikta Island, Alaska in 2021. Summaries are presented for nest sites monitored following the standard protocol (labeled “not handled, monitored only”; also presented in Table 39), as well as for nest sites with adult birds that were handled for a geolocator study. In 2021, geolocator loggers were deployed on 19 individuals who had successfully hatched a chick and the chicks had survived past the early chick period.

Parameter	Group		Total
	Not handled	Handled	
	Monitored only	Tag deployed	
Nests with eggs (B)	41	3	44
Nest sites w/ chicks (D)	13	3	16
Nests w/ chicks fledged (F)	6	3	9
Nest sites w/ young chicks still present <sup>a</sup> (H)	53	16	69
Nesting success (D/B) <sup>b</sup>	0.32	1.00	0.36
Fledging success (F/D) <sup>c</sup>	0.46	1.00	0.56
Reproductive success (F/B)	0.15	1.00	0.20
Max. potential nesting success [(D+H)/(B+H)]	0.70	1.00	0.75
Max. potential fledging success [(F+H)/(D+H)]	0.89	1.00	0.92
Max. potential reproductive success [(F+H)/(B+H)]	0.63	1.00	0.69

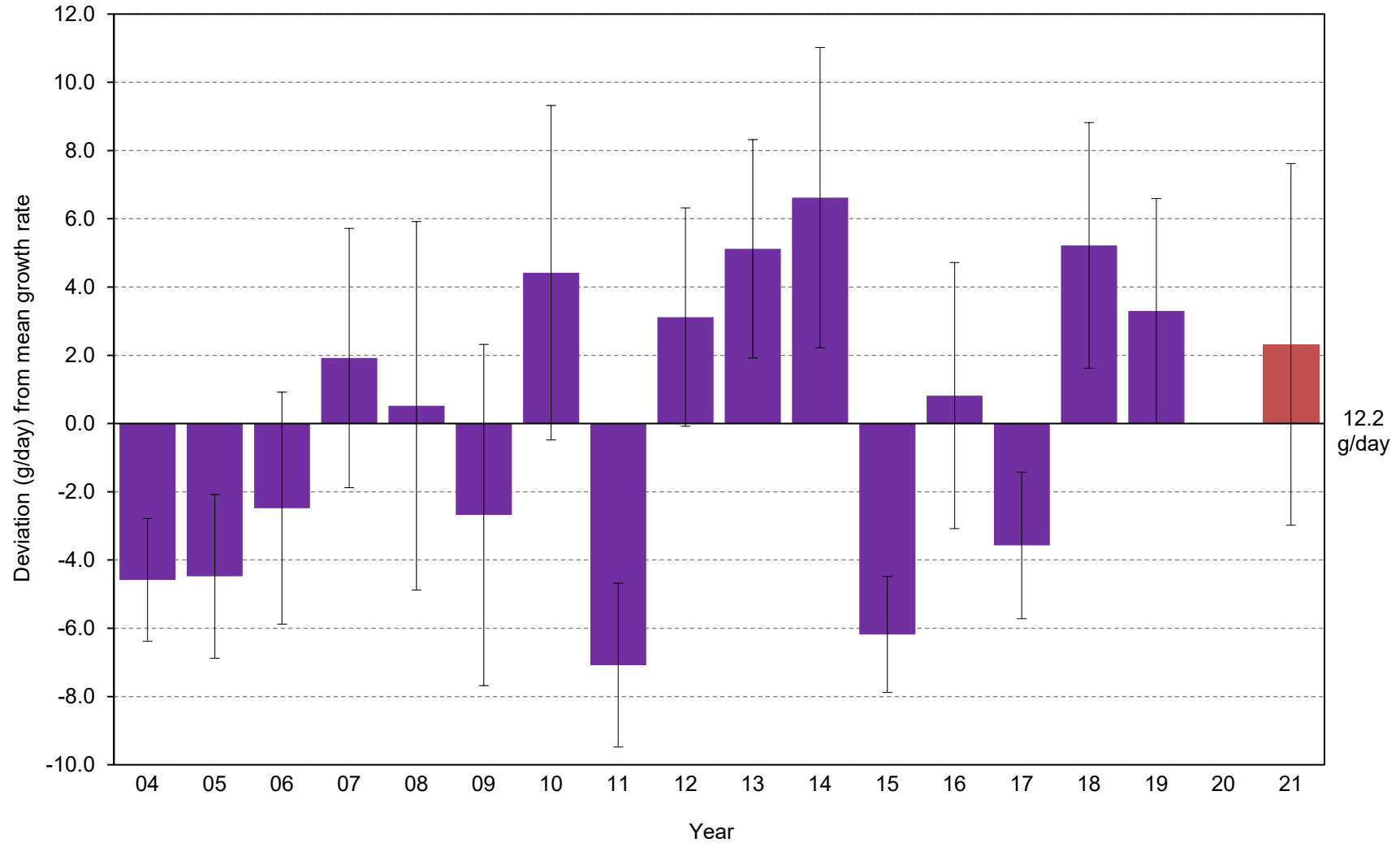


Figure 27. Yearly chick growth rate deviation (from the 2004-2020 average of 12.2 g/day) for tufted puffins at Aiktak Island, Alaska. Negative values indicate less than the mean growth rate, positive values exceed the mean growth rate. Error bars represent standard deviation around each year's mean growth rate; red highlights the current year. No chicks were measured in 2003 or 2020; data potentially exist from 1996-2002 but have not yet been summarized.

Table 41. Mean growth rates of tufted puffin chicks at Aiktak Island, Alaska. Data include chicks measured at least two times during the linear phase of growth (up to approximately 450g); chicks that died were excluded. No chicks were measured in 2003 or 2020.

Year	Mass (g/day)				Wing chord (mm/day) <sup>a</sup>			
	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>
1996	xx <sup>b</sup>	xx	xx - xx	xx	xx	xx	xx - xx	xx
1997	xx	xx	xx - xx	xx	xx	xx	xx - xx	xx
1998	xx	xx	xx - xx	xx	xx	xx	xx - xx	xx
1999	xx	xx	xx - xx	xx	xx	xx	xx - xx	xx
2000	xx	xx	xx - xx	xx	xx	xx	xx - xx	xx
2001	xx	xx	xx - xx	xx	xx	xx	xx - xx	xx
2002	xx	xx	xx - xx	xx	xx	xx	xx - xx	xx
2004	7.6	1.8	3.0 - 11.4	23	2.0	1.1	0.6 - 4.7	25
2005	7.7	2.4	3.4 - 14.5	23	2.8	0.4	1.8 - 3.5	23
2006	9.7	3.4	5.1 - 18.3	20	2.8	0.4	2.0 - 3.5	15
2007	14.1	3.8	9.7 - 23.5	13	3.8	0.6	3.1 - 5.0	11
2008	12.7	5.4	0.9 - 20.1	17	3.4	0.7	2.0 - 4.6	17
2009	9.5	5.0	2.3 - 22.7	28	3.1	0.9	1.1 - 5.8	28
2010	16.6	4.9	5.7 - 31.3	21	3.3	0.6	1.6 - 4.0	21
2011	5.1	2.4	1.4 - 10.2	15	2.6	0.9	0.6 - 4.1	15
2012	15.3	3.2	11.9 - 22.4	13	3.6	0.4	3.0 - 4.5	13
2013	17.3	3.2	11.6 - 22.2	12	3.6	1.1	1.2 - 6.1	14
2014	18.8	4.4	10.8 - 34.8	24	3.7	0.5	1.9 - 4.7	24
2015	6.0	1.7	3.7 - 8.3	7	1.8	0.4	1.1 - 2.5	7
2016	13.0	3.9	6.3 - 20.8	13	3.0	0.7	1.4 - 3.7	13
2017	8.6	2.1	6.4 - 12.0	5	2.7	0.5	2.3 - 3.3	5
2018	17.4	3.6	10.8 - 27.5	21	3.5	0.6	2.0 - 4.2	21
2019	15.5	3.3	10.4 - 22.4	17	3.5	0.4	2.6 - 4.3	17
2021	14.5	5.3	4.8 - 21.8	9	2.5	0.7	1.5 - 3.6	9

<sup>a</sup>All rates of growth are based on relaxed wing chord measurements, except 1998 when only flat wing data were recorded.

<sup>b</sup>xx indicates data potentially exist but have not yet been summarized.

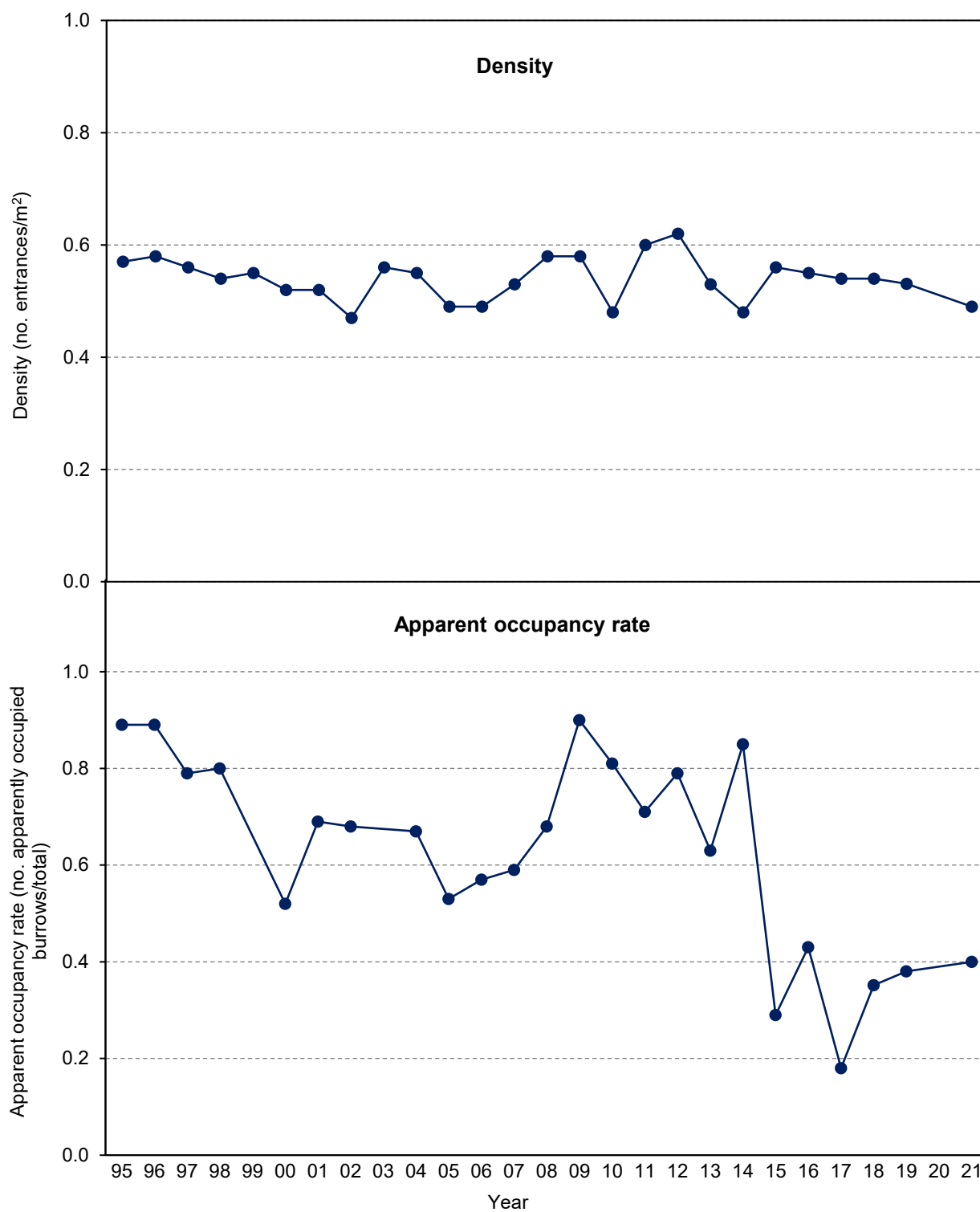


Figure 28. Burrow entrance densities and apparent occupancy rates of tufted puffins on index plots at Aiktak Island, Alaska. No data were collected in 2020.

Table 42. Burrow entrance densities of tufted puffins on index plots at Aiktak Island, Alaska. Density is expressed as the number of large (>14.5 cm) burrow entrances per m<sup>2</sup> and is assessed in late May or early June, before laying. No data were collected in 2020.

Year	Plot										Total	Mean	SD
	1	2	3	4	5	6	7	8	9	10			
1995	0.41	0.52	0.92	0.86	0.33	0.29	0.89	0.22	0.77	0.44	0.57	0.57	0.27
1996	0.39	0.63	0.93	0.87	0.36	0.31	0.85	0.18	0.72	0.43	0.58	0.57	0.27
1997	0.39	0.56	0.97	0.76	0.37	0.28	0.83	0.08	0.74	0.43	0.56	0.54	0.28
1998	0.35	0.54	0.92	0.76	0.37	0.31	0.74	0.20	0.81	0.36	0.54	0.54	0.25
1999	0.34	0.54	0.87	0.79	0.40	0.35	0.79	0.16	0.82	0.44	0.55	0.55	0.25
2000	0.32	0.47	0.83	0.78	0.38	0.30	0.81	0.22	0.73	0.29	0.52	0.51	0.24
2001	0.33	0.50	0.83	0.76	0.30	0.35	0.84	0.18	0.79	0.35	0.52	0.52	0.26
2002	0.22	0.45	0.66	0.59	0.39	0.34	0.73	0.24	0.83	0.40	0.47	0.49	0.21
2003	0.36	0.55	0.98	0.64	0.39	0.37	0.86	0.21	0.91	0.37	0.56	0.56	0.27
2004	0.33	0.47	0.90	0.76	0.40	0.35	0.85	0.20	0.86	0.42	0.55	0.55	0.26
2005	0.29	0.39	0.80	0.68	0.36	0.36	0.71	0.21	0.78	0.36	0.49	0.49	0.22
2006	0.29	0.42	0.75	0.72	0.32	0.32	0.79	0.21	0.77	0.32	0.49	0.49	0.23
2007	0.31	0.38	0.91	0.76	0.38	0.36	0.86	0.18	0.85	0.36	0.53	0.54	0.28
2008	0.33	0.46	0.98	0.83	0.35	0.43	0.95	0.23	0.90	0.34	0.58	0.58	0.30
2009	0.34	0.45	0.97	0.77	0.36	0.48	0.87	0.21	1.07	0.38	0.58	0.59	0.30
2010	0.25	0.39	0.67	0.84	0.22	0.40	0.76	0.19	0.81	0.31	0.48	0.49	0.26
2011	0.33	0.48	1.02	0.85	0.46	0.45	0.78	0.28	1.01	0.34	0.60	0.60	0.29
2012	0.31	0.45	1.00	0.87	0.51	0.50	0.85	0.37	1.01	0.42	0.62	0.63	0.26
2013	0.27	0.44	0.77	0.79	0.35	0.42	0.91	0.17	0.96	0.31	0.53	0.54	0.27
2014	0.32	0.34	0.88	0.66	0.38	0.54	0.81	0.19	0.68	0.14	0.48	0.49	0.24
2015	0.30	0.38	0.99	0.81	0.37	0.48	0.78	0.18	0.90	0.32	0.56	0.55	0.29
2016	0.27	0.36	0.92	0.82	0.46	0.49	0.72	0.19	0.91	0.35	0.55	0.55	0.27
2017	0.28	0.35	0.95	0.80	0.40	0.45	0.75	0.15	0.92	0.27	0.54	0.53	0.29
2018	0.25	0.32	0.98	0.77	0.38	0.48	0.76	0.18	0.92	0.31	0.54	0.54	0.29
2019	0.26	0.34	0.94	0.77	0.40	0.47	0.74	0.15	0.81	0.31	0.53	0.52	0.27
2021	0.22	0.25	0.87	0.78	0.31	0.48	0.69	0.14	0.86	0.19	0.49	0.48	0.29
Plot area (m <sup>2</sup> )	314.2	314.2	314.2	314.2	314.2	314.2	150.0	98.5	98.5	98.5	2330.5	-	-



Table 43. Apparent occupancy rates of tufted puffins on index plots at Aiktak Island, Alaska. Apparent occupancy rate is expressed as the proportion of large (>14.5 cm) burrows with evidence of apparent occupancy late in the nesting period. Evidence of apparent occupancy includes observations of feathers, droppings, fresh vegetation, clipped vegetation and roots, eggs, eggshell fragments, or chicks in the burrow. Apparent occupancy rate is assessed in mid to late August, towards the end of the chick-rearing period. No data were collected in 2020.

Year	Plot										Total	Mean	SD
	1	2	3	4	5	6	7	8	9	10			
1995	0.82	0.80	0.86	0.97	0.93	1.00	0.85	0.86	0.96	0.93	0.89	0.90	0.07
1996	0.87	0.95	0.85	0.96	0.67	0.96	0.90	0.62	0.95	0.81	0.89	0.85	0.12
1997	0.71	0.74	0.78	0.88	0.70	0.82	0.89	0.67	0.77	0.55	0.79	0.75	0.10
1998	0.70	0.82	0.83	0.81	0.77	0.81	0.87	0.69	0.74	0.63	0.80	0.77	0.07
1999	0.74	0.66	0.71	0.71	0.76	0.82	-	0.53	-	0.73	- <sup>a</sup>	-	-
2000	0.54	0.36	0.56	0.52	0.51	0.64	0.55	0.63	0.49	0.56	0.52	0.54	0.08
2001	0.78	0.73	0.55	0.77	0.70	0.75	0.69	0.57	0.69	0.56	0.69	0.68	0.09
2002	0.60	0.62	0.81	0.61	0.78	0.75	0.52	0.65	0.77	0.62	0.68	0.67	0.10
2003	<i>no data</i>	-	-	-	-	-	-	-	-	-	-	-	-
2004	0.39	0.56	0.74	0.57	0.83	0.83	0.66	0.60	0.79	0.76	0.67	0.67	0.14
2005	0.60	0.50	0.37	0.69	0.58	0.63	0.51	0.35	0.63	0.39	0.53	0.53	0.12
2006	0.53	0.46	0.46	0.69	0.63	0.70	0.54	0.52	0.57	0.56	0.57	0.57	0.08
2007	0.52	0.64	0.51	0.53	0.61	0.69	0.76	0.53	0.66	0.41	0.59	0.59	0.10
2008	0.73	0.70	0.57	0.79	0.69	0.70	0.65	0.71	0.69	0.56	0.68	0.68	0.07
2009	0.89	0.86	0.95	0.95	0.77	0.94	0.92	0.70	0.96	0.67	0.90	0.86	0.11
2010	0.87	0.87	0.86	0.89	0.78	0.68	0.67	0.90	0.76	0.66	0.81	0.79	0.10
2011	0.74	0.83	0.55	0.77	0.79	0.71	0.74	0.65	0.80	0.78	0.71	0.74	0.08
2012	0.78	0.64	0.74	0.92	0.82	0.79	0.77	0.58	0.87	0.58	0.79	0.75	0.12
2013	0.74	0.57	0.56	0.73	0.59	0.69	0.62	0.64	0.61	0.30	0.63	0.60	0.12
2014	0.93	0.84	0.87	0.84	0.79	0.95	0.85	0.87	0.84	0.50	0.85	0.83	0.12
2015	0.41	0.12	0.24	0.33	0.25	0.30	0.39	0.07	0.31	0.46	0.29	0.29	0.12
2016	0.50	0.38	0.36	0.53	0.45	0.38	0.46	0.28	0.47	0.33	0.43	0.41	0.08
2017	0.35	0.19	0.10	0.16	0.15	0.27	0.23	0.08	0.26	0.00	0.18	0.18	0.10
2018	0.44	0.38	0.36	0.39	0.35	0.25	0.26	0.43	0.44	0.16	0.35	0.35	0.09
2019	0.54	0.39	0.38	0.42	0.27	0.33	0.35	0.38	0.38	0.23	0.38	0.37	0.08
2021	0.41	0.34	0.31	0.50	0.39	0.48	0.37	0.58	0.39	0.12	0.40	0.39	0.12

<sup>a</sup>Summary statistics are not calculated in years when all plots are not surveyed.

Table 44. Burrow entrance densities and apparent occupancy rates of tufted puffins on index plots at Aiktak Island, Alaska in 2021. Density is expressed as the number of large (>14.5 cm) burrow entrances per m<sup>2</sup>. Apparent occupancy rate is expressed as the proportion of large (>14.5 cm) burrows with evidence of apparent occupancy late in the nesting period. Evidence of apparent occupancy includes observations of feathers, droppings, fresh vegetation, clipped vegetation and roots, eggs, eggshell fragments, or chicks in the burrow. Density is assessed in late May to 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.

Parameter	Plot										Total	Mean	SD
	1	2	3	4	5	6	7	8	9	10			
Density													
Number of burrow entrances													
Small (<9.5 cm)	1	3	1	5	17	3	5	0	3	1	39	3.9	4.9
Medium (9.5-14.5 cm)	9	14	16	10	34	9	17	3	14	11	137	13.7	8.2
Large (>14.5 cm)	70	77	272	246	96	150	104	14	85	19	1133	113.3	86.5
Plot area (m²)	314.2	314.2	314.2	314.2	314.2	314.2	150	98.5	98.5	98.5	2330.5	-	-
Density of large burrows	0.22	0.25	0.87	0.78	0.31	0.48	0.69	0.14	0.86	0.19	0.49	0.48	0.29
Survey date	27 May	27 May	30 May	30 May	29 May	30 May	26 May	27 May	26 May	26 May	-	-	-
Apparent occupancy													
Large (>14.5 cm) burrows w/ apparent occupancy	25	27	76	105	33	62	32	7	27	2	396	40	32
Total large (>14.5 cm) burrow entrances	61	79	242	211	84	130	87	12	69	17	992	99	76
Apparent occupancy rate of large burrows	0.41	0.34	0.31	0.50	0.39	0.48	0.37	0.58	0.39	0.12	0.40	0.39	0.12
Survey date	24 Aug	19 Aug	24 Aug	23 Aug	26 Aug	25 Aug	18 Aug	19 Aug	25 Aug	18 Aug	-	-	-

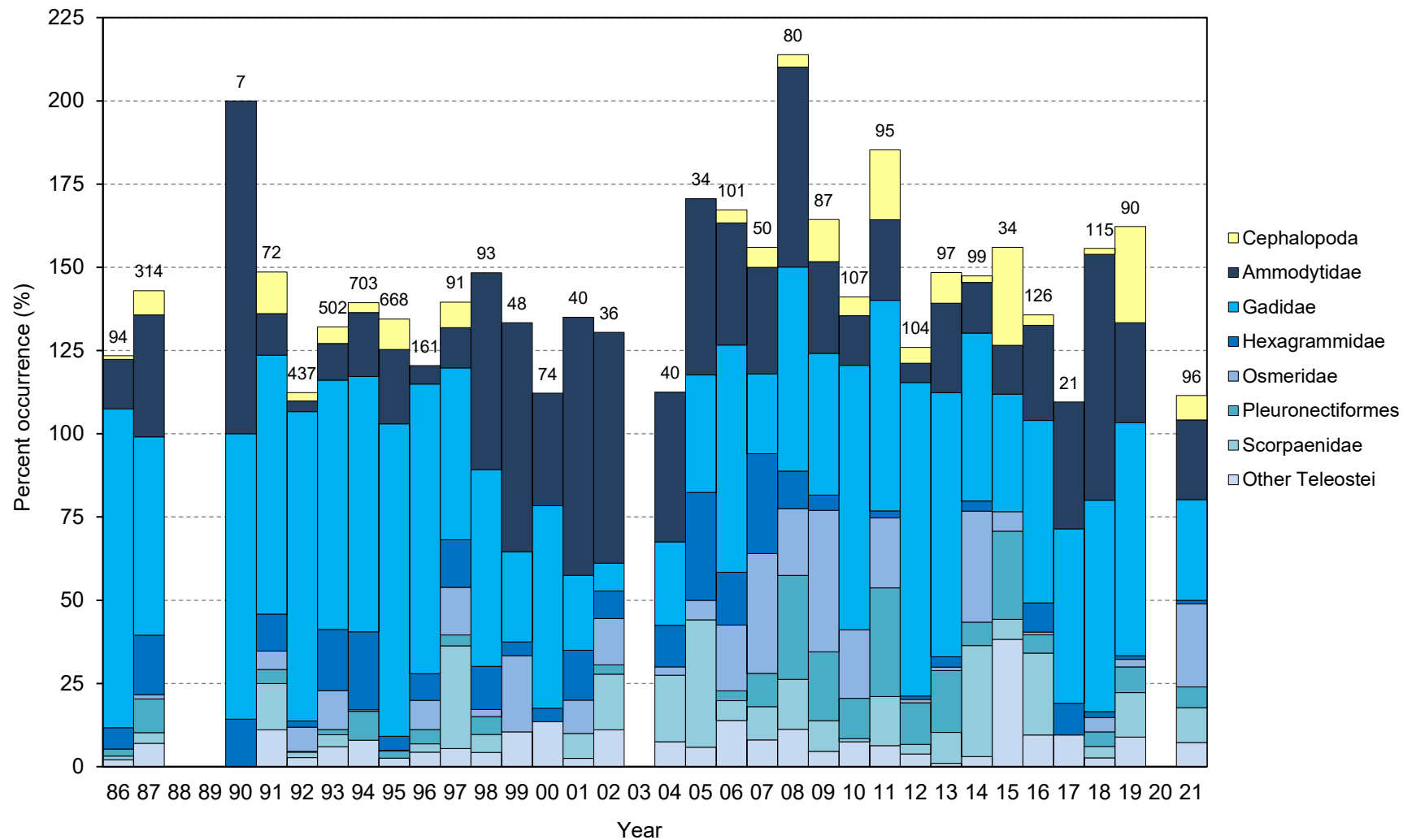


Figure 29. Frequency of occurrence of major prey items in diets of tufted puffin chicks at Aiktak Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of 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 1988-1989, 2003, or 2020.

Table 45. Frequency of occurrence of major prey items in diets of tufted puffin chicks at Aiktak 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 (1986-1995, 2000-2021) or the field (1996-1999) 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 1988-1989, 2003, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1986	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2004
No. samples	94	314	7	72	437	502	703	668	161	91	93	48	74	40	36	40
<b>Invertebrates</b>	<b>2.1</b>	<b>11.1</b>	-	<b>12.5</b>	<b>2.7</b>	<b>6.6</b>	<b>4.3</b>	<b>9.9</b>	<b>1.2</b>	<b>12.1</b>	<b>5.4</b>	<b>12.5</b>	<b>2.7</b>	-	-	<b>2.5</b>
Cephalopoda	1.1	7.3	-	12.5	2.5	5.0	3.0	9.1	-	7.7	-	-	-	-	-	-
Other Invertebrates	1.1	4.5	-	1.4	0.2	1.8	1.4	0.9	1.2	4.4	5.4	12.5	2.7	-	-	2.5
<b>Fish</b>	<b>100.0</b>	<b>96.8</b>	<b>100.0</b>	<b>98.6</b>	<b>99.5</b>	<b>97.4</b>	<b>98.7</b>	<b>99.6</b>	<b>100.0</b>	<b>94.5</b>	<b>100.0</b>	<b>95.8</b>	<b>97.3</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Teleostei</b>	<b>100.0</b>	<b>96.8</b>	<b>100.0</b>	<b>98.6</b>	<b>99.5</b>	<b>97.4</b>	<b>98.7</b>	<b>99.6</b>	<b>100.0</b>	<b>94.5</b>	<b>100.0</b>	<b>95.8</b>	<b>97.3</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Ammodytidae</b>	<b>14.9</b>	<b>36.6</b>	<b>100.0</b>	<b>12.5</b>	<b>3.2</b>	<b>11.0</b>	<b>19.2</b>	<b>22.3</b>	<b>5.6</b>	<b>12.1</b>	<b>59.1</b>	<b>68.8</b>	<b>33.8</b>	<b>77.5</b>	<b>69.4</b>	<b>45.0</b>
<i>Ammodytes</i> spp.	14.9	36.6	100.0	12.5	3.2	11.0	19.2	22.3	5.6	12.1	59.1	68.8	33.8	77.5	69.4	45.0
<b>Gadidae</b>	<b>95.7</b>	<b>59.6</b>	<b>85.7</b>	<b>77.8</b>	<b>92.9</b>	<b>74.9</b>	<b>76.7</b>	<b>93.9</b>	<b>87.0</b>	<b>51.6</b>	<b>59.1</b>	<b>27.1</b>	<b>60.8</b>	<b>22.5</b>	<b>8.3</b>	<b>25.0</b>
<i>Gadus chalcogrammus</i>	88.3	59.2	85.7	37.5	91.1	65.7	66.0	86.1	83.9	47.3	58.1	25.0	40.5	20.0	8.3	25.0
<i>G. macrocephalus</i>	34.0	0.3	-	4.2	5.0	15.5	6.5	43.1	18.6	11.0	4.3	-	-	5.0	-	-
Unid. Gadidae	1.1	-	-	9.7	8.9	8.2	26.0	12.4	-	2.2	1.1	8.3	18.9	-	-	-
Other Gadidae	-	0.3	-	50.0	-	-	-	-	-	-	-	-	1.4	-	-	-
<b>Hexagrammidae</b>	<b>6.4</b>	<b>17.8</b>	<b>14.3</b>	<b>11.1</b>	<b>1.8</b>	<b>18.3</b>	<b>23.5</b>	<b>4.2</b>	<b>8.1</b>	<b>14.3</b>	<b>12.9</b>	<b>4.2</b>	<b>4.1</b>	<b>15.0</b>	<b>8.3</b>	<b>12.5</b>
<i>Hexagrammos decagrammus</i>	-	-	-	-	0.5	14.3	22.6	-	7.5	14.3	12.9	4.2	2.7	15.0	8.3	12.5
Other Hexagrammidae	6.4	17.8	14.3	11.1	1.4	4.0	1.1	4.2	0.6	-	-	-	1.4	-	-	-
<b>Osmeridae</b>	-	<b>1.3</b>	-	<b>5.6</b>	<b>7.3</b>	<b>11.8</b>	<b>0.4</b>	<b>0.1</b>	<b>8.7</b>	<b>14.3</b>	<b>2.2</b>	<b>22.9</b>	-	<b>10.0</b>	<b>13.9</b>	<b>2.5</b>
<i>Mallotus villosus</i>	-	1.3	-	5.6	7.3	11.6	0.4	0.1	8.7	14.3	2.2	22.9	-	10.0	13.9	2.5
Other Osmeridae	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-
Pleuronectiformes	2.1	10.2	-	4.2	0.2	1.6	8.7	2.2	4.3	3.3	5.4	-	-	-	2.8	-
<b>Scorpaenidae</b>	<b>1.1</b>	<b>3.2</b>	-	<b>13.9</b>	<b>1.6</b>	<b>3.6</b>	-	-	<b>2.5</b>	<b>30.8</b>	<b>5.4</b>	-	-	<b>7.5</b>	<b>16.7</b>	<b>20.0</b>
<i>Sebastes</i> spp.	1.1	-	-	-	-	-	-	-	0.6	30.8	-	-	-	-	16.7	20.0
Other Scorpaenidae	-	3.2	-	13.9	1.6	3.6	-	-	1.9	-	5.4	-	-	7.5	-	-
Other Teleostei	2.1	7.0	-	11.1	2.7	6.0	8.0	2.5	4.3	5.5	4.3	10.4	13.5	2.5	11.1	7.5
Other	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-

Table 45 (continued). Frequency of occurrence of major prey items in diets of tufted puffin chicks at Aikta 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 (1986-1995, 2000-2021) or the field (1996-1999) 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 1988-1989, 2003, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	34	101	50	80	87	107	95	104	97	99	34	126	21	115	90	96
<b>Invertebrates</b>	-	<b>6.9</b>	<b>8.0</b>	<b>8.8</b>	<b>25.3</b>	<b>10.3</b>	<b>38.9</b>	<b>9.6</b>	<b>13.4</b>	<b>3.0</b>	<b>29.4</b>	<b>4.8</b>	-	<b>2.6</b>	<b>28.9</b>	<b>18.8</b>
Cephalopoda	-	4.0	6.0	3.8	12.6	5.6	21.1	4.8	9.3	2.0	29.4	3.2	-	1.7	28.9	7.3
Other Invertebrates	-	3.0	2.0	5.0	19.5	4.7	31.6	5.8	4.1	1.0	-	1.6	-	0.9	-	13.5
<b>Fish</b>	<b>100.0</b>	<b>97.0</b>	<b>100.0</b>	<b>100.0</b>	<b>94.3</b>	<b>99.1</b>	<b>91.6</b>	<b>98.1</b>	<b>96.9</b>	<b>100.0</b>	<b>85.3</b>	<b>98.4</b>	<b>100.0</b>	<b>100.0</b>	<b>93.3</b>	<b>88.5</b>
<b>Teleostei</b>	<b>100.0</b>	<b>97.0</b>	<b>100.0</b>	<b>100.0</b>	<b>94.3</b>	<b>99.1</b>	<b>91.6</b>	<b>98.1</b>	<b>96.9</b>	<b>100.0</b>	<b>85.3</b>	<b>98.4</b>	<b>100.0</b>	<b>100.0</b>	<b>93.3</b>	<b>88.5</b>
<b>Ammodytidae</b>	<b>52.9</b>	<b>36.6</b>	<b>32.0</b>	<b>60.0</b>	<b>27.6</b>	<b>15.0</b>	<b>24.2</b>	<b>5.8</b>	<b>26.8</b>	<b>15.2</b>	<b>14.7</b>	<b>28.6</b>	<b>38.1</b>	<b>73.9</b>	<b>30.0</b>	<b>24.0</b>
<i>Ammodytes</i> spp.	52.9	36.6	32.0	60.0	27.6	15.0	24.2	5.8	26.8	15.2	14.7	28.6	38.1	73.9	30.0	24.0
<b>Gadidae</b>	<b>35.3</b>	<b>68.3</b>	<b>24.0</b>	<b>61.3</b>	<b>42.5</b>	<b>79.4</b>	<b>63.2</b>	<b>94.2</b>	<b>79.4</b>	<b>50.5</b>	<b>35.3</b>	<b>54.8</b>	<b>52.4</b>	<b>63.5</b>	<b>70.0</b>	<b>30.2</b>
<i>Gadus chalcogrammus</i>	29.4	18.8	18.0	21.3	32.2	54.2	50.5	87.5	52.6	50.5	32.4	54.0	42.9	61.7	68.9	29.2
<i>G. macrocephalus</i>	-	4.0	-	22.5	17.2	52.3	17.9	9.6	54.6	2.0	5.9	-	9.5	1.7	-	-
Unid. Gadidae	8.8	50.5	6.0	16.3	8.0	22.4	10.5	7.7	17.5	1.0	2.9	0.8	-	6.1	6.7	2.1
Other Gadidae	-	-	6.0	31.3	4.6	18.7	18.9	1.0	-	-	-	-	4.8	-	-	-
<b>Hexagrammidae</b>	<b>32.4</b>	<b>15.8</b>	<b>30.0</b>	<b>11.3</b>	<b>4.6</b>	-	<b>2.1</b>	<b>1.0</b>	<b>3.1</b>	<b>3.0</b>	-	<b>8.7</b>	<b>9.5</b>	<b>1.7</b>	<b>1.1</b>	<b>1.0</b>
<i>Hexagrammos decagrammus</i>	32.4	10.9	24.0	8.8	3.4	-	1.1	1.0	-	-	-	-	-	-	-	-
Other Hexagrammidae	-	5.0	18.0	2.5	1.1	-	1.1	-	3.1	3.0	-	8.7	9.5	1.7	1.1	1.0
<b>Osmeridae</b>	<b>5.9</b>	<b>19.8</b>	<b>36.0</b>	<b>20.0</b>	<b>42.5</b>	<b>20.6</b>	<b>21.1</b>	<b>1.0</b>	<b>1.0</b>	<b>33.3</b>	<b>5.9</b>	<b>0.8</b>	-	<b>4.3</b>	<b>2.2</b>	<b>25.0</b>
<i>Mallotus villosus</i>	5.9	19.8	36.0	20.0	42.5	20.6	21.1	1.0	1.0	33.3	5.9	0.8	-	3.5	2.2	20.8
Other Osmeridae	-	-	-	-	-	-	-	-	-	-	-	-	-	0.9	-	4.2
Pleuronectiformes	-	3.0	10.0	31.3	20.7	12.1	32.6	12.5	18.6	7.1	26.5	5.6	-	4.3	7.8	6.3
<b>Scorpaenidae</b>	<b>38.2</b>	<b>5.9</b>	<b>10.0</b>	<b>15.0</b>	<b>9.2</b>	<b>0.9</b>	<b>14.7</b>	<b>2.9</b>	<b>9.3</b>	<b>33.3</b>	<b>6.0</b>	<b>24.6</b>	-	<b>3.5</b>	<b>13.3</b>	<b>10.4</b>
<i>Sebastes</i> spp.	38.2	2.0	-	-	-	-	-	-	-	33.3	20.6	24.6	-	3.5	13.3	3.1
Other Scorpaenidae	-	4.0	10.0	15.0	9.2	0.9	14.7	2.9	9.3	-	-	-	-	-	-	7.3
Other Teleostei	5.9	13.9	8.0	11.3	4.6	7.5	6.3	3.8	1.0	3.0	38.2	9.5	9.5	2.6	8.9	7.3
Other	-	3.0	-	-	1.1	-	-	-	-	-	-	-	-	-	-	-

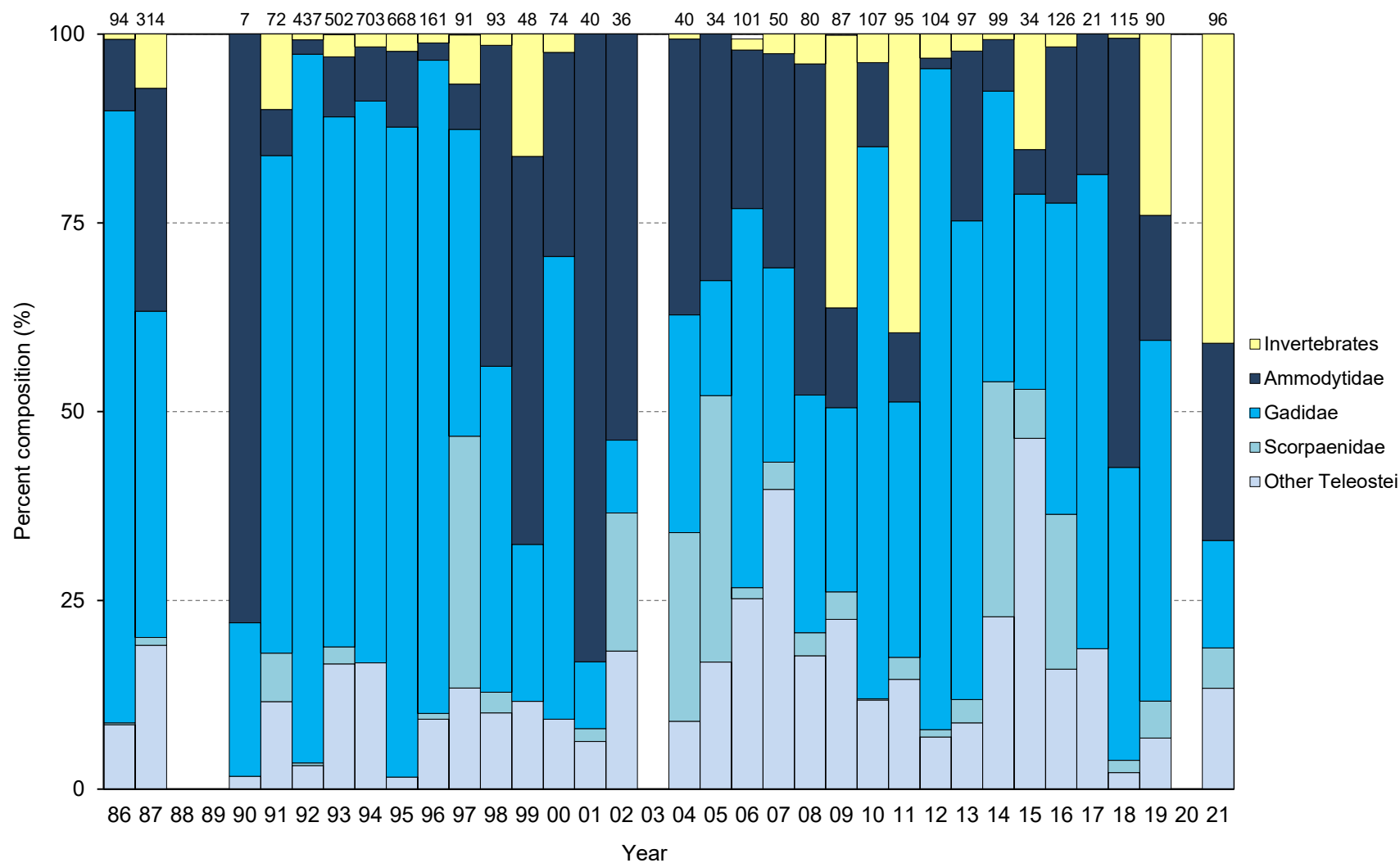


Figure 30. Percent composition of major prey items in diets of tufted puffin chicks at Aiktak Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition 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 1988-1989, 2003, or 2020.

Table 46. Percent composition of major prey items in diets of tufted puffin chicks at Aiktak 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 (1986-1995, 2000-2021) or the field (1996-1999) 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 1988-1989, 2003, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1986	1987	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2004
No. samples	94	314	7	72	437	502	703	668	161	91	93	48	74	40	36	40
No. individuals	433	1144	59	311	2299	1937	3587	5789	777	433	475	284	248	237	93	156
Invertebrates	0.7	7.2	-	10.0	0.7	2.9	1.7	2.3	1.2	6.5	1.5	16.2	2.4	-	-	0.6
<b>Fish</b>	<b>99.3</b>	<b>92.8</b>	<b>100.0</b>	<b>90.0</b>	<b>99.3</b>	<b>97.0</b>	<b>98.3</b>	<b>97.7</b>	<b>98.8</b>	<b>93.5</b>	<b>98.5</b>	<b>83.8</b>	<b>97.6</b>	<b>100.0</b>	<b>100.0</b>	<b>99.4</b>
<b>Teleostei</b>	<b>99.3</b>	<b>92.8</b>	<b>100.0</b>	<b>90.0</b>	<b>99.3</b>	<b>97.0</b>	<b>98.3</b>	<b>97.7</b>	<b>98.8</b>	<b>93.5</b>	<b>98.5</b>	<b>83.8</b>	<b>97.6</b>	<b>100.0</b>	<b>100.0</b>	<b>99.4</b>
<b>Ammodytidae</b>	<b>9.5</b>	<b>29.5</b>	<b>78.0</b>	<b>6.1</b>	<b>1.9</b>	<b>8.0</b>	<b>7.2</b>	<b>10.1</b>	<b>2.3</b>	<b>6.0</b>	<b>42.5</b>	<b>51.4</b>	<b>27.0</b>	<b>83.1</b>	<b>53.8</b>	<b>36.5</b>
<i>Ammodytes</i> spp.	9.5	29.5	78.0	6.1	1.9	8.0	7.2	10.1	2.3	6.0	42.5	51.4	27.0	83.1	53.8	36.5
<b>Gadidae</b>	<b>81.1</b>	<b>43.2</b>	<b>20.3</b>	<b>65.9</b>	<b>93.9</b>	<b>70.2</b>	<b>74.4</b>	<b>86.1</b>	<b>86.5</b>	<b>40.6</b>	<b>43.2</b>	<b>20.8</b>	<b>61.3</b>	<b>8.9</b>	<b>9.7</b>	<b>28.8</b>
<i>Gadus chalcogrammus</i>	68.1	43.0	20.3	27.3	90.6	58.9	63.8	66.7	80.8	36.5	41.7	16.9	50.0	8.0	9.7	28.8
Other Gadidae	12.9	0.2	-	38.6	3.3	11.4	10.6	19.3	5.7	4.2	1.5	3.9	11.3	0.8	-	-
<b>Scorpaenidae</b>	<b>0.2</b>	<b>1.0</b>	<b>-</b>	<b>6.4</b>	<b>0.3</b>	<b>2.3</b>	<b>-</b>	<b>-</b>	<b>0.8</b>	<b>33.3</b>	<b>2.7</b>	<b>-</b>	<b>-</b>	<b>1.7</b>	<b>18.3</b>	<b>25.0</b>
<i>Sebastes</i> spp.	0.2	-	-	-	-	-	-	-	0.1	33.3	-	-	-	-	18.3	25.0
Other Scorpaenidae	-	1.0	-	6.4	0.3	2.3	-	-	0.6	0.1	2.7	-	-	1.7	-	-
Other Teleostei	8.5	19.1	1.7	11.6	3.1	16.6	16.7	1.6	9.3	13.5	10.1	11.6	9.3	6.3	18.3	9.0
Other	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-

Table 46 (continued). Percent composition of major prey items in diets of tufted puffin chicks at Aiktak 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 (1986-1995, 2000-2021) or the field (1996-1999) 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 1988-1989, 2003, or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	34	101	50	80	87	107	95	104	97	99	34	126	21	115	90	96
No. individuals	190	472	194	657	574	610	819	725	582	408	170	478	43	732	429	337
Invertebrates	-	1.5	2.6	4.0	36.1	3.8	39.6	3.2	2.2	0.7	15.3	1.7	-	0.5	24.0	40.9
<b>Fish</b>	<b>100.0</b>	<b>97.9</b>	<b>97.4</b>	<b>96.0</b>	<b>63.8</b>	<b>96.2</b>	<b>60.4</b>	<b>96.8</b>	<b>97.8</b>	<b>99.3</b>	<b>84.7</b>	<b>98.3</b>	<b>100.0</b>	<b>99.5</b>	<b>76.0</b>	<b>59.1</b>
<b>Teleostei</b>	<b>100.0</b>	<b>97.9</b>	<b>97.4</b>	<b>96.0</b>	<b>63.8</b>	<b>96.2</b>	<b>60.4</b>	<b>96.8</b>	<b>97.8</b>	<b>99.3</b>	<b>84.7</b>	<b>98.3</b>	<b>100.0</b>	<b>99.5</b>	<b>76.0</b>	<b>59.1</b>
<b>Ammodytidae</b>	<b>32.6</b>	<b>21.0</b>	<b>28.4</b>	<b>43.8</b>	<b>13.2</b>	<b>11.1</b>	<b>9.2</b>	<b>1.4</b>	<b>22.5</b>	<b>6.9</b>	<b>5.9</b>	<b>20.7</b>	<b>18.6</b>	<b>56.8</b>	<b>16.6</b>	<b>26.1</b>
<i>Ammodytes</i> spp.	32.6	21.0	28.4	43.8	13.2	11.1	9.2	1.4	22.5	6.9	5.9	20.7	18.6	56.8	16.6	26.1
<b>Gadidae</b>	<b>15.3</b>	<b>50.2</b>	<b>25.8</b>	<b>31.5</b>	<b>24.4</b>	<b>73.1</b>	<b>33.8</b>	<b>87.6</b>	<b>63.4</b>	<b>38.5</b>	<b>25.9</b>	<b>41.2</b>	<b>62.8</b>	<b>38.8</b>	<b>47.8</b>	<b>14.2</b>
<i>Gadus chalcogrammus</i>	12.6	12.9	16.5	5.5	16.0	32.6	20.5	78.5	35.4	37.7	24.1	41.0	55.8	37.2	45.5	13.6
Other Gadidae	2.6	37.3	9.3	26.0	8.4	40.5	13.3	9.1	28.0	0.7	1.8	0.2	7.0	1.6	2.3	0.6
<b>Scorpaenidae</b>	<b>35.3</b>	<b>1.5</b>	<b>3.6</b>	<b>3.0</b>	<b>3.7</b>	<b>0.2</b>	<b>2.9</b>	<b>1.0</b>	<b>3.1</b>	<b>31.1</b>	<b>6.5</b>	<b>20.5</b>	-	<b>1.6</b>	<b>4.9</b>	<b>5.3</b>
<i>Sebastes</i> spp.	35.3	0.6	-	-	-	-	-	-	-	31.1	6.5	20.5	-	1.6	4.9	0.9
Other Scorpaenidae	-	0.8	3.6	3.0	3.7	0.2	2.9	1.0	3.1	-	-	-	-	-	-	4.5
Other Teleostei	16.8	25.2	39.7	17.7	22.5	11.8	14.5	6.9	8.8	22.8	46.5	15.9	18.6	2.2	6.8	13.4
Other	-	0.6	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-



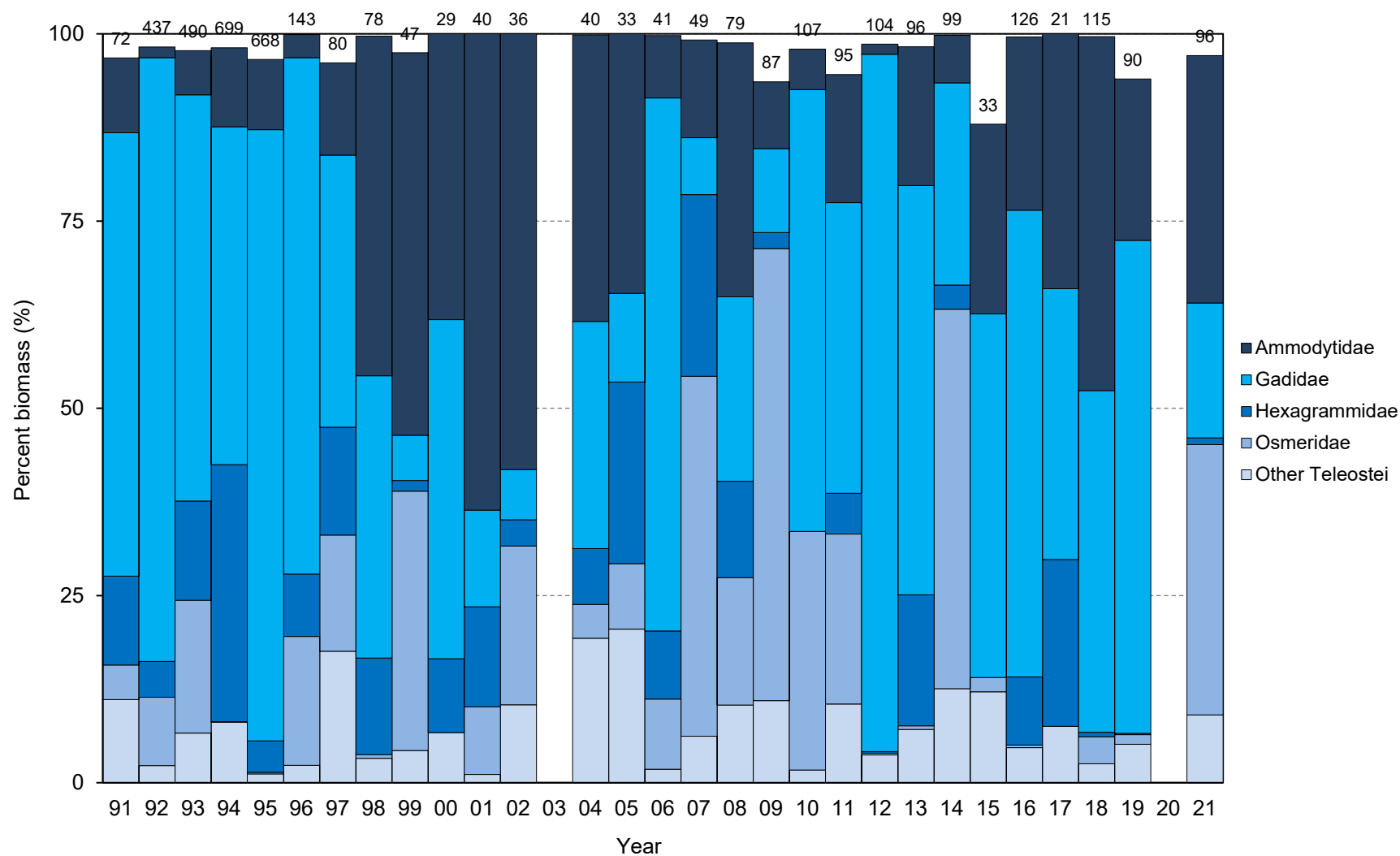


Figure 31. Relative biomass of major prey items in diets of tufted puffin chicks at Aiktak Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year). Prey is grouped to family level or higher; only taxa with an among-year 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 1988-1989, 2003, or 2020 and no mass data exist in 1990.

Table 47. Relative biomass of major prey items in diets of tufted puffin chicks at Aiktak 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 (1991-1995, 2000-2021) or the field (1996-1999) 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 1988-1989, 2003, or 2020 and no mass data exist in 1990. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2004	2005	2006
No. samples	72	437	490	699	668	143	80	78	47	29	40	36	40	33	41
Total mass (g)	497	2903	2405	2748	4673	1448	643	694	396	222	406	282	145	197	1037
Invertebrates	3.2	1.7	2.2	1.9	3.4	0.1	3.9	0.3	2.5	-	-	-	0.2	-	0.2
<b>Fish</b>	<b>96.8</b>	<b>98.3</b>	<b>97.8</b>	<b>98.1</b>	<b>96.6</b>	<b>99.9</b>	<b>96.1</b>	<b>99.7</b>	<b>97.5</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>99.8</b>	<b>100.0</b>	<b>99.8</b>
<b>Teleostei</b>	<b>96.8</b>	<b>98.3</b>	<b>97.8</b>	<b>98.1</b>	<b>96.6</b>	<b>99.9</b>	<b>96.1</b>	<b>99.7</b>	<b>97.5</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>99.8</b>	<b>100.0</b>	<b>99.8</b>
<b>Ammodytidae</b>	<b>10.0</b>	<b>1.4</b>	<b>5.9</b>	<b>10.6</b>	<b>9.3</b>	<b>3.1</b>	<b>12.3</b>	<b>45.4</b>	<b>51.1</b>	<b>38.1</b>	<b>63.6</b>	<b>58.2</b>	<b>38.2</b>	<b>34.7</b>	<b>8.3</b>
<i>Ammodytes</i> spp.	10.0	1.4	5.9	10.6	9.3	3.1	12.3	45.4	51.1	38.1	63.6	58.2	38.3	34.7	8.3
<b>Gadidae</b>	<b>59.2</b>	<b>80.6</b>	<b>54.3</b>	<b>45.1</b>	<b>81.6</b>	<b>68.9</b>	<b>36.4</b>	<b>37.7</b>	<b>6.0</b>	<b>45.3</b>	<b>12.9</b>	<b>6.7</b>	<b>30.3</b>	<b>11.8</b>	<b>71.2</b>
<i>Gadus chalcogrammus</i>	21.1	77.2	39.9	37.8	54.8	60.9	31.5	35.6	5.0	36.9	10.9	6.7	30.3	11.6	67.3
<i>G. macrocephalus</i>	1.5	2.5	12.1	3.4	24.4	8.0	4.7	2.1	-	-	2.0	-	-	-	1.9
Other Gadidae	36.6	0.9	2.3	3.9	2.4	-	0.2	-	1.0	8.4	-	-	-	0.3	1.9
<b>Hexagrammidae</b>	<b>11.9</b>	<b>4.8</b>	<b>13.2</b>	<b>34.3</b>	<b>4.2</b>	<b>8.3</b>	<b>14.4</b>	<b>12.9</b>	<b>1.4</b>	<b>9.9</b>	<b>13.3</b>	<b>3.5</b>	<b>7.5</b>	<b>24.3</b>	<b>9.1</b>
<i>Hexagrammos decagrammus</i>	-	0.3	9.5	31.7	-	8.1	14.4	12.9	1.4	4.4	13.3	3.5	7.5	24.3	8.4
Other Hexagrammidae	11.9	4.5	3.7	2.6	4.2	0.3	-	-	-	5.4	-	-	-	-	0.7
<b>Osmeridae</b>	<b>4.6</b>	<b>9.1</b>	<b>17.8</b>	<b>0.1</b>	<b>0.2</b>	<b>17.2</b>	<b>15.5</b>	<b>0.5</b>	<b>34.6</b>	-	<b>9.0</b>	<b>21.2</b>	<b>4.5</b>	<b>8.7</b>	<b>9.4</b>
<i>Mallotus villosus</i>	4.6	9.1	17.7	0.1	0.2	17.2	15.5	0.5	34.6	-	9.0	21.2	4.5	8.7	9.4
Other Osmeridae	-	-	<0.1	-	-	-	-	-	-	-	-	-	-	-	-
Other Teleostei	11.1	2.3	6.6	8.1	1.2	2.3	17.6	3.2	4.3	6.7	1.1	-	19.3	20.5	1.8
Other	-	-	0.1	-	-	-	-	-	-	-	-	10.4	-	-	-

Table 47 (continued). Relative biomass of major prey items in diets of tufted puffin chicks at Aikta 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 (1991-1995, 2000-2021) or the field (1996-1999) 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 1988-1989, 2003, or 2020 and no mass data exist in 1990. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	49	79	87	107	95	104	96	99	33	126	21	115	90	96
Total mass (g)	333	506	541	771	455	777	590	895	147	1022	77	811	632	454
Invertebrates	0.8	1.2	6.4	2.0	5.5	1.4	1.7	0.2	12.0	0.4	-	0.4	6.0	3.6
<b>Fish</b>	<b>99.2</b>	<b>98.8</b>	<b>93.6</b>	<b>98.0</b>	<b>94.5</b>	<b>98.6</b>	<b>98.3</b>	<b>99.8</b>	<b>87.9</b>	<b>99.6</b>	<b>100.0</b>	<b>99.6</b>	<b>94.0</b>	<b>96.4</b>
<b>Teleostei</b>	<b>99.2</b>	<b>98.8</b>	<b>93.6</b>	<b>98.0</b>	<b>94.5</b>	<b>98.6</b>	<b>98.3</b>	<b>99.8</b>	<b>87.9</b>	<b>99.6</b>	<b>100.0</b>	<b>99.6</b>	<b>94.0</b>	<b>96.4</b>
<b>Ammodytidae</b>	<b>13.0</b>	<b>33.9</b>	<b>8.9</b>	<b>5.4</b>	<b>17.1</b>	<b>1.4</b>	<b>18.5</b>	<b>6.4</b>	<b>25.3</b>	<b>23.2</b>	<b>34.0</b>	<b>47.3</b>	<b>21.6</b>	<b>33.0</b>
<i>Ammodytes</i> spp.	13.0	33.9	8.9	5.4	17.1	1.4	18.5	6.4	25.3	23.2	34.0	47.3	21.6	33.0
<b>Gadidae</b>	<b>7.6</b>	<b>24.6</b>	<b>11.2</b>	<b>59.0</b>	<b>38.8</b>	<b>93.1</b>	<b>54.7</b>	<b>27.0</b>	<b>48.6</b>	<b>62.3</b>	<b>36.2</b>	<b>45.6</b>	<b>65.8</b>	<b>18.0</b>
<i>Gadus chalcogrammus</i>	4.3	2.9	6.7	25.0	17.8	86.9	31.2	26.8	46.4	62.2	23.4	44.6	64.1	17.3
<i>G. macrocephalus</i>	-	8.0	2.7	19.5	7.4	4.0	21.9	0.2	1.9	-	12.2	0.4	-	-
Other Gadidae	3.3	13.7	1.8	14.5	13.6	2.3	1.6	0.1	0.3	0.1	0.6	0.6	1.7	0.7
<b>Hexagrammidae</b>	<b>24.2</b>	<b>12.9</b>	<b>2.1</b>	-	<b>5.5</b>	<b>0.2</b>	<b>17.5</b>	<b>3.2</b>	-	<b>9.1</b>	<b>22.3</b>	<b>0.6</b>	<b>0.2</b>	<b>0.9</b>
<i>Hexagrammos decagrammus</i>	13.4	2.5	1.6	-	0.4	0.2	-	-	-	-	-	-	-	-
Other Hexagrammidae	10.9	10.3	0.5	-	5.1	0.0	17.5	3.2	-	9.1	22.3	0.6	0.2	0.9
<b>Osmeridae</b>	<b>48.1</b>	<b>17.0</b>	<b>60.3</b>	<b>31.9</b>	<b>22.7</b>	<b>0.3</b>	<b>0.5</b>	<b>50.7</b>	<b>1.9</b>	<b>0.4</b>	-	<b>3.6</b>	<b>1.3</b>	<b>36.1</b>
<i>Mallotus villosus</i>	48.1	17.0	60.3	31.9	22.7	0.3	0.5	50.7	1.9	0.4	-	3.4	1.3	30.8
Other Osmeridae	-	-	-	-	-	-	-	-	-	-	-	0.2	-	5.3
Other Teleostei	6.2	10.4	11.0	1.7	10.5	3.7	7.1	12.6	12.1	4.7	7.5	2.5	5.1	9.1
Other	-	-	<0.1	-	-	-	-	-	-	-	-	-	-	-

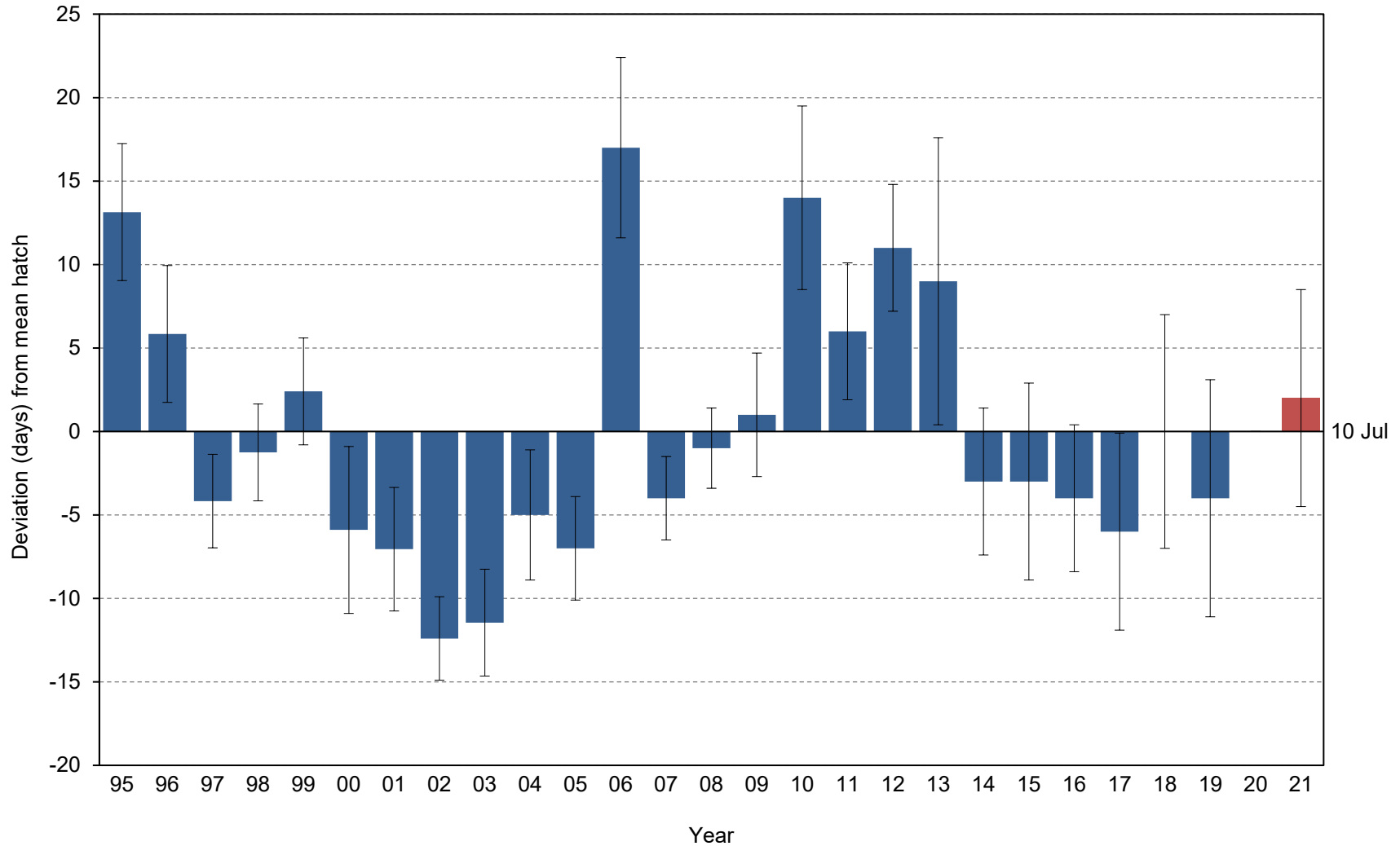


Figure 32. Yearly hatch date deviation (from the 1995-2020 average of 10 July) for glaucous-winged gulls at Aiktak Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date, red highlights the current year. No data were collected in 2020.

Table 48. Breeding chronology of glaucous-winged gulls at Aiktak Island, Alaska. No data were collected in 2020.

Year	Mean lay <sup>a</sup>	SD	n <sup>b</sup>	Mean hatch	SD	n <sup>c</sup>	First lay <sup>a</sup>	First hatch	Last hatch
1995	xx <sup>d</sup>	xx	xx	23 Jul	4.1	43	20 Jun	17 Jul	1 Aug
1996	xx	xx	xx	15 Jul	4.1	76	13 Jun	10 Jul	26 Jul
1997	xx	xx	xx	6 Jul	2.8	95	1 Jun	28 Jun	14 Jul
1998	xx	xx	xx	9 Jul	2.9	90	6 Jun	3 Jul	17 Jul
1999	xx	xx	xx	12 Jul	3.2	50	10 Jun	7 Jul	19 Jul
2000	xx	xx	xx	3 Jul	5.0	70	31 May	7 Jun	19 Jul
2001	xx	xx	xx	3 Jul	3.7	38	1 Jun	28 Jun	14 Jul
2002	xx	xx	xx	28 Jun	2.5	95	26 May	22 Jun	3 Jul
2003	xx	xx	xx	29 Jun	3.2	93	23 May	19 Jun	>5 Jul <sup>e</sup>
2004	xx	xx	xx	4 Jul	3.9	85	29 May	25 Jun	12 Jul
2005	xx	xx	xx	3 Jul	3.1	79	31 May	27 Jun	11 Jul
2006	xx	xx	xx	27 Jul	5.4	10 <sup>f</sup>	24 Jun	21 Jul	4 Aug
2007	xx	xx	xx	6 Jul	2.5	36	1 Jun	28 Jun	10 Jul
2008	xx	xx	xx	8 Jul	2.4	40	3 Jun	30 Jun	12 Jul
2009	xx	xx	xx	11 Jul	3.7	38	7 Jun	4 Jul	19 Jul
2010	xx	xx	xx	24 Jul	5.5	7 <sup>f</sup>	28 Jun	18 Jul	3 Aug
2011	xx	xx	xx	16 Jul	4.1	5 <sup>f</sup>	4 Jun	11 Jul	22 Jul
2012	20 Jun	5.4	44	20 Jul	3.8	3 <sup>f</sup>	10 Jun	17 Jul	24 Jul
2013	-	-	-	19 Jul	8.6	5 <sup>f</sup>	<4 Jun	11 Jul	30 Jul
2014	-	-	-	7 Jul	4.4	80	<29 May	29 Jun	21 Jul
2015	-	-	-	7 Jul	5.9	107	<1 Jun	25 Jun	24 Jul
2016	-	-	-	5 Jul	4.4	112	<26 May	27 Jun	16 Jul
2017	4 Jun	7.9	44	4 Jul	5.9	77	20 May	23 Jun	20 Jul
2018	-	-	-	10 Jul	7.0	41	<27 May	29 Jun	28 Jul
2019	-	-	-	6 Jul	7.1	97	<29 May	25 Jun	1 Aug
2021	-	-	-	12 Jul	6.5	54	<26 May	30 Jun	26 Jul

<sup>a</sup>In 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.

<sup>b</sup>Sample sizes for mean lay dates are a sub-sample of total nests for which no egg to egg interval is ≤ 7 days.

<sup>c</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.

<sup>d</sup>xx indicates data potentially exist but have not yet been summarized.

<sup>e</sup>In 2003, four nests had yet to hatch before researchers departed the island early on 10 July.

<sup>f</sup>In 2006 and 2010-2013, sample sizes were small and recorded hatch dates were late due to high rates of egg loss during the early egg-laying period.

Table 49. Frequency distribution of hatch dates for glaucous-winged gulls at Aiktak 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  $\leq 5$  days. No data were collected in 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date												
	95	96	97	98	99	00	01	02	03	04	05	06	07
170	-	-	-	-	-	-	-	-	1	-	-	-	-
171	-	-	-	-	-	-	-	-	-	-	-	-	-
172	-	-	-	-	-	-	-	-	-	-	-	-	-
173	-	-	-	-	-	-	-	3	-	-	-	-	-
174	-	-	-	-	-	-	-	2	-	-	-	-	-
175	-	-	-	-	-	-	-	7	-	-	-	-	-
176	-	-	-	-	-	-	-	7	25	-	-	-	-
177	-	-	-	-	-	-	-	-	-	3	-	-	-
178	-	-	-	-	-	-	-	39	4	-	2	-	-
179	-	-	1	-	-	11	7	-	4	-	3	-	1
180	-	-	-	-	-	-	-	18	43	6	10	-	-
181	-	-	-	-	-	-	2	4	1	-	5	-	-
182	-	-	-	-	-	22	3	10	-	-	11	-	-
183	-	-	13	-	-	-	7	3	1	-	8	-	1
184	-	-	2	3	-	-	4	2	4	30	12	-	-
185	-	-	-	-	-	-	5	-	-	-	4	-	15
186	-	-	44	2	-	16	1	-	10	-	14	-	-
187	-	-	-	-	-	2	2	-	-	25	3	-	8
188	-	-	20	39	6	11	4	-	-	-	2	-	-
189	-	-	-	8	-	-	1	-	-	2	1	-	8
190	-	-	-	5	1	-	-	-	-	5	2	-	-
191	-	-	8	21	-	2	1	-	-	5	-	-	3
192	-	18	4	-	22	-	-	-	-	-	2	-	-
193	-	-	-	-	-	-	-	-	-	7	-	-	-
194	-	4	2	7	1	1	-	-	-	2	-	-	-
195	-	13	1	-	-	1	1	-	-	-	-	-	-
196	-	5	-	-	16	1	-	-	-	-	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-	-
198	7	19	-	5	1	-	-	-	-	-	-	-	-
199	-	-	-	-	-	2	-	-	-	-	-	-	-
200	-	3	-	-	3	-	-	-	-	-	-	-	-
201	-	1	-	-	-	1	-	-	-	-	-	-	-
202	14	-	-	-	-	-	-	-	-	-	-	1	-
203	1	8	-	-	-	-	-	-	-	-	-	2	-
204	1	3	-	-	-	-	-	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-	-	-	-	1	-
206	9	1	-	-	-	-	-	-	-	-	-	1	-
207	-	-	-	-	-	-	-	-	-	-	-	2	-
208	8	1	-	-	-	-	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	-	-	-	-	-
211	-	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	-	-	-	-	-	-	-
213	3	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	-	-	-	-	1	-
215	-	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-	-	-	-	2	-
<i>n</i>	43	76	95	90	50	70	38	95	93	85	79	10	36

Table 49 (continued). Frequency distribution of hatch dates for glaucous-winged gulls at Aiktak 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  $\leq 5$  days. No data were collected in 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date												
	08	09	10	11	12	13	14	15	16	17	18	19	21
170	-	-	-	-	-	-	-	-	-	-	-	-	-
171	-	-	-	-	-	-	-	-	-	-	-	-	-
172	-	-	-	-	-	-	-	-	-	-	-	-	-
173	-	-	-	-	-	-	-	-	-	-	-	-	-
174	-	-	-	-	-	-	-	-	-	1	-	-	-
175	-	-	-	-	-	-	-	-	-	-	-	-	-
176	-	-	-	-	-	-	-	4	-	-	-	7	-
177	-	-	-	-	-	-	-	-	-	3	-	-	-
178	-	-	-	-	-	-	-	-	-	5	-	3	-
179	-	-	-	-	-	-	-	1	5	-	-	5	-
180	-	-	-	-	-	-	2	11	5	20	2	3	-
181	-	-	-	-	-	-	-	1	-	-	-	1	3
182	1	-	-	-	-	-	2	4	21	1	-	12	-
183	-	-	-	-	-	-	1	8	-	7	4	-	-
184	-	-	-	-	-	-	5	-	1	6	-	4	2
185	1	1	-	-	-	-	14	1	8	1	2	4	-
186	1	3	-	-	-	-	13	24	9	5	5	4	1
187	2	-	-	-	-	-	3	-	1	8	-	7	7
188	10	7	-	-	-	-	-	6	30	-	2	14	2
189	-	-	-	-	-	-	11	13	-	1	4	1	1
190	6	2	-	-	-	-	11	13	6	7	2	6	11
191	11	4	-	-	-	-	-	-	10	-	-	3	-
192	5	9	-	1	-	1	5	-	5	2	4	3	3
193	2	2	-	-	-	-	2	2	3	2	-	-	2
194	1	4	-	-	-	1	4	2	5	3	2	4	4
195	-	-	-	1	-	-	2	3	2	1	4	3	-
196	-	-	-	1	-	-	2	9	-	1	2	-	5
197	-	3	-	-	-	1	-	-	-	1	-	2	-
198	-	2	-	1	-	-	-	1	1	-	1	7	1
199	-	-	1	-	1	-	1	-	-	-	-	-	2
200	-	1	-	-	1	-	-	1	-	1	2	1	3
201	-	-	1	-	-	-	-	-	-	1	2	1	-
202	-	-	2	-	-	-	2	2	-	-	-	-	-
203	-	-	-	1	-	-	-	-	-	-	1	-	3
204	-	-	-	-	-	-	-	-	-	-	-	1	3
205	-	-	-	-	-	-	-	1	-	-	-	-	-
206	-	-	1	-	1	-	-	-	-	-	1	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-	1
208	-	-	1	-	-	1	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	1	-	-
210	-	-	-	-	-	-	-	-	-	-	-	-	-
211	-	-	-	-	-	1	-	-	-	-	-	-	-
212	-	-	-	-	-	-	-	-	-	-	-	-	-
213	-	-	-	-	-	-	-	-	-	-	-	1	-
214	-	-	-	-	-	-	-	-	-	-	-	-	-
215	-	-	1	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>n</i>	40	38	7	5	3	5	80	107	112	77	41	97	54

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

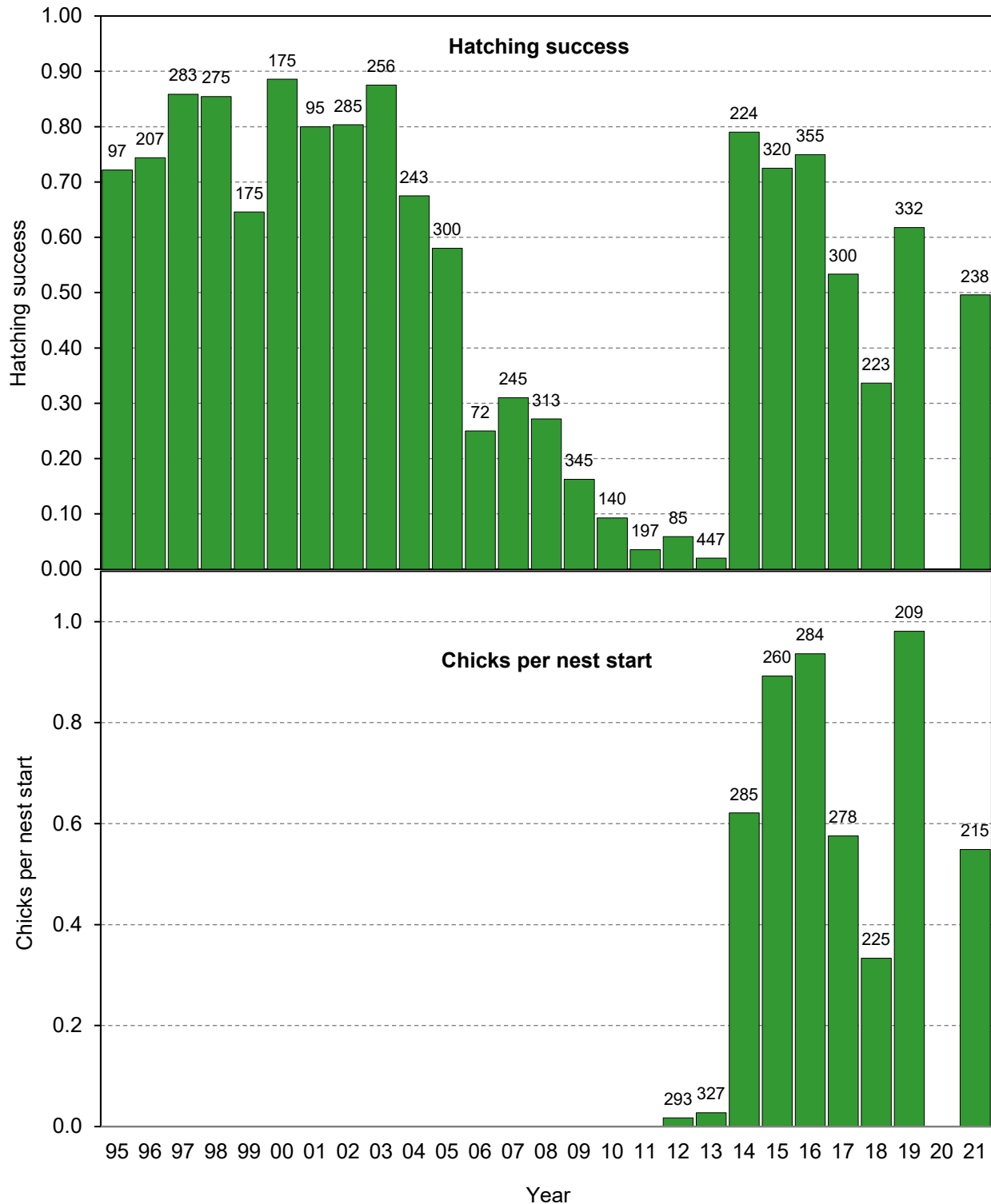


Figure 33. Reproductive performance of glaucous-winged gulls at Aiktak Island, Alaska. Hatching success= $E/C$ ; Chicks per nest start= $E/A$ ; where  $A$ =total nest starts,  $C$ =total eggs;  $E$ =total chicks. Numbers above columns indicate sample sizes ( $[C]$  for hatching success,  $[A]$  for chicks per nest start). No data were collected in 2020.



Table 50. Reproductive performance of glaucous-winged gulls at Aikta Island, Alaska, as determined by a nest-monitoring methodology. Measures of success are based on frequent monitoring of individual nests. No data were collected in 2020.

Year	Total nest starts	Nest sites w/ x eggs:					Nest sites w/ eggs (B)	Total eggs (C)	Nest sites w/ x chicks:				Nest sites w/ chicks (D)	Total chicks (E)	Laying success (B/A)	Mean clutch size (C/B)	Mean brood size (E/D)	Nesting success (D/B)	Hatching success (E/C)	Prop. nest sites w/ chicks (D/A) <sup>a</sup>	Chicks/ nest start (E/A) <sup>a</sup>
		(A) <sup>a</sup>	0	1	2	3			4	1	2	3									
1995	-	-	11	25	12	0	48	97	9	20	7	0	36	70	-	2.0	1.9	0.75	0.72	-	-
1996	-	-	17	38	38	0	93	207	19	33	23	0	75	154	-	2.2	2.1	0.81	0.74	-	-
1997	-	-	9	17	80	0	106	283	3	30	60	0	93	243	-	2.7	2.6	0.88	0.86	-	-
1998	-	-	11	21	74	0	106	275	4	30	57	0	91	235	-	2.6	2.6	0.86	0.85	-	-
1999	-	-	16	27	35	0	78	175	7	23	20	0	50	113	-	2.2	2.3	0.64	0.65	-	-
2000	-	-	6	17	45	0	68	175	11	21	34	0	66	155	-	2.6	2.4	0.97	0.89	-	-
2001	-	-	2	21	17	0	40	95	8	22	8	0	38	76	-	2.4	2.0	0.95	0.80	-	-
2002	-	-	1	13	86	0	100	285	7	42	46	0	95	229	-	2.9	2.4	0.95	0.80	-	-
2003	-	-	8	23	66	1	98	256	13	30	49	1	93	224	-	2.6	2.4	0.95	0.88	-	-
2004	-	-	13	33	52	2	100	243	27	37	21	0	85	164	-	2.4	1.9	0.85	0.67	-	-
2005	-	-	15	33	73	0	117	300	16	31	32	0	79	174	-	2.6	2.2	0.68	0.58	-	-
2006	-	-	26	17	4	0	47	72	2	8	0	0	10	18	-	1.5	1.8	0.21	0.25	-	-
2007	-	-	43	20	54	0	117	245	8	16	12	0	36	76	-	2.1	2.1	0.30	0.31	-	-
2008	-	-	48	63	45	1	157	313	9	17	14	0	40	85	-	2.0	2.1	0.25	0.27	-	-
2009	-	-	93	69	38	0	200	345	21	16	1	0	38	56	-	1.7	1.5	0.18	0.16	-	-
2010	-	-	78	25	4	0	107	140	2	4	1	0	7	13	-	1.3	1.9	0.07	0.09	-	-
2011	-	-	80	42	11	0	133	197	3	2	0	0	5	7	-	1.5	1.4	0.04	0.04	-	-
2012	293	240	28	18	7	0	53	85	2	0	1	0	3	5	0.18	1.6	1.7	0.06	0.06	0.01	<0.1
2013	327	49	149	89	40	0	278	447	1	4	0	0	5	9	0.85	1.6	1.8	0.02	0.02	0.02	<0.1
2014	285	186	23	27	49	0	99	224	12	39	29	0	80	177	0.35	2.3	2.2	0.81	0.79	0.28	0.6
2015	260	127	21	40	74	0	135	320	24	38	44	0	106	232	0.52	2.4	2.2	0.79	0.73	0.41	0.9
2016	284	142	21	30	90	1	142	355	15	40	57	0	112	266	0.50	2.5	2.4	0.79	0.75	0.39	0.9
2017	278	165	50	41	66	0	157	300	21	37	28	0	86	160	0.56	1.9	1.9	0.55	0.53	0.31	0.6
2018	225	113	37	39	36	0	112	223	15	18	8	0	41	75	0.50	2.0	1.8	0.37	0.34	0.18	0.3
2019	209	55	44	48	60	2	154	328	27	43	28	1	99	201	0.74	2.1	2.0	0.64	0.61	0.47	1.0
2021	215	97	36	44	38	0	118	238	14	28	22	0	64	118	0.55	2.0	1.8	0.54	0.50	0.30	0.5

<sup>a</sup>From 1995 to 2011, sampling at Aikta included only nests with eggs so total nest starts (A), laying success (B/A), proportion of nest sites with chicks (D/A) and chicks per nest start (E/A) cannot be estimated.

Table 51. Standard deviation in reproductive performance parameters of glaucous-winged gulls at Aiktak Island, Alaska. No data were collected in 2020.

Year	No. plots <sup>a</sup>	Total nest starts	Sampling design <sup>b</sup>	Laying success	Mean clutch size	Mean brood size	Nesting success	Hatching success	Prop. nest sites w/ chicks	Chicks/ nest start
1995	xx <sup>c</sup>	-	xx	-	xx	xx	xx	xx	-	-
1996	xx	-	xx	-	xx	xx	xx	xx	-	-
1997	xx	-	xx	-	xx	xx	xx	xx	-	-
1998	xx	-	xx	-	xx	xx	xx	xx	-	-
1999	4	-	Cluster by plot	-	0.16	0.13	0.12	0.12	-	-
2000	3	-	Cluster by plot	-	0.06	0.13	0.01	0.04	-	-
2001	2	-	Cluster by plot	-	0.16	0.13	0.01	<0.01	-	-
2002	4	-	Cluster by plot	-	0.02	0.04	0.01	0.02	-	-
2003	4	-	Cluster by plot	-	0.11	0.09	0.03	0.04	-	-
2004	4	-	Cluster by plot	-	0.13	0.19	0.03	0.07	-	-
2005	4	-	Cluster by plot	-	0.12	0.15	0.09	0.09	-	-
2006	4	-	Cluster by plot	-	0.03	0.20	0.04	0.04	-	-
2007	4	-	Cluster by plot	-	0.14	0.09	0.13	0.11	-	-
2008	4	-	Cluster by plot	-	0.08	0.08	0.05	0.05	-	-
2009	4	-	Cluster by plot	-	0.11	0.03	0.03	0.02	-	-
2010	4	-	Cluster by plot	-	0.05	0.32	0.02	0.03	-	-
2011	4	-	Cluster by plot	-	0.07	0.07	0.02	0.02	-	-
2012	4	-	Cluster by plot	0.07	0.14	0.00	0.07	0.06	0.01	0.00
2013	4	327	Cluster by plot	0.11	0.14	0.22	<0.01	<0.01	<0.01	<0.01
2014	4	285	Cluster by plot	0.05	0.15	0.10	0.06	0.04	0.06	0.16
2015	4	260	Cluster by plot	0.08	0.03	0.11	0.05	0.06	0.08	0.21
2016	4	284	Cluster by plot	0.07	0.05	0.06	0.06	0.06	0.07	0.19
2017	4	278	Cluster by plot	0.14	0.11	0.15	0.13	0.10	0.15	0.25
2018	4	225	Cluster by plot	0.07	0.11	0.04	0.07	0.06	0.06	0.11
2019	4	209	Cluster by plot	0.03	0.16	0.08	0.07	0.05	0.06	0.14
2021	4	215	Cluster by plot	0.10	0.10	0.17	0.09	0.08	0.10	0.14

<sup>a</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>b</sup>Sampling 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  $\sqrt{p * (1 - p) / n}$ , where  $p$  is the success rate and  $n$  is the sample size of individual nests.

<sup>c</sup>xx indicates data potentially exist but have not yet been summarized.

Table 52. Reproductive performance of glaucous-winged gulls at Aiktak Island, Alaska in 2021, as determined by a nest-monitoring methodology. Data come from frequent monitoring of individual nests.

Parameter		Plot				Total	SD <sup>a</sup>
		40 [a]	41 [b]	42 [c]	43 [d]		
Total nest starts (A)		51	52	59	53	215	-
Nest sites w/ x eggs:	0	21	29	13	34	97	-
	1	9	5	18	4	36	-
	2	10	10	18	6	44	-
	3	11	8	10	9	38	-
	4	0	0	0	0	0	-
Nest sites w/ eggs (B)		30	23	46	19	118	-
Total eggs (C)		62	49	84	43	238	-
Nest sites w/ x chicks:	1	4	4	5	1	14	-
	2	5	6	16	1	28	-
	3	5	5	10	2	22	-
	4	0	0	0	0	0	-
Nest sites w/ chicks (D)		14	15	31	4	64	-
Total chicks (E)		29	31	49	9	118	-
Laying success (B/A)		0.59	0.44	0.78	0.36	0.55	0.10
Mean clutch size (C/B)		2.1	2.1	1.8	2.3	2.0	0.10
Mean brood size (E/D)		2.1	2.1	1.6	2.3	1.8	0.17
Nesting success (D/B)		0.47	0.65	0.67	0.21	0.54	0.09
Hatching success (E/C)		0.47	0.63	0.58	0.21	0.50	0.08
Prop. nest sites w/ chicks (D/A)		0.27	0.29	0.53	0.08	0.30	0.10
Chicks/nest start (E/A)		0.6	0.6	0.8	0.2	0.5	0.14

<sup>a</sup>Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

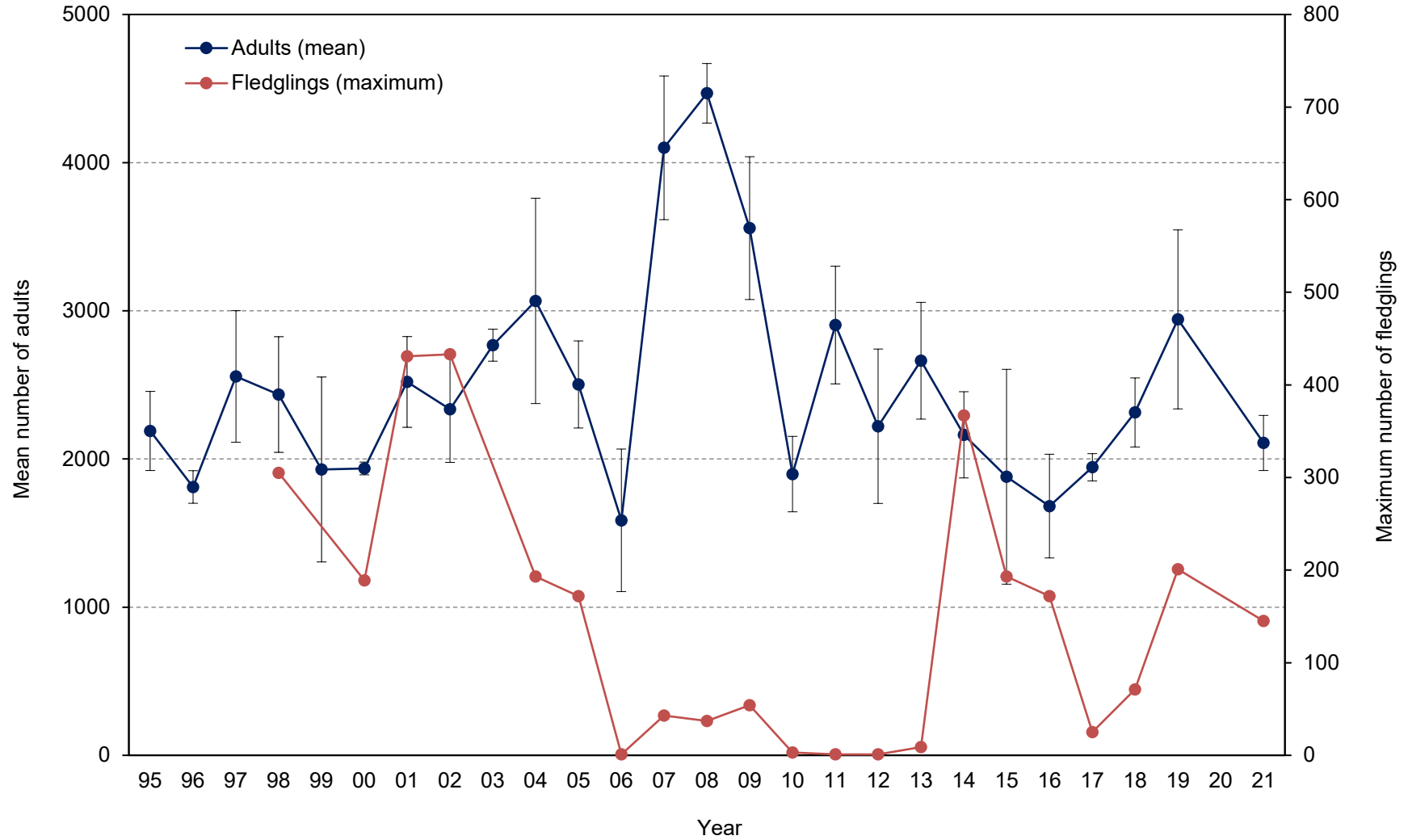


Figure 34. Mean numbers of glaucous-winged gull adults and maximum numbers of glaucous-winged gull fledglings counted on index plots (adults) or along beach transects (fledglings) at Aiktak Island, Alaska. No fledgling counts were conducted in 1999, 2003, or 2020.

Table 53. Numbers of glaucous-winged gulls counted on index plots at Aikta Island, Alaska. No data were collected in 2020.

Replicate	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	1994	1701	2689	2481	2004	1975	2564	2233	2804	2280	2130	2333	3412
2	2240	1875	3211	3039	1275	1872	2996	2684	2725	2639	2887	1450	4546
3	2527	1671	2329	2553	1631	1926	-	2719	2936	4007	2423	999	4176
4	-	-	-	2592	2734	1909	-	2152	2718	3519	2695	1530	4265
5	-	-	-	1944	-	-	-	1887	2657	2889	2379	1617	-
Mean	2189	1811	2557	2435	1929	1936	2520	2335	2768	3067	2503	1586	4100
Max.	2527	1875	3211	3039	2734	1975	2996	2719	2936	4007	2887	2333	4546
n	3	3	3	5	4	4	2	5	5	5	5	5	4
SD	267	110	444	390	624	43	306	358	108	693	294	481	485
First count	9 Jun	19 Jun	30 May	2 Jun	30 May	16 Jun	6 Jun	29 May	22 May	24 May	3 Jun	1 Jun	4 Jun
Last count	16 Jul	18 Jul	16 Jun	15 Jun	11 Jun	25 Jun	8 Jun	15 Jun	6 Jun	14 Jun	19 Jun	17 Jun	14 Jun

Table 53 (continued). Numbers of glaucous-winged gulls counted on index plots at Aikta Island, Alaska. No data were collected in 2020.

Replicate	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
1	4494	3252	1775	2993	1615	2242	2457	1171	1458	2026	2150	3636	2048
2	4749	3749	2191	2676	1730	3173	2368	2255	1920	2012	2212	2651	2316
3	4187	4227	1728	3046	2370	2507	1902	2710	2037	1908	2581	2539	1959
4	4490	2966	-	3427	2655	2731	1923	1385	1314	1831	-	-	-
5	4420	3600	-	2377	2737	-	1697	-	-	-	-	-	-
Mean	4468	3558	1898	2904	2211	2663	2163	1880	1682	1944	2314	2942	2108
Max.	4749	4227	2191	3427	2737	3173	2457	2710	2037	2026	2581	3636	2316
n	5	5	3	5	5	4	5	4	4	4	3	3	3
SD	201	482	255	397	521	394	291	725	350	92	233	604	186
First count	3 Jun	4 Jun	31 May	3 Jun	6 Jun	5 Jun	6 Jun	25 May	24 May	24 May	30 May	3 Jun	29 May
Last count	11 Jun	12 Jun	5 Jun	8 Jun	11 Jun	20 Jun	13 Jun	12 Jun	11 Jun	11 Jun	5 Jun	9 Jun	11 Jun

Table 54. Numbers of glaucous-winged gull fledglings counted on New Camp and Old Camp beaches at Aiktak Island, Alaska. No counts were conducted in 1999, 2003, or 2020.

Replicate	1998	2000	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
1	28	37	112	81	20	14	0	3	1	11	3	0	1	0	28	1	0	0	1	53	28
2	31	87	431	376	22	17	0	9	23	9	1	0	0	7	77	46	11	4	16	139	62
3	38	189	62	404	50	18	1	15	37	22	-	1	0	9	356	85	81	25	71	201	145
4	106	120	-	433	133	50	-	31	-	28	-	1	0	-	367	186	172	24	-	191	-
5	305	113	-	361	193	123	-	43	-	40	-	-	1	-	-	193	-	-	-	-	-
6	-	171	-	-	-	172	-	-	-	54	-	-	-	-	-	-	-	-	-	-	-
Max.	305	189	431	433	193	172	1	43	37	54	3	1	1	9	367	193	172	25	71	201	145
n	5	6	3	5	5	6	3	5	3	6	2	4	5	3	4	5	4	4	3	4	3
SD	118	56	200	142	77	67	1	17	18	17	1	1	1	9	180	85	79	13	37	68	60
First count	14 Aug	13 Aug	17 Aug	10 Aug	10 Aug	4 Aug	23 Aug	13 Aug	20 Aug	24 Aug	28 Aug	20 Aug	19 Aug	18 Aug	14 Aug	11 Aug	9 Aug	7 Aug	15 Aug	10 Aug	19 Aug
Last count	1 Sep	7 Sep	8 Sep	25 Aug	28 Aug	31 Aug	2 Sep	30 Aug	28 Aug	4 Sep	2 Sep	3 Sep	2 Sep	29 Aug	30 Aug	28 Aug	27 Aug	27 Aug	29 Aug	30 Aug	28 Aug

Table 55. Numbers of glaucous-winged gulls counted on index plots at Aiktak Island, Alaska in 2021.

Plot	Date			Mean	SD
	29 May	5 Jun	11 Jun		
A	7	13	8	-	-
B	361	424	273	-	-
C-west	915	892	821	-	-
C-north	479	663	571	-	-
D	0	0	0	-	-
E	17	20	23	-	-
F	25	24	22	-	-
G	12	15	10	-	-
H	40	29	24	-	-
I	11	32	19	-	-
Club A	75	107	102	-	-
Club B	82	75	63	-	-
Club C	24	22	23	-	-
Total	2048	2316	1959	2108	186

Table 56. Numbers of glaucous-winged gull fledglings counted on New Camp and Old Camp beaches at Aiktak Island, Alaska in 2021.

Plot	Date			Max.
	19 Aug	21 Aug	28 Aug	
Old Camp Beach	8	4	17	-
New Camp Beach	20	58	128	-
Total	28	62	145	145

Table 57. Density of glaucous-winged gull nests on index plots at Aiktak Island, Alaska. No data were collected in 2020.

Year	Total nest starts (A)	Nest sites w/ x eggs:					Nest sites w/ eggs (B)	Total eggs (C)	Area (m <sup>2</sup> )	Mean clutch size (C/B)	Density of nests w/ eggs (B/area)	Density of total nests (A/area)	Survey date
		0	1	2	3	4							
1997	93	48	3	13	29	0	45	114	1885.2 <sup>a</sup>	2.5	0.02	0.05	17 Jun
1998	76	48	2	7	19	0	28	73	1885.2	2.6	0.01	0.04	23 Jun
1999	84	53	3	18	10	0	31	63	1885.2	2.0	0.02	0.04	29 Jun
2000	47	8	7	16	15	0	38	84	1885.2	2.2	0.02	0.02	27+29 Jun
2001	70	17	2	15	36	0	53	154	1885.2	2.7	0.03	0.04	8+10 Jun
2002	90	30	1	12	47	0	49	136	1885.2	2.8	0.03	0.07	4,5,10 Jun
2003	90	41	1	9	39	0	49	136	1885.2	2.8	0.03	0.05	21 Jun
2004	81	24	7	18	32	0	57	140	1885.2	2.5	0.03	0.04	9+14 Jun
2005	81	39	14	8	20	0	42	90	1885.2	2.1	0.02	0.04	15 Jun
2006	86	85	1	0	0	0	1	1	1885.2	1.0	<0.01 <sup>b</sup>	0.05 <sup>b</sup>	15 Jun
2007	232	204	10	13	5	0	28	54	1885.2	1.9	0.02	0.12	19 Jun
2008	312	275	7	18	11	1	37	80	1885.2	2.1	0.02	0.17	20 Jun
2009	220	182	17	14	7	0	38	66	1885.2	1.7	0.02	0.12	20 Jun
2010	153	151	1	1	0	0	2	3	1885.2	1.5	<0.01 <sup>b</sup>	0.08 <sup>b</sup>	27+28 Jun
2011	170	161	5	3	1	0	9	14	1885.2	1.6	<0.01 <sup>b</sup>	0.09 <sup>b</sup>	23 Jun
2012	227	204	8	8	7	0	23	45	1885.2	2.0	0.01	0.12	29 Jun
2013	188	181	3	2	2	0	7	13	1885.2	1.9	<0.01	0.10	27 Jun
2014	172	117	10	11	34	0	55	134	1885.2	2.4	0.03	0.09	23 Jun
2015	87	42	3	12	30	0	45	117	1885.2	2.6	0.02	0.05	27 Jun
2016 <sup>c</sup>	98	58	2	16	22	0	40	100	1885.2	2.5	0.02	0.05	22+23 Jun
2017	176	146	7	11	12	0	30	65	1885.2	2.2	0.02	0.09	19 Jun
2018	158	139	4	5	10	0	19	44	1885.2	2.3	0.01	0.08	27 Jun
2019	92	53	8	12	19	0	39	89	1885.2	2.3	0.02	0.05	19 Jun
2021	197	168	8	14	7	0	29	57	1885.2	1.7	0.02	0.11	19 Jun

<sup>a</sup>Total area consists of sum of six plots of 314.2 m<sup>2</sup> each.

<sup>b</sup>In 2006, 2010, and 2011 density values may underestimate actual effort because gulls suffered exceptionally high rates of egg loss during the early egg-laying period before density surveys were conducted.

<sup>c</sup>In 2016 index plots were counted during two consecutive days.



Table 58. Density of glaucous-winged gulls on index plots at Aiktak Island, Alaska in 2021.

Parameter		Plot						Total	SD
		40	41	42	43	55	78		
Total nest starts (A)		50	7	46	29	30	35	197	-
Nest sites w/ x eggs:	0	42	6	33	29	26	32	168	-
	1	2	0	3	0	2	1	8	-
	2	6	1	7	0	0	0	14	-
	3	0	0	3	0	2	2	7	-
	4	0	0	0	0	0	0	0	-
Nest sites w/ eggs (B)		8	1	13	0	4	3	29	-
Total eggs (C)		14	2	26	0	8	7	57	-
Area (m <sup>2</sup> )		314.2	314.2	314.2	314.2	314.2	314.2	1885.2	-
Mean clutch size (C/B)		1.8	2.0	2.0	0.0	2.0	2.3	1.7	0.84
Density of nests w/ eggs (B/area)		0.03	0.0	0.04	0.0	0.01	0.01	0.02	0.02
Density of total nests (A/area)		0.16	0.02	0.15	0.09	0.1	0.11	0.11	0.05
Survey date		19 Jun	19 Jun	19 Jun	19 Jun	19 Jun	19 Jun	-	-

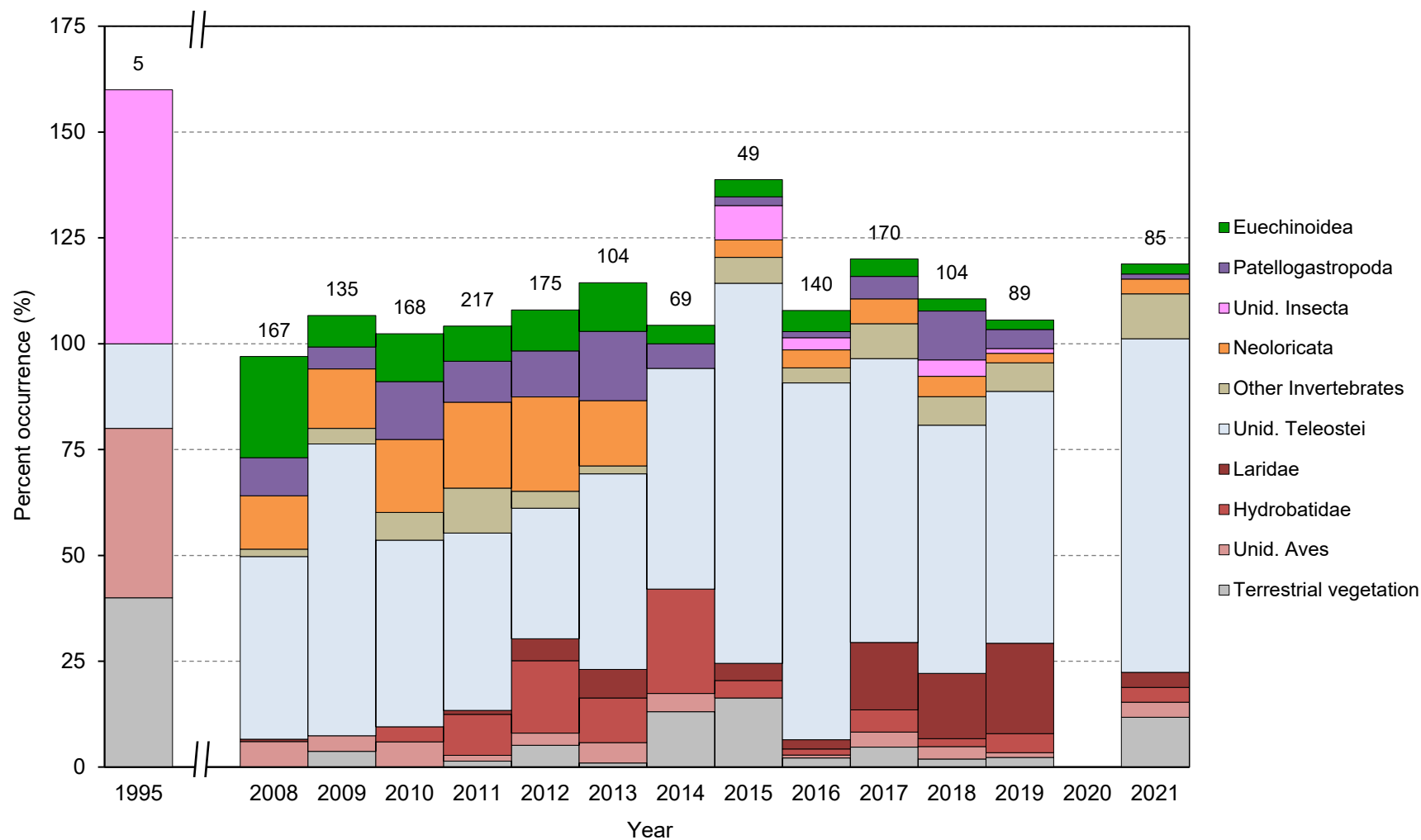


Figure 35. Frequency of occurrence of major prey items in diets of glaucous-winged gull adults at Aiktak Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence 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 (2008-2021). Numbers above columns indicate sample sizes. No diet samples were collected in 1996-2007 or 2020.

Table 59. Frequency of occurrence of major prey items in diets of glaucous-winged gull adults at Aiktak 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 (2008-2021) 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 (2008-2021). No diet samples were collected in 1996-2007 or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1995	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	5	167	135	168	217	175	104	69	49	140	170	104	89	85
<b>Invertebrates</b>	<b>60.0</b>	<b>50.3</b>	<b>27.4</b>	<b>45.8</b>	<b>44.7</b>	<b>45.1</b>	<b>37.5</b>	<b>10.1</b>	<b>22.4</b>	<b>17.9</b>	<b>19.4</b>	<b>23.1</b>	<b>16.9</b>	<b>17.6</b>
<b>Echinoidea</b>	-	<b>24.0</b>	<b>7.4</b>	<b>11.3</b>	<b>8.3</b>	<b>9.7</b>	<b>11.5</b>	<b>4.3</b>	<b>4.1</b>	<b>5.0</b>	<b>4.1</b>	<b>2.9</b>	<b>2.2</b>	<b>2.4</b>
Euechinoidea	-	24.0	7.4	11.3	8.3	9.7	11.5	4.3	4.1	5.0	4.1	2.9	2.2	2.4
<b>Gastropoda</b>	-	<b>15.0</b>	<b>6.7</b>	<b>13.7</b>	<b>12.4</b>	<b>20.6</b>	<b>16.3</b>	<b>5.8</b>	<b>2.0</b>	<b>1.4</b>	<b>5.9</b>	<b>11.5</b>	<b>4.5</b>	<b>1.2</b>
Patellogastropoda	-	9.0	5.2	13.7	9.7	10.9	16.3	5.8	2.0	1.4	5.3	11.5	4.5	1.2
Other Gastropoda	-	7.2	2.2	-	2.8	13.7	-	-	-	-	0.6	1.9	-	-
<b>Insecta</b>	<b>60.0</b>	-	-	-	<b>0.5</b>	-	<b>1.0</b>	-	<b>10.2</b>	<b>8.6</b>	<b>1.2</b>	<b>4.8</b>	<b>5.6</b>	<b>10.6</b>
Unid. Insecta	60.0	-	-	-	-	-	-	-	8.2	2.9	-	3.8	1.1	-
Other Insecta	-	-	-	-	0.5	-	1.0	-	2.0	5.7	1.2	1.0	4.5	10.6
<b>Polyplacophora</b>	-	<b>12.6</b>	<b>14.1</b>	<b>17.3</b>	<b>20.3</b>	<b>22.3</b>	<b>15.4</b>	-	<b>4.1</b>	<b>4.3</b>	<b>5.9</b>	<b>4.8</b>	<b>2.2</b>	<b>3.5</b>
Neoloricata	-	12.6	14.1	17.3	20.3	22.3	15.4	-	4.1	4.3	5.9	4.8	2.2	3.5
Other Invertebrates	-	1.8	3.7	6.5	10.6	4.0	1.9	-	6.1	3.6	8.2	6.7	6.7	10.6
<b>Fish</b>	<b>20.0</b>	<b>43.1</b>	<b>68.9</b>	<b>44.0</b>	<b>41.9</b>	<b>31.4</b>	<b>46.2</b>	<b>52.2</b>	<b>89.8</b>	<b>84.3</b>	<b>67.1</b>	<b>58.7</b>	<b>61.8</b>	<b>80.0</b>
<b>Teleostei</b>	<b>20.0</b>	<b>43.1</b>	<b>68.9</b>	<b>44.0</b>	<b>41.9</b>	<b>31.4</b>	<b>46.2</b>	<b>52.2</b>	<b>89.8</b>	<b>84.3</b>	<b>67.1</b>	<b>58.7</b>	<b>61.8</b>	<b>80.0</b>
Unid. Teleostei	20.0	43.1	68.9	44.0	41.9	30.9	46.2	52.2	89.8	84.3	67.1	58.7	59.6	78.8
Other Teleostei	-	-	-	-	-	0.6	-	-	-	-	-	-	2.2	1.2
<b>Birds</b>	<b>40.0</b>	<b>10.8</b>	<b>7.4</b>	<b>12.5</b>	<b>15.2</b>	<b>27.4</b>	<b>26.0</b>	<b>36.2</b>	<b>14.3</b>	<b>5.0</b>	<b>23.5</b>	<b>23.1</b>	<b>29.2</b>	<b>11.8</b>
<b>Charadriiformes</b>	-	<b>1.8</b>	<b>2.2</b>	<b>1.2</b>	<b>3.2</b>	<b>8.0</b>	<b>7.7</b>	<b>4.3</b>	<b>4.1</b>	<b>2.1</b>	<b>15.9</b>	<b>18.3</b>	<b>23.6</b>	<b>3.5</b>
<b>Laridae</b>	-	<b>0.6</b>	-	-	<b>0.9</b>	<b>5.1</b>	<b>6.7</b>	-	<b>4.1</b>	<b>2.1</b>	<b>15.9</b>	<b>15.4</b>	<b>21.3</b>	<b>3.5</b>
<i>Larus glaucescens</i> egg	-	0.6	-	-	0.9	5.1	6.7	-	4.1	2.1	15.3	15.4	18.0	3.5
Other Laridae	-	-	-	-	-	-	-	-	-	-	0.6	-	3.4	-
Other Charadriiformes	-	1.2	2.2	1.2	2.3	2.9	1.0	4.3	-	-	-	2.9	2.2	-
<b>Procellariiformes</b>	-	-	-	<b>3.6</b>	<b>9.7</b>	<b>17.1</b>	<b>10.6</b>	<b>24.6</b>	<b>4.1</b>	<b>1.4</b>	<b>5.3</b>	<b>1.9</b>	<b>4.5</b>	<b>3.5</b>
Hydrobatidae	-	-	-	3.6	9.7	17.1	10.6	24.6	4.1	1.4	5.3	1.9	4.5	3.5
Unid. Aves	40.0	6.0	3.7	6.0	1.4	2.9	4.8	4.3	-	0.7	3.5	2.9	1.1	3.5
Other Birds	-	4.8	1.5	1.8	2.3	-	2.9	7.2	-	0.7	-	-	-	-
Mammals	-	-	-	0.6	-	-	-	2.9	-	0.7	-	1.0	-	-
<b>Other</b>	<b>40.0</b>	<b>2.4</b>	<b>9.6</b>	<b>1.8</b>	<b>12.0</b>	<b>10.9</b>	<b>3.8</b>	<b>15.9</b>	<b>18.4</b>	<b>7.9</b>	<b>10.0</b>	<b>7.7</b>	<b>3.4</b>	<b>14.1</b>
Terrestrial vegetation	40.0	-	3.7	-	1.4	5.1	1.0	13.0	16.3	2.1	4.7	1.9	2.2	11.8
Other	-	2.4	6.7	1.8	11.1	6.3	2.9	2.9	2.0	6.4	6.5	5.8	2.2	3.5

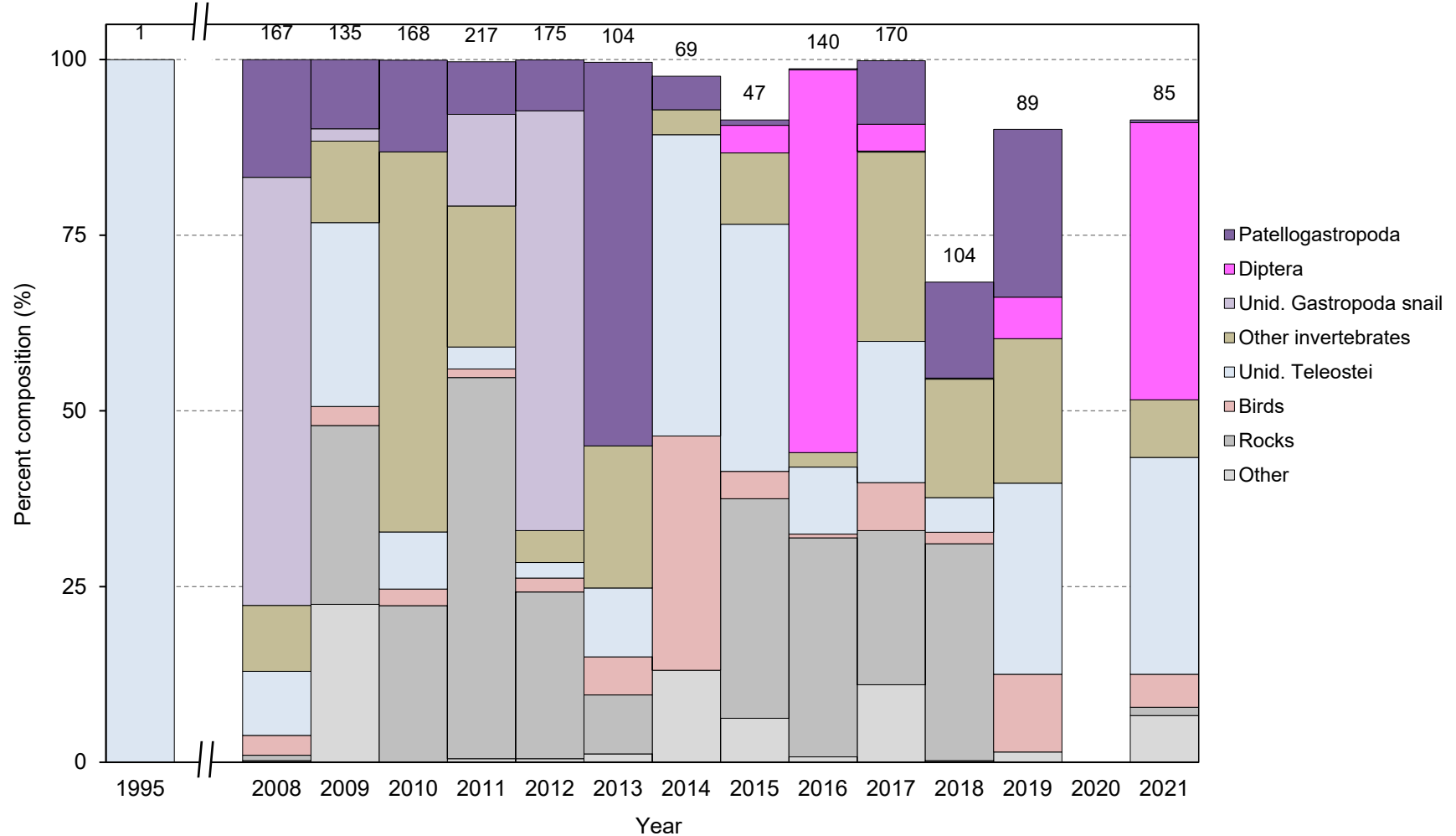


Figure 36. Percent composition of major prey items in diets of glaucous-winged gull adults at Aiktak Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of stomach contents from adults collected at or near the colony (1995) and pellets regurgitated by adults at the colony (2008-2021). Numbers above columns indicate sample sizes. No diet samples were collected in 1996-2007 or 2020.

Table 60. Percent composition of major prey items in diets of glaucous-winged gull adults at Aikta 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 (1995) or field (2008-2021) 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 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 stomach contents from adults collected at or near the colony (1995) and pellets regurgitated by adults at the colony (2008-2021). No diet samples were collected in 1996-2007 or 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1995	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	1	167	135	168	217	175	104	69	47	140	170	104	89	85
No. individuals	1	788	405	897	2943	2445	500	84	128	1300	661	1588	272	256
<b>Invertebrates</b>	-	<b>87.1</b>	<b>23.2</b>	<b>67.1</b>	<b>40.9</b>	<b>71.5</b>	<b>75.2</b>	<b>8.3</b>	<b>23.4</b>	<b>57.9</b>	<b>40.1</b>	<b>62.3</b>	<b>54.0</b>	<b>48.8</b>
<b>Gastropoda</b>	-	<b>77.7</b>	<b>11.6</b>	<b>13.0</b>	<b>20.5</b>	<b>67.0</b>	<b>54.6</b>	<b>4.8</b>	<b>0.8</b>	<b>0.2</b>	<b>9.2</b>	<b>13.8</b>	<b>23.9</b>	<b>0.4</b>
Patellologastropoda	-	16.8	9.9	13.0	7.4	7.3	54.6	4.8	0.8	0.2	9.1	13.7	23.9	0.4
Other Gastropoda	-	60.9	1.7	-	13.0	59.7	-	-	-	-	0.2	0.1	-	-
<b>Insecta</b>	-	-	-	-	<b>0.3</b>	-	<b>0.4</b>	-	<b>12.5</b>	<b>55.7</b>	<b>3.9</b>	<b>31.6</b>	<b>9.6</b>	<b>40.2</b>
<b>Diptera</b>	-	-	-	-	-	-	-	-	<b>3.9</b>	<b>54.5</b>	<b>3.8</b>	-	<b>5.9</b>	<b>39.5</b>
Unid. Diptera	-	-	-	-	-	-	-	-	3.9	54.5	3.8	-	5.9	39.5
Other Insecta	-	-	-	-	0.3	-	0.4	-	8.6	1.2	0.2	31.6	3.7	0.8
Other Invertebrates	-	9.4	11.6	54.1	20.1	4.5	20.2	3.6	10.2	2.1	26.9	16.9	20.6	8.2
<b>Fish</b>	<b>100.0</b>	<b>9.1</b>	<b>26.2</b>	<b>8.1</b>	<b>3.1</b>	<b>2.2</b>	<b>9.8</b>	<b>42.9</b>	<b>35.2</b>	<b>9.5</b>	<b>20.1</b>	<b>4.9</b>	<b>33.5</b>	<b>38.7</b>
<b>Teleostei</b>	<b>100.0</b>	<b>9.1</b>	<b>26.2</b>	<b>8.1</b>	<b>3.1</b>	<b>2.2</b>	<b>9.8</b>	<b>42.9</b>	<b>35.2</b>	<b>9.5</b>	<b>20.1</b>	<b>4.9</b>	<b>33.5</b>	<b>38.7</b>
Unid. Teleostei	100.0	9.1	26.2	8.1	3.1	2.2	9.8	42.9	35.2	9.5	20.1	4.9	27.2	30.9
Other Teleostei	-	-	-	-	-	<0.1	-	-	-	-	-	-	6.3	7.8
Birds	-	2.8	2.7	2.3	1.2	2.0	5.4	33.3	3.9	0.5	6.8	1.6	11.0	4.7
Mammals	-	-	-	0.1	-	-	-	2.4	-	0.1	-	0.1	-	-
<b>Other</b>	-	<b>1.0</b>	<b>47.9</b>	<b>22.3</b>	<b>54.7</b>	<b>24.2</b>	<b>9.6</b>	<b>13.1</b>	<b>37.5</b>	<b>31.9</b>	<b>33.0</b>	<b>31.1</b>	<b>1.5</b>	<b>7.8</b>
Rocks	-	0.8	25.4	22.3	54.2	23.7	8.4	-	31.3	31.2	21.9	30.9	-	1.2
Other	-	0.3	22.5	-	0.5	0.5	1.2	13.1	6.3	0.8	11.0	0.3	1.5	6.6

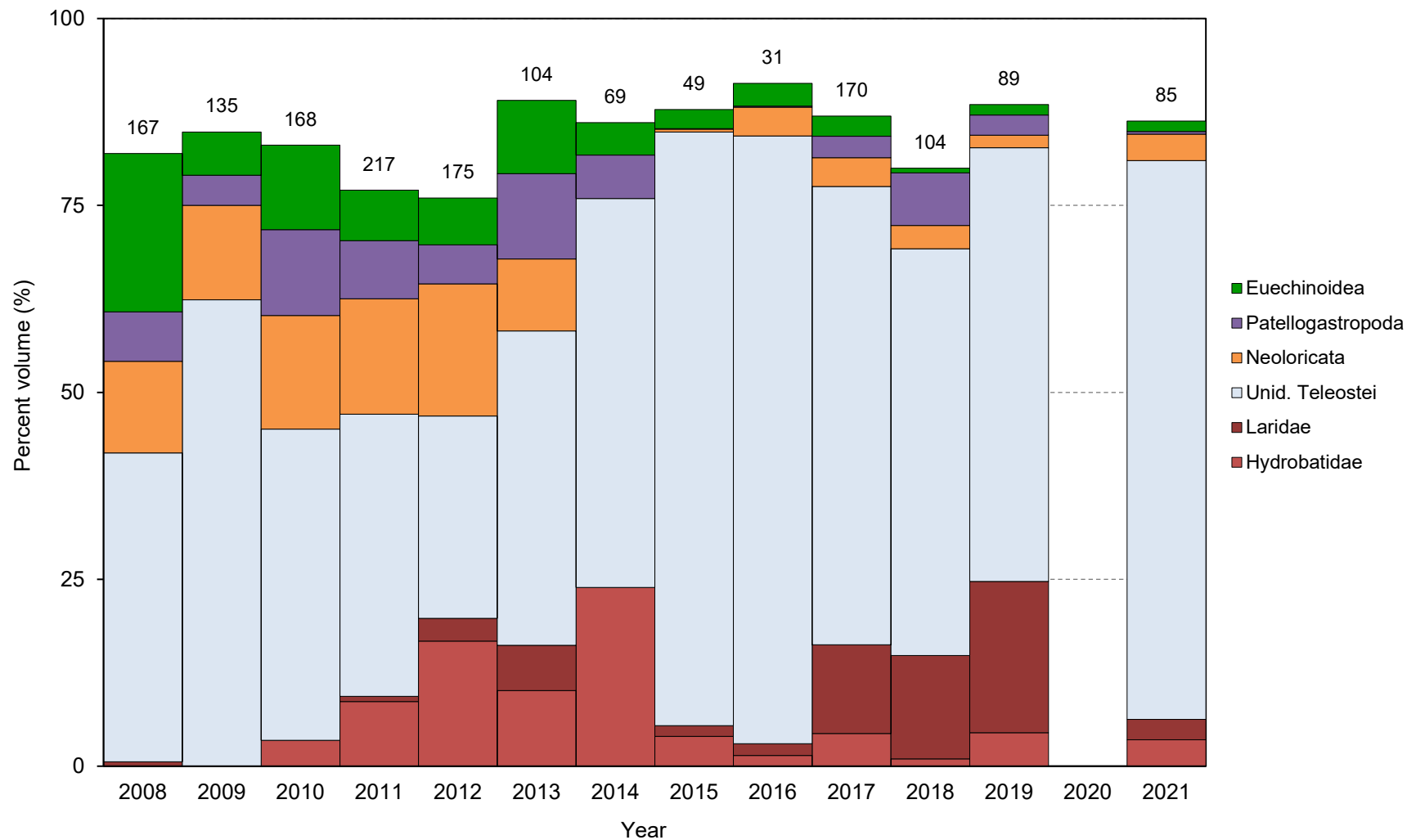


Figure 37. Percent volume of major prey items diets of glaucous-winged gull adults at Aiktak Island, Alaska. Values represent the average percent volume of a prey item in all pellets. Prey is grouped to family level or higher; only taxa with an among-year average volume of at least 5% are shown. Samples consist of pellets regurgitated by adults at the colony. Numbers above columns indicate sample sizes. No diet samples were collected in 1996-2007 or 2020; no volume data exist for 1995.

Table 61. Percent volume of major prey items diets of glaucous-winged gull adults at Aiktak 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. Samples consist of pellets regurgitated by adults at the colony. No diet samples were collected in 1996-2007 or 2020; no volume data exist for 1995. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	167	135	168	217	175	104	69	49	31	170	104	89	85
<b>Invertebrates</b>	<b>48.4</b>	<b>25.4</b>	<b>44.2</b>	<b>39.9</b>	<b>42.8</b>	<b>33.4</b>	<b>10.1</b>	<b>7.8</b>	<b>10.3</b>	<b>16.1</b>	<b>18.5</b>	<b>10.8</b>	<b>8.4</b>
<b>Echinoidea</b>	<b>21.2</b>	<b>5.8</b>	<b>11.3</b>	<b>6.8</b>	<b>6.3</b>	<b>9.8</b>	<b>4.3</b>	<b>2.6</b>	<b>3.1</b>	<b>2.7</b>	<b>0.6</b>	<b>1.4</b>	<b>1.4</b>
Euechinoidea	21.2	5.8	11.3	6.8	6.3	9.8	4.3	2.6	3.1	2.7	0.6	1.4	1.4
<b>Gastropoda</b>	<b>12.5</b>	<b>5.0</b>	<b>11.5</b>	<b>9.6</b>	<b>17.1</b>	<b>11.4</b>	<b>5.8</b>	<b>0.1</b>	<b>0.1</b>	<b>2.9</b>	<b>7.1</b>	<b>2.7</b>	<b>0.4</b>
Patellogastropoda	6.6	4.0	11.5	7.7	5.2	11.4	5.8	0.1	0.1	2.9	7.1	2.7	0.4
Other Gastropoda	5.9	0.9	-	1.8	11.9	-	-	-	-	0.1	0.1	-	-
<b>Polyplacophora</b>	<b>12.3</b>	<b>12.6</b>	<b>15.2</b>	<b>15.4</b>	<b>17.7</b>	<b>9.6</b>	<b>&lt;0.1</b>	<b>0.4</b>	<b>3.9</b>	<b>3.8</b>	<b>3.1</b>	<b>1.7</b>	<b>3.5</b>
Neoloricata	12.3	12.6	15.2	15.4	17.7	9.6	<0.1	0.4	3.9	3.8	3.1	1.7	3.5
Other Invertebrates	2.4	2.0	6.2	8.1	1.8	2.5	-	4.8	3.2	6.6	7.7	5.0	3.1
<b>Fish</b>	<b>41.3</b>	<b>62.4</b>	<b>41.6</b>	<b>37.8</b>	<b>27.6</b>	<b>42.1</b>	<b>52.0</b>	<b>79.4</b>	<b>81.3</b>	<b>61.3</b>	<b>54.4</b>	<b>60.2</b>	<b>75.9</b>
<b>Teleostei</b>	<b>41.3</b>	<b>62.4</b>	<b>41.6</b>	<b>37.8</b>	<b>27.6</b>	<b>42.1</b>	<b>52.0</b>	<b>79.4</b>	<b>81.3</b>	<b>61.3</b>	<b>54.4</b>	<b>60.2</b>	<b>75.9</b>
Unid. Teleostei	41.3	62.4	41.6	37.8	27.1	42.1	52.0	79.4	81.3	61.3	54.4	58.0	74.7
Other Teleostei	-	-	-	-	0.6	-	-	-	-	-	-	2.2	1.2
<b>Birds</b>	<b>9.3</b>	<b>6.4</b>	<b>12.4</b>	<b>13.8</b>	<b>24.3</b>	<b>24.1</b>	<b>33.4</b>	<b>5.4</b>	<b>4.4</b>	<b>19.6</b>	<b>21.1</b>	<b>28.1</b>	<b>11.0</b>
<b>Charadriiformes</b>	<b>1.8</b>	<b>2.2</b>	<b>1.2</b>	<b>2.5</b>	<b>5.9</b>	<b>7.0</b>	<b>4.2</b>	<b>1.4</b>	<b>1.6</b>	<b>11.8</b>	<b>16.7</b>	<b>22.5</b>	<b>2.7</b>
Laridae	0.6	-	-	0.7	3.1	6.1	-	1.4	1.6	11.8	13.8	20.2	2.7
Other Charadriiformes	1.2	2.2	1.2	1.8	2.9	1.0	4.2	-	-	-	2.9	2.2	-
<b>Procellariiformes</b>	<b>-</b>	<b>-</b>	<b>3.5</b>	<b>8.6</b>	<b>16.7</b>	<b>10.1</b>	<b>23.9</b>	<b>4.0</b>	<b>1.4</b>	<b>4.4</b>	<b>1.0</b>	<b>4.5</b>	<b>3.5</b>
Hydrobatidae	-	-	3.5	8.6	16.7	10.1	23.9	4.0	1.4	4.4	1.0	4.5	3.5
Other Birds	7.5	4.2	7.7	2.6	1.7	7.0	5.3	-	1.4	3.4	3.5	1.1	4.7
Mammals	-	-	0.6	-	-	-	2.8	-	0.4	-	0.3	-	-
Other	1.0	5.8	1.2	8.5	5.2	0.4	1.6	7.4	3.7	3.0	5.6	0.9	4.7

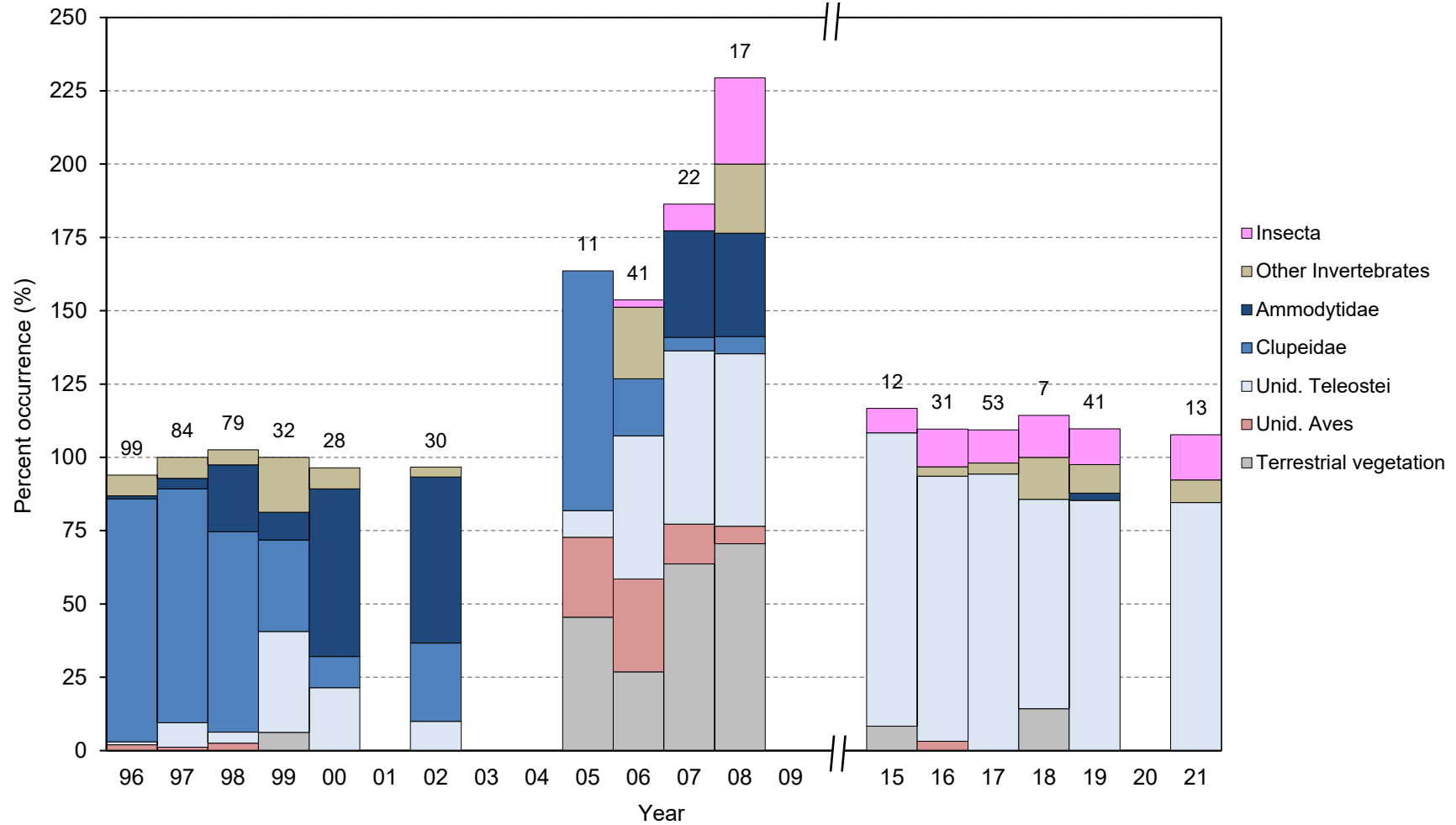


Figure 38. Frequency of occurrence of major prey items in diets of glaucous-winged gull chicks at Aiktak Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence of at least 5% are shown. Samples consist of boluses or regurgitations picked up on the ground at the colony (1996-2006, 2015-2021) and regurgitation samples collected directly from chicks (2001, 2007-2009). Numbers above columns indicate sample sizes. No diet samples were collected in 2003-2004, 2010-2014 or 2020; samples were collected in 2001 but were too degraded for analysis. Samples were collected in 2009 but have not yet been analyzed.



Table 62. Frequency of occurrence of major prey items in diets of glaucous-winged gull chicks at Aiktak Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey was identified in the laboratory (1996-2009) or field (2015-2021) 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 boluses or regurgitations picked up on the ground at the colony (1996-2006, 2015-2021) and regurgitation samples collected directly from chicks (2007-2009). No diet samples were collected in 2003-2004, 2010-2014 or 2020; samples were collected in 2001 but were too degraded for analysis. Samples were collected in 2009 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1996	1997	1998	1999	2000	2002	2005	2006	2007	2008	2009	2015	2016	2017	2018	2019	2021
No. samples	99	84	79	32	28	30	11	41	22 <sup>a</sup>	17 <sup>b</sup>	12	12	31	53	7	41	13
<b>Invertebrates</b>	<b>7.1</b>	<b>7.1</b>	<b>5.1</b>	<b>18.8</b>	<b>7.1</b>	<b>3.3</b>	-	<b>26.8</b>	<b>9.1</b>	<b>41.2</b>	<i>pending</i>	<b>8.3</b>	<b>16.1</b>	<b>15.1</b>	<b>28.6</b>	<b>22.0</b>	<b>23.1</b>
Insecta	-	-	-	-	-	-	-	2.4	9.1	29.4	-	8.3	12.9	11.3	14.3	12.2	15.4
Other Invertebrates	7.1	7.1	5.1	18.8	7.1	3.3	-	24.4	-	23.5	-	-	3.2	3.8	14.3	9.8	7.7
<b>Fish</b>	<b>88.9</b>	<b>89.3</b>	<b>97.5</b>	<b>71.9</b>	<b>89.3</b>	<b>96.7</b>	<b>90.9</b>	<b>68.3</b>	<b>100.0</b>	<b>100.0</b>	-	<b>100.0</b>	<b>90.3</b>	<b>94.3</b>	<b>71.4</b>	<b>87.8</b>	<b>84.6</b>
<b>Teleostei</b>	<b>88.9</b>	<b>89.3</b>	<b>97.5</b>	<b>71.9</b>	<b>89.3</b>	<b>96.7</b>	<b>90.9</b>	<b>68.3</b>	<b>100.0</b>	<b>100.0</b>	-	<b>100.0</b>	<b>90.3</b>	<b>94.3</b>	<b>71.4</b>	<b>87.8</b>	<b>84.6</b>
<b>Ammodytidae</b>	<b>1.0</b>	<b>3.6</b>	<b>22.8</b>	<b>9.4</b>	<b>57.1</b>	<b>56.7</b>	-	-	<b>36.4</b>	<b>35.3</b>	-	-	-	-	-	<b>2.4</b>	-
<i>Ammodytes</i> spp.	1.0	3.6	22.8	9.4	57.1	56.7	-	-	36.4	35.3	-	-	-	-	-	2.4	-
<b>Clupeidae</b>	<b>82.8</b>	<b>79.8</b>	<b>68.4</b>	<b>31.3</b>	<b>10.7</b>	<b>26.7</b>	<b>81.8</b>	<b>19.5</b>	<b>4.5</b>	<b>5.9</b>	-	-	-	-	-	-	-
<i>Clupea pallasii</i>	82.8	79.8	68.4	31.3	10.7	26.7	81.8	19.5	4.5	5.9	-	-	-	-	-	-	-
Unid. Teleostei	1.0	8.3	3.8	34.4	21.4	10.0	9.1	48.8	59.1	58.8	-	100.0	90.3	94.3	71.4	85.4	84.6
Other Teleostei	5.1	-	13.9	-	3.6	3.3	-	-	-	-	-	-	-	-	-	-	-
<b>Birds</b>	<b>15.2</b>	<b>8.3</b>	<b>5.1</b>	<b>9.4</b>	<b>3.6</b>	-	<b>27.3</b>	<b>31.7</b>	<b>13.6</b>	<b>5.9</b>	-	-	<b>6.5</b>	<b>1.9</b>	-	<b>4.9</b>	-
Unid. Aves	2.0	1.2	2.5	-	-	-	27.3	31.7	13.6	5.9	-	-	3.2	-	-	-	-
Other Birds	13.1	7.1	2.5	9.4	3.6	-	-	-	-	-	-	-	3.2	1.9	-	4.9	-
Mammals	-	-	1.3	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Other</b>	-	-	-	<b>6.3</b>	<b>3.6</b>	-	<b>45.5</b>	<b>29.3</b>	<b>72.7</b>	<b>76.5</b>	-	<b>8.3</b>	<b>6.5</b>	-	<b>14.3</b>	-	-
Terrestrial vegetation	-	-	-	6.3	-	-	45.5	26.8	63.6	70.6	-	8.3	-	-	14.3	-	-
Other	-	-	-	3.1	3.6	-	-	4.9	18.2	5.9	-	-	6.5	-	-	-	-

<sup>a</sup>Eight additional samples are still pending analysis.

<sup>b</sup>One additional sample is still pending analysis.

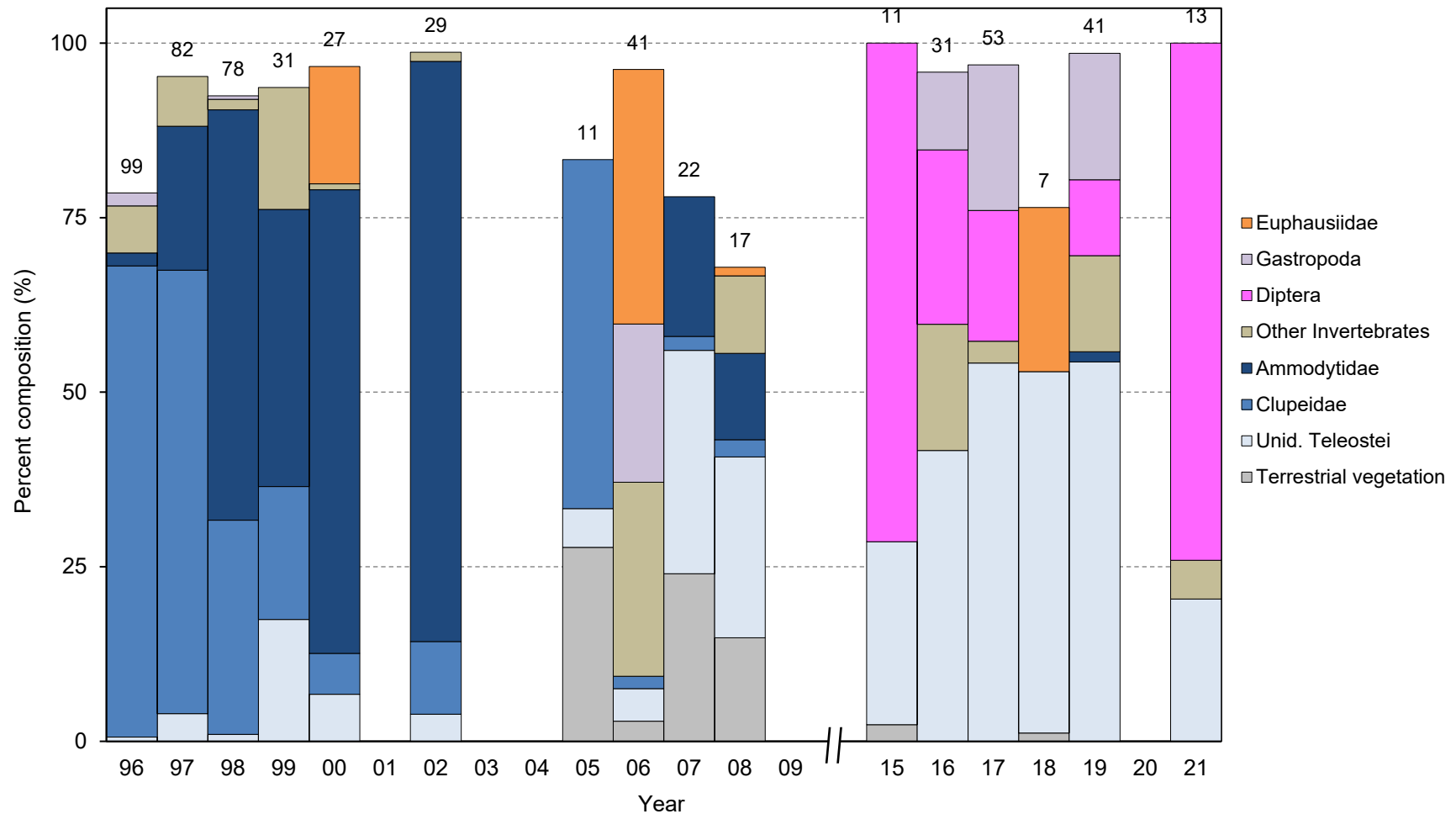


Figure 39. Percent composition of major prey items in diets of glaucous-winged gull chicks at Aiktak Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition of at least 5% are shown. Samples consist of boluses or regurgitations picked up on the ground at the colony (1996-2006, 2015-2021) and regurgitation samples collected directly from chicks (2001, 2007-2009). Numbers above columns indicate sample sizes. No diet samples were collected in 2003-2004, 2010-2014, or 2020; samples were collected in 2001 but were too degraded for analysis. Samples were collected in 2009 but have not yet been analyzed.

Table 63. Percent composition of major prey items in diets of glaucous-winged gull chicks at Aiktak 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 (1996-2009) or field (2015-2021) 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 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 boluses or regurgitations picked up on the ground at the colony (1996-2006, 2015-2021) and regurgitation samples collected directly from chicks (2007-2009). No diet samples were collected in 2003-2004, 2010-2014, or 2020; samples were collected in 2001 but were too degraded for analysis. Samples were collected in 2009 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1996	1997	1998	1999	2000	2002	2005	2006	2007	2008	2009	2015	2016	2017	2018	2019	2021
No. samples	99	82	78	31	27	29	11	41	22 <sup>a</sup>	17 <sup>b</sup>	12	11	31	53	7	41	13
No. individuals	163	126	199	63	119	77	18	450	50	81	<i>pending</i>	42	72	96	85	138	54
<b>Invertebrates</b>	<b>8.6</b>	<b>7.1</b>	<b>2.0</b>	<b>17.5</b>	<b>17.6</b>	<b>1.3</b>	-	<b>87.1</b>	<b>8.0</b>	<b>32.1</b>	-	<b>71.4</b>	<b>54.2</b>	<b>44.8</b>	<b>47.1</b>	<b>42.8</b>	<b>79.6</b>
<b>Euphausiacea</b>	-	-	-	-	<b>16.8</b>	-	-	<b>36.4</b>	-	<b>1.2</b>	-	-	-	-	<b>23.5</b>	-	-
Euphausiidae	-	-	-	-	16.8	-	-	36.4	-	1.2	-	-	-	-	23.5	-	-
Gastropoda	1.8	-	0.5	-	-	-	-	22.7	-	-	-	-	11.1	20.8	-	18.1	-
<b>Insecta</b>	-	-	-	-	-	-	-	<b>0.2</b>	<b>8.0</b>	<b>19.8</b>	-	<b>71.4</b>	<b>25.0</b>	<b>20.8</b>	<b>23.5</b>	<b>10.9</b>	<b>74.1</b>
<b>Diptera</b>	-	-	-	-	-	-	-	-	-	-	-	<b>71.4</b>	<b>25.0</b>	<b>18.8</b>	-	<b>10.9</b>	<b>74.1</b>
Unid. Diptera	-	-	-	-	-	-	-	-	-	-	-	71.4	25.0	18.8	-	10.9	74.1
Other Insecta	-	-	-	-	-	-	-	0.2	8.0	19.8	-	-	-	2.1	23.5	-	-
Other Invertebrates	6.7	7.1	1.5	17.5	0.8	1.3	-	27.8	-	11.1	-	-	18.1	3.1	-	13.8	5.6
<b>Fish</b>	<b>81.6</b>	<b>88.1</b>	<b>95.5</b>	<b>76.2</b>	<b>81.5</b>	<b>98.7</b>	<b>55.6</b>	<b>6.4</b>	<b>54.0</b>	<b>40.7</b>	-	<b>26.2</b>	<b>41.7</b>	<b>54.2</b>	<b>51.8</b>	<b>55.8</b>	<b>20.4</b>
<b>Teleostei</b>	<b>81.6</b>	<b>88.1</b>	<b>95.5</b>	<b>76.2</b>	<b>81.5</b>	<b>98.7</b>	<b>55.6</b>	<b>6.4</b>	<b>54.0</b>	<b>40.7</b>	-	<b>26.2</b>	<b>41.7</b>	<b>54.2</b>	<b>51.8</b>	<b>55.8</b>	<b>20.4</b>
<b>Ammodytidae</b>	<b>1.8</b>	<b>20.6</b>	<b>58.8</b>	<b>39.7</b>	<b>66.4</b>	<b>83.1</b>	-	-	<b>20.0</b>	<b>12.3</b>	-	-	-	-	-	<b>1.4</b>	-
<i>Ammodytes</i> spp.	1.8	20.6	58.8	39.7	66.4	83.1	-	-	20.0	12.3	-	-	-	-	-	1.4	-
<b>Clupeidae</b>	<b>67.5</b>	<b>63.5</b>	<b>30.7</b>	<b>19.0</b>	<b>5.9</b>	<b>10.4</b>	<b>50.0</b>	<b>1.8</b>	<b>2.0</b>	<b>2.5</b>	-	-	-	-	-	-	-
<i>Clupea pallasii</i>	67.5	63.5	30.7	19.0	5.9	10.4	50.0	1.8	2.0	2.5	-	-	-	-	-	-	-
Unid. Teleostei	0.6	4.0	1.0	17.5	6.7	3.9	5.6	4.7	32.0	25.9	-	26.2	41.7	54.2	51.8	54.3	20.4
Other Teleostei	11.7	-	5.0	-	2.5	1.3	-	-	-	-	-	-	-	-	-	-	-
Birds	9.8	4.8	2.0	4.8	0.8	-	16.7	3.1	6.0	1.2	-	-	2.8	1.0	-	1.4	-
Mammals	-	-	0.5	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Other</b>	-	-	-	-	-	-	<b>27.8</b>	<b>3.3</b>	<b>32.0</b>	<b>25.9</b>	-	<b>2.4</b>	<b>1.4</b>	-	<b>1.2</b>	-	-
Terrestrial vegetation	-	-	-	-	-	-	27.8	2.9	24.0	14.8	-	2.4	-	-	1.2	-	-
Other	-	-	-	-	-	-	-	0.4	8.0	11.1	-	-	1.4	-	-	-	-

<sup>a</sup>Eight additional samples are still pending analysis.

<sup>b</sup>One additional sample is still pending analysis.

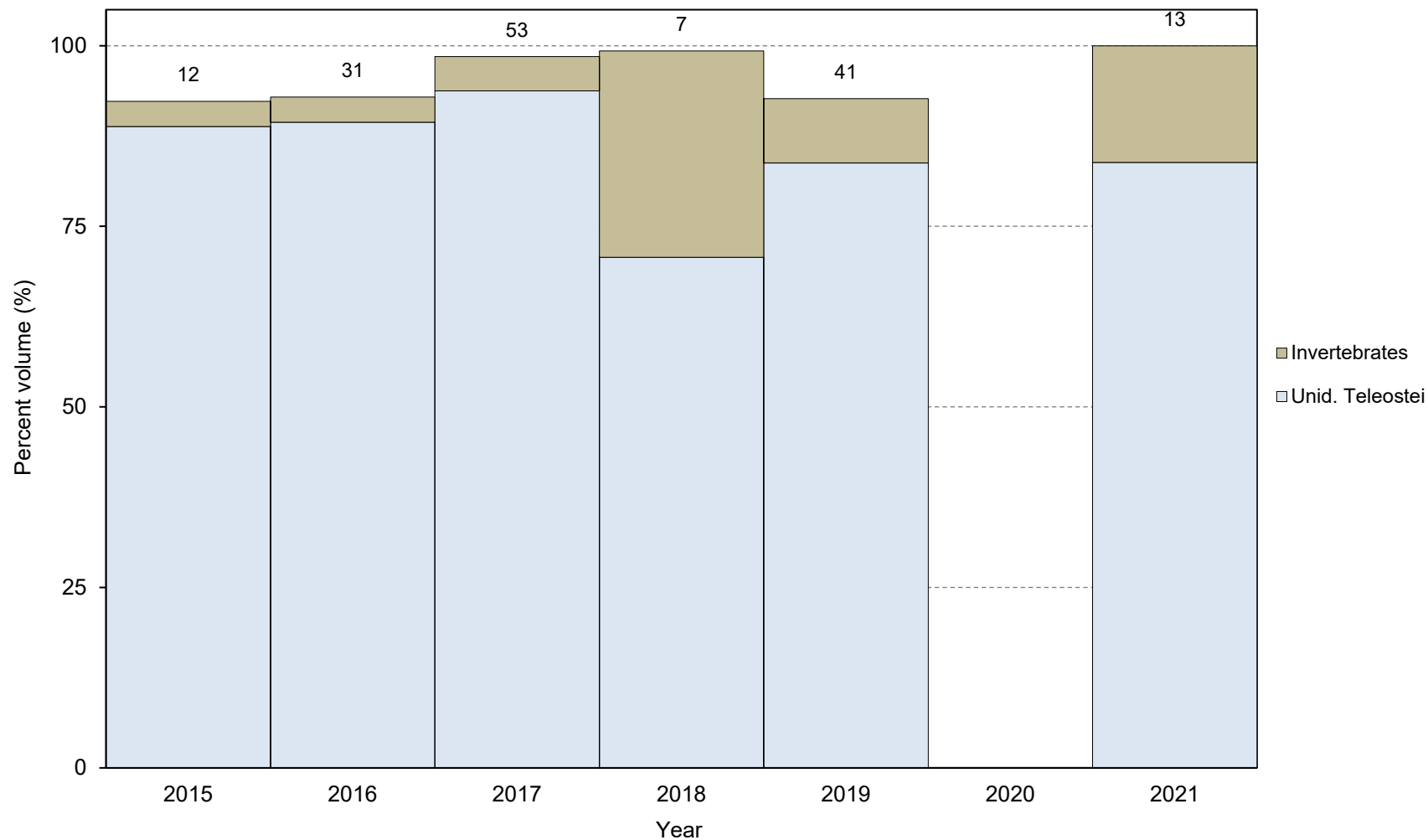


Figure 40. Percent volume of major prey items diets of glaucous-winged gull chicks at Aiktak Island, Alaska. Values represent the average percent volume of a prey item in all pellets. Prey is grouped to family level or higher; only taxa with an among-year average volume of at least 5% are shown. Samples consist of boluses or regurgitations picked up on the ground at the colony. No volume data exist before 2015 and no samples were collected in 2020.

Table 64. Percent volume of major prey items diets of glaucous-winged gull chicks at Aiktak 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. Samples consist of boluses or regurgitations picked up on the ground at the colony. No volume data exist before 2015 and no samples were collected in 2020. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2015	2016	2017	2018	2019	2021
No. samples	12	31	53	7	41	13
Invertebrates	3.5	3.5	4.7	28.6	8.9	16.2
<b>Fish</b>	<b>88.8</b>	<b>89.4</b>	<b>93.8</b>	<b>70.7</b>	<b>86.2</b>	<b>83.8</b>
<b>Teleostei</b>	<b>88.8</b>	<b>89.4</b>	<b>93.8</b>	<b>70.7</b>	<b>86.2</b>	<b>83.8</b>
Unid. Teleostei	88.8	89.4	93.8	70.7	83.8	83.8
Other Teleostei	-	-	-	-	2.4	-
Birds	-	3.5	1.9	-	4.9	-
Other	7.7	3.5	-	0.7	-	-

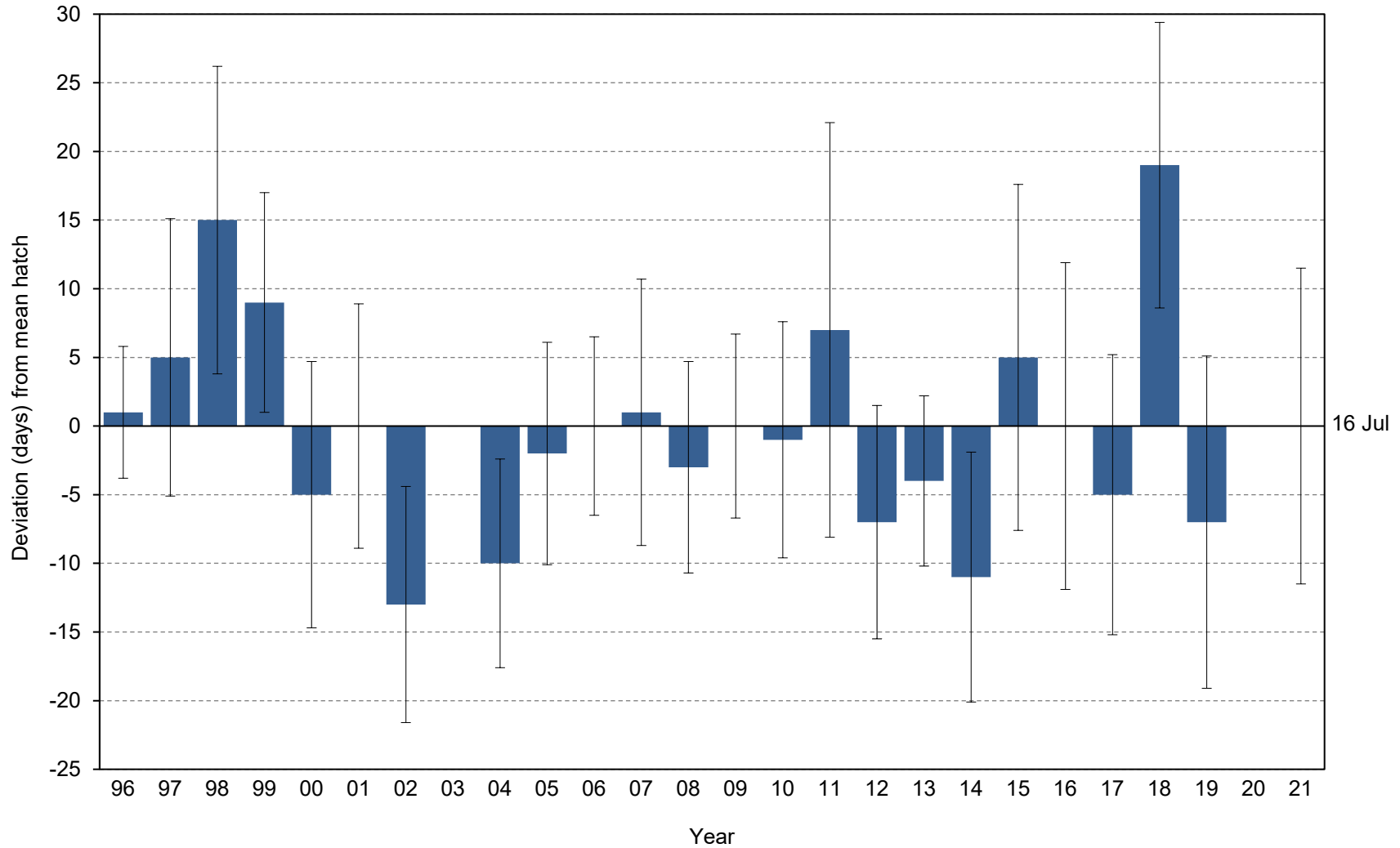


Figure 41. Yearly hatch date deviation (from the 1996-2020 average of 16 July) for fork-tailed storm-petrels at Aikta Island, Alaska. Data include only chronology plots monitored on an interval of about 7 days. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date. No data were collected in 2003 or 2020.

Table 65. Breeding chronology of fork-tailed storm-petrels at Aiktak Island, Alaska. Data include only chronology plots monitored on an interval of about 7 days. No data were collected in 2003 or 2020.

Year	Mean hatch	SD	<i>n</i> <sup>a</sup>	First hatch	Last hatch	First fledge <sup>b</sup>
1996	16 Jul	4.8	6	3 Jul	25 Jul	21 Aug
1997	21 Jul	10.1	16	7 Jul	13 Aug	>1 Sep
1998	31 Jul	11.2	16	14 Jul	20 Aug	>3 Sep
1999	25 Jul	8.0	28	9 Jul	21 Aug	>31 Aug
2000	10 Jul	9.7	35	26 Jun	13 Aug	25 Aug
2001	16 Jul	8.4	38	16 Jun	4 Aug	3 Sep
2002	3 Jul	8.6	21	20 Jun	2 Aug	22 Aug
2004	6 Jul	7.6	32	22 Jun	19 Jul	17 Aug
2005	14 Jul	8.1	45	23 Jun	10 Aug	30 Aug
2006	16 Jul	6.5	20	8 Jul	30 Jul	>1 Sep
2007	17 Jul	9.7	23	5 Jul	13 Aug	>30 Aug
2008	12 Jul	7.7	28	2 Jul	31 Jul	25 Aug
2009	16 Jul	6.7	29	29 Jun	12 Aug	>2 Sep
2010	15 Jul	8.6	26	3 Jul	4 Aug	>30 Aug
2011	23 Jul	15.1	21	3 Jul	28 Aug	>5 Sep
2012	8 Jul	8.5	24	26 Jun	24 Jul	29 Aug
2013	12 Jul	6.2	18	25 Jun	17 Jul	>26 Aug
2014	5 Jul	9.1	26	21 Jun	27 Jul	15 Aug
2015	21 Jul	12.6	26	5 Jul	14 Aug	>28 Aug
2016	15 Jul	11.9	34	22 Jun	13 Aug	25 Aug
2017	11 Jul	10.2	44	25 Jun	8 Aug	27 Aug
2018	4 Aug	10.4	26	17 Jul	24 Aug	>30 Aug
2019	9 Jul	12.1	48	21 Jun	22 Aug	22 Aug
2021	16 Jul	11.5	54	27 Jun	25 Aug	25 Aug

<sup>a</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is  $\leq 7$  days.

<sup>b</sup>In 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 66. Frequency distribution of hatch dates for fork-tailed storm-petrels at Aikta Island, Alaska. Data include only chronology plots in which observations of egg to chick  $\leq 7$  days. No data were collected in 2003 or 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date																							
	96	97	98	99	00	01	02	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	21
171	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	4	-
173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
174	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
176	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-
177	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
178	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	6	-	3	2	-	-	1
179	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	6	-
180	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
182	-	-	-	-	2	-	8	5	-	-	-	-	-	-	-	-	-	-	-	1	5	-	-	2
183	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184	-	-	-	-	-	-	-	3	3	-	-	5	2	2	1	-	1	-	-	2	4	-	-	5
185	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	-	9	3	5	4	-	-	-	-	-	-	-	13	-	10	3	-	-	-	21	1
187	-	-	-	-	-	-	-	-	-	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	1	-	-	-	1	-	-	9	-	-	-	-	-	-	-	-	-	-	2	10	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	-	-	-	-	-
190	-	-	-	-	10	2	1	-	-	-	-	11	-	5	5	-	7	-	-	-	-	-	-	6
191	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
192	-	-	-	-	-	1	1	5	16	-	-	-	8	-	-	1	-	-	3	3	7	-	8	-
193	-	1	-	1	-	-	-	-	-	7	7	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
195	4	-	1	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	-	-	-	8	8	-	-	-	-	10	-	-	-	1	1	6	3	-	-	5
197	1	5	-	3	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	1	-	7	-	-	-	-	-	-	14	-	6	-	9	-	1	4	3	2	-	8
199	-	1	2	1	3	2	-	-	-	8	6	-	-	-	-	-	-	-	-	-	-	-	-	1
200	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-	3	-	1	1	-	-	1	2	-
201	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
202	-	-	1	2	-	3	-	2	-	-	-	-	-	-	-	-	-	-	4	3	1	-	-	4
203	-	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	3	-	-	2	-	4	2	-	-	-	-	-	-	3	-	2
205	-	-	-	4	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	1	1	-	1	-	-	-	-	-	-	3	-	-	3	-	1	2	3	2	-	3	-
207	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	4	1	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-
209	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
210	-	-	1	1	1	5	-	-	-	-	-	2	-	2	-	-	-	-	2	3	4	-	-	3
211	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	3
212	-	-	-	1	-	-	-	-	1	-	-	-	2	-	3	-	-	-	1	1	-	1	-	-
213	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	6	3	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	1	-	-	1	-	-	-	-	2	-	-	-	-	-	1	-	-	-	1
217	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	2	-	1
219	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
221	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-
223	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
225	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
226	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	2	1	-	5	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
229	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
231	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
232	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-



Table 66 (continued). Frequency distribution of hatch dates for fork-tailed storm-petrels at Aikta Island, Alaska. Data include only chronology plots in which observations of egg to chick  $\leq 7$  days. No data were collected in 2003 or 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date																							
	96	97	98	99	00	01	02	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	21
233	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
235	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
236	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
237	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
238	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
239	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>n</i>	6	16	16	28	35	38	21	32	45	20	23	28	29	26	21	24	18	26	26	34	44	26	48	54

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.

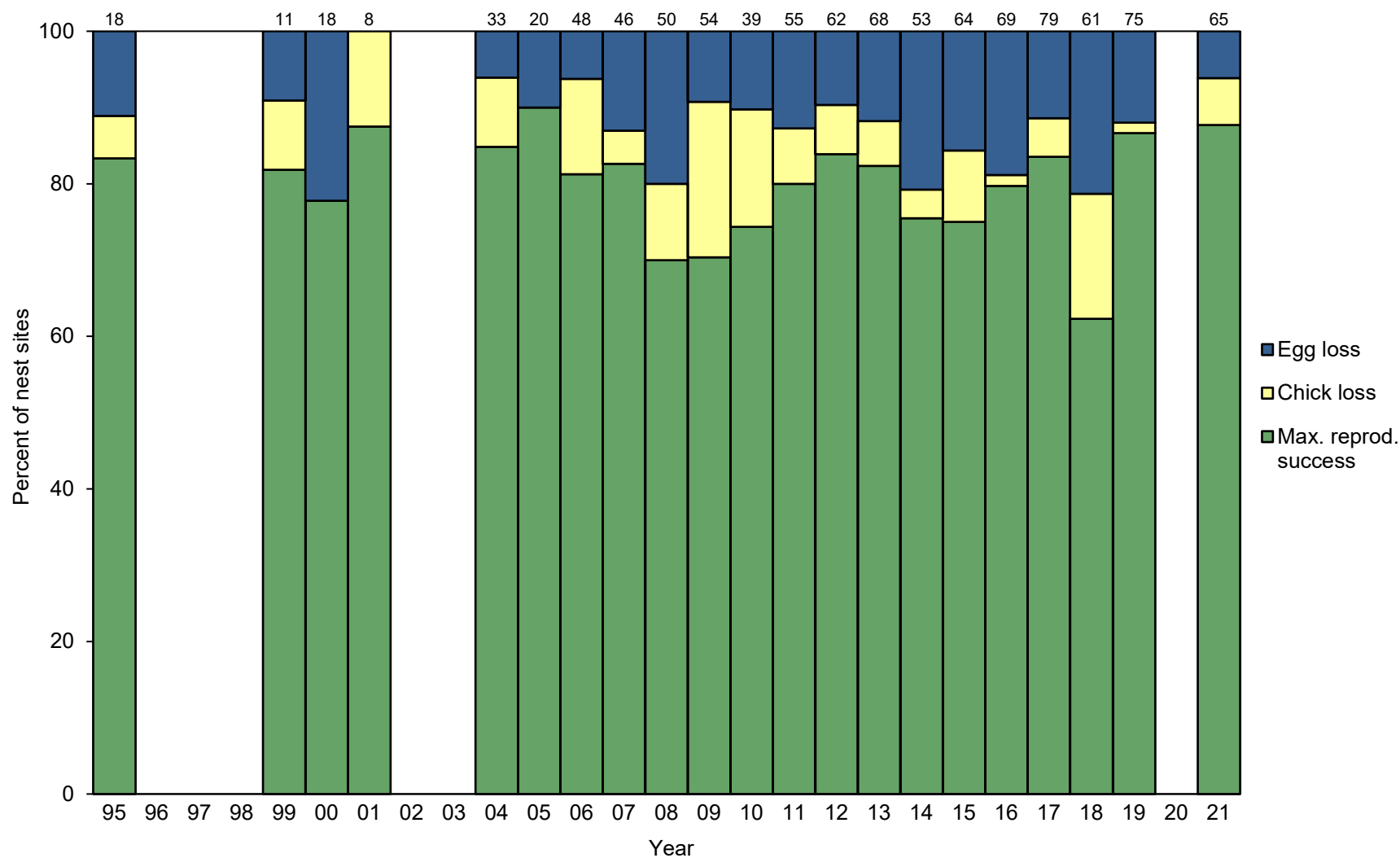


Figure 42. Reproductive performance of fork-tailed storm-petrels at Aiktak Island, Alaska. Data include only non-chronology plots monitored on an interval of about 14 days. Egg loss= $[(B+H)-(D+H)]/(B+H)$ ; Chick loss= $[(D+H)-(F+H)]/(B+H)$ ; Maximum potential reproductive success= $(F+H)/(B+H)$ , where B+H=maximum nest sites with eggs; D+H=maximum nest sites with chicks; F+H=maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes (B+H). No data were collected in 1996-1998, 2002-2003, or 2020.

Table 67. Reproductive performance of fork-tailed storm-petrels at Aiktak Island, Alaska. Data include only non-chronology plots monitored on an interval of about 14 days. Most chicks are too young to fledge by the time of last visit so measures of success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in 1996-1998, 2002-2003, or 2020.

Year	Max. nest sites w/ eggs	Max nest sites w/ chicks	Max. nest sites w/ chicks fledged	Nest sites w/ viable eggs at last visit <sup>b</sup>	Max. potential nesting success [(D+H)/(B+H)] <sup>c</sup>		Max. potential fledging success [(F+H)/(D+H)] <sup>d</sup>		Max. potential reproductive success [(F+H)/(B+H)]		No. plots <sup>e</sup>	Sampling design <sup>f</sup>
	(B+H)	(D+H)	(F+H) <sup>a</sup>		Total	SD	Total	SD	Total	SD		
1995	18	16	15	0	0.89	0.07	0.94	0.07	0.83	0.09	7	Cluster by plot
1999	11	10	9	0	0.91	0.09	0.90	0.15	0.82	0.16	7	Cluster by plot
2000	18	14	14	0	0.78	0.10	1.00	0.00	0.78	0.10	11	Cluster by plot
2001	8	8	7	0	1.00	0.00	0.88	0.13	0.88	0.13	6	Cluster by plot
2004	33	31	28	0	0.94	0.06	0.90	0.06	0.85	0.07	11	Cluster by plot
2005	20	18	18	0	0.90	0.06	1.00	0.00	0.90	0.06	7	Cluster by plot
2006	48	45	39	1	0.94	0.03	0.87	0.05	0.81	0.06	14	Cluster by plot
2007	46	40	38	0	0.87	0.07	0.95	0.03	0.83	0.07	13	Cluster by plot
2008	50	40	35	0	0.80	0.03	0.88	0.05	0.70	0.06	13	Cluster by plot
2009	54	49	38	0	0.91	0.04	0.78	0.05	0.70	0.07	13	Cluster by plot
2010	39	35	29	1	0.90	0.04	0.83	0.05	0.74	0.06	12	Cluster by plot
2011	55	48	44	2	0.87	0.04	0.92	0.04	0.80	0.03	12	Cluster by plot
2012	62	56	52	0	0.90	0.03	0.93	0.04	0.84	0.06	13	Cluster by plot
2013	68	60	56	1	0.88	0.04	0.93	0.04	0.82	0.03	14	Cluster by plot
2014	53	42	40	0	0.79	0.05	0.95	0.03	0.75	0.06	13	Cluster by plot
2015	64	54	48	2	0.84	0.04	0.89	0.04	0.75	0.05	13	Cluster by plot
2016	69	56	55	0	0.81	0.04	0.98	0.02	0.80	0.04	13	Cluster by plot
2017	79	70	66	1	0.89	0.02	0.94	0.03	0.84	0.03	13	Cluster by plot
2018	61	48	38	1	0.79	0.06	0.79	0.06	0.62	0.06	13	Cluster by plot
2019	75	66	65	0	0.88	0.03	0.98	0.02	0.87	0.04	13	Cluster by plot
2021	65	61	57	4	0.94	0.03	0.93	0.03	0.88	0.04	13	Cluster by plot

<sup>a</sup>F+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

<sup>b</sup>Eggs still present and apparently viable at last check are considered unknown fate and are not included in sample sizes or success estimates.

<sup>c</sup>For 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).

<sup>d</sup>For 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).

<sup>e</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>f</sup>Sampling for storm-petrels 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  $\sqrt{p * (1 - p) / n}$ , where  $p$  is the success rate and  $n$  is the sample size of individual nests.

Table 68. Reproductive performance of fork-tailed storm-petrels at Aiktak Island, Alaska in 2021. Data include only non-chronology plots monitored on an interval of about 14 days.

Parameter	Plot													Total	SD <sup>a</sup>
	9	10	11	13	16	17	18	19	20	21	22	24	26		
Max. nest sites w/ eggs (B+H)	10	4	13	3	1	4	4	5	2	3	1	2	13	65	-
Max. nest sites w/ chicks (D+H)	10	4	13	3	1	4	3	5	1	2	1	2	12	61	-
Max. nest sites w/ chicks fledged (F+H) <sup>b</sup>	9	3	13	3	1	4	2	4	1	2	1	2	12	57	-
Nest sites w/ viable eggs at last visit <sup>c</sup>	0	0	0	0	0	0	1	1	1	0	0	0	1	4	-
Max. potential nesting success[(D+H)/(B+H)] <sup>d</sup>	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	0.50	0.67	1.00	1.00	0.92	0.94	0.03
Max. potential fledging success [(F+H)/(D+H)] <sup>e</sup>	0.90	0.75	1.00	1.00	1.00	1.00	0.67	0.80	1.00	1.00	1.00	1.00	1.00	0.93	0.03
Max. potential reproductive success [(F+H)/(B+H)]	0.90	0.75	1.00	1.00	1.00	1.00	0.50	0.80	0.50	0.67	1.00	1.00	0.92	0.88	0.04

<sup>a</sup>Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

<sup>b</sup>F+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

<sup>c</sup>Eggs still present and apparently viable at last check are considered unknown fate and are not included in the number of nest sites w/ eggs (B) or success estimates.

<sup>d</sup>For 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).

<sup>e</sup>For 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).

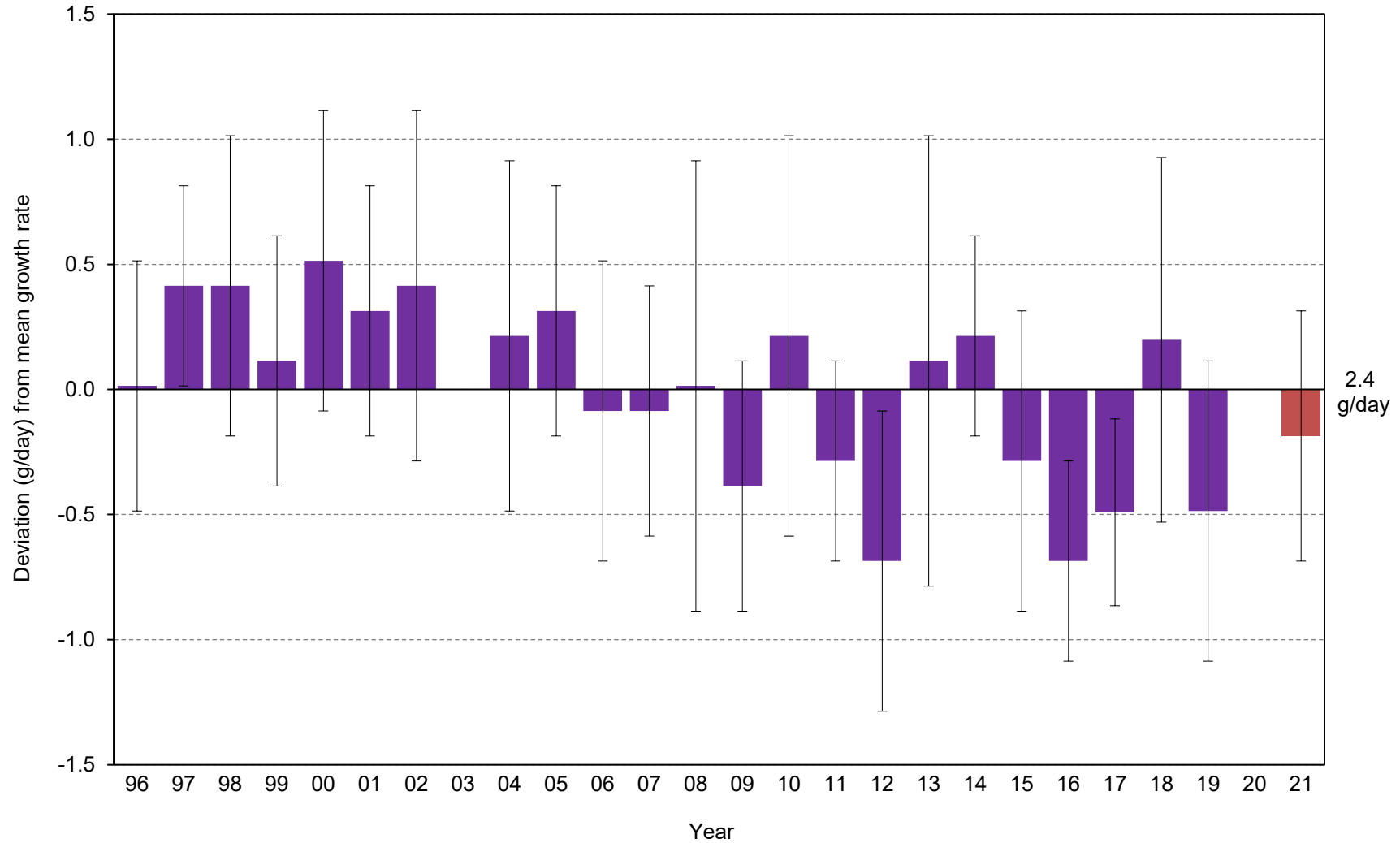


Figure 43. Yearly chick growth rate deviation (from the 1996-2020 average of 2.4 g/day) for fork-tailed storm-petrels at Aiktak Island, Alaska. Negative values indicate less than the mean growth rate, positive values exceed the mean growth rate. Error bars represent standard deviation around each year's mean growth rate; red highlights the current year. No data were collected in 2003 or 2020.

Table 69. Mean growth rates of fork-tailed storm-petrel chicks at Aiktak Island, Alaska. Data include chicks measured at least two times during the linear phase of growth (approximately mass 0-80g; wing chord 20-140mm); chicks that died were excluded. No data were collected in 2003 or 2020.

Year	Mass (g/day)				Wing chord (mm/day) <sup>a</sup>			
	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>
1996	2.4	0.5	1.7 - 3.6	16	3.4	0.2	3.0 - 3.6	16
1997	2.8	0.4	1.7 - 3.7	16	3.4	0.3	2.7 - 4.0	16
1998	2.8	0.6	1.9 - 4.4	25	3.2	0.8	1.1 - 4.1	24
1999	2.5	0.5	1.4 - 3.9	32	3.6	0.3	2.8 - 4.1	30
2000	2.9	0.6	2.0 - 4.7	33	3.5	0.2	3.0 - 3.8	33
2001	2.7	0.5	1.3 - 4.1	44	3.5	0.2	3.2 - 4.0	16
2002	2.8	0.7	1.6 - 4.0	17	3.5	0.5	2.4 - 4.6	18
2004	2.6	0.7	1.1 - 4.0	26	3.2	0.6	0.7 - 4.2	37
2005	2.7	0.5	1.7 - 3.8	41	2.9	0.3	2.1 - 3.6	40
2006	2.3	0.6	1.3 - 4.1	19	3.0	0.2	2.7 - 3.4	20
2007	2.3	0.5	1.5 - 3.1	18	3.1	0.4	2.0 - 3.5	20
2008	2.4	0.9	0.8 - 4.0	22	3.2	0.3	2.2 - 3.6	21
2009	2.0	0.5	1.5 - 3.2	22	3.0	0.3	2.2 - 3.6	22
2010	2.6	0.8	1.2 - 4.5	20	3.0	0.5	1.7 - 3.6	20
2011	2.1	0.4	1.3 - 2.6	18	2.7	0.6	1.4 - 3.3	18
2012	1.7	0.6	1.0 - 3.6	19	2.9	0.5	1.1 - 3.4	23
2013	2.5	0.9	1.2 - 5.3	22	3.2	0.4	2.1 - 3.9	22
2014	2.6	0.4	1.8 - 3.7	26	3.4	0.3	2.4 - 3.9	26
2015	2.1	0.6	1.1 - 4.2	23	3.5	0.2	3.1 - 4.0	18
2016	1.7	0.4	1.0 - 2.5	29	3.2	0.5	1.8 - 3.8	32
2017	1.9	0.4	1.1 - 2.8	34	3.3	0.4	1.5 - 3.8	35
2018	2.6	0.7	1.5 - 4.9	23	3.5	0.4	2.8 - 4.2	14
2019	1.9	0.6	0.9 - 4.0	38	3.5	0.2	3.1 - 3.9	36
2021	2.2	0.5	1.3 - 3.2	31	3.3	0.3	2.7 - 4.0	28

<sup>a</sup>All rates of growth are based on relaxed wing chord measurements, except 1998 when only flat wing data were recorded.

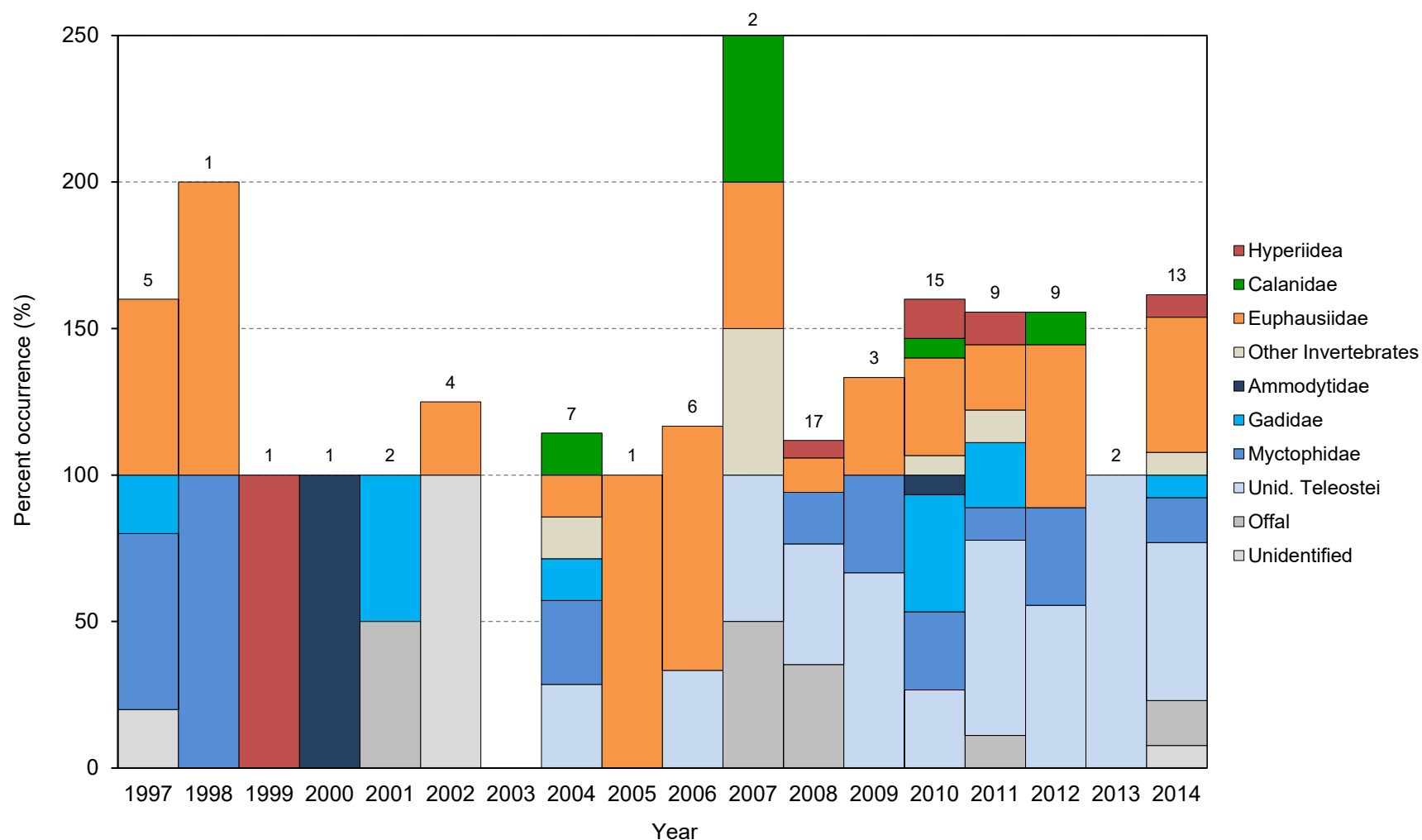


Figure 44. Frequency of occurrence of major prey items in diets of fork-tailed storm-petrel chicks at Aiktak Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence 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 2003 or 2020; samples were collected in 2015-2019 and 2021 but have not yet been analyzed.

Table 70. Frequency of occurrence of major prey items in diets of fork-tailed storm-petrel chicks at Aiktak 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 2003 or 2020; samples were collected in 2015-2019 and 2021 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1997	1998	1999	2000	2001	2002	2004	2005	2006	2007	2008	2009
No. samples	5	1	1	1	2	4	7	1	6	2	17	3 <sup>a</sup>
<b>Invertebrates</b>	<b>60.0</b>	<b>100.0</b>	<b>100.0</b>	-	-	<b>25.0</b>	<b>28.6</b>	<b>100.0</b>	<b>100.0</b>	<b>50.0</b>	<b>23.5</b>	<b>33.3</b>
<b>Amphipoda</b>	-	-	<b>100.0</b>	-	-	-	-	-	<b>33.3</b>	-	<b>11.8</b>	-
<b>Hyperiidea</b>	-	-	<b>100.0</b>	-	-	-	-	-	-	-	<b>5.9</b>	-
<i>Themisto</i> spp.	-	-	100.0	-	-	-	-	-	-	-	-	-
Other Hyperiidea	-	-	-	-	-	-	-	-	-	-	-	-
Other Amphipoda	-	-	-	-	-	-	-	-	33.3	-	11.8	-
<b>Copepoda</b>	-	-	-	-	-	-	<b>14.3</b>	-	-	<b>50.0</b>	-	-
Calanidae	-	-	-	-	-	-	14.3	-	-	50.0	-	-
Other Copepoda	-	-	-	-	-	-	-	-	-	-	-	-
<b>Euphausiacea</b>	<b>60.0</b>	<b>100.0</b>	-	-	-	<b>25.0</b>	<b>14.3</b>	<b>100.0</b>	<b>83.3</b>	<b>50.0</b>	<b>11.8</b>	<b>33.3</b>
<b>Euphausiidae</b>	<b>60.0</b>	<b>100.0</b>	-	-	-	<b>25.0</b>	<b>14.3</b>	<b>100.0</b>	<b>83.3</b>	<b>50.0</b>	<b>11.8</b>	<b>33.3</b>
<i>Thysanoessa</i> spp.	-	-	-	-	-	-	-	-	66.7	-	11.8	33.3
Unid. Euphausiidae	60.0	100.0	-	-	-	25.0	14.3	100.0	50.0	50.0	-	-
Other Euphausiidae	-	-	-	-	-	-	-	-	-	-	5.9	-
Other Invertebrates	-	-	-	-	-	-	14.3	-	-	50.0	-	-
<b>Fish</b>	<b>80.0</b>	<b>100.0</b>	-	<b>100.0</b>	<b>50.0</b>	-	<b>71.4</b>	-	<b>33.3</b>	<b>50.0</b>	<b>64.7</b>	<b>100.0</b>
<b>Teleostei</b>	<b>80.0</b>	<b>100.0</b>	-	<b>100.0</b>	<b>50.0</b>	-	<b>71.4</b>	-	<b>33.3</b>	<b>50.0</b>	<b>64.7</b>	<b>100.0</b>
<b>Ammodytidae</b>	-	-	-	<b>100.0</b>	-	-	-	-	-	-	-	-
<i>Ammodytes</i> spp.	-	-	-	100.0	-	-	-	-	-	-	-	-
<b>Gadidae</b>	<b>20.0</b>	-	-	-	<b>50.0</b>	-	<b>14.3</b>	-	-	-	-	-
<i>Gadus chalcogrammus</i>	20.0	-	-	-	50.0	-	14.3	-	-	-	-	-
Other Gadidae	-	-	-	-	-	-	-	-	-	-	-	-
<b>Myctophidae</b>	<b>60.0</b>	<b>100.0</b>	-	-	-	-	<b>28.6</b>	-	-	-	<b>17.6</b>	<b>33.3</b>
<i>Stenobrachius leucopsarus</i>	60.0	100.0	-	-	-	-	-	-	-	-	-	-
Other Myctophidae	-	-	-	-	-	-	28.6	-	-	-	17.6	33.3
Unid. Teleostei	-	-	-	-	-	-	28.6	-	33.3	50.0	41.2	66.7
Other Teleostei	-	-	-	-	-	-	-	-	-	-	5.9	-
<b>Other</b>	<b>20.0</b>	-	-	-	<b>50.0</b>	<b>100.0</b>	-	-	-	<b>100.0</b>	<b>35.3</b>	-
Offal	-	-	-	-	50.0	-	-	-	-	50.0	35.3	-
Other	20.0	-	-	-	-	100.0	-	-	-	50.0	-	-

<sup>a</sup>One additional sample is still pending analysis.



Table 70 (continued). Frequency of occurrence of major prey items in diets of fork-tailed storm-petrel chicks at Aikta 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 2003 or 2020; samples were collected in 2015-2019 and 2021 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	15	9	9	2	13	1	15	9	4	12	9
<b>Invertebrates</b>	<b>53.3</b>	<b>33.3</b>	<b>77.8</b>	-	<b>53.8</b>	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>
<b>Amphipoda</b>	<b>26.7</b>	<b>11.1</b>	<b>22.2</b>	-	<b>15.4</b>	-	-	-	-	-	-
<b>Hyperiidea</b>	<b>13.3</b>	<b>11.1</b>	-	-	<b>7.7</b>	-	-	-	-	-	-
<i>Themisto</i> spp.	-	-	-	-	-	-	-	-	-	-	-
Other Hyperiidea	-	11.1	-	-	-	-	-	-	-	-	-
Other Amphipoda	13.3	-	22.2	-	7.7	-	-	-	-	-	-
<b>Copepoda</b>	<b>13.3</b>	-	<b>11.1</b>	-	-	-	-	-	-	-	-
Calanidae	6.7	-	11.1	-	-	-	-	-	-	-	-
Other Copepoda	6.7	-	-	-	-	-	-	-	-	-	-
<b>Euphausiacea</b>	<b>33.3</b>	<b>22.2</b>	<b>55.6</b>	-	<b>46.2</b>	-	-	-	-	-	-
<b>Euphausiidae</b>	<b>33.3</b>	<b>22.2</b>	<b>55.6</b>	-	<b>46.2</b>	-	-	-	-	-	-
<i>Thysanoessa</i> spp.	20.0	11.1	33.3	-	15.4	-	-	-	-	-	-
Unid. Euphausiidae	13.3	11.1	22.2	-	7.7	-	-	-	-	-	-
Other Euphausiidae	-	22.2	-	-	30.8	-	-	-	-	-	-
Other Invertebrates	6.7	11.1	-	-	7.7	-	-	-	-	-	-
<b>Fish</b>	<b>100.0</b>	<b>88.9</b>	<b>88.9</b>	<b>100.0</b>	<b>76.9</b>	-	-	-	-	-	-
<b>Teleostei</b>	<b>100.0</b>	<b>88.9</b>	<b>88.9</b>	<b>100.0</b>	<b>76.9</b>	-	-	-	-	-	-
<b>Ammodytidae</b>	<b>6.7</b>	-	-	-	-	-	-	-	-	-	-
<i>Ammodytes</i> spp.	6.7	-	-	-	-	-	-	-	-	-	-
<b>Gadidae</b>	<b>40.0</b>	<b>22.2</b>	-	-	<b>7.7</b>	-	-	-	-	-	-
<i>Gadus chalcogrammus</i>	6.7	11.1	-	-	-	-	-	-	-	-	-
Other Gadidae	33.3	11.1	-	-	7.7	-	-	-	-	-	-
<b>Myctophidae</b>	<b>26.7</b>	<b>11.1</b>	<b>33.3</b>	-	<b>15.4</b>	-	-	-	-	-	-
<i>Stenobrachius leucopsarus</i>	-	-	-	-	-	-	-	-	-	-	-
Other Myctophidae	26.7	11.1	33.3	-	15.4	-	-	-	-	-	-
Unid. Teleostei	26.7	66.7	55.6	100.0	53.8	-	-	-	-	-	-
Other Teleostei	-	-	-	-	-	-	-	-	-	-	-
<b>Other</b>	<b>6.7</b>	<b>22.2</b>	-	-	<b>23.1</b>	-	-	-	-	-	-
Offal	-	11.1	-	-	15.4	-	-	-	-	-	-
Other	6.7	11.1	-	-	7.7	-	-	-	-	-	-

\*One additional sample is still pending analysis.

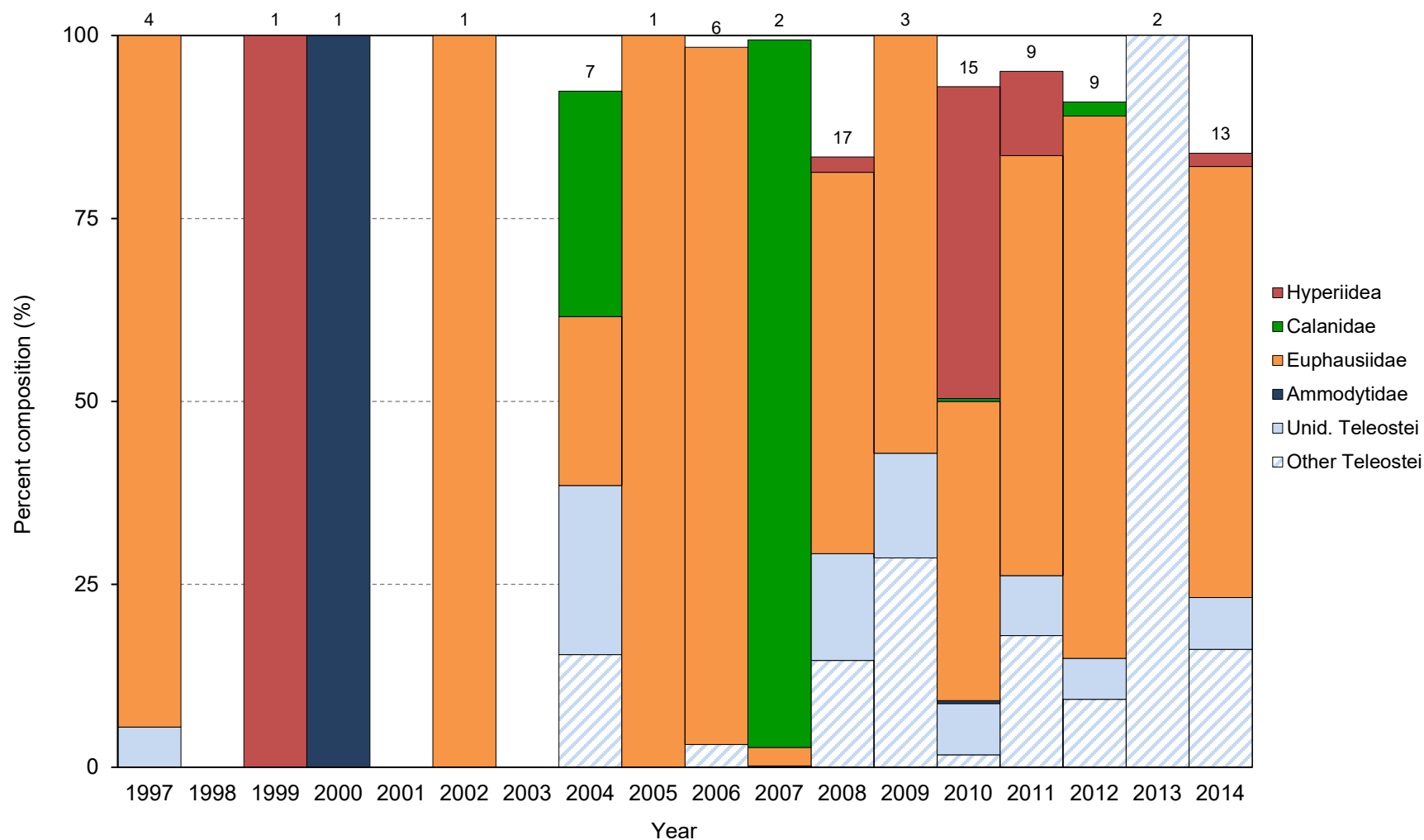


Figure 45. Percent composition of major prey items in diets of fork-tailed storm-petrel chicks at Aiktak Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition 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 2003 or 2020, and no count data exist for 1998 or 2001; samples were collected in 2015-2019 and 2021 but have not yet been analyzed.

Table 71. Percent composition of major prey items in diets of fork-tailed chicks at Aikta 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 regurgitations collected from adults returning to the colony to feed chicks. No diet samples were collected in 2003 or 2020, and no count data exist for 1998 or 2001; samples were collected in 2015-2019 and 2021 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1997	1999	2000	2002	2004	2005	2006	2007	2008	2009	2010
No. samples	4	1	1	1	7	1	6	2	17	3 <sup>a</sup>	15
No. individuals	91	2	5	6	13	12	128	521	48	7	242
<b>Invertebrates</b>	<b>94.5</b>	<b>100.0</b>	-	<b>100.0</b>	<b>61.5</b>	<b>100.0</b>	<b>96.9</b>	<b>99.8</b>	<b>70.8</b>	<b>57.1</b>	<b>90.9</b>
<b>Amphipoda</b>	-	<b>100.0</b>	-	-	-	-	<b>1.6</b>	-	<b>6.3</b>	-	<b>46.7</b>
<b>Hyperiidea</b>	-	<b>100.0</b>	-	-	-	-	-	-	<b>2.1</b>	-	<b>42.6</b>
<i>Themisto</i> spp.	-	100.0	-	-	-	-	-	-	-	-	-
Other Hyperiidea	-	-	-	-	-	-	-	-	2.1	-	42.6
Other Amphipoda	-	-	-	-	-	-	1.6	-	4.2	-	4.1
<b>Copepoda</b>	-	-	-	-	<b>30.8</b>	-	-	<b>96.7</b>	-	-	<b>1.7</b>
<b>Calanidae</b>	-	-	-	-	<b>30.8</b>	-	-	<b>96.7</b>	-	-	<b>0.4</b>
<i>Neocalanus plumchrus/flemengeri</i>	-	-	-	-	-	-	-	96.7	-	-	-
Other Calanidae	-	-	-	-	30.8	-	-	-	-	-	0.4
Other Copepoda	-	-	-	-	-	-	-	-	-	-	1.2
<b>Euphausiacea</b>	<b>94.5</b>	-	-	<b>100.0</b>	<b>23.1</b>	<b>100.0</b>	<b>95.3</b>	<b>2.5</b>	<b>52.1</b>	<b>57.1</b>	<b>40.9</b>
<b>Euphausiidae</b>	<b>94.5</b>	-	-	<b>100.0</b>	<b>23.1</b>	<b>100.0</b>	<b>95.3</b>	<b>2.5</b>	<b>52.1</b>	<b>57.1</b>	<b>40.9</b>
<i>Thysanoessa</i> spp.	-	-	-	-	-	-	28.1	-	41.7	57.1	39.7
Unid. Euphausiidae	94.5	-	-	100.0	23.1	100.0	67.2	2.5	-	-	1.2
Other Euphausiidae	-	-	-	-	-	-	-	-	10.4	-	-
Other Invertebrates	-	-	-	-	7.7	-	-	0.6	12.5	-	1.7
<b>Fish</b>	<b>5.5</b>	-	<b>100.0</b>	-	<b>38.5</b>	-	<b>3.1</b>	<b>0.2</b>	<b>29.2</b>	<b>42.9</b>	<b>9.1</b>
<b>Teleostei</b>	<b>5.5</b>	-	<b>100.0</b>	-	<b>38.5</b>	-	<b>3.1</b>	<b>0.2</b>	<b>29.2</b>	<b>42.9</b>	<b>9.1</b>
<b>Ammodytidae</b>	-	-	<b>100.0</b>	-	-	-	-	-	-	-	<b>0.4</b>
<i>Ammodytes</i> spp.	-	-	100.0	-	-	-	-	-	-	-	0.4
Unid. Teleostei	-	-	-	-	23.1	-	-	-	14.6	14.3	7.0
Other Teleostei	5.5	-	-	-	15.4	-	3.1	0.2	14.6	28.6	1.7
Other	1.1	-	-	-	-	-	-	0.4	12.5	-	0.4

<sup>a</sup>One additional sample is still pending analysis.

Table 71 (continued). Percent composition of major prey items in diets of fork-tailed chicks at Aiktak 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 regurgitations collected from adults returning to the colony to feed chicks. No diet samples were collected in 2003 or 2020, and no count data exist for 1998 or 2001; samples were collected in 2015-2019 and 2021 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
No. samples	9	9	2	13	1	15	9	4	12	9
No. individuals	61	54	2	56	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>
<b>Invertebrates</b>	<b>73.8</b>	<b>85.2</b>	-	<b>76.8</b>	-	-	-	-	-	-
<b>Amphipoda</b>	<b>11.5</b>	<b>7.4</b>	-	<b>10.7</b>	-	-	-	-	-	-
<b>Hyperiidea</b>	<b>11.5</b>	-	-	<b>1.8</b>	-	-	-	-	-	-
<i>Themisto</i> spp.	-	-	-	-	-	-	-	-	-	-
Other Hyperiidea	11.5	-	-	1.8	-	-	-	-	-	-
Other Amphipoda	-	7.4	-	8.9	-	-	-	-	-	-
<b>Copepoda</b>	-	<b>1.9</b>	-	-	-	-	-	-	-	-
<b>Calanidae</b>	-	<b>1.9</b>	-	-	-	-	-	-	-	-
<i>Neocalanus plumchrus/flemengeri</i>	-	1.9	-	-	-	-	-	-	-	-
Other Calanidae	-	-	-	-	-	-	-	-	-	-
Other Copepoda	-	-	-	-	-	-	-	-	-	-
<b>Euphausiacea</b>	<b>57.4</b>	<b>74.1</b>	-	<b>58.9</b>	-	-	-	-	-	-
<b>Euphausiidae</b>	<b>57.4</b>	<b>74.1</b>	-	<b>58.9</b>	-	-	-	-	-	-
<i>Thysanoessa</i> spp.	18.0	70.4	-	35.7	-	-	-	-	-	-
Unid. Euphausiidae	4.9	3.7	-	1.8	-	-	-	-	-	-
Other Euphausiidae	34.4	-	-	21.4	-	-	-	-	-	-
Other Invertebrates	4.9	1.9	-	7.1	-	-	-	-	-	-
<b>Fish</b>	<b>26.2</b>	<b>14.8</b>	<b>100.0</b>	<b>23.2</b>	-	-	-	-	-	-
<b>Teleostei</b>	<b>26.2</b>	<b>14.8</b>	<b>100.0</b>	<b>23.2</b>	-	-	-	-	-	-
<b>Ammodytidae</b>	-	-	-	-	-	-	-	-	-	-
<i>Ammodytes</i> spp.	-	-	-	-	-	-	-	-	-	-
Unid. Teleostei	8.2	5.6	-	7.1	-	-	-	-	-	-
Other Teleostei	18.0	9.3	100.0	16.1	-	-	-	-	-	-
Other	3.3	-	-	5.4	-	-	-	-	-	-

<sup>a</sup>One additional sample is still pending analysis.

Table 72. Morphological measurements of adult fork-tailed storm-petrels at Aiktak Island, Alaska. No data were collected in 1998-2000 or 2020.

Year	Mass (g)				Wing chord (mm)				Diagonal tarsus (mm)			
	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>
1995	72.7	4.0	65.0-79.0	18	-	-	-	-	27.5	1.0	25.4-29.3	22
1996	73.1	5.4	57.0-86.0	54	-	-	-	-	27.5	0.9	24.9-29.3	38
1997	65.0	4.3	52.0-76.0	56	-	-	-	-	27.5	0.7	26.0-29.1	47
2001	68.6	5.6	59.5-77.0	9	162	5.7	158- 166	2	-	-	-	-
2002	69.5	7.1	57.0-82.0	20	159	5.6	152-176	20	29.8	35	19.5-38.6	20
2003	65.5	5.8	56.0-75.0	12	157	3.1	153-163	12	-	-	-	-
2004	67.9	6.9	42.0-82.0	50	159	4.3	150-167	50	30.4	3.7	24.3-39.6	50
2005	67.5	5.9	58.5-80.0	22	157	4.4	146-163	22	27.9	0.9	26.0-29.0	22
2006	65.5	5.8	55.0-81.5	33	158	3.8	150-165	33	27.5	1.0	26.0-29.5	33
2007	65.0	4.5	55.0-74.0	30	157	4.9	147-166	30	27.1	0.9	25.1-28.5	30
2008	58.9	4.9	47.5-71.0	32	156	4.2	148-165	32	26.9	0.7	25.1-28.2	32
2009	60.6	2.8	57.0-65.0	10	160	3.6	155-165	10	27.3	0.7	25.5-28.1	10
2010	62.9	5.9	50.0-76.0	41	156	5.9	140-165	41	26.6	0.9	24.3-28.4	41
2011	61.8	4.3	55.0-71.0	12	158	2.9	153-163	12	26.4	0.9	24.8-28.2	12
2012	60.4	4.8	55.0-73.5	22	159	3.9	153-166	22	26.9	1.1	24.4-29.6	22
2013	63.7	6.3	56.0-76.0	11	157	3.0	151-161	11	26.6	0.8	25.2-28.2	11
2014	64.0	3.3	59.0-71.0	22	159	3.1	154-165	22	26.2	0.8	24.8-27.6	22
2015	62.0	4.5	57.0-70.0	9	157	3.2	150-160	9	26.7	0.9	25.4-28.3	9
2016	62.4	7.3	52.0-80.0	21	161	5.1	152-172	21	27.1	1.1	25.4-29.1	21
2017	62.6	5.2	55.0-71.0	12	162	3.4	156-167	12	26.7	0.9	25.5-28.3	12
2018	58.5	1.3	57.0-60.0	4	157	3.1	155-162	4	27.5	0.8	26.3-28.1	4
2019	62.7	5.0	53.0-75.0	20	160	3.9	153-166	20	27.2	0.6	26.2-28.4	20
2021	61.3	4.9	56.0-70.0	8	158	3.5	154-165	8	27.4	0.7	26.5-28.5	8

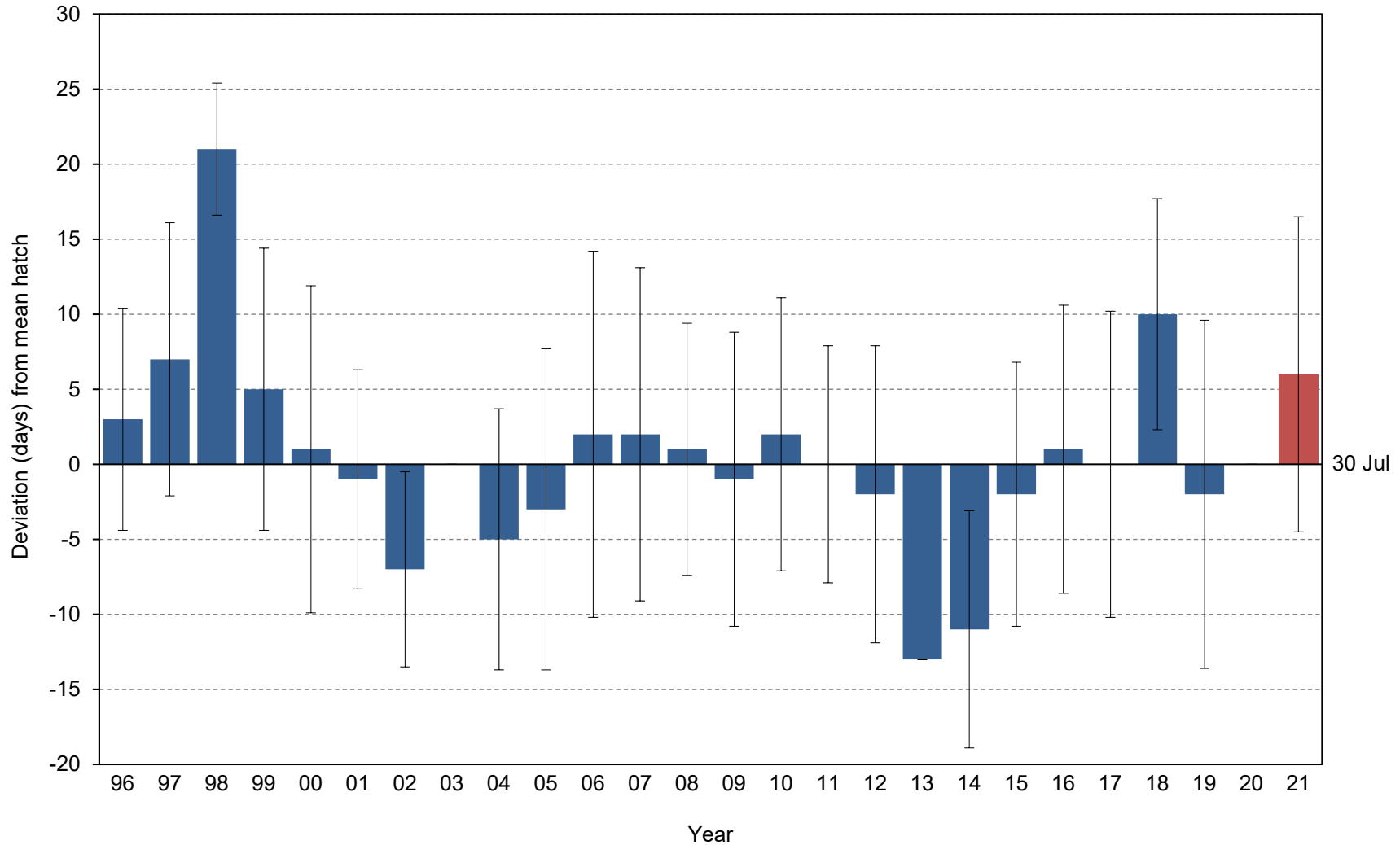


Figure 46. Yearly hatch date deviation (from the 1996-2020 average of 30 July) for Leach's storm-petrels at Aiktak Island, Alaska. Data include only chronology plots monitored on an interval of about 7 days. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year. No data were collected in 2003 and 2020.

Table 73. Breeding chronology of Leach's storm-petrels at Aiktak Island, Alaska. Data include only chronology plots monitored on an interval of about 7 days. No data were collected in 2003 or 2020.

Year	Mean hatch	SD	<i>n</i> <sup>a</sup>	First hatch	Last hatch	First fledge <sup>b</sup>
1996	1 Aug	7.4	33	6 Jul	18 Aug	>20 Aug
1997	6 Aug	9.1	62	20 Jul	30 Aug	>1 Sep
1998	20 Aug	4.4	23	14 Jul	1 Sep	>3 Sep
1999	4 Aug	9.4	35	11 Jul	29 Aug	>31 Aug
2000	30 Jul	10.9	42	9 Jul	4 Sep	>11 Sep
2001	29 Jul	7.3	27	10 Jul	26 Aug	>8 Sep
2002	23 Jul	6.5	10	9 Jul	31 Jul	>9 Sep
2004	24 Jul	8.7	37	5 Jul	16 Aug	>31 Aug
2005	27 Jul	10.7	44	11 Jul	30 Aug	>31 Aug
2006	1 Aug	12.2	34	12 Jul	29 Aug	>1 Sep
2007	1 Aug	11.1	38	17 Jul	23 Aug	>30 Aug
2008	30 Jul	8.4	45	15 Jul	25 Aug	>28 Aug
2009	29 Jul	9.8	57	11 Jul	28 Aug	>2 Sep
2010	1 Aug	9.1	23	15 Jul	18 Aug	>30 Aug
2011	30 Jul	7.9	29	17 Jul	20 Aug	>5 Sep
2012	27 Jul	9.9	42	18 Jul	21 Aug	>2 Sep
2013	17 Jul	0.0	5	17 Jul	17 Jul	>26 Aug
2014	19 Jul	7.9	36	5 Jul	10 Aug	>27 Aug
2015	28 Jul	8.8	36	15 Jul	22 Aug	>28 Aug
2016	30 Jul	9.6	48	14 Jul	25 Aug	>1 Sep
2017	30 Jul	10.2	49	11 Jul	22 Aug	>31 Aug
2018	9 Aug	7.7	40	23 Jul	20 Aug	>31 Aug
2019	28 Jul	11.6	54	11 Jul	28 Aug	>30 Aug
2021	5 Aug	10.5	56	10 Jul	24 Aug	>28 Aug

<sup>a</sup>Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is  $\leq 7$  days.

<sup>b</sup>In 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 74. Frequency distribution of hatch dates for Leach's storm-petrels at Aikta Island, Alaska. Data includes only chronology plots in which observations of egg to chick  $\leq 7$  days. No data were collected in 2003 or 2020.

Julian date <sup>a</sup>	No. nests hatching on Julian date																							
	96	97	98	99	00	01	02	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	21
186	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
192	-	-	-	-	-	-	-	1	4	-	-	-	2	-	-	-	-	7	-	-	1	-	3	-
193	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	-	-	-	6	-	-	-	-	-	1	-	-	-	-	1	1	3	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-	-	11	-	3	-	5	-	3	2	5	-	-	3
199	-	-	-	-	3	1	1	-	-	4	5	-	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	13	-	17	-	-	-	-	18	-
201	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	3	-	8	2	-	-	-	-	-	-	-	-	-	5	7	5	-	-	2
203	2	2	-	1	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
204	4	1	-	-	-	-	5	1	13	-	-	14	-	6	6	-	-	-	-	-	-	1	-	5
205	-	-	-	3	-	-	-	-	-	11	11	-	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	8	7	-	8	-	-	-	-	15	-	-	15	-	1	9	8	7	-	13	-
207	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	3	-	-	-	1	-	-
209	-	10	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
210	2	-	-	-	4	7	1	-	-	-	-	12	-	6	-	-	-	-	7	7	5	-	-	1
211	7	1	-	-	-	-	-	-	-	3	6	-	-	-	-	-	-	-	-	-	-	-	-	8
212	1	-	-	1	-	-	2	4	4	-	-	-	13	-	13	-	-	-	4	8	6	8	-	-
213	-	13	-	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	4	1	-	-	1	-	-	-	-	-	-	6	-	2	1	-	-	4	6	-
215	7	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	2	-	5	2	-	-	-	-	6	-	-	-	-	1	5	4	-	-	5
217	-	8	-	3	-	-	-	-	-	8	7	-	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	-	2	-	-	-	-	-	-	10	-	-	5	-	-	-	-	-	-	4	-	8
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221	-	8	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	9	2	-	3	3	-	-	-	-	1	-	-	-	1	1	-	3	7	-	-
223	3	1	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
224	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	11
225	-	4	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
226	-	-	2	-	-	2	-	1	-	-	-	7	3	-	1	-	-	-	2	1	-	2	-	-
227	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
228	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	-	-	8	5	-
229	-	6	-	1	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	3	-	2	-	-	-	-	-	-	-	-	3	-	-	-	-	-	1	2	-	-	11
231	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
232	-	-	7	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	5	-	-
233	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
234	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	2	1	-	2	-
235	-	-	1	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
236	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
237	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
238	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
239	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
240	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-
241	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
242	-	2	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
243	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
244	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>n</i>	33	62	23	35	42	27	10	37	44	34	38	45	57	23	29	42	5	36	36	48	49	40	54	56

<sup>a</sup>In leap years, hatch dates are calculated using a leap year-specific Julian date calendar.



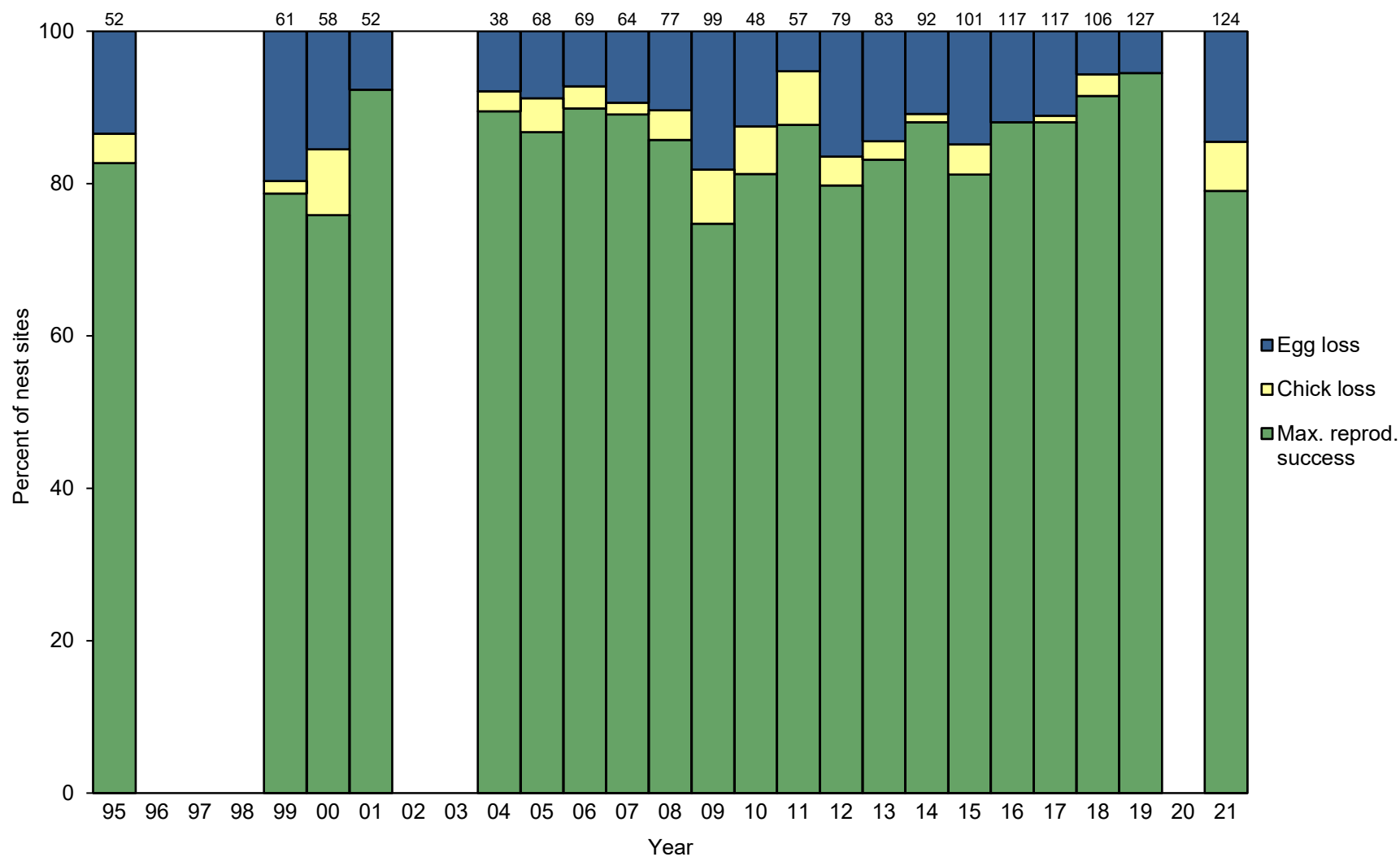


Figure 47. Reproductive performance of Leach's storm-petrels at Aiktak Island, Alaska. Data include only non-chronology plots monitored on an interval of about 14 days. Egg loss= $[(B+H)-(D+H)]/(B+H)$ ; Chick loss= $[(D+H)-(F+H)]/(B+H)$ ; Maximum potential reproductive success= $(F+H)/(B+H)$ , where B+H=maximum nest sites with eggs; D+H=maximum nest sites with chicks; F+H=maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes (B+H). No data were collected in 1996-1998, 2002-2003, or 2020.

Table 75. Reproductive performance of Leach's storm-petrels at Aikta Island, Alaska. Data include only non-chronology plots monitored on an interval of about 14 days. Most chicks are too young to fledge by the time of last visit so measures of success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in 1996-1998, 2002-2003, or 2020.

Year	Max. nest sites w/ eggs	Max nest sites w/ chicks	Max. nest sites w/ chicks fledged	Nest sites w/ viable eggs at last visit <sup>b</sup>	Max. potential nesting success [(D+H)/(B+H)] <sup>c</sup>		Max. potential fledging success [(F+H)/(D+H)] <sup>d</sup>		Max. potential reproductive success [(F+H)/(B+H)]		No. plots <sup>e</sup>	Sampling design <sup>f</sup>
	(B+H)	(D+H)	(F+H) <sup>a</sup>		Total	SD	Total	SD	Total	SD		
1995	52	45	43	0	0.87	0.07	0.96	0.02	0.83	0.07	11	Cluster by plot
1999	61	49	48	2	0.80	0.05	0.98	0.02	0.79	0.06	12	Cluster by plot
2000	58	49	44	1	0.84	0.04	0.90	0.04	0.76	0.04	13	Cluster by plot
2001	52	48	48	0	0.92	0.04	1.00	0.00	0.92	0.04	13	Cluster by plot
2004	38	35	34	0	0.92	0.10	0.97	0.03	0.89	0.10	11	Cluster by plot
2005	68	62	59	1	0.91	0.03	0.95	0.03	0.87	0.04	13	Cluster by plot
2006	69	64	62	1	0.93	0.02	0.97	0.02	0.90	0.03	14	Cluster by plot
2007	64	58	57	1	0.91	0.04	0.98	0.02	0.89	0.04	14	Cluster by plot
2008	77	69	66	4	0.90	0.04	0.96	0.02	0.86	0.04	13	Cluster by plot
2009	99	81	74	0	0.82	0.03	0.91	0.03	0.75	0.04	13	Cluster by plot
2010	48	42	39	0	0.88	0.06	0.93	0.03	0.81	0.05	12	Cluster by plot
2011	57	54	50	10	0.95	0.03	0.93	0.03	0.88	0.04	12	Cluster by plot
2012	79	66	63	2	0.84	0.04	0.95	0.03	0.80	0.04	12	Cluster by plot
2013	83	71	69	6	0.86	0.04	0.97	0.02	0.83	0.04	14	Cluster by plot
2014	92	82	81	2	0.89	0.02	0.99	0.01	0.88	0.02	14	Cluster by plot
2015	101	86	82	1	0.85	0.04	0.95	0.02	0.81	0.03	13	Cluster by plot
2016	117	103	103	0	0.88	0.02	1.00	0.00	0.88	0.02	14	Cluster by plot
2017	117	104	103	3	0.89	0.03	0.99	0.01	0.88	0.03	12	Cluster by plot
2018	106	100	97	11	0.94	0.03	0.97	0.02	0.92	0.03	12	Cluster by plot
2019	127	120	120	3	0.94	0.02	1.00	0.00	0.94	0.02	12	Cluster by plot
2021	124	106	98	12	0.85	0.04	0.92	0.03	0.79	0.04	12	Cluster by plot

<sup>a</sup>F+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

<sup>b</sup>Eggs still present and apparently viable at last check are considered unknown fate and are not included in sample sizes or success estimates.

<sup>c</sup>For 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).

<sup>d</sup>For 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).

<sup>e</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>f</sup>Sampling for storm-petrels 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  $\sqrt{p * (1 - p) / n}$ , where  $p$  is the success rate and  $n$  is the sample size of individual nests.

Table 76. Reproductive performance of Leach's storm-petrels at Aiktak Island, Alaska in 2021. Data include only non-chronology plots monitored on an interval of about 14 days.

Parameter	Plot												Total	SD <sup>a</sup>
	9	10	11	13	17	18	19	20	21	22	24	26		
Max. nest sites w/ eggs (B+H)	14	12	12	4	10	10	11	11	13	11	4	12	124	-
Max. nest sites w/ chicks (D+H)	13	11	12	3	10	10	8	9	9	7	3	11	106	-
Max. nest sites w/ chicks fledged (F+H) <sup>b</sup>	12	10	12	3	10	7	7	9	9	6	3	10	98	-
Nest sites w/ viable eggs at last visit <sup>c</sup>	0	1	2	1	0	2	0	1	2	2	0	1	12	-
Max. potential nesting success[(D+H)/(B+H)] <sup>d</sup>	0.93	0.92	1.00	0.75	1.00	1.00	0.73	0.82	0.69	0.64	0.75	0.92	0.85	0.04
Max. potential fledging success [(F+H)/(D+H)] <sup>e</sup>	0.92	0.91	1.00	1.00	1.00	0.70	0.88	1.00	1.00	0.86	1.00	0.91	0.92	0.03
Max. potential reproductive success [(F+H)/(B+H)]	0.86	0.83	1.00	0.75	1.00	0.70	0.64	0.82	0.69	0.55	0.75	0.83	0.79	0.04

<sup>a</sup>Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

<sup>b</sup>F+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

<sup>c</sup>Eggs still present and apparently viable at last check are considered unknown fate and are not included in the number of nest sites w/ eggs (B) or success estimates.

<sup>d</sup>For 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).

<sup>e</sup>For 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).

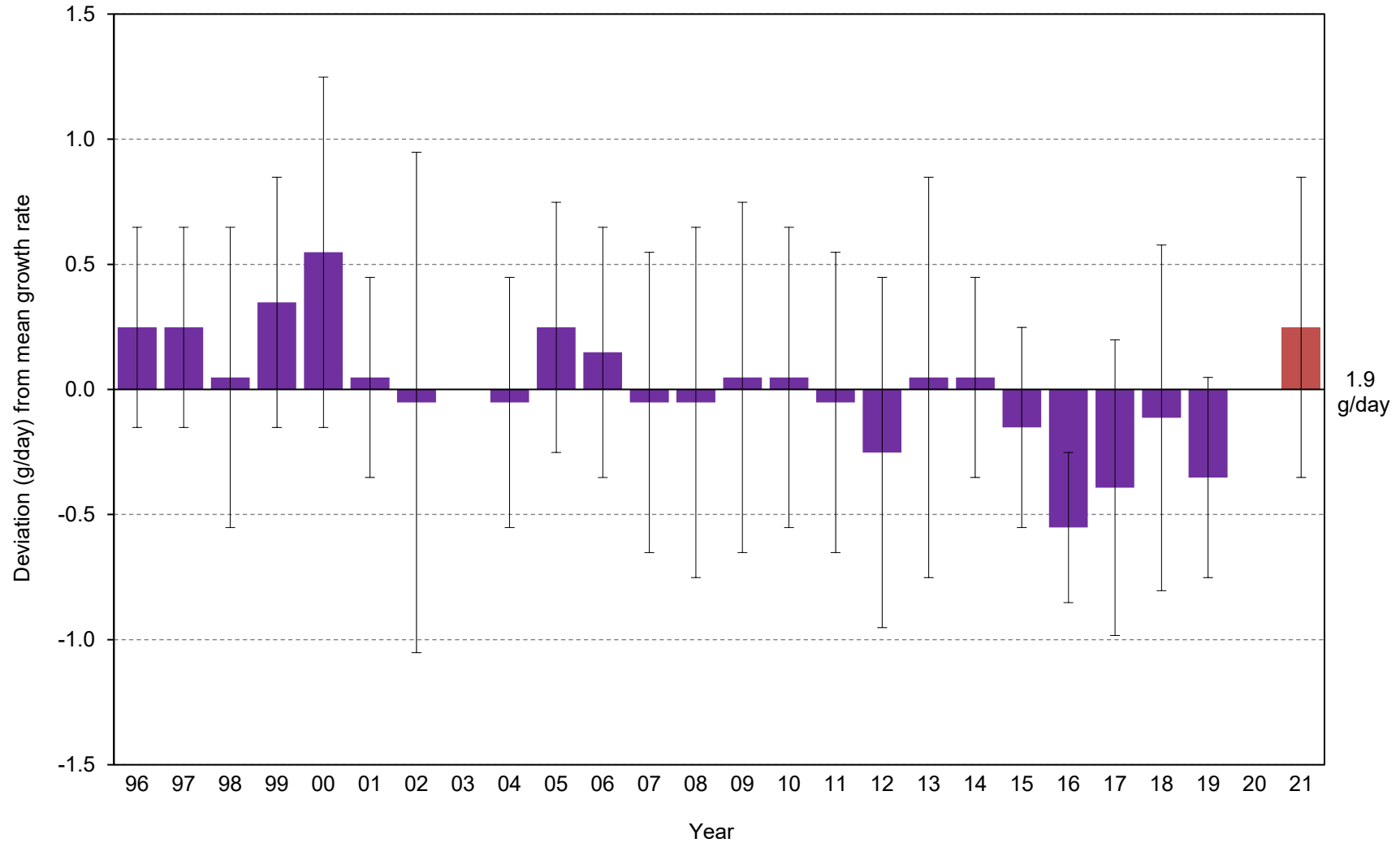


Figure 48. Yearly chick growth rate deviation (from the 1996-2020 average of 1.9 g/day) for Leach's storm-petrels at Aiktak Island, Alaska. Negative values indicate less than the mean growth rate, positive values exceed the mean growth rate. Error bars represent standard deviation around each year's mean growth rate; red highlights the current year. No data were collected in 2003 or 2020.

Table 77. Mean growth rates of Leach's storm-petrel chicks at Aiktak Island, Alaska. Data include chicks measured at least two times during the linear phase of growth (approximately mass 0-60g; wing chord 20-140mm); chicks that died were excluded. No data were collected in 2003 or 2020.

Year	Mass (g/day)				Wing chord (mm/day) <sup>a</sup>			
	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>
1996	2.1	0.4	1.3 - 3.4	36	2.8	0.4	1.8 - 3.4	35
1997	2.1	0.4	1.1 - 3.0	40	2.4	0.5	1.4 - 3.5	32
1998	1.9	0.6	0.6 - 3.2	40	2.3	0.6	1.2 - 3.4	24
1999	2.2	0.5	0.7 - 3.4	29	3.1	0.1	3.0 - 3.3	3
2000	2.4	0.7	1.4 - 4.5	36	3.3	0.8	1.3 - 5.0	20
2001	1.9	0.4	1.4 - 2.7	28	-	-	-	-
2002	1.8	1.0	1.0 - 2.5	8	3.1	0.5	2.5 - 4.1	7
2004	1.8	0.5	0.9 - 3.1	41	2.7	0.9	0.9 - 4.2	24
2005	2.1	0.5	1.4 - 4.1	37	2.4	0.4	1.1 - 3.3	37
2006	2.0	0.5	1.1 - 3.4	26	2.5	0.3	1.8 - 3.0	25
2007	1.8	0.6	1.1 - 3.0	30	2.5	0.5	1.7 - 3.6	19
2008	1.8	0.7	0.3 - 3.7	30	2.5	0.4	1.8 - 3.0	21
2009	1.9	0.7	0.5 - 3.6	42	2.0	0.5	1.0 - 3.8	41
2010	1.9	0.6	0.8 - 3.1	21	2.2	0.6	1.1 - 3.2	20
2011	1.8	0.6	0.9 - 3.3	27	2.1	0.6	0.9 - 3.4	27
2012	1.6	0.7	0.4 - 3.5	33	2.2	0.6	0.8 - 2.9	26
2013	1.9	0.8	0.6 - 4.3	30	2.2	0.7	0.6 - 3.3	30
2014	1.9	0.4	1.3 - 2.7	33	2.9	0.3	2.0 - 3.3	32
2015	1.7	0.4	0.9 - 2.7	32	2.9	0.4	2.0 - 3.6	20
2016	1.3	0.3	0.8 - 2.1	31	2.7	0.3	1.6 - 3.3	30
2017	1.5	0.6	0.5 - 3.4	32	2.9	0.4	1.6 - 3.7	27
2018	1.7	0.7	0.5 - 3.5	22	2.8	0.4	1.9 - 3.3	8
2019	1.5	0.4	0.4 - 2.1	28	3.0	0.3	2.3 - 3.8	24
2021	2.1	0.6	0.9 - 3.1	21	2.7	0.3	2.2 - 3.3	10

<sup>a</sup>All rates of growth are based on relaxed wing chord measurements, except 1998 when only flat wing data were recorded.

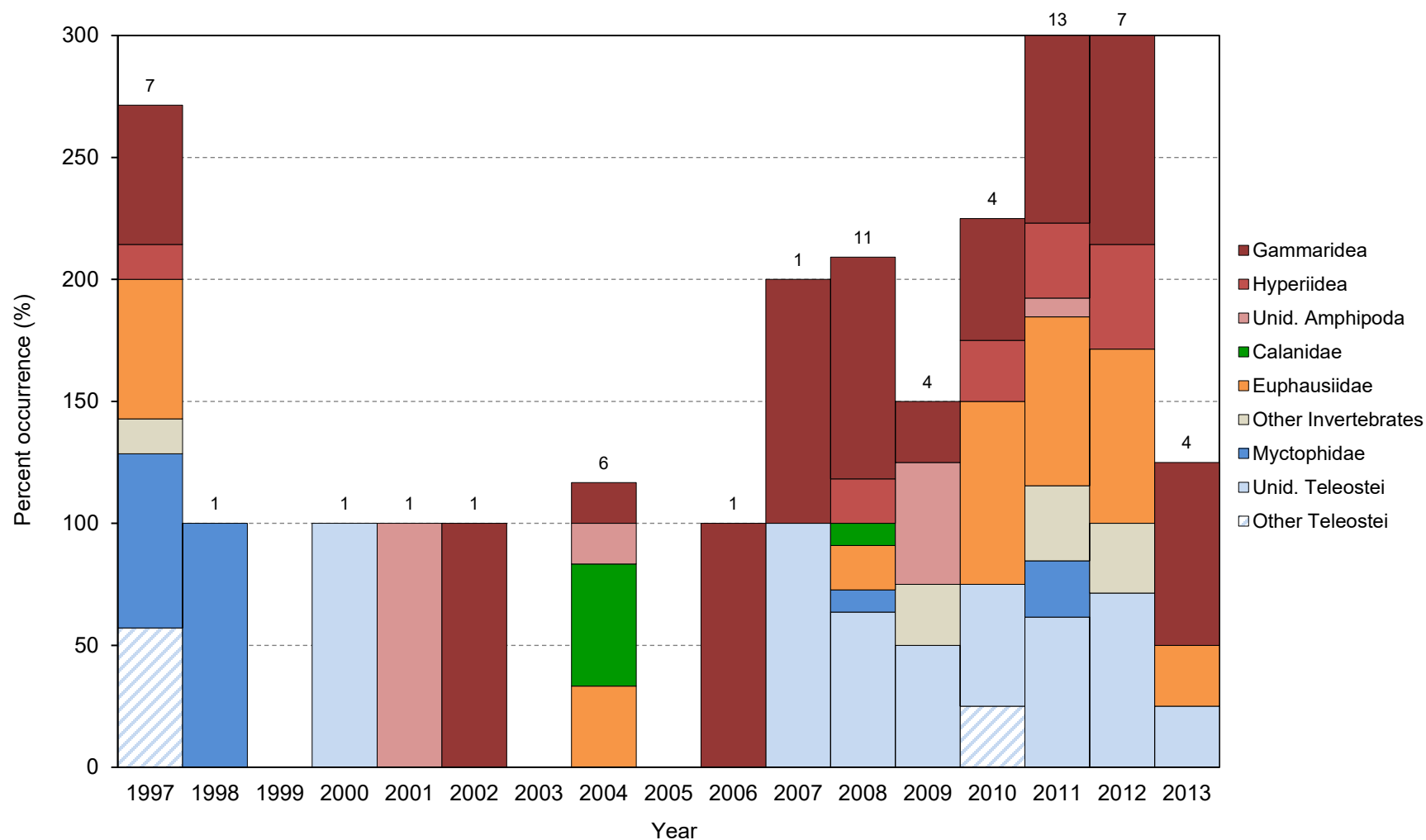


Figure 49. Frequency of occurrence of major prey items in diets of Leach's storm-petrel chicks at Aiktak Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present. Prey is grouped to family level or higher; only taxa with an among-year average occurrence 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 1999, 2003, 2005, 2014, 2020, or 2021; samples were collected in 2015-2019 but have not yet been analyzed.

Table 78. Frequency of occurrence of major prey items in diets of Leach's storm-petrel chicks at Aiktak 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 1999, 2003, 2005, 2014, 2020, or 2021; samples were collected in 2015-2019 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1997	1998	2000	2001	2002	2004	2006	2007	2008	2009	2010	2011	2012	2013	2015	2016	2017	2018	2019
No. samples	7	1	1	1	1	6	1	1	11 <sup>a</sup>	4	4	13	7	4	6	5	7	2	4
<b>Invertebrates</b>	<b>57.1</b>	-	-	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>90.9</b>	<b>75.0</b>	<b>75.0</b>	<b>100.0</b>	<b>100.0</b>	<b>75.0</b>	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>
<b>Amphipoda</b>	<b>57.1</b>	-	-	<b>100.0</b>	<b>100.0</b>	<b>33.3</b>	<b>100.0</b>	<b>100.0</b>	<b>90.9</b>	<b>75.0</b>	<b>50.0</b>	<b>84.6</b>	<b>100.0</b>	<b>75.0</b>	-	-	-	-	-
<b>Gammaridea</b>	<b>57.1</b>	-	-	-	<b>100.0</b>	<b>16.7</b>	<b>100.0</b>	<b>100.0</b>	<b>90.9</b>	<b>25.0</b>	<b>50.0</b>	<b>76.9</b>	<b>85.7</b>	<b>75.0</b>	-	-	-	-	-
Lysianassidae	57.1	-	-	-	-	16.7	100.0	-	-	-	50.0	-	71.4	-	-	-	-	-	-
<i>Paracallisoma coecum</i>	-	-	-	-	-	-	-	100.0	54.5	25.0	-	69.2	-	25.0	-	-	-	-	-
Unid. Gammaridea	-	-	-	-	100.0	-	-	-	63.6	25.0	25.0	7.7	42.9	50.0	-	-	-	-	-
Other Gammaridea	-	-	-	-	-	-	-	-	9.1	-	-	46.2	-	-	-	-	-	-	-
Hyperiidea	14.3	-	-	-	-	-	-	-	18.2	-	25.0	30.8	42.9	-	-	-	-	-	-
Unid. Amphipoda	-	-	-	100.0	-	16.7	-	-	-	50.0	-	7.7	-	-	-	-	-	-	-
<b>Copepoda</b>	-	-	-	-	-	<b>50.0</b>	-	-	<b>9.1</b>	-	-	-	<b>14.3</b>	-	-	-	-	-	-
Calanidae	-	-	-	-	-	50.0	-	-	9.1	-	-	-	-	-	-	-	-	-	-
Other Copepoda	-	-	-	-	-	-	-	-	-	-	-	-	14.3	-	-	-	-	-	-
<b>Euphausiacea</b>	<b>57.1</b>	-	-	-	-	<b>33.3</b>	-	-	<b>18.2</b>	-	<b>75.0</b>	<b>69.2</b>	<b>71.4</b>	<b>25.0</b>	-	-	-	-	-
<b>Euphausiidae</b>	<b>57.1</b>	-	-	-	-	<b>33.3</b>	-	-	<b>18.2</b>	-	<b>75.0</b>	<b>69.2</b>	<b>71.4</b>	<b>25.0</b>	-	-	-	-	-
<i>Thysanoessa</i> spp.	-	-	-	-	-	-	-	-	9.1	-	50.0	38.5	28.6	-	-	-	-	-	-
Unid. Euphausiidae	57.1	-	-	-	-	33.3	-	-	-	-	25.0	30.8	28.6	25.0	-	-	-	-	-
Other Euphausiidae	-	-	-	-	-	-	-	-	9.1	-	-	7.7	14.3	-	-	-	-	-	-
Other Invertebrates	14.3	-	-	-	-	-	-	-	-	25.0	-	30.8	28.6	-	-	-	-	-	-
<b>Fish</b>	<b>85.7</b>	<b>100.0</b>	<b>100.0</b>	-	-	-	-	<b>100.0</b>	<b>72.7</b>	<b>50.0</b>	<b>75.0</b>	<b>84.6</b>	<b>71.4</b>	<b>25.0</b>	-	-	-	-	-
<b>Teleostei</b>	<b>85.7</b>	<b>100.0</b>	<b>100.0</b>	-	-	-	-	<b>100.0</b>	<b>72.7</b>	<b>50.0</b>	<b>75.0</b>	<b>84.6</b>	<b>71.4</b>	<b>25.0</b>	-	-	-	-	-
<b>Myctophidae</b>	<b>71.4</b>	<b>100.0</b>	-	-	-	-	-	-	<b>9.1</b>	-	-	<b>23.1</b>	-	-	-	-	-	-	-
<i>Stenobrachius leucopsarus</i>	71.4	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Myctophidae	-	-	-	-	-	-	-	-	9.1	-	-	23.1	-	-	-	-	-	-	-
Unid. Teleostei	-	-	100.0	-	-	-	-	100.0	63.6	50.0	50.0	61.5	71.4	25.0	-	-	-	-	-
Other Teleostei	57.1	-	-	-	-	-	-	-	-	-	25.0	-	-	-	-	-	-	-	-
Other	28.6	-	-	-	-	-	-	-	-	-	-	15.4	-	-	-	-	-	-	-

<sup>a</sup>One additional sample is still pending analysis.

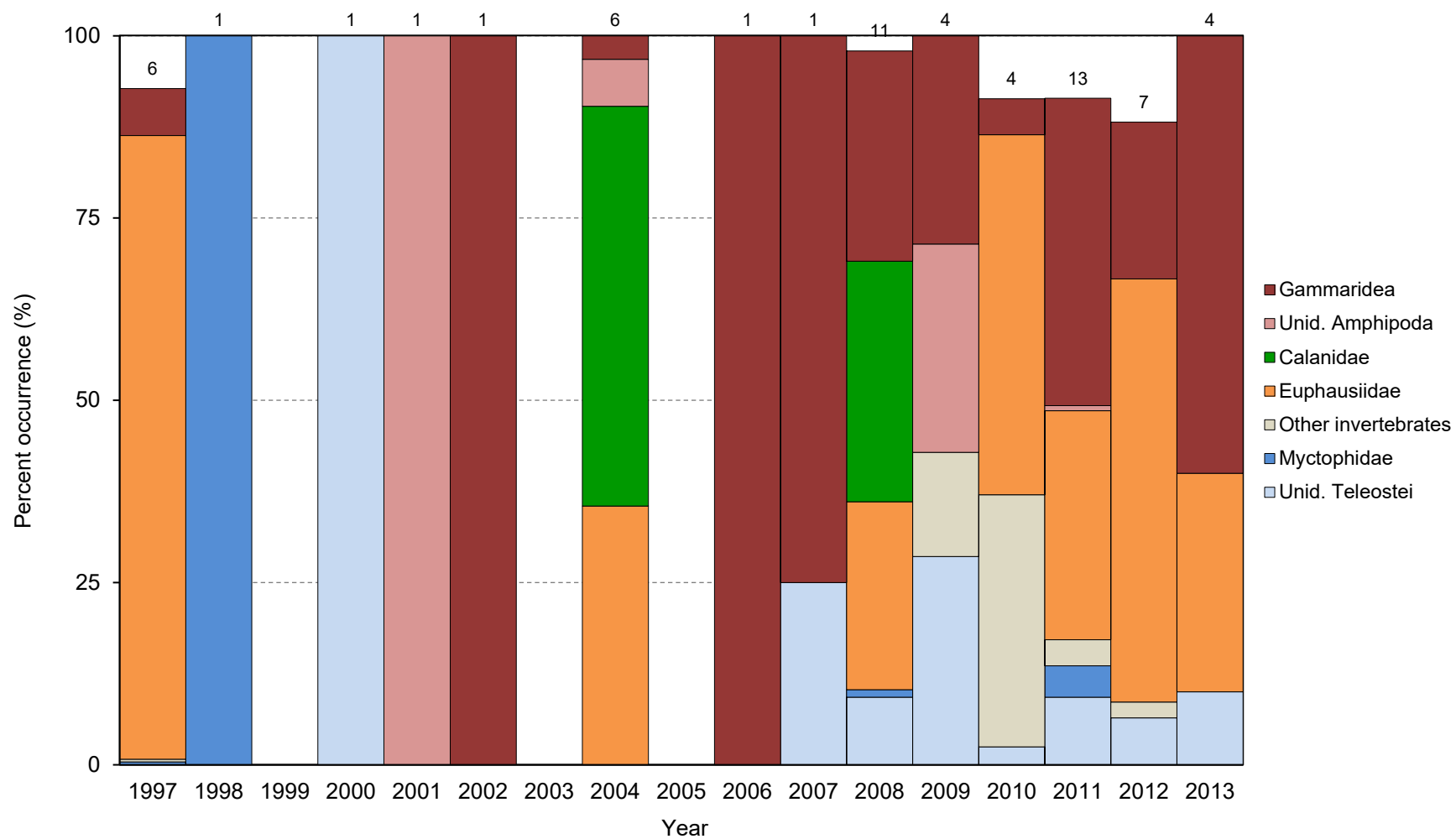


Figure 50. Percent composition of major prey items in diets of Leach's storm-petrel chicks at Aiktak Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item. Prey is grouped to family level or higher; only taxa with an among-year average composition 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 1999, 2003, 2005, 2014, or 2020-2021; samples were collected in 2015-2019 but have not yet been analyzed.



Table 79. Percent composition of major prey items in diets of Leach's chicks at Aiktak 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 regurgitations collected from adults returning to the colony to feed chicks. No diet samples were collected in 1999, 2003, 2005, 2014, or 2020-2021; samples were collected in 2015-2019 but have not yet been analyzed. More detailed diet data and prey identifications are available, contact refuge biologists for details.

Prey	1997	1998	2000	2001	2002	2004	2006	2007	2008	2009	2010	2011	2012	2013	2015	2016	2017	2018	2019
No. samples	6	1	1	1	1	6	1	1	11 <sup>a</sup>	4	4	13	7	4	6	5	7	2	4
No individuals	263	1	1	1	2	31	2	4	97	7	81	140	93	10	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>	<i>pending</i>
<b>Invertebrates</b>	<b>92.8</b>	-	-	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>75.0</b>	<b>89.7</b>	<b>71.4</b>	<b>96.3</b>	<b>85.0</b>	<b>93.5</b>	<b>90.0</b>	-	-	-	-	-
<b>Amphipoda</b>	<b>6.8</b>	-	-	<b>100.0</b>	<b>100.0</b>	<b>9.7</b>	<b>100.0</b>	<b>75.0</b>	<b>30.9</b>	<b>57.1</b>	<b>12.3</b>	<b>50.0</b>	<b>28.0</b>	<b>60.0</b>	-	-	-	-	-
<b>Gammaridea</b>	<b>6.5</b>	-	-	-	<b>100.0</b>	<b>3.2</b>	<b>100.0</b>	<b>75.0</b>	<b>28.9</b>	<b>28.6</b>	<b>4.9</b>	<b>42.1</b>	<b>21.5</b>	<b>60.0</b>	-	-	-	-	-
Lysianassidae	6.5	-	-	-	-	3.2	100.0	-	-	-	3.7	-	12.9	-	-	-	-	-	-
<i>Paracallisoma coecum</i>	-	-	-	-	-	-	-	75.0	13.4	14.3	-	28.6	-	40.0	-	-	-	-	-
Unid. Gammaridea	-	-	-	-	100.0	-	-	-	13.4	14.3	1.2	0.7	8.6	20.0	-	-	-	-	-
Other Gammaridea	-	-	-	-	-	-	-	-	2.1	-	-	12.9	-	-	-	-	-	-	-
Unid. Amphipoda	-	-	-	100.0	-	6.5	-	-	-	28.6	-	0.7	-	-	-	-	-	-	-
Other Amphipoda	0.4	-	-	-	-	-	-	-	2.1	-	7.4	7.1	6.5	-	-	-	-	-	-
<b>Copepoda</b>	-	-	-	-	-	<b>54.8</b>	-	-	<b>33.0</b>	-	-	-	<b>5.4</b>	-	-	-	-	-	-
Calanidae	-	-	-	-	-	54.8	-	-	33.0	-	-	-	-	-	-	-	-	-	-
Other Copepoda	-	-	-	-	-	-	-	-	-	-	-	-	5.4	-	-	-	-	-	-
<b>Euphausiacea</b>	<b>85.6</b>	-	-	-	-	<b>35.5</b>	-	-	<b>25.8</b>	-	<b>49.4</b>	<b>31.4</b>	<b>58.1</b>	<b>30.0</b>	-	-	-	-	-
<b>Euphausiidae</b>	<b>85.6</b>	-	-	-	-	<b>35.5</b>	-	-	<b>25.8</b>	-	<b>49.4</b>	<b>31.4</b>	<b>58.1</b>	<b>30.0</b>	-	-	-	-	-
<i>Thysanoessa</i> spp.	-	-	-	-	-	-	-	-	1.0	-	18.5	24.3	38.7	-	-	-	-	-	-
Unid. Euphausiidae	85.6	-	-	-	-	35.5	-	-	-	-	30.9	5.7	12.9	30.0	-	-	-	-	-
Other Euphausiidae	-	-	-	-	-	-	-	-	24.7	-	-	1.4	6.5	-	-	-	-	-	-
Other Invertebrates	0.4	-	-	-	-	-	-	-	-	14.3	34.6	3.6	2.2	-	-	-	-	-	-
<b>Fish</b>	<b>6.1</b>	<b>100.0</b>	<b>100.0</b>	-	-	-	-	<b>25.0</b>	<b>10.3</b>	<b>28.6</b>	<b>3.7</b>	<b>13.6</b>	<b>6.5</b>	<b>10.0</b>	-	-	-	-	-
<b>Teleostei</b>	<b>6.1</b>	<b>100.0</b>	<b>100.0</b>	-	-	-	-	<b>25.0</b>	<b>10.3</b>	<b>28.6</b>	<b>3.7</b>	<b>13.6</b>	<b>6.5</b>	<b>10.0</b>	-	-	-	-	-
<b>Myctophidae</b>	<b>0.4</b>	<b>100.0</b>	<b>100.0</b>	-	-	-	-	-	<b>1.0</b>	-	-	<b>4.3</b>	-	-	-	-	-	-	-
<i>Stenobrachius leucopsarus</i>	0.4	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Myctophidae	-	-	-	-	-	-	-	-	1.0	-	-	4.3	-	-	-	-	-	-	-
Unid. Teleostei	-	-	100.0	-	-	-	-	25.0	9.3	28.6	2.5	9.3	6.5	10.0	-	-	-	-	-
Other Teleostei	5.7	-	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-
Other	1.1	-	-	-	-	-	-	-	-	-	-	1.4	-	-	-	-	-	-	-

<sup>a</sup>One additional sample is still pending analysis.

Table 80. Morphological measurements of adult Leach's storm-petrels at Aikta Island, Alaska. No data were collected in 1998-2000 or 2020.

Year	Mass (g)				Wing chord (mm)				Diagonal tarsus (mm)			
	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>
1995	51.5	4.4	43.0-60.0	63	-	-	-	-	24.6	0.8	22.5-26.1	72
1996	53.8	5.1	40.0-67.0	130	-	-	-	-	24.6	0.6	22.9-26.0	91
1997	46.5	4.1	38.0-58.0	157	-	-	-	-	24.5	0.6	23.0-25.7	83
2001	49.4	3.9	42.5-55.3	18	154	2.2	152-156	2	-	-	-	-
2002	50.0	3.4	42.0-55.0	15	157	3.8	150-163	15	26.2	1.6	24.1-29.8	15
2003	44.8	4.2	41.0-55.5	10	156	3.2	153-163	10	-	-	-	-
2004	48.2	6.3	35.0-59.0	42	156	4.8	140-165	42	25.1	2.3	20.5-29.9	42
2005	47.1	4.2	39.0-58.0	72	154	3.1	148-160	71	24.5	0.8	23.0-26.0	71
2006	46.2	4.4	38.5-55.5	48	154	3.8	146-162	48	24.4	0.6	22.5-25.5	48
2007	45.9	4.4	38.0-54.0	57	156	4.1	147-166	56	24.3	0.9	22.9-27.3	57
2008	42.9	3.2	37.5-53.0	45	155	3.3	148-163	45	24.1	0.7	22.9-25.6	45
2009	42.7	2.6	36.5-42.7	34	155	3.9	148-165	34	24.5	0.9	22.2-26.7	34
2010	42.0	3.2	36.0-50.0	51	154	4.6	143-163	51	24.0	0.7	22.7-25.4	51
2011	41.1	3.0	35.0-49.0	36	155	3.4	144-161	36	24.1	0.9	22.3-26.1	36
2012	41.6	3.0	36.0-50.0	37	154	3.1	150-162	37	24.5	0.7	23.2-26.2	37
2013	42.1	3.2	34.0-56.0	91	154	3.7	144-165	91	24.2	0.7	22.4-26.2	91
2014	44.3	3.0	40.0-48.0	9	157	2.6	155-164	9	23.7	0.4	23.1-24.1	9
2015	41.8	3.2	37.0-53.0	33	156	5.0	145-167	34	24.4	0.9	22.6-26.1	34
2016	43.1	2.6	38.0-48.0	25	157	3.8	150-165	25	24.4	0.6	23.1-25.3	25
2017	42.4	2.9	36.0-47.0	23	155	3.1	150-161	23	24.1	0.7	22.7-25.6	23
2018	39.0	3.6	35.0-42.0	4	159	1.6	157-160	4	24.8	0.7	24.2-25.7	4
2019	41.8	2.7	39.0-51.0	21	156	2.5	150-159	21	24.6	0.7	23.2-26.5	21
2021	41.4	1.4	39.0-44.0	10	156	3.0	152-160	10	24.6	0.8	23.3-26.0	10

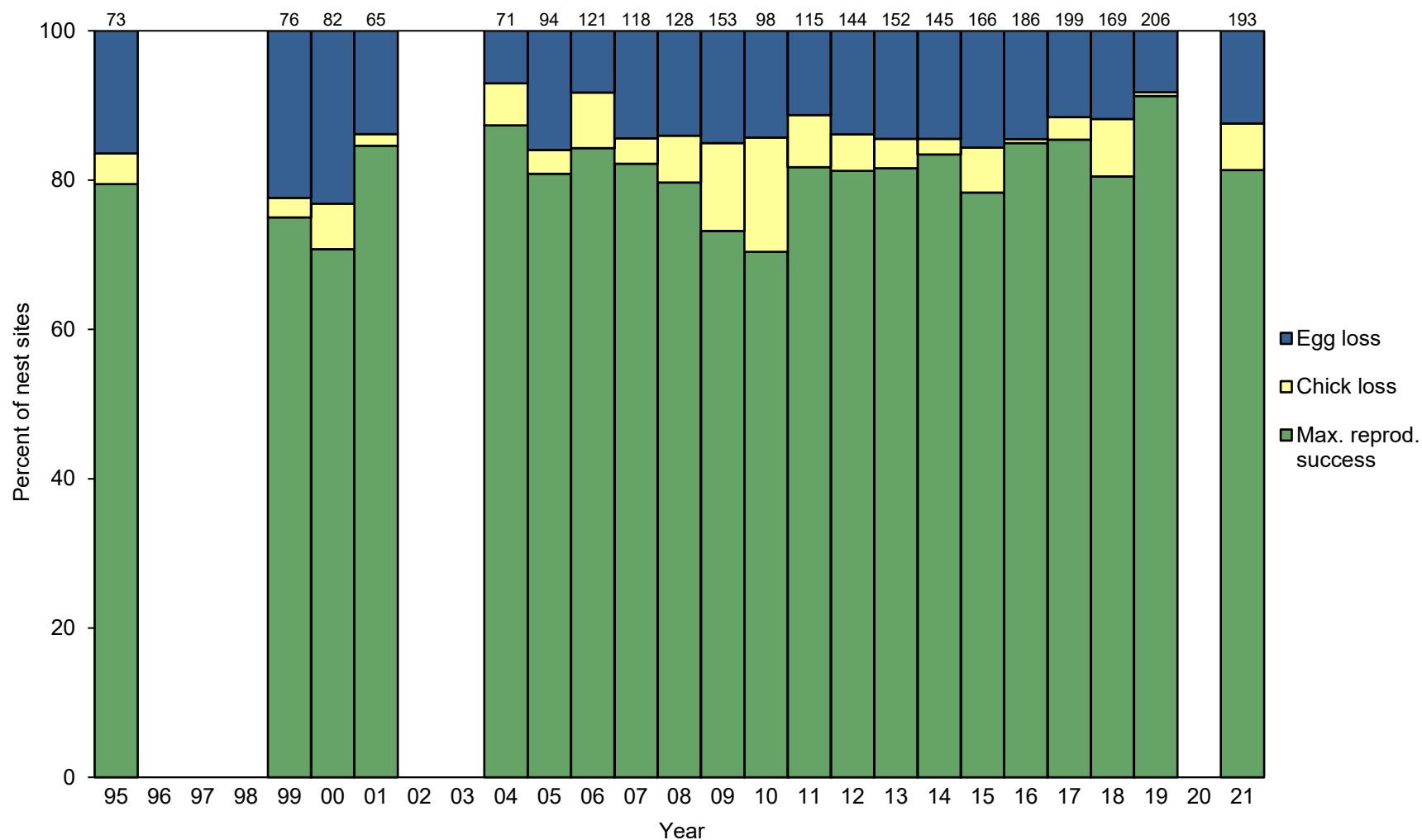


Figure 51. Reproductive performance of all storm-petrels (fork-tailed, Leach's, and unknown storm-petrel species) at Aiktak Island, Alaska. Data include only non-chronology plots monitored on an interval of about 14 days. Egg loss= $[(B+H)-(D+H)]/(B+H)$ ; Chick loss= $[(D+H)-(F+H)]/(B+H)$ ; Maximum potential reproductive success=  $(F+H)/(B+H)$ , where B+H=maximum nest sites with eggs; D+H=maximum nest sites with chicks; F+H=maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes (B+H). No data were collected in 1996-1998, 2002-2003, or 2020.

Table 81. Reproductive performance of all storm-petrels (fork-tailed, Leach's, and unknown storm-petrel species) at Aikta Island, Alaska. Data include only non-chronology plots monitored on an interval of about 14 days. Most chicks are too young to fledge by the time of last visit so measures of success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in 1996-1998, 2002-2003, or 2020.

Year	Max. nest sites w/ eggs	Max nest sites w/ chicks	Max. nest sites w/ chicks fledged	Nest sites w/ viable eggs at last visit <sup>b</sup>	Max. potential nesting success [(D+H)/(B+H)] <sup>c</sup>		Max. potential fledging success [(F+H)/(D+H)] <sup>d</sup>		Max. potential reproductive success [(F+H)/(B+H)]		No. plots <sup>e</sup>	Sampling design <sup>f</sup>
	(B+H)	(D+H)	(F+H) <sup>a</sup>		Total	SD	Total	SD	Total	SD		
1995	73	61	58	0	0.84	0.05	0.95	0.02	0.79	0.05	11	Cluster by plot
1999	76	59	57	4	0.78	0.05	0.97	0.03	0.75	0.05	12	Cluster by plot
2000	82	63	58	1	0.77	0.04	0.92	0.03	0.71	0.04	13	Cluster by plot
2001	65	56	55	4	0.86	0.04	0.98	0.00	0.85	0.04	14	Cluster by plot
2004	71	66	62	0	0.93	0.03	0.94	0.03	0.87	0.05	12	Cluster by plot
2005	94	79	76	1	0.84	0.02	0.96	0.02	0.81	0.03	13	Cluster by plot
2006	121	111	102	1	0.92	0.02	0.92	0.03	0.84	0.05	14	Cluster by plot
2007	118	101	97	2	0.86	0.04	0.96	0.02	0.82	0.04	14	Cluster by plot
2008	128	110	102	4	0.86	0.03	0.93	0.02	0.80	0.03	13	Cluster by plot
2009	153	130	112	0	0.85	0.04	0.86	0.02	0.73	0.03	13	Cluster by plot
2010	98	84	69	3	0.86	0.03	0.82	0.03	0.70	0.03	13	Cluster by plot
2011	115	102	94	14	0.89	0.03	0.92	0.03	0.82	0.03	13	Cluster by plot
2012	144	124	117	2	0.86	0.02	0.94	0.02	0.81	0.03	13	Cluster by plot
2013	152	130	124	7	0.86	0.03	0.95	0.01	0.82	0.03	16	Cluster by plot
2014	145	124	121	2	0.86	0.02	0.98	0.01	0.84	0.02	14	Cluster by plot
2015	166	140	130	3	0.84	0.04	0.93	0.04	0.78	0.03	13	Cluster by plot
2016	186	159	158	0	0.85	0.02	0.99	0.01	0.85	0.03	14	Cluster by plot
2017	199	176	170	4	0.88	0.02	0.97	0.01	0.85	0.03	13	Cluster by plot
2018	169	149	136	14	0.88	0.02	0.91	0.03	0.80	0.03	13	Cluster by plot
2019	206	189	188	3	0.92	0.01	0.99	0.01	0.91	0.01	13	Cluster by plot
2021	193	169	157	18	0.88	0.03	0.93	0.03	0.81	0.04	13	Cluster by plot

<sup>a</sup>F+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

<sup>b</sup>Eggs still present and apparently viable at last check are considered unknown fate and are not included in sample sizes or success estimates.

<sup>c</sup>For 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).

<sup>d</sup>For 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).

<sup>e</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>f</sup>Sampling for storm-petrels 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  $\sqrt{p * (1 - p) / n}$ , where  $p$  is the success rate and  $n$  is the sample size of individual nests.

Table 82. Reproductive performance of all storm-petrels (fork-tailed, Leach's, and unknown storm-petrel species) at Aikta Island, Alaska in 2021. Data include only non-chronology plots monitored on an interval of about 14 days.

Parameter	Plot													Total	SD <sup>a</sup>
	9	10	11	13	16	17	18	19	20	21	22	24	26		
Max. nest sites w/ eggs (B+H)	24	16	26	7	1	14	14	17	13	16	12	6	27	193	-
Max. nest sites w/ chicks (D+H)	23	15	26	6	1	14	13	13	10	11	8	5	24	169	-
Max. nest sites w/ chicks fledged (F+H) <sup>b</sup>	21	13	26	6	1	14	9	11	10	11	7	5	23	157	-
Nest sites w/ viable eggs at last visit <sup>c</sup>	1	1	2	1	0	0	3	1	2	3	2	0	2	18	-
Max. potential nesting success[(D+H)/(B+H)] <sup>d</sup>	0.96	0.94	1.00	0.86	1.00	1.00	0.93	0.76	0.77	0.69	0.67	0.83	0.89	0.88	0.03
Max. potential fledging success [(F+H)/(D+H)] <sup>e</sup>	0.91	0.87	1.00	1.00	1.00	1.00	0.69	0.85	1.00	1.00	0.88	1.00	0.96	0.93	0.03
Max. potential reproductive success [(F+H)/(B+H)]	0.88	0.81	1.00	0.86	1.00	1.00	0.64	0.65	0.77	0.69	0.58	0.83	0.85	0.81	0.04

<sup>a</sup>Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

<sup>b</sup>F+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

<sup>c</sup>Eggs still present and apparently viable at last check are considered unknown fate and are not included in the number of nest sites w/ eggs (B) or success estimates.

<sup>d</sup>For 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).

<sup>e</sup>For 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).

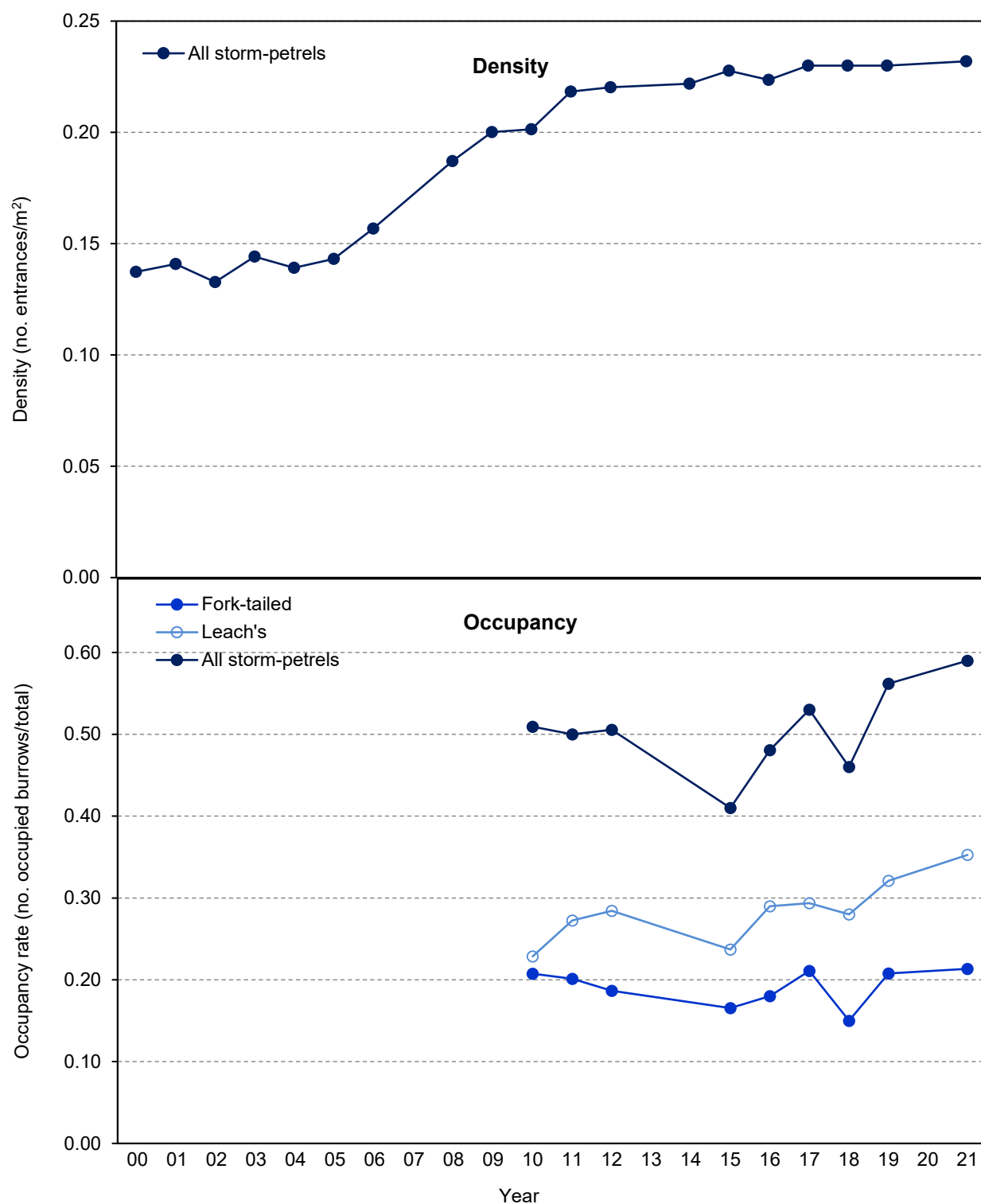


Figure 52. Burrow entrance densities and chamber occupancy rates of storm-petrels on index plots at Aikta Island, Alaska. All data from 1990 and 1995-1999 are excluded because not all plots were counted; density data from 2007 and 2013 and occupancy data from 2013 and 2014 are excluded due to data inconsistencies. No density data were collected in 2020 and no occupancy data were collected in 2003 or 2020. Occupancy data from 2002-2004 and 2004-2009 are currently under review.

Table 83. Burrow entrance densities of storm-petrels on index plots at Aiktak Island, Alaska. Density is expressed as the number of small/medium burrow entrances per m<sup>2</sup>. Data include all plots except plot 26, which is excluded due to the existence of artificial burrows within the plot. Density data presented here have been revised from values presented in previous reports. Data from 1990 and 1995-1999 are excluded because not all plots were counted; data from 2007 and 2013 are excluded due to data inconsistencies. No data were collected in 2020.

Year	Plot																	Total	Mean	SD
	8	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	27			
2000	0.52	0.22	0.20	0.52	0.48	0.12	0.09	0.36	0.07	0.29	0.40	0.25	0.06	0.14	0.25	0.04	0.16	0.14	0.25	0.16
2001	0.45	0.24	0.21	0.58	0.48	0.16	0.10	0.42	0.08	0.29	0.40	0.24	0.07	0.14	0.25	0.04	0.16	0.14	0.25	0.16
2002	0.38	0.21	0.20	0.6	0.44	0.16	0.08	0.42	0.08	0.27	0.39	0.23	0.07	0.13	0.25	0.04	0.16	0.13	0.24	0.16
2003	0.51	0.21	0.21	0.58	0.50	0.20	0.10	0.42	0.08	0.28	0.40	0.24	0.07	0.15	0.27	0.04	0.19	0.14	0.26	0.17
2004	0.41	0.22	0.20	0.64	0.46	0.18	0.08	0.40	0.08	0.26	0.39	0.24	0.07	0.15	0.29	0.04	0.17	0.14	0.25	0.16
2005	0.51	0.24	0.19	0.56	0.50	0.24	0.09	0.38	0.07	0.30	0.41	0.26	0.06	0.14	0.31	0.04	0.19	0.14	0.26	0.16
2006	0.55	0.23	0.24	0.62	0.46	0.26	0.14	0.44	0.09	0.33	0.41	0.29	0.07	0.16	0.42	0.04	0.19	0.16	0.29	0.17
2008	0.51	0.34	0.29	0.74	0.46	0.30	0.15	0.60	0.14	0.43	0.45	0.30	0.09	0.15	0.37	0.04	0.26	0.19	0.33	0.19
2009	0.53	0.35	0.31	0.76	0.54	0.38	0.15	0.60	0.14	0.47	0.47	0.32	0.09	0.18	0.35	0.05	0.29	0.20	0.35	0.19
2010	0.52	0.35	0.31	0.78	0.50	0.36	0.15	0.66	0.15	0.47	0.47	0.31	0.10	0.18	0.37	0.04	0.31	0.20	0.35	0.20
2011	0.54	0.40	0.32	0.82	0.54	0.38	0.15	0.86	0.16	0.52	0.51	0.34	0.10	0.20	0.38	0.05	0.31	0.22	0.39	0.23
2012	0.54	0.38	0.33	0.88	0.58	0.38	0.15	0.80	0.16	0.50	0.56	0.33	0.11	0.22	0.38	0.05	0.32	0.22	0.39	0.23
2014	0.55	0.38	0.31	0.88	0.56	0.40	0.15	0.92	0.16	0.50	0.60	0.32	0.11	0.21	0.40	0.05	0.32	0.22	0.40	0.25
2015	0.56	0.39	0.35	0.90	0.54	0.42	0.16	0.88	0.17	0.50	0.59	0.34	0.11	0.23	0.40	0.05	0.31	0.23	0.41	0.24
2016	0.57	0.38	0.37	0.92	0.48	0.42	0.15	0.84	0.16	0.47	0.59	0.32	0.10	0.24	0.38	0.05	0.31	0.22	0.40	0.24
2017	0.56	0.39	0.34	0.98	0.50	0.42	0.17	0.80	0.16	0.48	0.57	0.34	0.10	0.23	0.38	0.06	0.31	0.23	0.40	0.24
2018	0.57	0.39	0.34	0.98	0.50	0.42	0.16	0.82	0.16	0.48	0.57	0.34	0.10	0.23	0.38	0.06	0.30	0.23	0.40	0.24
2019	0.57	0.39	0.35	0.98	0.50	0.38	0.16	0.80	0.15	0.49	0.56	0.34	0.11	0.24	0.37	0.06	0.31	0.23	0.40	0.2
2021	0.58	0.39	0.33	1.00	0.58	0.42	0.16	0.76	0.15	0.55	0.58	0.35	0.11	0.24	0.37	0.06	0.31	0.23	0.41	0.2
Plot area (m <sup>2</sup> )	100	200	150	50	50	50	100	50	494	125	75	119	288	455	52	1219	340	3917	-	-

Table 84. Occupancy rates of fork-tailed storm-petrels on index plots at Aiktak Island, Alaska. Occupancy is expressed as the number of occupied burrows over the number of burrows with known contents. Data include all plots except plot 26, which is excluded due to the existence of artificial burrows within the plot. Occupancy data presented have been revised from values presented in previous reports. Data from 1990 and 1995-1999 are excluded because not all plots were counted; data from 2013 and 2014 are excluded due to data inconsistencies. No data were collected in 2003 or 2020. Data from 2000-2002 and 2004-2009 are currently under review and will be updated in a future report.

Year	Plot																	Total	Mean	SD
	8	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	27			
2000	xx <sup>a</sup>	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2001	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2002	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2004	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2005	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2006	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2007	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2008	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2009	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2010	0.24	0.29	0.17	0.28	0.08	0.50	0.29	0.13	0.23	0.21	0.07	0.11	0.10	0.27	0.00	0.26	0.16	0.21	0.20	0.12
2011	0.13	0.24	0.11	0.45	0.00	0.22	0.22	0.17	0.29	0.25	0.14	0.17	0.00	0.21	0.00	0.32	0.16	0.20	0.18	0.12
2012	0.13	0.13	0.22	0.30	0.19	0.29	0.44	0.19	0.22	0.26	0.17	0.13	0.12	0.21	0.10	0.16	0.14	0.19	0.20	0.09
2015	0.21	0.13	0.03	0.27	0.24	0.20	0.21	0.21	0.13	0.21	0.16	0.08	0.08	0.17	0.08	0.20	0.17	0.17	0.16	0.07
2016	0.17	0.14	0.14	0.32	0.29	0.17	0.17	0.23	0.18	0.18	0.16	0.09	0.04	0.19	0.15	0.21	0.20	0.18	0.18	0.06
2017	0.25	0.17	0.14	0.34	0.28	0.25	0.15	0.26	0.18	0.28	0.15	0.09	0.04	0.22	0.14	0.21	0.27	0.21	0.20	0.08
2018	0.28	0.11	0.13	0.27	0.11	0.17	0.17	0.24	0.14	0.23	0.13	0.08	0.04	0.14	0.08	0.14	0.15	0.15	0.15	0.07
2019	0.29	0.19	0.17	0.38	0.15	0.08	0.30	0.25	0.19	0.21	0.13	0.08	0.04	0.26	0.08	0.19	0.24	0.21	0.19	0.09
2021	0.30	0.19	0.14	0.33	0.26	0.33	0.10	0.19	0.14	0.17	0.12	0.13	0.05	0.31	0.18	0.22	0.24	0.21	0.20	0.09

<sup>a</sup>xx indicates data potentially exist but have not yet been summarized.



Table 85. Occupancy rates of Leach's storm-petrels on index plots at Aiktak Island, Alaska. Occupancy is expressed as the number of occupied burrows over the number of burrows with known contents. Data include all plots except plot 26, which is excluded due to the existence of artificial burrows within the plot. Occupancy data presented have been revised from values presented in previous reports. Data from 1990 and 1995-1999 are excluded because not all plots were counted; data from 2013 and 2014 are excluded due to data inconsistencies. No data were collected in 2003 or 2020. Data from 2000-2002 and 2004-2009 are currently under review and will be updated in a future report.

Year	Plot																	Total	Mean	SD
	8	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	27			
2000	xx <sup>a</sup>	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2001	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2002	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2004	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2005	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2006	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2007	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2008	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2009	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2010	0.10	0.38	0.17	0.39	0.31	0.00	0.29	0.27	0.19	0.11	0.33	0.33	0.30	0.27	0.25	0.11	0.23	0.23	0.24	0.11
2011	0.17	0.24	0.22	0.27	0.29	0.11	0.22	0.24	0.25	0.21	0.41	0.42	0.44	0.36	0.33	0.14	0.29	0.27	0.27	0.10
2012	0.20	0.26	0.26	0.37	0.25	0.29	0.00	0.26	0.41	0.19	0.33	0.38	0.41	0.25	0.30	0.27	0.35	0.28	0.28	0.10
2015	0.18	0.25	0.28	0.27	0.12	0.20	0.07	0.21	0.17	0.15	0.23	0.54	0.35	0.22	0.42	0.24	0.20	0.24	0.24	0.11
2016	0.28	0.26	0.48	0.29	0.24	0.33	0.08	0.38	0.21	0.21	0.39	0.45	0.39	0.25	0.23	0.40	0.13	0.29	0.30	0.11
2017	0.31	0.28	0.31	0.29	0.22	0.25	0.00	0.37	0.20	0.24	0.36	0.52	0.52	0.27	0.36	0.35	0.20	0.29	0.30	0.12
2018	0.31	0.30	0.32	0.29	0.21	0.33	0.00	0.28	0.18	0.31	0.31	0.54	0.52	0.20	0.31	0.24	0.23	0.28	0.29	0.12
2019	0.35	0.34	0.37	0.35	0.20	0.33	0.00	0.36	0.24	0.33	0.41	0.50	0.46	0.25	0.38	0.32	0.27	0.32	0.32	0.11
2021	0.30	0.26	0.50	0.35	0.16	0.42	0.00	0.41	0.34	0.33	0.48	0.65	0.59	0.29	0.45	0.37	0.25	0.35	0.36	0.16

<sup>a</sup>xx indicates data potentially exist but have not yet been summarized.

Table 86. Occupancy rates of all storm-petrels (including fork-tailed, Leach's, and unknown species) on index plots at Aiktak Island, Alaska. Occupancy is expressed as the number of occupied burrows over the number of burrows with known contents. Data include all plots except plot 26, which is excluded due to the existence of artificial burrows within the plot. Occupancy data presented have been revised from values presented in previous reports. Data from 1990 and 1995-1999 are excluded because not all plots were counted; data from 2013 and 2014 are excluded due to data inconsistencies. No data were collected in 2003 or 2020. Data from 2000-2002 and 2004-2009 are currently under review and will be updated in a future report.

Year	Plot																	Total	Mean	SD
	8	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	27			
2000	xx <sup>a</sup>	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2001	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2002	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2004	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2005	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2006	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2007	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2008	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2009	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
2010	0.41	0.76	0.46	0.83	0.46	0.50	0.71	0.40	0.54	0.32	0.53	0.56	0.40	0.61	0.25	0.41	0.43	0.51	0.51	0.15
2011	0.39	0.53	0.39	0.77	0.29	0.33	0.56	0.41	0.54	0.46	0.55	0.67	0.44	0.57	0.33	0.50	0.47	0.50	0.48	0.12
2012	0.40	0.39	0.48	0.67	0.44	0.57	0.56	0.52	0.63	0.52	0.63	0.56	0.53	0.46	0.50	0.46	0.53	0.51	0.52	0.08
2015	0.42	0.38	0.31	0.54	0.35	0.40	0.29	0.43	0.30	0.35	0.39	0.65	0.42	0.41	0.50	0.44	0.41	0.41	0.41	0.09
2016	0.44	0.40	0.62	0.61	0.53	0.50	0.25	0.62	0.39	0.39	0.55	0.55	0.43	0.46	0.38	0.64	0.36	0.48	0.48	0.11
2017	0.58	0.48	0.48	0.63	0.50	0.58	0.23	0.63	0.41	0.59	0.55	0.61	0.57	0.57	0.50	0.56	0.47	0.53	0.53	0.10
2018	0.66	0.48	0.52	0.56	0.37	0.50	0.17	0.55	0.34	0.58	0.44	0.63	0.57	0.36	0.38	0.41	0.42	0.46	0.47	0.12
2019	0.65	0.53	0.63	0.73	0.45	0.42	0.30	0.64	0.46	0.61	0.56	0.58	0.54	0.57	0.62	0.53	0.52	0.56	0.55	0.10
2021	0.67	0.53	0.68	0.75	0.47	0.75	0.10	0.63	0.51	0.53	0.60	0.83	0.64	0.60	0.64	0.59	0.51	0.59	0.59	0.16

<sup>a</sup>xx indicates data potentially exist but have not yet been summarized.

Table 87. Burrow entrance densities and chamber occupancy rates of storm-petrels on index plots at Aiktak Island, Alaska in 2021. Data include all plots except plot 26, which is excluded due to the existence of artificial burrows within the plot.

Parameter	Plot																	Total	Mean	SD
	8	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	27			
Density <sup>a</sup>																				
No. burrow entrances <sup>b</sup>	58	77	49	50	29	21	16	38	76	69	44	42	30	111	19	73	107	909	53	29
Total area (m <sup>2</sup> )	100	200	150	50	50	50	100	50	494	125	75	119	288	455	52	1219	340	3917	-	-
Density of burrow entrances	0.58	0.39	0.33	1.00	0.58	0.42	0.16	0.76	0.15	0.55	0.58	0.35	0.11	0.24	0.37	0.06	0.31	0.23	0.41	0.2
Occupancy																				
No. burrows occupied (O) <sup>c</sup> by:																				
Fork-tailed storm-petrels	10	10	4	13	5	4	1	5	5	6	3	3	1	18	2	12	16	118	-	-
Leach's storm-petrels	10	14	14	14	3	5	0	11	12	12	12	15	13	17	5	20	17	194	-	-
All storm-petrels <sup>d</sup>	22	28	19	30	9	9	1	17	18	19	15	19	14	35	7	32	34	328	-	-
Total no. burrows w/ known contents (N) <sup>e</sup>	33	53	28	40	19	12	10	27	35	36	25	23	22	58	11	54	67	553	-	-
Occupancy rate (O/N) of:																				
Fork-tailed storm-petrels	0.30	0.19	0.14	0.33	0.26	0.33	0.10	0.19	0.14	0.17	0.12	0.13	0.05	0.31	0.18	0.22	0.24	0.21	0.20	0.09
Leach's storm-petrels	0.30	0.26	0.50	0.35	0.16	0.42	0.00	0.41	0.34	0.33	0.48	0.65	0.59	0.29	0.45	0.37	0.25	0.35	0.36	0.16
All storm-petrels <sup>d</sup>	0.67	0.53	0.68	0.75	0.47	0.75	0.10	0.63	0.51	0.53	0.60	0.83	0.64	0.60	0.64	0.59	0.51	0.59	0.59	0.16

<sup>a</sup>Density is expressed as the number of burrow entrances per m<sup>2</sup>.

<sup>b</sup>Number of burrow entrances comprise all entrances viewable from the outside, regardless of the presence of a chamber or numerous branching tunnels further in.

<sup>c</sup>For occupancy, burrows are those with a chamber that, at some point in the season, contained an adult with unknown status (BU) on two consecutive checks or an egg, fresh membrane/eggshell fragments, or chick on at least one check; nest does not have to have known reproductive fate. Nests with multiple chambers are counted as separate "burrows".

<sup>d</sup>Includes fork-tailed, Leach's, and unknown species.

<sup>e</sup>Burrows with known contents are those with a chamber that were either occupied (see definition above) or confirmed empty (burrow ends could be reached).

Table 88. Band resights of fork-tailed storm-petrels at Aiktak Island, Alaska in 2021. Resight data are collected primarily as incidental observations of banded birds captured during the course of other work and should not be considered a comprehensive dataset of banded individuals for survival analysis.

	Birds initially banded in:			Total
	1995	1996	1997	
No. birds banded	22	38	17	77
No. birds ever resighted <sup>a</sup>	16	31	8	55
No. birds resighted in 2021	0	0	0	0

<sup>a</sup>Includes any bird resighted in at least one year following the year it was banded.

Table 89. Band resights of Leach's storm-petrels at Aiktak Island, Alaska in 2021. Resight data are collected primarily as incidental observations of banded birds captured during the course of other work and should not be considered a comprehensive dataset of banded individuals for survival analysis.

	Birds initially banded in:			Total
	1995	1996	1997	
No. birds banded	72	90	59	221
No. birds ever resighted <sup>a</sup>	51	66	28	145
No. birds resighted in 2021	0	0	0	0

<sup>a</sup>Includes any bird resighted in at least one year following the year it was banded.

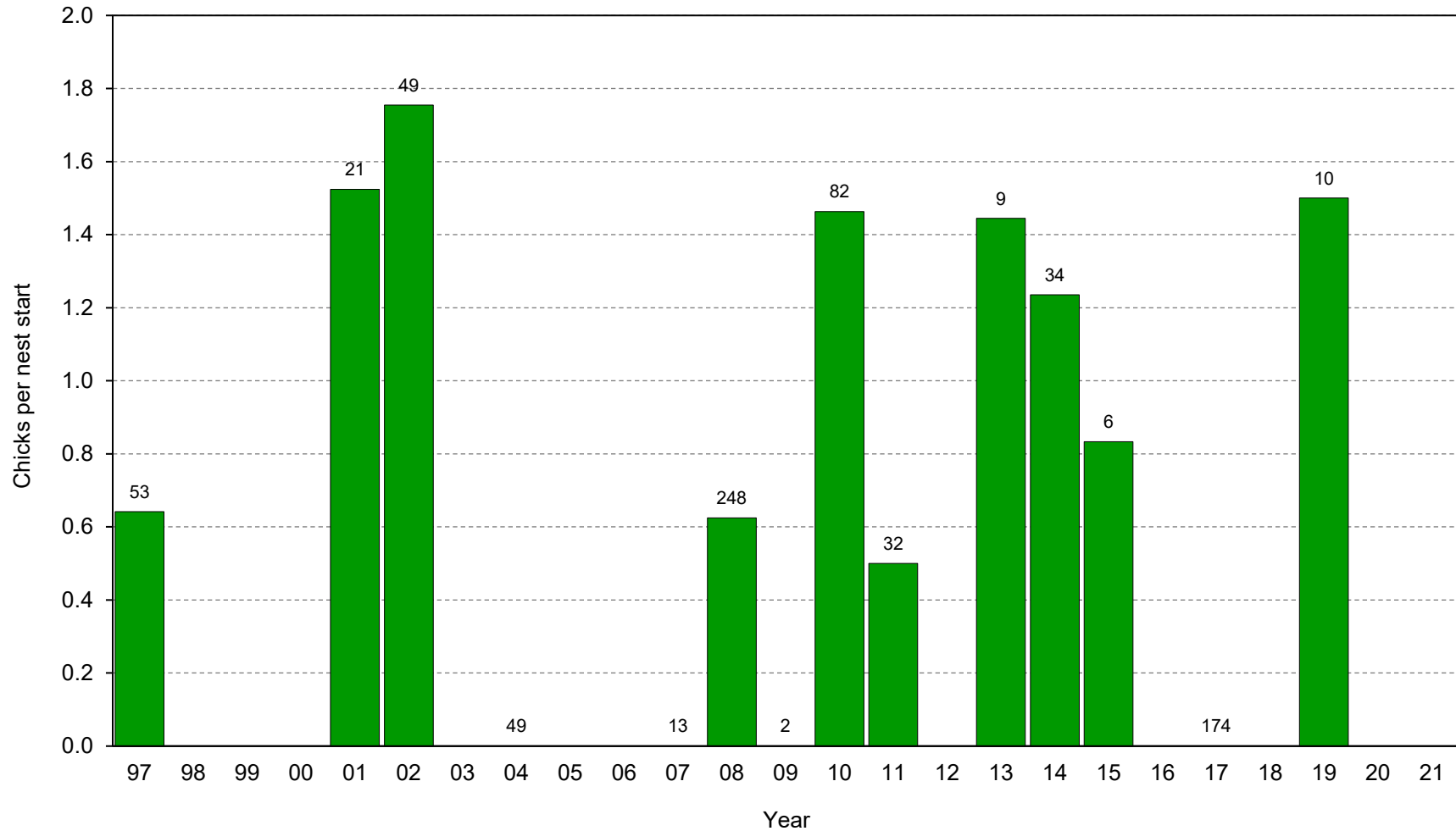


Figure 53. Reproductive performance of red-faced cormorants at Aiktak Island, Alaska. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A). Data come from Boom-or-Bust methodology (1997-2009, 2011, 2014-2021) and frequent monitoring of individual nests (2010 and 2013). Red-faced cormorants bred at Aiktak but no data were collected in 1998, 2003, or 2021; no nests were found in 1995-1996, 1999-2000, 2005-2006, 2012, 2016, or 2018. No data were collected and breeding status was unknown in 2020; in 2021 three nests (contents unknown) were found during a boat-based survey on 14 July.

Table 90. Reproductive performance of red-faced cormorants at Aikta 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. Red-faced cormorants bred at Aikta but no data were collected in 1998, 2003, or 2021; no nests were found in 1995-1996, 1999-2000, 2005-2006, 2012, 2016, or 2018. No data were collected and breeding status was unknown in 2020; in 2021 three nests (contents unknown) were found during a boat-based survey on 14 July.

Year	Total nest starts (A)	Nest sites w/ x chicks <sup>a</sup> :				Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)		Prop. nest sites w/ chicks (D/A) <sup>b</sup>		Chicks/nest start (E/A) <sup>b</sup>		Date(s) of max. nest count	Date(s) of max. chick count	Sampling design <sup>c</sup>
		1	2	3	4			Total	SD	Total	SD	Total	SD			
1997	53	4	6	6	0	16	34	2.1	xx <sup>d</sup>	0.30	0.06	0.6	xx <sup>d</sup>	N/A <sup>e</sup>	N/A	Simple random
2001	21	3	3	6	1	13	32	2.5	xx	0.62	0.11	1.5	xx	N/A	N/A	Simple random
2002	49	3	19	15	0	37	86	2.3	xx	0.76	0.06	1.8	xx	N/A	N/A	Simple random
2004	49	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	22 Jun	-	Simple random
2007	13	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	10 Jun	-	Simple random
2008	248	41	71	20	3	135	155	1.9	xx	0.54	0.03	0.6	xx	17 Jun	20 Aug	Simple random
2009	2	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	16 Jun	-	Simple random
2010 <sup>f</sup>	134	<i>individual nests monitored during 2010; see Table 91</i>							-	-	-	-	-	7 Jul	-	-
2011	32	1	3	3	0	7	16	2.3	xx	0.22	0.07	0.5	xx	21 Jun+1 Jul	26 Jul	Simple random
2013 <sup>f</sup>	13	<i>individual nests monitored during 2013; see Table 91</i>							-	-	-	-	-	1 Jul-5 Aug	-	-
2014	34	4	10	6	0	20	42	2.1	xx	0.59	0.08	1.2	xx	5 Jul	29 Aug	Simple random
2015	6	0	1	1	0	2	5	2.5	xx	0.33	0.19	0.8	xx	26 Jun	26 Aug	Simple random
2017	174	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	1 Jul	-	Simple random
2019	10	2	0	3	1	6	15	2.5	xx	0.60	0.15	1.5	xx	30 Jun	27 Jul	Simple random

<sup>a</sup>Numbers of chicks may represent a minimum count as not all may have been visible.

<sup>b</sup>Proportion 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.

<sup>c</sup>Sampling 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  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

<sup>d</sup>xx indicates data potentially exist but have not yet been summarized.

<sup>e</sup>N/A indicates data not available.

<sup>f</sup>Excluding counts of nest starts (A), remainder of reproductive performance data in 2010 and 2013 come from a subset of individual nests that were monitored frequently and may not be comparable with estimates of reproductive performance from Boom-or-Bust methodology; thus, these data are presented separately (see Table 91).

Table 91. Reproductive performance of red-faced cormorants at Aikta, Alaska. Measures of success are based on frequent monitoring of individual nests (as opposed to Boom-or-Bust methodology presented in Table 90). Most chicks were too young to fledge by the time of the last visit so fledgling numbers and productivity represent maximum estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in years not listed.

Year	Total nest starts	Nest sites w/ x chicks <sup>a</sup> :					Nest sites w/ chicks	Total chicks	Max. nest sites w/ chicks fledged	Max. total chicks fledged	Mean brood size (E/D)		Prop. nest sites w/ chicks (D/A)		Chicks/ nest start (E/A)		Max. fledglings/ nest start (Gmax/A)		Max. prod. (Fmax/A)		No. plots <sup>c</sup>	Sampling design <sup>d</sup>
	(A)	0	1	2	3	4	(D)	(E)	(Fmax) <sup>b</sup>	(Gmax) <sup>b</sup>	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD		
2010	82	29	8	24	20	1	53	120	41	75	2.3	xx <sup>e</sup>	0.65	0.05	1.5	xx	0.9	xx	0.50	0.06	-	Simple random
2013	9	3	2	1	3	0	6	13	5	12	2.2	xx	0.67	0.16	1.4	xx	1.3	xx	0.56	0.17	-	Simple random

<sup>a</sup>Numbers of chicks may represent a minimum count as not all may have been visible.

<sup>b</sup>All chicks that were present at last check and chicks that were huge when they disappeared were considered to be potentially fledged.

<sup>c</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>d</sup>Sampling for cormorants with individual nest monitoring 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  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

<sup>e</sup>xx indicates data potentially exist but have not yet been summarized.

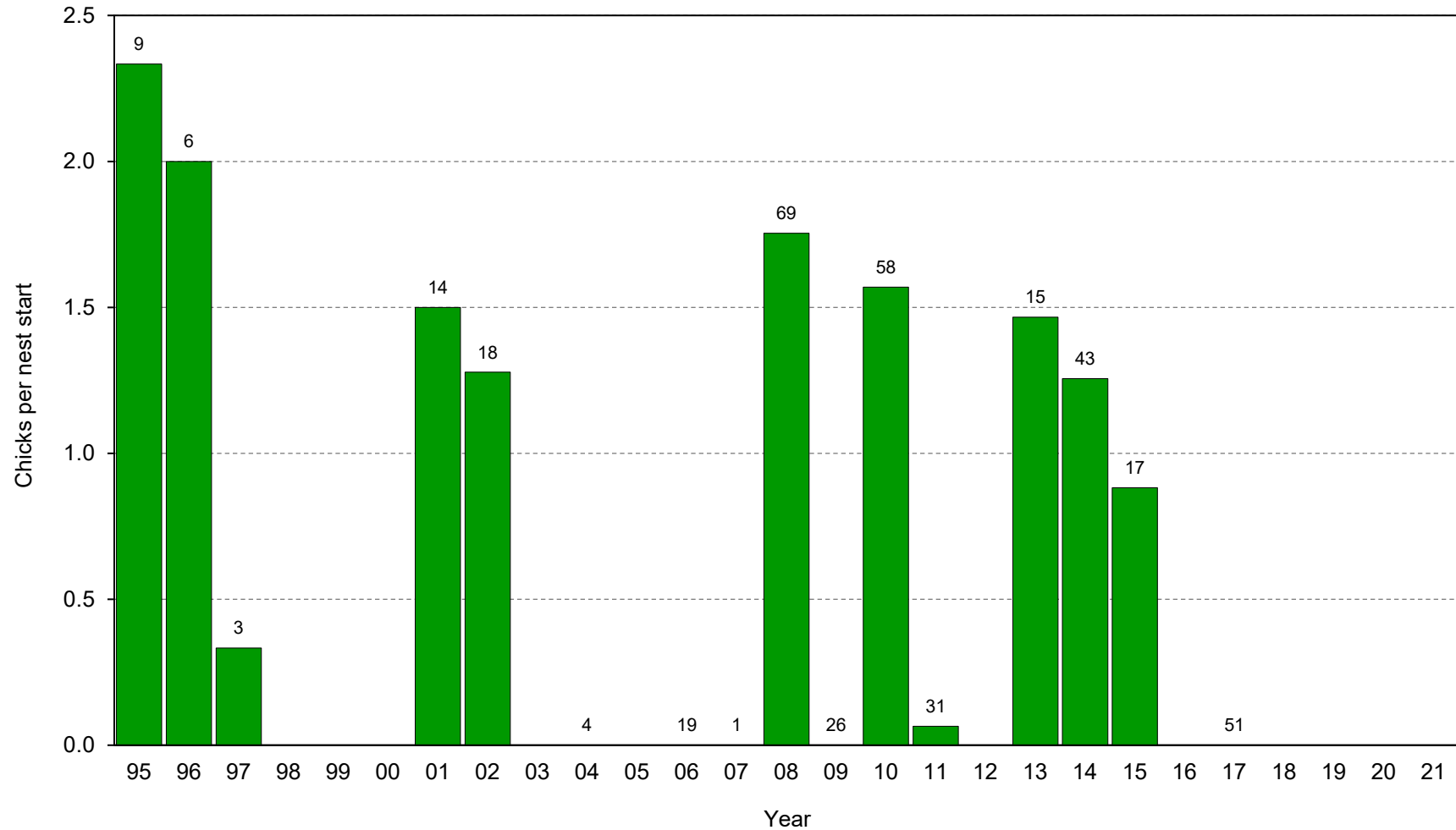


Figure 54. Reproductive performance of pelagic cormorants at Aiktak Island, Alaska. Success is measured by the number of chicks per nest start ( $E/A$ ), where  $E$ =total chicks and  $A$ =total nest starts (including those without chicks). Numbers above columns indicate sample sizes ( $A$ ). Data come from Boom-or-Bust methodology (1995-2009, 2011, and 2014-2021) and frequent monitoring of individual nests (2010 and 2013). Pelagic cormorants bred at Aiktak but no data were collected in 1998, 2000, 2003, or 2021; no nests were found in 1999, 2005, 2012, 2016, or 2018-2019. No data were collected and breeding status was unknown in 2020; in 2021 three nests (contents unknown) were found during a boat-based survey on 14 July.



Table 92. Reproductive performance of pelagic cormorants at Aikta 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. Pelagic cormorants bred at Aikta but no data were collected in 1998, 2000, 2003, or 2021; no nests were found in 1999, 2005, 2012, 2016, or 2018-2019. No data were collected and breeding status was unknown in 2020; in 2021 three nests (contents unknown) were found during a boat-based survey on 14 July.

Year	Total nest starts (A)	Nest sites w/ x chicks <sup>a</sup> :				Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)		Prop. nest sites w/ chicks (D/A) <sup>b</sup>		Chicks/nest start (E/A) <sup>b</sup>		Date(s) of max. nest count	Date(s) of max. chick count	Sampling design <sup>c</sup>
		1	2	3	4			Total	SD	Total	SD	Total	SD			
1995	9	N/A <sup>d</sup>	N/A	N/A	N/A	9	21	2.3	xx <sup>e</sup>	1.00	0.00	2.3	xx	N/A	N/A	Simple random
1996	6	N/A	N/A	N/A	N/A	5	12	2.4	xx	0.83	0.15	2.0	xx	N/A	N/A	Simple random
1997	3	1	0	0	0	1	1	1.0	xx	0.33	0.27	0.3	xx	N/A	N/A	Simple random
2001	14	4	4	3	0	11	21	1.9	xx	0.79	0.11	1.5	xx	N/A	N/A	Simple random
2002	18	2	6	3	0	11	23	2.1	xx	0.61	0.11	1.3	xx	N/A	N/A	Simple random
2004	4	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	22 Jun		Simple random
2006	19	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	17 Jul	-	Simple random
2007	1	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	10 Jun	-	Simple random
2008	69	10	31	15	1	57	121	2.1	xx	0.83	0.05	1.8	xx	22 Jul	20 Aug	Simple random
2009	26	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	16 Jun	-	Simple random
2010 <sup>f</sup>	64	<i>individual nests monitored during 2010; see Table 93</i>							-	-	-	-	-	27 Jun	-	-
2011	31	0	1	0	0	1	2	2.0	xx	0.03	0.03	0.1	xx	21 Jun+1 Jul	28 Jul	Simple random
2013 <sup>f</sup>	25	<i>individual nests monitored during 2013; see Table 93</i>							-	-	-	-	-	1 Jul-6 Aug	-	-
2014	43	5	9	0	1	24	54	2.3	xx	0.56	0.08	1.3	xx	5 Jul	29 Aug	Simple random
2015	17	2	5	1	0	8	15	1.9	xx	0.47	0.12	0.9	xx	26 Jun	26 Aug	Simple random
2017	51	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	1 Jul	-	Simple random

<sup>a</sup>Numbers of chicks may represent a minimum count as not all may have been visible.

<sup>b</sup>Proportion 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.

<sup>c</sup>Sampling 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  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

<sup>d</sup>N/A indicates data not available.

<sup>e</sup>xx indicates data potentially exist but have not yet been summarized.

<sup>f</sup>Excluding counts of nest starts (A), remainder of reproductive performance data in 2010 and 2013 come from a subset of individual nests that were monitored frequently and may not be comparable with estimates of reproductive performance from Boom-or-Bust methodology; thus, these data are presented separately (see Table 93).

Table 93. Reproductive performance of pelagic cormorants at Aiktak, Alaska. Measures of success are based on frequent monitoring of individual nests (as opposed to Boom-or-Bust methodology presented in Table 92). Most chicks were too young to fledge by the time of the last visit so fledgling numbers and productivity represent maximum estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in years not listed.

Year	Total nest starts	Nest sites w/ x chicks <sup>a</sup> :					Nest sites w/ chicks	Total chicks	Max. nest sites w/ chicks fledged	Max. total chicks fledged	Mean brood size (E/D)		Prop. nest sites w/ chicks (D/A)		Chicks/ nest start (E/A)		Max. fledglings/ nest start (Gmax/A)		Max. prod. (Fmax/A)		No. plots <sup>c</sup>	Sampling design <sup>d</sup>
		(A)	0	1	2	3	4	(D)	(E)	(Fmax) <sup>b</sup>	(Gmax) <sup>b</sup>	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD	
2010	58	16	8	20	13	1	42	91	39	85	2.2	xx <sup>e</sup>	0.72	0.06	1.6	xx	1.5	xx	0.67	0.06	-	Simple random
2013	15	4	1	9	1	0	11	22	9	18	2.0	xx	0.73	0.11	1.5	xx	1.2	xx	0.60	0.13	-	Simple random

<sup>a</sup>Numbers of chicks may represent a minimum count as not all may have been visible.

<sup>b</sup>All chicks that were present at last check and chicks that were huge when they disappeared were considered to be potentially fledged.

<sup>c</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>d</sup>Sampling for cormorants with individual nest monitoring 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  $\sqrt{p * (1 - p)/n}$ , where  $p$  is the success rate and  $n$  is the sample size of individual nests.

<sup>e</sup>xx indicates data potentially exist but have not yet been summarized.

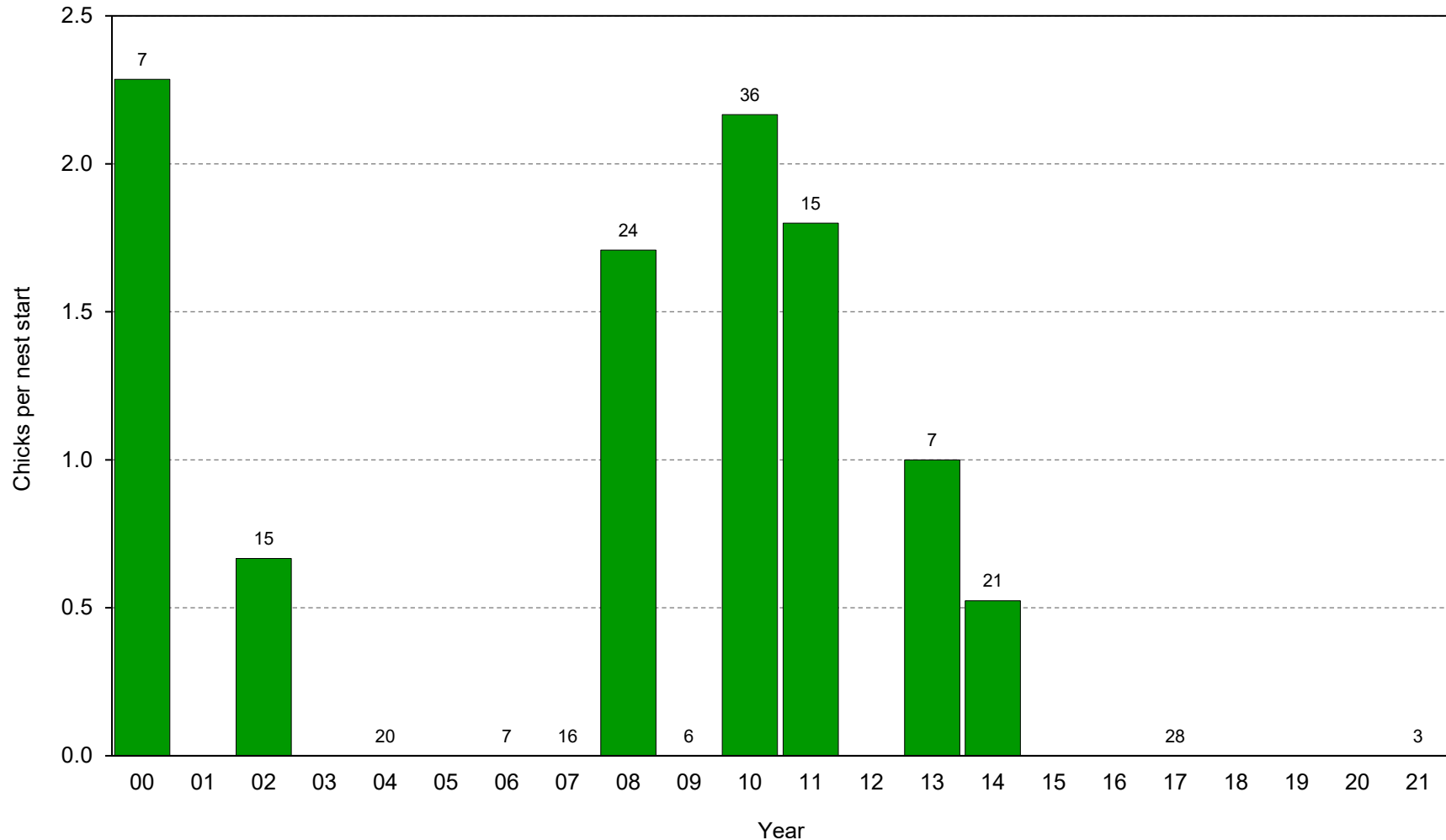


Figure 55. Reproductive performance of double-crested cormorants at Aiktak Island, Alaska. Success is measured by the number of chicks per nest start ( $E/A$ ), where  $E$ =total chicks and  $A$ =total nest starts (including those without chicks). Numbers above columns indicate sample sizes ( $A$ ). Data come from Boom-or-Bust methodology (2000-2009, 2011, 2014-2021) and frequent monitoring of individual nests (2010 and 2013). Double-crested cormorants bred at Aiktak but no data were collected in 1995-1998 or 2003; no nests were found in 1999, 2001, 2005, 2012, 2015-2016, or 2018-2019. No data were collected and breeding status was unknown in 2020.

Table 94. Reproductive performance of double-crested cormorants at Aiktak 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. Double-crested cormorants bred at Aiktak but no data were collected in 1995-1998 or 2003; no nests were found in 1999, 2001, 2005, 2012, 2015-2016, or 2018-2019. No data were collected and breeding status was unknown in 2020.

Year	Total nest starts (A)	Nest sites w/ x chicks <sup>a</sup> :				Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)		Prop. nest sites w/ chicks (D/A) <sup>b</sup>		Chicks/nest start (E/A) <sup>b</sup>		Date(s) of max. nest count	Date(s) of max. chick count	Sampling design <sup>c</sup>
		1	2	3	4			Total	SD	Total	SD	Total	SD			
2000	7	2	2	2	1	7	16	2.3	xx <sup>d</sup>	1.00	0.00	2.3	xx	20 Aug	20 Aug	Simple random
2002	15	2	4	0	0	6	10	1.7	xx	0.40	0.13	0.7	xx	N/A <sup>e</sup>	N/A	Simple random
2004	20	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	22 Jun	-	Simple random
2006	7	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	11 Jul	-	Simple random
2007	16	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	10 Jun	-	Simple random
2008	24	4	5	9	0	18	41	2.3	xx	0.75	0.09	1.7	xx	17 Jun	20 Aug	Simple random
2009	6	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	16 Jun	-	Simple random
2010 <sup>f</sup>	40	individual nests monitored during 2010; see Table 96							-	-	-	-	-	18 Jun	-	Simple random
2011	15	2	6	3	1	12	27	2.3	xx	0.80	0.10	1.8	xx	21 Jun	5 Aug	Simple random
2013 <sup>f</sup>	7	individual nests monitored during 2013; see Table 96							-	-	-	-	-	1-27 Jul	-	Simple random
2014	21	0	4	0	1	5	11	2.2	xx	0.24	0.09	0.5	xx	5 Jul	29 Aug	Simple random
2017	28	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	1 Jul	-	Simple random
2021	3	0	0	0	0	0	0	0.0	xx	0.00	0.00	0.0	xx	5 Jun	4 Aug	Simple random

<sup>a</sup>Numbers of chicks may represent a minimum count as not all may have been visible.

<sup>b</sup>Proportion 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.

<sup>c</sup>Sampling 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  $\rho$  is the success rate and  $n$  is the sample size of individual nests.

<sup>d</sup>xx indicates data potentially exist but have not yet been summarized.

<sup>e</sup>N/A indicates data not available.

<sup>f</sup>Excluding counts of nest starts (A), remainder of reproductive performance data in 2010 and 2013 come from a subset of individual nests that were monitored frequently and may not be comparable with estimates of reproductive performance from Boom-or-Bust methodology; thus, these data are presented separately (see Table 96).

Table 95. Reproductive performance of double-crested cormorants at Aiktak Island, Alaska in 2021 as determined by a Boom or Bust methodology.

Date	Total nest starts (A)	Nest sites w/ x chicks <sup>a</sup> :				Nest sites w/ chicks (D)	Total chicks (E)
		1	2	3	4		
5 Jun	3	-	-	-	-	-	-
18 Jun	3	-	-	-	-	-	-
4 Aug	-	0	0	0	0	0	0

<sup>a</sup>Numbers of chicks may represent a minimum count as not all may have been visible.

Table 96. Reproductive performance of double-crested cormorants at Aiktak, Alaska. Measures of success are based on frequent monitoring of individual nests (as opposed to Boom-or-Bust methodology presented in Table 94). Most chicks were too young to fledge by the time of the last visit so fledgling numbers and productivity represent maximum estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in years not listed.

Year	Total nest starts	Nest sites w/ x chicks <sup>a</sup> :					Nest sites w/ chicks	Total chicks	Max. nest sites w/ chicks fledged	Max. total chicks fledged	Mean brood size (E/D)		Prop. nest sites w/ chicks (D/A)		Chicks/ nest start (E/A)		Max. fledglings/ nest start (Gmax/A)		Max. prod. (Fmax/A)		No. plots <sup>c</sup>	Sampling design <sup>d</sup>
	(A)	0	1	2	3	4	(D)	(E)	(Fmax) <sup>b</sup>	(Gmax) <sup>b</sup>	Total	SD	Total	SD	Total	SD	Total	SD	Total	SD		
2010	36	6	2	10	16	2	30	78	26	65	2.6	xx <sup>e</sup>	0.83	0.06	2.2	xx	1.8	xx	0.72	0.07	-	Simple random
2013	7	4	1	0	2	0	3	7	3	7	2.3	xx	0.43	0.19	1.0	xx	1.0	xx	0.43	0.19	-	Simple random

<sup>a</sup>Numbers of chicks may represent a minimum count as not all may have been visible.

<sup>b</sup>All chicks that were present at last check and chicks that were huge when they disappeared were considered to be potentially fledged.

<sup>c</sup>Plots that are combined for analysis are counted as a single "plot".

<sup>d</sup>Sampling for cormorants with individual nest monitoring 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  $\sqrt{p * (1 - p) / n}$ , where  $p$  is the success rate and  $n$  is the sample size of individual nests.

<sup>e</sup>xx indicates data potentially exist but have not yet been summarized.

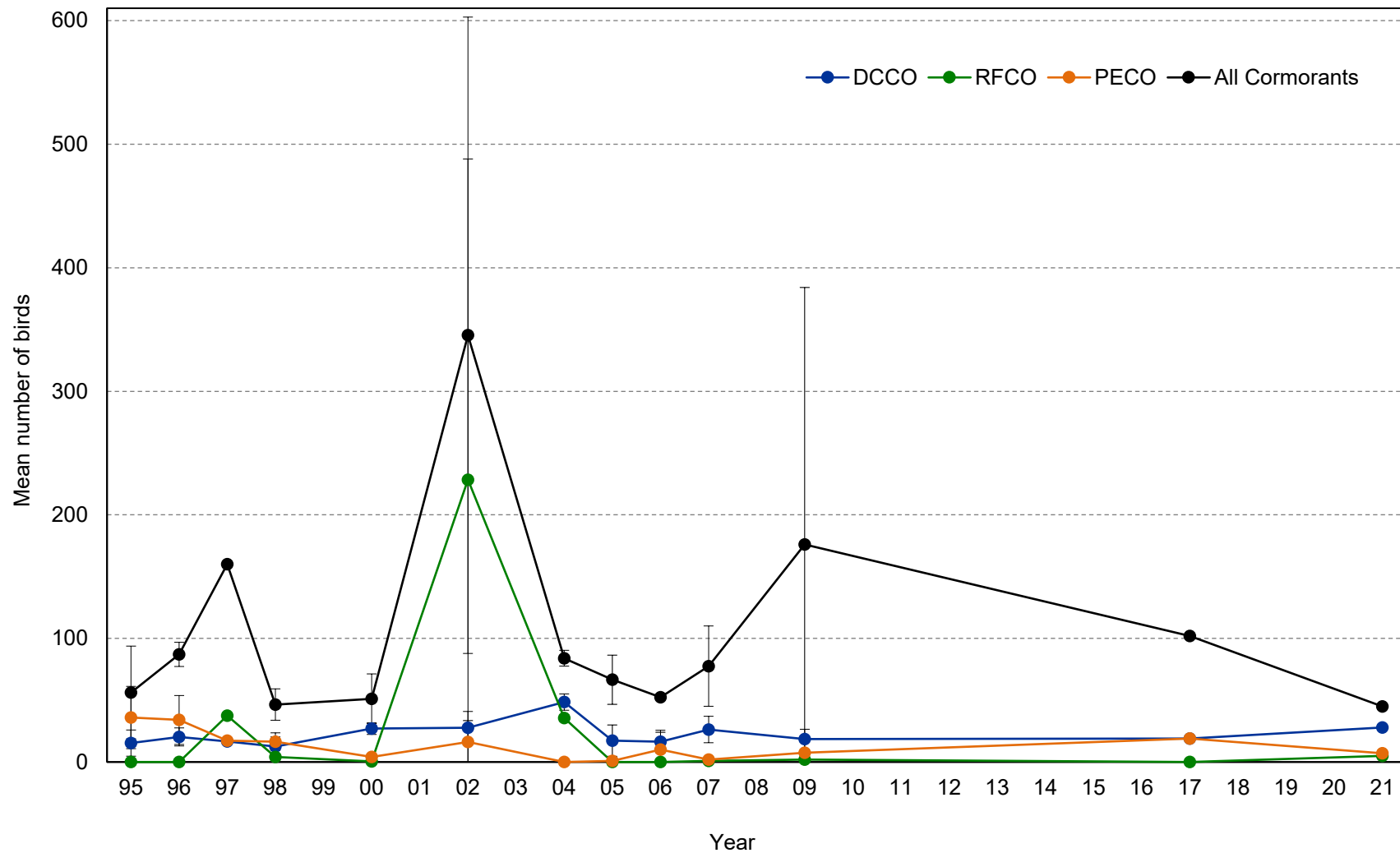


Figure 56. Mean numbers of cormorants counted during circumnavigation surveys at Aiktak Island, Alaska. Values come from general circumnavigation data (Table 97). Error bars represent standard deviation. No circumnavigation surveys were conducted in 1999, 2001, 2003, 2008, 2010-2016, or 2018-2020.

Table 97. Mean numbers of birds and marine mammals counted during circumnavigation surveys at Aiktak Island, Alaska. No circumnavigation surveys were conducted in 1999, 2001, 2003, 2008, 2010-2016, or 2018-2020.

Species	1995	1996	1997	1998	2000	2002	2004	2005	2006	2007	2009	2017	2021
Green-winged teal	1	3	0	1	3	11	25	2	4	1	9	0	0
Harlequin duck	12	25	8	48	3	4	3	15	21	13	9	24	13
Black oystercatcher	31	28	20	23	29	24	28	25	91	41	44	5	27
Rock sandpiper	0	0	0	0	0	0	0	<1	0	0	0	0	0
Murre (both species)	4989	5898	6398	4414	2913	602	1766	2698	2856	3097	2235 <sup>a</sup>	312	4026
Pigeon guillemot	39	35	34	33	28	9	4	16	12	13	4	34	16
Ancient murrelet	0	0	0	0	0	0	0	0	0	0	1	0	0
Parakeet auklet	0	0	0	0	<1	0	0	0	0	0	1	0	0
Whiskered auklet	<1	0	0	0	0	0	0	0	0	0	0	0	0
Horned puffin	92	91	73	52	114	91	40	141	192	195	93	81	16
Tufted puffin	NC <sup>b</sup>	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	12,520	NC
Black-legged kittiwake	0	0	0	0	0	0	0	0	0	0	0	19	0
Glaucous-winged gull	1670	1168	1175	NC	823	409	877	NC <sup>b</sup>	NC	NC	NC	375	NC
Northern fulmar	0	0	0	0	<1	0	0	0	0	0	0	3	0
Short-tailed shearwater	0	0	0	0	0	0	0	0	0	<1	0	0	0
Unid. shearwater	0	0	6	0	0	0	0	<1	1	0	0	0	0
Cormorant (all species)	56	87	160	47	51	345	84	67	53	78	176	102	0
Red-faced cormorant	0	0	38	4	<1	229	36	0	0	1	2	0	5
Pelagic cormorant	36	34	17	17	4	16	0	1	10	2	8	19	7
Double-crested cormorant	15	20	17	13	27	28	49	17	17	26	19	19	28
Unid. cormorant	5	33	89	14	20	73	0	48	26	48	149	64	5
Bald eagle	7	5	6	10	5	12	16	5	4	8	6	8	12
Peregrine falcon	0	0	1	2	1	1	4	0	0	1	2	1	1
Common raven	4	2	3	10	4	14	13	7	2	9	4	7	5
Sea otter	<1	0	0	0	0	0	<1	1	0	0	1	0	0
Steller sea lion	35	3	4	1	5	47	66	62	109	106	95	7	49
Harbor seal	31	29	29	28	27	23	10	21	23	42	39	17	12
<i>n</i>	3	4	3	2	5	4	4	3	2	3	2	1	1
Survey dates	25 Jun- 5 Aug	21 Jul- 15 Aug	23 Jul- 9 Aug	27 Jul- 3 Aug	9 Jul- 11 Aug	26 May- 18 Jul	22 Jul- 10 Aug	22 Jul- 14 Aug	21 Jul- 27 Aug	22 Jul- 20 Aug	25 Jul- 15 Aug	6 Aug	14 Jul

<sup>a</sup>In 2009, murre counts are birds observed on cliffs and not those rafting below in water.

<sup>b</sup>Tufted puffins (between 1995 and 2009) and glaucous-winged gulls (between 2005 and 2009) were not counted during circumnavigation surveys due to their abundance.



Table 98. Numbers of birds detected during off-road point count survey<sup>a</sup> at Ugamak Island, Alaska. Data represent only individuals observed from survey points and do not include birds flying over census area; asterisks indicate species observed between points along the route but not at actual survey points. No point count surveys were conducted in 1999 or after 2009.

Species	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Green-winged teal	3	0	0	3	9	0	0	0*	2	1	0*	0
Harlequin duck	0	0	0	0	0	0	0	0	0	0	0	1
Common goldeneye	0	0	0	0	1	0	0	0	0	0	0	0
Rock ptarmigan	0*	1	1	2	3	5	5	6	10	4	2	6
Black oystercatcher	1	0	0	0	0	1	0	0	0	0*	0	0
Rock sandpiper	0*	2	1	8	2	1	6	4	5	1	9	13
Least sandpiper	0	0	0	0	0	0	0	0	0	0	0	1
Tufted puffin	0	0	0	0	0	0	0	0	0	4	0	0
Glaucous-winged gull	10	0	23	0	4	1	0	1	0	6	4	2
Double-crested cormorant	0	0	0	0	2	0	0	1	0	0	0	0
Bald eagle	1	0	0*	0	12	0	0	2	2	4	3	0
Rough-legged hawk	0	0	0	0	0	0	0	0	0	0*	1	1
Short-eared owl	2	0*	0	0	0	0	1	1	2	0*	0*	0
Peregrine falcon	0	0	0	0	0	0	0	0*	0*	1	0	0
Common raven	1	1	1	0	1	0	0	1	0	1	4	1
Bank swallow	0	0	0	0	0	3	3	0	1	0	0	0
Pacific wren	3	3	0	5	8	12	1	2	7	1	11	8
American pipit	0	0	0	0	0	0	0	2	0*	9	4	3
Gray-crowned rosy-finch	1	4	0	4	5	2	3	12	4	0*	4	5
Lapland longspur	7	5	5	15	6	22	9	3	2	9	18	9
Snow bunting	5	2	0*	1	1	0	0	1	2	0*	0*	1
Fox sparrow	0	0	0	0	0	0	0	0	0	0	1	0
Savannah sparrow	19	33	8	24	10	14	14	25	33	32	26	22
Song sparrow	5	8	17	8	24	23	19	9	1	12	11	3
Date	4 Jun	14 Jun	16 Jun	18 Jun	4 Jun	4 Jun	9 Jun	22 Jun	11 Jun	12 Jun	10 Jun	13 Jun
Survey design <sup>b</sup>	xx <sup>c</sup>	xx	xx	xx	xx	xx	xx	xx	xx	xx	B	B

<sup>a</sup>Route established 8 September 1996.

<sup>b</sup>A=5-minute counts, < and > 50m; B=5-minute counts, distance estimation out to 400m.

<sup>c</sup>xx indicates data potentially exist but have not yet been summarized.

Table 99. Mean numbers of birds detected on beach transect surveys along Old Camp Beach, Aiktak Island, Alaska. Data represent species' presence but not necessarily absence in all years. No counts were conducted in 2000 or 2020.

Species	96	97	98	99	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	21	
Black oystercatcher	7	7	9	9	0	5	4	8	6	6	6	6	4	5	6	6	4	8	5	5	6	7	6	2	
Rock sandpiper	0	0	0	0	0	1	0	<1	0	0	0	0	<1	<1	0	0	0	0	0	0	0	0	0	0	
Least sandpiper	xx <sup>b</sup>	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	<1	0	0	
Spottted sandpiper	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	<1	0	
Wandering tattler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	
Bald eagle	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	1	1	<1
Common raven	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	<1	0	0	
Pacific wren	3	4	0	1	2	2	3	4	2	1	1	3	2	<1	<1	7	1	6	3	2	0	1	2	2	
Gray-crowned rosy finch	0	2	0	0	0	<1	0	3	1	<1	0	0	<1	0	0	0	0	1	1	0	<1	2	1	1	
Savannah sparrow	4	3	N/A <sup>a</sup>	2	1	1	4	5	N/A	2	6	8	3	<1	0	5	1	3	0	0	1	1	<1	2	
Song sparrow	6	7	5	5	9	4	9	7	12	12	8	10	7	7	10	12	5	10	11	12	12	9	11	8	
<i>n</i>	5	5	5	4	1	5	6	5	3	4	5	5	6	5	5	5	6	5	5	5	5	5	5	5	
First survey	21 Jun	1 Jun	11 Jun	8 Jun	7 Jun	2 Jun	26 May	30 May	6 Jun	1 Jun	1 Jun	1 Jun	4 Jun	3 Jun	3 Jun	6 Jun	7 Jun	8 Jun	6 Jun	4 Jun	2 Jun	1 Jun	2 Jun	2 Jun	
Last survey	10 Jul	10 Jun	20 Jun	18 Jun	- Jun	13 Jun	13 Jun	12 Jun	12 Jun	14 Jun	14 Jun	14 Jun	14 Jun	11 Jun	9 Jun	13 Jun	15 Jun	13 Jun	13 Jun	8 Jun	9 Jun	8 Jun	9 Jun	7 Jun	

<sup>a</sup>N/A indicates species was not counted during surveys, so presence is unknown.

<sup>b</sup>xx indicates data potentially exist but have not yet been summarized.

Table 100. Numbers of birds detected on beach transect surveys along Old Camp Beach, Aikta Island, Alaska in 2021.

Species	Date					Mean	SD
	2 Jun	3 Jun	4 Jun	6 Jun	7 Jun		
Black oystercatcher	0	1	5	2	4	2	2
Rock sandpiper	0	0	0	0	0	-	-
Least sandpiper	0	0	0	0	0	-	-
Spotted sandpiper	0	0	0	0	0	-	-
Wandering tattler	0	0	0	0	0	-	-
Bald eagle	0	0	0	1	0	<1	<1
Common raven	0	0	0	0	0	-	-
Pacific wren	2	3	2	2	1	2	1
Gray-crowned rosy finch	0	0	1	2	2	1	1
Savannah sparrow	0	4	2	2	1	2	1
Song sparrow	10	6	8	6	9	8	2
Start time (ALDT) <sup>a</sup>	0756	0823	0833	0753	0723	-	-
End time (ALDT) <sup>a</sup>	0823	0849	0859	0817	0758	-	-

<sup>a</sup>Times are Aleutian Daylight Time (-1 hr from Alaska Daylight Time).

Table 101. Mean numbers of individuals found and encounter rates during COASST surveys along Old Camp-New Camp Beach, Aiktak 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 (1.3 km for Old Camp-New Camp Beach) divided by the number of surveys. No data were collected in 2020.

Species	2006		2007		2008		2009		2010		2011		2012		2013	
	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate
Black oystercatcher	-	-	-	-	-	-	0.1	0.3	-	-	-	-	-	-	-	-
Common murre	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	-	-	-
Unidentified murre	-	-	-	-	-	-	-	-	-	-	0.3	0.4	-	-	-	-
Ancient murrelet	-	-	-	-	-	-	-	-	0.1	0.1	-	-	-	-	-	-
Cassin's auklet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Horned puffin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tufted puffin	0.1	0.1	0.6	0.4	0.1	0.1	0.1	0.1	0.3	0.4	0.1	0.1	-	-	-	-
Unidentified puffin	-	-	0.3	0.3	0.1	0.1	-	-	-	-	-	-	-	-	-	-
Glaucous-winged gull	-	-	-	-	-	-	0.1	0.1	-	-	-	-	0.3	0.3	-	-
Fork-tailed storm-petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern fulmar	-	-	-	-	-	-	0.1	0.2	-	-	-	-	-	-	-	-
Short-tailed shearwater	0.1	0.2	-	-	-	-	0.1	0.1	-	-	-	-	-	-	-	-
Unidentified shearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pelagic cormorant	-	-	0.1	0.5	-	-	-	-	-	-	-	-	-	-	-	-
Bald eagle	-	-	0.1	0.1	-	-	-	-	-	-	-	-	-	-	0.4	1.1
Unidentified bird	-	-	-	-	0.1	0.4	-	-	-	-	-	-	-	-	-	-
All species	0.2	0.3	1.1	1.4	0.4	0.7	0.7	0.9	0.4	0.5	0.5	0.6	0.3	0.3	0.4	1.1
<i>n</i>	17		7		7		7		9		8		8		7	
First survey	17 May		2 Jun		28 May		29 May		22 May		27 May		25 May		1 Jun	
Last survey	30 Aug		24 Aug		20 Aug		26 Aug		28 Aug		3 Sep		2 Sep		29 Aug	

Table 101 (continued). Mean numbers of individuals found and encounter rates during COASST surveys along Old Camp-New Camp Beach, Aiktak 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 (1.3 km for Old Camp-New Camp Beach) divided by the number of surveys. No data were collected in 2020.

Species	2014		2015		2016		2017		2018		2019		2021	
	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate
Black oystercatcher	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	-
Common murre	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified murre	-	-	0.2	0.6	0.3	1.3	-	-	-	-	-	-	-	-
Ancient murrelet	-	-	-	-	0.4	0.8	-	-	-	-	-	-	0.4	0.8
Cassin's auklet	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1
Horned puffin	-	-	0.2	0.1	0.1	0.2	-	-	-	-	-	-	-	-
Tufted puffin	0.1	0.1	0.5	0.9	0.6	0.4	-	-	0.3	0.2	0.1	0.3	0.3	0.8
Unidentified puffin	-	-	0.3	0.8	0.4	1.1	-	-	0.3	0.2	0.1	0.6	0.6	0.9
Glaucous-winged gull	-	-	0.3	0.9	0.1	0.7	0.3	0.2	0.1	0.1	0.7	0.6	-	-
Fork-tailed storm-petrel	-	-	-	-	-	-	-	-	-	-	0.1	0.5	-	-
Northern fulmar	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Short-tailed shearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified shearwater	-	-	-	-	-	-	-	-	-	-	0.2	0.1	-	-
Pelagic cormorant	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bald eagle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified bird	0.3	0.2	-	-	-	-	-	-	-	-	-	-	0.1	0.1
All species	0.5	0.4	1.5	3.3	2.0	4.5	0.3	0.2	0.7	0.5	1.4	2.3	1.6	2.6
<i>n</i>	8		6		7		7		7		6		7	
First survey	27 May		18 Jun		28 May		28 May		1 Jun		11 Jun		23 May	
Last survey	26 Aug		28 Aug		21 Aug		19 Aug		23 Aug		17 Aug		15 Aug	

Table 102. Mean numbers of individuals found and encounter rates during COASST surveys along Petrel Cove, Aiktak 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 Petrel Cove) divided by the number of surveys. No surveys were conducted in 2008-2009 or after 2010.

Species	2006		2007		2010	
	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate	Mean # ind.	Enc. rate
Ancient murrelet	-	-	0.1	1.0	0.1	1.4
Tufted puffin	-	-	-	-	0.1	1.4
Unidentified puffin	-	-	0.1	2.0	0.1	1.4
Unidentified gull	-	-	-	-	0.1	1.4
Northern fulmar	-	-	0.1	2.0	-	-
Unidentified bird	0.1	4.0	-	-	-	-
All species	0.1	4.0	0.3	5.0	0.6	5.7
<i>n</i>	10		10		7	
First survey	18 May		2 Jun		22 May	
Last survey	2 Sep		2 Sep		27 Aug	

Table 103. Numbers of birds encountered on COASST surveys along Old Camp-New Camp Beach, Aiktak 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 <sup>a</sup>			Encounters <sup>b</sup>	
	23 May		6 Jun		20 Jun		4 Jul		18 Jul		1 Aug		15 Aug		Total	Mean	SD	Total	Enc. rate <sup>c</sup>
Ancient murrelet	0	(0)	1	(0)	0	(0)	0	(0)	2	(0)	0	(2)	0	(2)	3	0.4	0.8	7	0.8
Cassin's auklet	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	1	(0)	0	(0)	1	0.1	0.4	1	0.1
Tufted puffin	0	(0)	0	(0)	0	(0)	1	(0)	0	(1)	1	(2)	0	(2)	2	0.3	0.5	7	0.8
Unidentified puffin	0	(0)	1	(0)	0	(0)	1	(0)	1	(1)	1	(1)	0	(2)	4	0.6	0.5	8	0.9
Unidentified bird	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	1	(0)	0	(0)	1	0.1	0.4	1	0.1
Total new individuals	0		2		0		2		3		4		0		11	1.6	1.6	-	-
Total encounters	0		2		0		2		5		9		6		-	-	-	24	2.6

<sup>a</sup>Individuals represent new birds seen on surveys only and do not include birds still present and re-encountered on surveys.

<sup>b</sup>Encounters represent all birds seen on surveys, including both new individuals and all instances of re-encountered birds.

<sup>c</sup>Encounter rate = number of birds encountered / km beach surveyed (1.3 km for Old Camp-New Camp Beach) / number of surveys.

Abundance categories are 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 of 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 probable** (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 based on multiple years of observations and should not change based on deviations in a single year.

## BIRDS

**Emperor goose** (*Anser canagicus*). Uncommon migrant. A group was observed between 27 August and 29 August in the intertidal zone of Guillemot Rock and Upland Access. The maximum number of individuals observed in the group was 11; it was uncertain if any of these birds had bands.

**Aleutian cackling goose** (*Branta hutchinsii leucopareia*). Uncommon migrant. Groups were observed on five days between 24 May and 4 June, most often in the air around Gull Mountain. The largest group observed was made up of 50 individuals.

**American wigeon** (*Mareca americana*). Accidental migrant. One male-female pair was observed on 4 June and 6 June offshore of New Camp Beach. This is the second known record for Aiktak (last observed 2007).

**Mallard** (*Anas platyrhynchos*). Irregular migrant. Individuals, pairs, and/or groups were observed on 14 days between 23 May and 28 August in intertidal zones on the north side of the island, most commonly along New Camp Beach.

**Northern pintail** (*Anas acuta*). Irregular migrant. Individuals and/or groups were observed on seven days between 23 May and 29 May offshore of New Camp Beach. A maximum of two birds were observed.

**Green-winged teal** (*Anas crecca*). Common breeder. Individuals and/or groups were observed between 23 May and 14 August. A maximum of 30-45 individuals was observed from New Camp Beach to Sea Lion Cove on 26 May. Individuals were most commonly observed in the intertidal zone of New Camp Beach. The first ducklings were observed on 26 May in Petrel Valley; the maximum number of ducklings observed in a day was 14 (for two broods). Broods of small ducklings were observed from 26 May to 1 August, the largest was comprised of eight ducklings.



**Harlequin duck** (*Histrionicus histrionicus*). Common resident non-breeder. Individuals and/or groups were observed on 45 days between 23 May and 28 August (maximum of 21 individuals). Groups were most commonly observed on the water at Pleasure Cove, Little West, New Camp Beach, Upland Access, and Sea Lion Cove.

**Black scoter** (*Melanitta americana*). Irregular migrant. One individual was observed on 31 May offshore of Sea Lion Cove.

**Common merganser** (*Mergus merganser*). Casual migrant. A male-female pair was observed on 24 June and 6 July, on the water (ocean), at New Camp Beach.

**Red-breasted merganser** (*Mergus serrator*). Rare migrant. Individuals, pairs, and/or groups were observed on six days between 3 June and 24 July. A maximum of three individuals (one male and two unknown sex) were observed as a group offshore of New Camp Beach.

**Black oystercatcher** (*Haematopus bachmani*). Common breeder. Individuals and/or groups were observed between 23 May and 23 August; birds were most commonly observed at beaches and coves on the north side of the island. Overall in 2021 black oystercatcher nesting was earlier than average and reproductive success was below average. Upon our arrival on 23 May we observed evidence that a high water event may have occurred relatively recently, which we suspect explained the lack of usual nests used for productivity and chronology. There were three weather events during the season that directly impacted active oystercatcher nests through heavy rainfall and/or over washing from storm-surge. On 27 May a group of 12 individuals was observed on Old Camp Beach, possibly made up in part of breeding birds that failed early in the season (prior to our arrival); similar groups were seen throughout the season. Petrel Valley Cove contained two oystercatcher territories: one on the east end and one on the west end (both failed). The Spire contained an oystercatcher territory and likely an active nest, but this was never confirmed (this may have been a territory in past seasons too).

**Semipalmated plover** (*Charadrius semipalmatus*). Irregular migrant. Individuals and/or groups were observed on three days between 29 May and 3 June. A maximum of two birds were observed at Sea Lion Cove on 3 June.

**Ruddy turnstone** (*Arenaria interpres*). Rare migrant. Individuals and/or groups were observed on three days between 26 May and 19 July at New Camp Beach, Ivory Cove, and Little West. A maximum of six individuals was observed on 26 May.

**Rock sandpiper** (*Calidris ptilocnemis*). Uncommon migrant. Individuals and/or groups were observed on three days between 4 July and 12 August. A maximum of two individuals was observed on 4 July in the intertidal zone by Guillemot Rock.

**Least sandpiper** (*Calidris minutilla*). Uncommon possible breeder. Individuals were observed on 8 days between 29 May and 7 August on New Camp Beach (maximum of one individual).

**Wandering tattler** (*Tringa incana*). Uncommon migrant. One individual was observed on 26 May in Ivory Cove.

**Common and thick-billed murre** (*Uria aalge* and *U. lomvia*). Abundant breeders. Individuals and/or groups observed between 26 May and 25 August on cliff faces and in waters on the south side of the island including Sail Rock (Population Plot 5). Significantly larger numbers of murres were present on Aiktak in

2021 compared to recent years with reproductive success above average for both common and thick-billed murres. Land-based population counts for murres were the highest recorded since 1997 and the boat-based count during the circumnavigation survey on 14 July was the highest since 1998. The absence of the usual bald eagle nest atop The Fin (below Pole 89) in 2021 (and 2019) may have contributed to the increased attendance, nest initiation, and reproductive success of thick-billed murres on Sail Rock and adjacent cliff faces. Subplot A, on Sail Rock, an area where common murre productivity typically conducted, was completely empty in 2021, which was the first time we have seen this; outside of Subplot 5, common murres were in their normal areas. Thick-billed murres were observed standing on cliffs east of Pole 51 and The Fin (Population Plot 10), these areas are typically devoid of murres.

**Pigeon guillemot** (*Cepphus columba*). Common breeder. Individuals were observed between 11 June and 26 June (but birds were likely present all season long), most commonly in the kelp forests along the north side of the island.

**Ancient murrelet** (*Synthliboramphus antiquus*). Abundant breeder. Individuals were observed between 23 May and 18 July, most commonly at New Camp Beach, Upland Access, and around the cabin. Ancient murrelets had the earliest mean recorded hatch in 2021 of all years recorded for Aiktaak and reproductive success was above average. In 2021, we did not follow all previously marked murrelet burrows; specifically 67 burrows not occupied in the last six years, of poor quality, or in fragile areas were not visited or visited sporadically. These burrows remain on nest site maps and still have past years flags. A new source of burrows to monitor was found in the low bluffs adjacent to Old Camp Beach (54.18508° N 164.84598° W), more burrows could likely be found here. One of the five remaining Global Location Sensing (GLS) loggers deployed on birds during the 2018 field season was recovered this season; the remaining four birds with loggers were not detected. Three of the remaining four burrows, where a bird was tagged in 2018, had non-tagged birds present. A previously tagged bird was detected in one of the four remaining burrows for one check; the bird was not removed to read the band. It's possible this bird had a tag and lost it, but more likely this was a previously tagged bird from a nearby burrow. Between 4 July and 8 July four living and three dead adult birds (assumed breeding) were found at New Camp Beach, Cabin, and the Petrel Valley and Two-Crik drainages. Two dead birds found on New Camp Beach were predated or scavenged. Live birds were generally skinny (had prominent keels), lethargic, and wet; the one intact dead bird was also skinny. Live birds not already on New Camp Beach were captured and released there.

**Cassin's auklet** (*Ptychoramphus aleutica*). Irregular breeder. A fully feathered chick (little down) was observed in a burrow at Little West on 6 July; this burrow has been used by the species in previous seasons. Many medium sized burrows (fist-sized) were found at Little West, these were assumed to belong to Cassin's auklets. On 1 August a dead individual (unknown age) was found at Pleasure Point during a COASST survey.

**Horned puffin** (*Fratercula corniculata*). Abundant breeder. Individuals and/or groups observed between 26 May and 28 August, most commonly rafting off Petrel Valley Cove and the south side of Big West. On Aiktaak this species only nests in crevices. In 2021, horned puffins exhibited earlier than average hatch dates and reproductive success was above average. We painted nest numbers for 22 crevices, 18 in Petrel Valley Cove and four in Pleasure Cove. Others not occupied in 2021 and 2015-2019 were not maintained this season as these crevices were deemed poor quality and not worth repainting (although these crevices remain on nest site maps and still have what remains of old marking paint).

**Tufted puffin** (*Fratercula cirrhata*). Abundant breeder. Individuals and/or groups were observed on most days (1000's present on big days). In 2021, tufted puffin breeding was late but reproductive success was above average. Chick growth was higher than the long term mean. Colony attendance was highest in

August with many birds standing in colony areas around island during this time. Diet samples were collected by screening 25-100 burrows at a time during 11 sampling bouts from 10 August to 27 August along the cliff from the top of Raven's Gulch (54.18136° N 164.84430° W) heading west and the top of Petrel Valley Cove (54.182114° N 164.838714° W). Between 23 June and 26 August, we found 29 downed birds in island drainages and trails and subsequently captured and released them in colonies or on beaches; seven dead birds were found in the same locations. Nineteen breeding birds, with chicks about 14-days old, were tagged with Global Location Sensing (GLS) loggers. At last check, just prior to departure from the island, all chicks from burrows with tagged adults were still alive. Lastly, on a couple occasions in July, tufted puffins were observed standing on slopes on Ugamak Island, across from the Aiktak Cabin; we suspect they are breeding in that location (tufted puffins are documented breeders on Ugamak).

**Black-legged kittiwake** (*Rissa tridactyla*). Irregular resident non-breeder. A group was observed flying by New Camp Beach on 16 July and one bird was observed foraging in the intertidal zone of New Camp Beach on 28 August.

**Glaucous-winged gull** (*Larus glaucescens*). Abundant breeder. Individuals and/or groups were observed on most days. In 2021, glaucous-winged gull breeding was late with average reproductive success. A few birds made nesting attempts on cliffs in 2021 on the east side of The Fin below Pole 89. The Fin is a thin projection of land that a bald eagle pair frequently nests on and thus gulls don't typically nest there; 2021 was the first year we noticed nesting gulls in that area. The first fledgling was observed on 8 August on New Camp Beach. In August three adults and one fledgling were observed mired in grass on the west end of the island; three of these birds we captured and released on island beaches. On 18 August adult gulls were observed on Sail Rock (Murre Population Plot 5) trying to pull murre chicks and/or eggs off cliffs. At the end of August, on a few occasions, adult gulls were observed kleptoparasitizing inbound tufted puffins of their bill loads of prey intended for their chicks. On 9 July, from Aiktak we observed glaucous-winged gulls on Ugamak Island on the slopes above the cliffs on the southeast point of the island and suspect a breeding colony in that location.

**Fork-tailed storm-petrel** (*Hydrobates furcatus*). Abundant breeder. Individuals were observed between 23 May and 29 August in and around colony areas. In 2021, fork-tailed storm-petrels mean hatch was average, reproductive success was above average while chick growth was lower than the long-term mean. On 10 June and 27 July predated birds (mostly wings) were found in storm-petrel chronology Plot 25; it is assumed these were the prey remains of one or more short-eared owls observed in the area.

**Leach's storm-petrel** (*Hydrobates leucorhous*). Abundant breeder. Individuals were observed between 23 May and 29 August in and around colony areas. In 2021, Leach's storm-petrels mean hatch was later than average, reproductive success was below average while chick growth was higher than the long-term mean. On 10 June and 27 July predated birds (mostly wings) were found in storm-petrel chronology Plot 25; it is assumed these were the prey remains of one or more short-eared owls observed in the area.

**Short-tailed shearwater** (*Ardenna tenuirostris*). Irregular resident non-breeder. On 15 August three birds were observed in the Little West Channel (on the water). Birds appeared wet and having trouble gaining flight; eventually all three birds took to the air and left the channel. On 30 May and 26 July large rafts of shearwaters were observed south of the island (roughly 1-2 miles out), we assumed they were predominately short-tailed shearwaters. On 23 May, when crossing Unimak Pass and arriving to Aiktak, small groups of shearwaters were observed (species undetermined).

**Red-faced, pelagic and double-crested cormorant** (*Urile urile*, *Urile pelagicus* and *Nannopterum auritum*). Common breeders. Individuals and/or groups were observed between 25 May and 19 August,

mainly in kelp forests and intertidal areas. Double-crested were the most common species. Six double-crested cormorants, with three nest starts, were observed on the cliffs east of Pole 51 (54.181665°N 164.818651°W) on 5 June; this species was never observed at this location, or any island cliffs, after that. Its possible Aikta's double-crested cormorants decided to nest on Ugamak Island as defecated cliff areas were observed at the island's southeast point. A raft of 40 red-faced cormorants was observed below and east of Pole 51 on 5 June, but this species was not observed after that except during the island circumnavigation on 14 July. Three red-faced and three pelagic cormorant nests (contents unknown) were observed during the circumnavigation on the south side of Sail Rock (segment nine). A total of seven pelagic cormorants were observed during the island circumnavigation, but no other times.

**Bald eagle** (*Haliaeetus leucocephalus*). Common breeder. One to 10 individuals were observed between 23 May and 25 August. Eagles were frequently observed predating glaucous-winged gulls and tufted puffins. In 2021, two nests were initiated: one at Four-Sisters (54.189088° N 164.831495° W) and one above Phallic Rock / Zipper Rock (54.182023° N 164.833476° W). We weren't able to confirm if either nest hatched more than one chick, but each only fledged one chick. On 26 May one dead bald eagle was found in the intertidal of Petrel Valley Cove; the bird appeared to be an adult and had no bands.

**Short-eared owl** (*Asio flammeus*). Uncommon breeder. Individuals were observed on 11 days between 27 May and 28 August, most often in Petrel Valley. On 27 July, at dusk, a short-eared owl was observed perched on a storm-petrel plot marking pole in Petrel Valley. We suspect storm-petrel carcasses found in storm-petrel chronology Plot 25 on 10 June and 27 July were predated by this owl. On 1 August a short-eared owl was found downed near Petrel Valley Creek, adjacent to storm-petrel chronology Plot 25. The owl was wet and couldn't fly; we captured the owl, attempted to dry it off, and placed it on a rock on New Camp Beach later that day. The owl was still on New Camp Beach the next day, but could fly, although not well. Late that day the owl was observed flying away from New Camp Beach.

**Gyrfalcon** (*Falco rusticolus*). Accidental resident non-breeder. One individual was observed on 18 August over New Camp Beach sparring and/or playing with a juvenile peregrine falcon. This is the first known observation of gyrfalcon on Aikta. Gibson and Byrd (2007) described gyrfalcon in the eastern Aleutians as probably a rare resident, with most observations known in fall and winter.

**Peregrine falcon** (*Falco peregrinus*). Uncommon breeder. One to two individuals were observed between 27 May and 19 August. Falcons were most commonly observed around the southeast cliff face and New Camp Beach (later in the season). On 5 June, one nest was found on the cliff face west of Pole 51 and east of Pole 89 (54.182541° N 164.822380° W); this nest produced three chicks, but only one was still alive by 2 July (chick partially feathered then). On 9 July the aforementioned nest site was empty, with no adults or chicks at the site or in the vicinity. It's assumed one chick fledged from this nest, but this was not confirmed.

**Common raven** (*Corvus corax*). Common breeder. Individuals and/or groups were observed between 26 May and 28 August in and around coastal areas of island. A maximum of six individuals was observed as a group on 28 August at New Camp Beach. One raven nest was found on a cliff in Petrel Valley Cove on 26 May (54.181717° N 164.837516° W); this site has been used in previous years. The aforementioned nest was found with four chicks, but only three were later confirmed fledged (on 19 June). After chicks fledged, the family group was observed and/or heard frequently around the island.

**Bank swallow** (*Riparia riparia*). Uncommon migrant. Individuals were observed on 17 days between 29 May and 22 August (maximum of 6 individuals), most commonly observed feeding around the cabin.

**Pacific wren** (*Troglodytes pacificus*). Common breeder. Individuals and/or groups were observed between 24 May and 28 August across the island but most common in coastal areas. A nest with chicks was found in a storm-petrel burrow in Plot 19 on 7 June. The first fledgling was observed on 22 June.

**American pipit** (*Anthus rubescens*). Irregular migrant. Individuals were observed (maximum of one) on four days between 30 May and 28 August on New Camp Beach and at the Cabin. Observations were made during migration periods.

**Gray-crowned rosy finch** (*Leucosticte tephrocotis*). Common breeder. Individuals and/or groups were observed between 24 May and 18 July across the island, but most commonly in coastal areas and on cliff tops. The first fledgling was observed on 24 June in Petrel Valley Cove.

**Fox sparrow** (*Passerella iliaca*). Irregular migrant. One individual was observed at the cabin on 24 August.

**Savannah sparrow** (*Passerculus sandwichensis*). Abundant breeder. Individuals and/or groups were observed between 23 May and 28 August across the island but most commonly in coastal areas. The first fledgling was observed on 17 June in Petrel Valley.

**Song sparrow** (*Melospiza melodia*). Abundant breeder. Individuals and/or groups were observed between 23 May and 29 August across the island but most commonly in coastal areas. On 29 May, in Petrel Valley, one adult bird was observed with a bill load of insects. The first fledgling was observed on 15 June.

**Wilson's warbler** (*Cardellina pusilla*). Irregular migrant. One female/immature individual was observed on 24 August at the cabin.

## MARINE MAMMALS

**Sea otter** (*Enhydra lutris*). Common breeder. Individuals and/or groups were observed on 19 days between 24 May and 28 August in kelp forests and intertidal areas (predominately on west end of island). The first pup was observed on 10 August (the pup looked old); a maximum of one pup was observed four times at Little West, Old Camp Beach, and Petrel Valley Cove.

**Steller sea lion** (*Eumetopias jubatus*). Common resident non-breeder. Individuals and/or groups were observed between 23 May and 26 August; most commonly observed hauled out at Little West, Pleasure Cove, and Guillemot Rock. A maximum of 16 individuals was observed on 19 August at Little West and Guillemot Rock. One branded individual (A713; photos taken) was observed at Little West on 2 August and 14 August. On 2 August a hauled out individual was observed at Little West having reduced mobility, tending to slither to get around instead of moving in the normal upright position.

**Harbor seal** (*Phoca vitulina*). Common breeder. Individuals and/or groups were observed between 23 May and 17 July; most commonly observed hauled out in Harbor Barbor and Phoca Cove intertidal zones. A maximum of 11 individuals, excluding pups and weaners, was observed on 4 June in Harbor Barbor. The first pups were observed on 11 June in Harbor Barbor and Phoca Cove. A maximum of seven pups was observed in one day on 25 June.

**Humpback whale** (*Megaptera novaeangliae*). Rare migrant. Five individuals were observed on 30 May out from Pole 22; they appeared to be feeding, as were large rafts of shearwaters (likely short-tailed).

**Orca** (*Orcinus orca*). Rare migrant. At least three individuals were observed on 19 July outside the kelp line of Little West heading west around Big West. The three individuals observed had short dorsal fins.

Table 104. Observations and breeding status of birds and selected mammals at Aikta 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. No data were collected in 2020.

Codes: B=confirmed breeder, P=probable/possible breeder, X=observed non-breeder X/B?=bred in other years but not specified in current year																					
Species	2000	2001	2002	2003 <sup>a</sup>	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
Emperor goose	X	X	X	-	X	X	X	X	-	X	X	X	X	-	X	X	X	X	X	X	X
Snow goose	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Greater white-fronted goose	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Brant	-	-	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Aleutian cackling goose	-	X	X	-	X	X	X	X	X	X	X	-	X	X	-	X	X	X	X	-	X
Northern shoveler	-	X	X	X	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Gadwall	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Eurasian wigeon	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
American wigeon	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Mallard	-	-	-	-	-	X	X	-	-	X	-	X	-	X	-	X	X	-	X	X	X
Northern pintail	X	X	X	-	-	X	-	X	X	-	X	-	X	-	-	-	-	X	-	-	X
Green-winged teal	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
King eider	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Common eider	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Harlequin duck	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surf scoter	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White-winged scoter	-	-	X	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Black scoter	-	-	-	-	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	X
Long-tailed duck	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Common merganser	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	-	-	-	-	-	X
Red-breasted merganser	X	X	X	-	X	X	X	X	-	X	X	X	-	-	X	X	X	X	X	X	X
Rock ptarmigan	-	-	-	X	X	-	X	-	X	X	X	-	-	-	-	-	-	-	-	-	-
Red-necked grebe	-	-	-	-	-	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Oriental turtle-dove	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Oriental cuckoo	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Sandhill crane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	-
Black oystercatcher	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Pacific golden-plover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-
Semipalmated plover	X	-	-	X	X	X	X	X	X	X	X	X	X	-	X	X	-	X	X	-	X
Bristle-thighed curlew	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-
Bar-tailed godwit	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-
Ruddy turnstone	X	X	X	-	-	X	X	X	X	X	X	-	X	X	X	-	X	X	X	X	X
Dunlin	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-
Rock sandpiper	X	X	X	-	X	P	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X
Least sandpiper	X	X	X	X	X	P	P	P	P	P	P	X	P	P	P	X	X	X	P	X	X
Semipalmated sandpiper	-	-	-	-	-	-	-	X	-	-	-	-	X	-	X	X	-	-	X	-	-

Table 104 (continued). Observations and breeding status of birds and selected mammals at Aiktak 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. No data were collected in 2020.

Codes: B=confirmed breeder, P=probable/possible breeder, X=observed non-breeder X/B?=bred in other years but not specified in current year																					
Species	2000	2001	2002	2003 <sup>a</sup>	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
Western sandpiper	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-
Short-billed dowitcher	X	X	X	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Wilson's snipe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Terek sandpiper	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spotted sandpiper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Gray-tailed tattler	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Wandering tattler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	-	X
Lesser yellowlegs	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-
Wood sandpiper	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red-necked phalarope	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red phalarope	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Common murre	B	B	X	B	X	X	B	B	B	B	B	B	B	B	B	B	B	X	B	B	B
Thick-billed murre	B	B	X	B	X	X	B	B	B	B	B	B	B	B	B	B	B	X	B	B	B
Pigeon guillemot	B	X/B?	B	P	P	B	B	B	P	B	B	B	B	P	P	P	P	P	P	P	P
Marbled murrelet	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Ancient murrelet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Cassin's auklet	-	-	-	-	-	-	-	-	-	B	P	-	-	-	-	-	P	B	B	P	B
Parakeet auklet	X	-	X	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-
Least auklet	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Whiskered auklet	-	-	-	-	-	-	-	X	-	P	-	X	P	-	X	-	-	-	-	-	-
Rhinoceros auklet	X	-	-	-	-	X	-	-	-	P	X/B?	-	X	-	-	-	P	B	P	P	-
Horned puffin	B	B	B	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	B	B	B
Black-legged kittiwake	-	X	-	-	-	X	X	-	-	X	-	X	-	-	-	X	-	X	X	-	X
Slaty-backed gull	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Glaucous-winged gull	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Glaucous gull	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Common loon	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Fork-tailed storm-petrel	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Leach's storm-petrel	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Northern fulmar	X	-	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-
Short-tailed shearwater	-	-	-	-	-	X	X	X	-	-	-	-	-	X	-	-	-	-	-	-	X
Sooty shearwater	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-
Red-faced cormorant	X	B	B	B	B	X	X	B	B	B	B	B	X	B	B	B	X <sup>b</sup>	B	X	B	B
Pelagic cormorant	B	B	B	B	B	X	B	B	B	B	B	B	X	B	B	B	X <sup>b</sup>	B	X	X	B
Double-crested cormorant	B	X	B	B	B	X	B	B	B	B	B	B	X	B	B	X	X <sup>b</sup>	B	P	X	B



Table 104 (continued). Observations and breeding status of birds and selected mammals at Aiktak 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. No data were collected in 2020.

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Species	2000	2001	2002	2003 <sup>a</sup>	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
Golden eagle	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern harrier	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Bald eagle	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	X	B
Rough-legged hawk	-	-	-	-	-	-	-	-	-	X	-	-	X	X	-	-	-	-	-	-	-
Short-eared owl	X	P	X	X	X	X	X	X	X	P	X	P	X	P	P	X	X	P	B	X	X
Belted kingfisher	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyr Falcon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Peregrine falcon	B	B	B	B	B	B	P	B	B	B	B	B	B	X	B	P	P	B	P	P	B
Black-billed magpie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Common raven	P	B	B	B	B	P	P	B	B	B	P	B	B	P	B	P	P	B	B	X	B
Bank swallow	X	X	X	X	X	-	X	X	X	X	X	-	X	B	X	X	X	X	X	X	X
Tree swallow	-	-	-	-	X	X	X	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Violet-green swallow	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Purple martin	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barn swallow	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cliff swallow	-	X	-	-	-	-	-	X	-	-	X	-	-	-	X	-	-	-	-	-	-
Ruby-crowned kinglet	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific (formerly winter) wren	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
American pipit	X	X	X	-	-	X	X	X	X	X	X	X	X	-	X	-	X	X	X	X	X
Gray-crowned rosy-finch	B	B	B	X	X	B	B	B	B	B	P	B	B	B	B	B	B	P	B	B	B
Lapland longspur	-	-	-	-	X	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
Snow bunting	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fox sparrow	X	X	-	-	X	-	X	X	-	X	-	X	X	X	X	X	-	X	-	X	X
White-crowned sparrow	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Golden-crowned sparrow	X	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-
Savannah sparrow	B	B	B	B	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	B	B	B	B
Yellow warbler	-	-	-	-	-	-	-	-	-	X	-	-	X	-	X	-	-	X	X	X	-
Wilson's warbler	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	X	X	X	X	X
Sea otter	X	X	X	X	X	X	X	B	X	X	X	X	X	P	X	X	B	X	B	B	B
Steller sea lion	?	?	?	X	X	X	X	X	X	B	X	X	X	X	X	X	X	X	X	X	X
Northern elephant seal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Harbor seal	X/B?	X/B?	X/B?	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Minke whale	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Humpback whale	X	-	-	-	X	-	-	X	X	X	X	X	X	X	X	-	-	-	X	-	X

Table 104 (continued). Observations and breeding status of birds and selected mammals at Aiktak 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. No data were collected in 2020.

Codes: B=confirmed breeder, P=probable/possible breeder, X=observed non-breeder X/B?=bred in other years but not specified in current year																					
Species	2000	2001	2002	2003 <sup>a</sup>	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
Orca	X	-	-	-	X	X	X	X	X	X	X	X	-	-	-	X	-	X	X	-	X
Gray whale	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Harbor porpoise	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Porpoise spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Observation dates	16 Jun-	16 May-	12 May-	18 May-	10 May-	10 May-	16 May-	24 May-	21 May-	21 May-	21 May-	23 May-	21 May	24 May-	21 May-	22 May-	23 May-	18 May-	23 May-	27 May-	23 May-
	12 Sep	11 Sep	11 Sep	10 Jul	28 Aug	10 Sep	3 Sep	1 Sep	31 Aug	4 Sep	3 Sep	5 Sep	2 Sep	30 Aug	31 Aug	1 Sep	2 Sep	1 Sep	31 Aug	1 Sep	29 Aug

<sup>a</sup>Data may be incomplete in 2003 due to the early departure of field crew (10 July).

<sup>b</sup>In 2016, four cormorant nest starts were observed in June but species determination could not be ascertained.

Table 105. First flowering dates of plants identified on Aiktak 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 found, but for which no flowering data are available, are denoted by an "X". Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in 2015 or 2020.

Family	Species	2003	2004	2005	2006	2007	2008	2009	2010	2011
Lycopodiaceae	<i>Lycopodium selago</i>	-	-	16 May	late May	-	-	-	-	-
	<i>Lycopodium annotinum</i>	-	-	16 May	late May	-	-	-	-	-
Equisetaceae	<i>Equisetum arvense</i>	3 Jun	-	18 Jun	27 May	late May	early Jun	8 Jun	early Jun	28 May
Ophioglossaceae	<i>Botrychium lunaria</i>	-	-	-	-	-	-	28 May	-	-
Athyriaceae	<i>Cystopteris fragilis</i>	-	-	early Jun	1 Jun	-	-	8 Jun	-	-
	<i>Athyrium filix-femina cyclosorum</i>	-	-	early Jun	early Jun	-	-	8 Jun	-	-
Graminae	<i>Poa</i> spp.	22 May	15 Jul	-	-	-	-	-	-	-
	<i>Leymus mollis</i>	20 Jun	10 Jul	-	-	early Jul	12 Jul	early Jul	-	-
	<i>Calamagrostis canadensis</i>	25 Jun	15 Jul	-	-	-	-	Jul	-	-
	<i>Festuca rubra aucta</i>	14 Jun	15 Jul	-	-	-	-	Jul	-	-
	<i>Phleum commutatum americanum</i>	early Jun	10 Jul	-	-	-	-	2 Jul	-	-
	<i>Hordeum brachyantherum</i>	-	17 Jul	-	-	-	-	Jun	-	-
Cyperaceae	<i>Eriophorum russeolum</i> spp.	15 Jun	26 Jun	5 Jul	18 Jun	-	late Jun	-	6 Jul	2 Jul
	<i>Eriophorum angustifolium subarcticum</i>	-	27 Jun	-	-	-	-	-	-	-
	<i>Carex macrochaeta</i>	-	1 Jun	-	-	-	-	2 Jun	-	-
	<i>Carex saxatilis laxa</i>	-	1 Jun	-	-	-	-	-	-	-
	<i>Carex</i> spp.	4 Jun	-	-	-	-	7 Jun	-	-	-
Juncaceae	<i>Luzula multiflora</i>	-	1 Jul	-	-	-	-	-	-	-
	<i>Luzula multiflora Kobayasii</i>	-	1 Jul	-	-	-	-	-	-	-
	<i>Juncus arcticus sitchensis</i>	-	1 Jul	-	-	-	-	-	-	-
Liliaceae	<i>Fritillaria camschatcensis</i>	8 Jun	12 Jun	4 Jun	6 Jun	27 Jun	26 Jun	12 Jun	23 Jun	15 Jun
	<i>Streptopus amplexifolius</i>	-	-	-	-	-	-	-	6 Jul	-
Orchidaceae	<i>Platanthera convallariaefolia</i>	2 Jul	1 Jul	early Jul	25 Jun	27 Jun	2 Jul	23 Jun	6 Jul	23 Jun
	<i>Platanthera dilatata</i>	19 Jun	16 Jun	-	-	-	-	-	-	-
	<i>Listera chordata</i>	5 Jun	1 Jun	-	-	-	-	-	-	-
	<i>Dactylorhiza aristata</i>	3 Jun	29 May	4 Jun	27 May	26 Jun	13 Jun	28 May	9 Jun	28 May
Salicaceae	<i>Salix arctica crassijulis</i>	19 Jun	26 Jun	-	14 Jun	26 May	22 Jun	-	23 Jun	14 Jun
	<i>Salix reticulata</i>	-	-	-	29 Jul	29 Jul	-	-	-	-
Polygonaceae	<i>Oxyria digyna</i>	-	-	-	-	27 Jun	-	-	-	-
	<i>Rumex fenestratus</i>	-	3 Jul	early Jul	20 Jun	late Jun	2 Jul	29 Jun	6 Jul	15 Jun
	<i>Polygonum viviparum</i>	-	-	-	23 Jul	1 Aug	25 Jul	7 Jul	26 Jul	14 Jul
Portulacaceae	<i>Claytonia sibirica</i>	<18 May	13 May	16 May	24 May	29 May	3 Jun	24 May	9 Jun	26 May
	<i>Montia fontana Fontana</i>	-	-	-	-	-	-	Jun	-	-
Caryophyllaceae	<i>Honkenya peploides major</i>	-	13 May	30 May	19 Jun	-	9 Jun	13 Jul	-	-
	<i>Cerastium beeringianum grandiflorum</i>	-	12 Jun	-	27 May	late May	13 Jun	10 Jun	23 Jun	28 May
	<i>Cerastium fischerianum</i>	-	-	-	-	-	-	<30 Jun	-	-
	<i>Moehringia lateriflora</i>	-	-	-	-	-	-	1 Jul	-	-
	<i>Stellaria media</i>	-	-	-	-	late Jun	-	24 May	-	28 May
	<i>Stellaria ruscifolia</i>	-	-	-	31 May	-	-	-	-	-
	<i>Stellaria sitchana bongardiana</i>	-	-	-	13 Aug	-	-	-	-	-
Ranunculaceae	<i>Caltha palustris asarifolia</i>	-	17 May	24 May	28 May	late Jun	11 Jun	8 Jun	23 Jun	2 Jun
	<i>Aconitum maximum</i>	-	16 Jul	-	14 Jul	-	25 Jul	22 Jul	6 Aug	20 Jul

Table 105 (continued). First flowering dates of plants identified on Aiktak 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 found, but for which no flowering data are available, are denoted by an "X". Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in 2015 or 2020.

Family	Species	2012	2013	2014	2016	2017	2018	2019	2021
Lycopodiaceae	<i>Lycopodium selago</i>	late May	-	late May	-	-	-	-	-
	<i>Lycopodium annotinum</i>	late May	-	late May	-	-	-	-	-
Equisetaceae	<i>Equisetum arvense</i>	9 Jun	4 Jun	late May	24 May	19 May	<24 May	X	2 Jun
Ophioglossaceae	<i>Botrychium lunaria</i>	-	-	-	-	-	-	<11 Jun	>17 Jun
Athyriaceae	<i>Cystopteris fragilis</i>	-	2 Jun	-	-	-	-	-	-
	<i>Athyrium filix-femina cyclosorum</i>	-	2 Jun	-	-	-	-	-	-
Graminae	<i>Poa</i> spp.	7 Jun	-	-	-	-	-	X	X
	<i>Leymus mollis</i>	22 Jul	-	-	-	-	-	5 Jun	11 Jun
	<i>Calamagrostis canadensis</i>	late Jul	-	-	-	-	-	-	-
	<i>Festuca rubra aucta</i>	-	-	-	-	-	-	-	-
	<i>Phleum commutatum americanum</i>	25 Jun	-	-	-	-	-	-	-
	<i>Hordeum brachyantherum</i>	-	-	-	-	-	-	-	-
Cyperaceae	<i>Eriophorum russeolum</i> spp.	-	-	-	19 Jun	>5 Jun	7 Jun	9 Jun	28 May
	<i>Eriophorum angustifolium subarcticum</i>	4 Jul	-	23 Jun	17 Jun	16 Jun	7 Jun	1 Jun	28 May
	<i>Carex macrochaeta</i>	22 Jun	-	1 Jun	-	-	-	-	-
	<i>Carex saxatilis laxa</i>	-	1 Jun	-	-	-	-	-	-
	<i>Carex</i> spp.	-	-	-	-	-	-	-	-
Juncaceae	<i>Luzula multiflora</i>	-	-	-	-	-	-	-	-
	<i>Luzula multiflora Kobayasii</i>	-	-	-	-	-	-	-	-
	<i>Juncus arcticus sitchensis</i>	-	-	-	-	-	-	-	-
Liliaceae	<i>Fritillaria camschatcensis</i>	24 Jun	10 Jun	29 May	1 Jun	8 Jun	30 May	2 Jun	2 Jun
	<i>Streptopus amplexifolius</i>	24 Jul	22 Jul	26 Jun	<1 Sep	>16 Jun	20 Jul	22 Jun	-
Orchidaceae	<i>Platanthera convallariaefolia</i>	4 Jul	24 Jun	9 Jun	10 Jun	16 Jun	1 Jun	30 Jun	17 Jun
	<i>Platanthera dilatata</i>	-	-	-	-	<1 Aug	1 Jul	9 Jun	3 Jul
	<i>Listera chordata</i>	-	-	-	-	-	-	-	-
	<i>Dactylorhiza aristata</i>	9 Jun	1 Jun	24 May	24 May	24 May	<24 May	<28 May	26 May
Salicaceae	<i>Salix arctica crassijulis</i>	23 Jun	3 Jul	24 May	12 Jun	5 Jun	1 Jun	4 Jul	28 May
	<i>Salix reticulata</i>	2 Jul	-	23 Jun	-	-	-	-	7 Jun
Polygonaceae	<i>Oxyria digyna</i>	-	-	-	-	-	-	-	-
	<i>Rumex fenestratus</i>	30 Jun	29 Jun	1 Jun	19 Jun	23 Jun	10 Jun	X	30 Jun
	<i>Polygonum viviparum</i>	20 Jul	17 Jun	20 Jul	22 Jun	<10 Jul	18 Jun	6 Jul	26 Jun
Portulacaceae	<i>Claytonia sibirica</i>	7 Jun	27 May	23 May	23 May	<18 May	<24 May	<27 May	23 May
	<i>Montia fontana</i>	-	-	-	-	-	-	-	-
Caryophyllaceae	<i>Honkenya peploides major</i>	1 Aug	4 Aug	10 Jun	24 Jun	30 Jun	30 Jun	20 Jun	4 Jul
	<i>Cerastium beerianum grandiflorum</i>	29 Jun	6 Jun	1 Jun	24 May	24 May	<24 May	<28 May	26 May
	<i>Cerastium fischerianum</i>	-	-	-	-	-	-	-	-
	<i>Moehringia lateriflora</i>	-	-	-	-	-	-	-	7 Jun
	<i>Stellaria media</i>	-	-	-	-	-	-	-	-
	<i>Stellaria ruscifolia</i>	-	-	-	-	-	-	-	-
	<i>Stellaria sitchana bongardiana</i>	12 Aug	-	1 Jun	-	-	-	18 Jun	<7 Jul
Ranunculaceae	<i>Caltha palustris asarifolia</i>	12 Jun	3 Jun	24 May	23 May	26 May	<24 May	<27 May	23 May
	<i>Aconitum maximum</i>	31 Jul	23 Jul	5 Jul	29 Jun	7 Jul	4 Jul	17 Jun	28 Jun

Table 105 (continued). First flowering dates of plants identified on Aikta 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 found, but for which no flowering data are available, are denoted by an "X". Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in 2015 or 2020.

Family	Species	2003	2004	2005	2006	2007	2008	2009	2010	2011
Ranunculaceae (continued)	<i>Aconitum delphinifolium</i>	-	16 Jul	mid Jul	mid Jul	2 Aug	late Jul	25 Jul	early Aug	20 Jul
	<i>Ranunculus occidentalis</i>	-	-	-	-	-	-	5 Jun	-	14 Jun
	<i>Ranunculus eschscholtzii</i>	-	-	-	-	-	-	8 Jun	-	-
	<i>Ranunculus</i> spp.	-	15 Jun	mid Jun	1 Jun	mid Jun	3 Jun	-	9 Jun	-
	<i>Anemone narcissiflora villosissiflora</i>	-	13 May	19 May	24 May	24 May	31 May	26 May	9 Jun	<22 May
Cruciferae	<i>Draba hyperborea</i>	26 May	13 Jun	-	26 May	-	1 Jun	22 May	1 Jul	24 May
	<i>Draba borealis</i>	26 May	25 May	late May	27 May	-	early Jun	17 Jun	9 Jun	3 Jun
	<i>Draba nivalis</i>	-	-	-	14 Jun	-	-	-	-	-
	<i>Cardamine umbellata</i>	15 Jun	15 Jun	5 Jul	31 May	mid Jun	mid Jul	23 May	-	13 Jul
	<i>Arabis lyrata</i>	-	15 Jun	-	-	-	-	-	-	-
Saxifragaceae	<i>Cochlearia officialis oblongifolia</i>	-	-	-	28 Jul	-	-	-	-	28 Jul
	<i>Saxifraga punctata insularis</i>	25 Jun	25 Jun	-	19 Jun	1 Jul	15 Jun	2 Jul	6 Jul	12 Jul
	<i>Saxifraga bracteata</i>	5 Jun	5 Jun	-	31 May	-	20 Jun	28 May	20 Jun	4 Jun
	<i>Parnassia palustris</i>	-	-	-	8 Aug	-	-	-	-	-
	<i>Parnassia kotzebuei</i>	-	-	-	27 Jun	-	-	30 Jul	-	-
Rosaceae	<i>Chrysosplenium wrightii</i>	-	-	-	-	-	-	13 Jul	10 Jul	-
	<i>Rubus arcticus stellatus</i>	14 Jun	30 May	19 Jun	6 Jun	late Jun	3 Jul	16 Jun	-	3 Jun
	<i>Potentilla villosa</i>	30 May	10 Jun	16 Jun	6 Jun	mid Jun	20 Jun	10 Jun	6 Jul	28 May
	<i>Geum macrophyllum</i>	19 Jun	16 Jun	-	27 Jun	26 Jul	11 Jul	26 Jun	-	-
	<i>Sanguisorba stipulata</i>	-	20 Jun	29 Jul	-	mid Jul	-	2 Aug	-	-
Leguminosae	<i>Lupinus nootkatensis</i>	<18 May	13 May	25 May	28 May	28 May	13 Jun	5 Jun	9 Jun	26 May
Geraniaceae	<i>Geranium erianthum</i>	early Jun	29 May	4 Jun	2 Jun	27 Jun	29 Jun	23 Jun	23 Jun	2 Jun
Violaceae	<i>Viola langsdoeffii</i>	23 May	17 May	31 May	28 May	29 May	9 Jun	28 May	9 Jun	22 May
Onagraceae	<i>Epilobium glandulosum</i>	7 Jul	6 Jul	-	4 Jul	8 Aug	20 Jul	19 Jul	-	13 Jul
	<i>Epilobium treleaseanum</i>	-	-	-	28 Jul	-	-	-	-	-
	<i>Epilobium angustifolium</i>	-	14 Aug	6 Aug	29 Jul	-	28 Aug	15 Aug	-	24 Aug
	<i>Epilobium behringianum</i>	-	-	27 Jul	-	-	-	-	-	-
	<i>Epilobium hornemannii</i>	-	-	27 Jul	-	-	-	-	-	-
Apiaceae	<i>Epilobium leptocarpum</i>	-	29 Jul	-	-	-	-	-	-	-
	<i>Epilobium sertulatum</i>	-	-	-	-	-	-	16 Jul	>3 Sep	-
	<i>Heracleum lanatum</i>	25 Jun	2 Jul	5 Jul	11 Jul	13 Jul	15 Jul	7 Jul	19 Jul	6 Jul
	<i>Angelica lucida</i>	15 Jun	30 Jun	5 Jul	28 Jun	1 Jul	10 Jul	29 Jun	early Jul	15 Jun
	<i>Ligusticum scoticum-Hultenii</i>	27 Jun	30 Jun	late Jun	-	26 Jul	7 Aug	late Jul	-	26 Jul
Ericaceae	<i>Conioselinum chinense</i>	-	20 Jul	4 Aug	28 Jul	10 Aug	19 Aug	18 Jul	4 Aug	6 Aug
	<i>Rhododendron camtschaticum</i>	7 Jul	26 Jun	8 Jul	17 Jul	23 Jul	31 Jul	16 Jul	3 Aug	26 Jul
Primulaceae	<i>Trientalis europaea arctica</i>	25 Jun	30 Jun	5 Jul	14 Jun	-	11 Jul	30 Jun	-	29 Jun
	<i>Androsace chameejasme Lehmanniana</i>	8 Jun	7 Jun	-	-	-	-	20 Jun	1 Jul	-
	<i>Primula tschuktschorum</i>	-	-	-	-	-	-	21 Jun	-	-
Gentianaceae	<i>Gentiana amarella acuta</i> var. <i>Plebeya</i>	-	-	28 Jul	-	-	-	16 Jun	-	3 Aug
Polemoniaceae	<i>Polemonium acutiflorum</i>	25 Jun	15 Jun	10 Jul	20 Jun	late Jun	14 Jul	3 Jul	5 Jul	28 Jul
Hydrophyllaceae	<i>Romanzoffia unalaschecensis</i>	-	10 Jun	-	-	-	-	21 Jun	-	-
Boraginaceae	<i>Mertensia maritima</i>	-	-	-	-	7 Jul	-	-	-	-

Table 105 (continued). First flowering dates of plants identified on Aiktak 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 found, but for which no flowering data are available, are denoted by an "X". Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in 2015 or 2020.

Family	Species	2012	2013	2014	2016	2017	2018	2019	2021
Ranunculaceae (continued)	<i>Aconitum delphinifolium</i>	2 Aug	-	13 Jul	13 Jul	21 Jul	11 Jul	6 Jul	14 Jul
	<i>Ranunculus occidentalis</i>	29 Jun	-	1 Jun	23 May	-	-	<28 May	-
	<i>Ranunculus eschscholtzii</i>	-	6 Jun	-	-	-	-	-	-
	<i>Ranunculus</i> spp.	29 Jun	-	1 Jun	23 May	5 Jun	<24 May	-	26 May
Cruciferae	<i>Anemone narcissiflora villosissiflora</i>	9 Jun	24 May	23 May	23 May	<18 May	<24 May	<28 May	23 May
	<i>Draba hyperborea</i>	31 May	6 Jun	24 May	23 May	22 May	<24 May	<27 May	26 May
	<i>Draba borealis</i>	12 Jun	-	24 May	-	31 May	7 Jun	X	27 May
	<i>Draba nivalis</i>	-	-	-	1 Jun	-	-	-	-
Saxifragaceae	<i>Cardamine umbellata</i>	8 Jun	6 Jun	2 Jun	24 May	5 Jun	-	X	23 May
	<i>Arabis lyrata</i>	-	-	-	-	-	-	-	-
	<i>Cochlearia officinalis oblongifolia</i>	3 Aug	-	1 Jul	-	-	-	-	-
	<i>Saxifraga punctata insularis</i>	21 Jun	6 Jul	11 Jun	10 Jun	7 Jun	8 Jun	6 Jun	18 Jun
Rosaceae	<i>Saxifraga bracteata</i>	7 Jun	-	25 May	1 Jun	-	<24 May	31 May	8 Jun
	<i>Parnassia palustris</i>	11 Aug	-	-	22 Jul	2 Aug	30 Jun	15 Jul	20 Jul
	<i>Parnassia kotzebuei</i>	-	-	-	-	-	-	-	-
	<i>Chrysosplenium wrightii</i>	-	-	-	-	-	-	-	-
Leguminosae	<i>Rubus arcticus stellatus</i>	23 Jun	23 Jun	27 May	25 May	31 May	29 May	31 May	27 May
	<i>Potentilla villosa</i>	21 Jun	1 Jun	6 Jun	23 May	25 May	26 May	30 May	26 May
	<i>Geum macrophyllum</i>	22 Jun	29 May	24 May	< 17 Jun	9 Jun	7 Jun	<4 Jul	3 Jun
	<i>Sanguisorba stipulata</i>	7 Aug	late Jul	25 Jul	22 Jul	14 Jul	7 Jul	6 Jul	10 Jul
Geraniaceae	<i>Lupinus nootkatensis</i>	12 Jun	6 Jun	23 May	23 May	28 May	<24 May	<28 May	23 May
Violaceae	<i>Geranium erianthum</i>	24 Jun	6 Jun	30 May	25 May	24 May	29 May	<28 May	26 May
Onagraceae	<i>Viola langsdoeffii</i>	9 Jun	1 Jun	23 May	24 May	24 May	<24 May	<28 May	26 May
Ericaceae	<i>Epilobium glandulosum</i>	23 Jul	6 Jul	25 Jun	1 Jul	9 Jul	14 Jul	30 Jun	15 Jul
	<i>Epilobium treleaseanum</i>	-	-	-	17 Jul	1 Jul	-	30 Jun	28 Jun
	<i>Epilobium angustifolium</i>	-	mid Aug	23 Jun	22 Jul	4 Aug	30 Jul	18 Jul	1 Aug
	<i>Epilobium behringianum</i>	-	-	-	-	-	-	-	-
Apiaceae	<i>Epilobium hornemannii</i>	-	-	-	-	-	-	-	-
	<i>Epilobium leptocarum</i>	-	-	-	-	-	-	-	-
	<i>Epilobium sertulatum</i>	-	-	-	-	-	-	-	-
	<i>Heracleum lanatum</i>	16 Jul	mid Jul	15 Jun	17 Jun	23 Jun	21 Jun	17 Jun	17 Jun
Primulaceae	<i>Angelica lucida</i>	15 Jul	mid Jul	9 Jun	3 Jun	20 Jun	19 Jun	8 Jun	28 May
	<i>Ligusticum scoticum-Hultenii</i>	11 Jun	mid Jul	8 Jun	28 Jun	19 Jul	11 Jul	6 Jul	6 Jul
	<i>Conioselinum chinense</i>	16 Jul	mid Jul	15 Jun	19 Jun	29 Jul	-	7 Jun	19 Jul
	<i>Rhododendron camtschaticum</i>	3 Aug	late Jul	3 Jul	24 Jun	6 Jul	3 Jul	28 Jun	8 Jul
Gentianaceae	<i>Trientalis europaea arctica</i>	7 Jul	-	17 Jun	28 Jun	8 Jun	9 Jun	7 Jun	10 Jun
Polemoniaceae	<i>Androsace chameejasme Lehmanniana</i>	-	-	-	19 Jun	4 Jun	10 Jun	30 May	2 Jun
Hydrophyllaceae	<i>Primula tschuktschorum</i>	21 Jun	-	-	-	-	-	-	-
Boraginaceae	<i>Gentiana amarella acuta</i> var. <i>Plebeya</i>	14 Aug	mid Aug	26 Jul	17 Jul	15 Aug	5 Aug	28 Jul	26 Jul
	<i>Polemonium acutiflorum</i>	7 Jul	12 Jul	8 Jun	17 Jun	6 Jul	1 Jul	20 Jun	25 Jun
	<i>Romanzoffia unalaschecensis</i>	12 Jun	6 Jul	25 May	23 May	10 Jun	-	X	26 May
	<i>Mertensia maritima</i>	-	-	-	-	-	8 Jun	15 Jun	-

Table 105 (continued). First flowering dates of plants identified on Aikta 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 found, but for which no flowering data are available, are denoted by an "X". Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in 2015 or 2020.

Family	Species	2003	2004	2005	2006	2007	2008	2009	2010	2011
Scrophulariaceae	<i>Mimulus guttatus</i>	7 Jul	5 Jul	6 Jul	29 Jun	16 Jul	25 Jul	14 Jul	26 Jul	13 Jul
	<i>Pedicularis langsdoeffii</i>	15 Jun	23 Jun	15 Jun	22 Jun	14 Jul	11 Jul	14 Jul	7 Jul	15 Jun
	<i>Veronica stelleri</i>	11 Jun	11 Jun	-	-	-	29 Jun	23 Jun	6 Jul	14 Jun
	<i>Veronica wormsjoldii</i>	-	-	-	15 Jun	-	-	-	-	-
	<i>Veronica serpyllifolia</i>	-	-	-	-	-	-	-	-	-
	<i>Castilleja unalaschcenis</i>	8 Jun	15 Jun	5 Jul	9 Jun	30 Jun	11 Jul	23 Jun	23 Jun	15 Jun
	<i>Rhinanthus minor boreales</i>	-	27 Jul	29 Jul	8 Aug	8 Aug	12 Aug	13 Aug	-	3 Aug
	<i>Lagotis glauca</i>	-	-	-	8 Jun	-	25 Jun	15 Jun	27 Jun	11 Jun
	<i>Galium aparine</i>	-	26 Jun	5 Jul	23 Jul	-	24 Jul	13 Jul	-	-
Rubiaceae	<i>Galium triflorum</i>	-	-	-	-	-	-	-	early Aug	-
Campanulaceae	<i>Campanula lasiocarpa</i>	-	28 Jul	1 Aug	23 Jul	-	5 Aug	14 Jul	-	28 Jul
	<i>Campanula chamissonis</i>	-	-	-	30 Jul	27 Aug	-	-	5 Jul	-
Asteraceae	<i>Petasites frigidus</i>	25 Jun	17 May	-	31 May	late May	23 May	22 May	6 Jul	23 May
	<i>Achillea borealis</i>	15 Jun	2 Jun	-	19 Jun	27 Jun	11 Jul	11 Jul	-	11 Jul
	<i>Senecio pseudo-arnica</i>	3 Jul	17 Jul	7 Jul	10 Jul	23 Jul	20 Jul	13 Jul	9 Jun	7 Jul
	<i>Taraxacum trigonolobum</i>	15 Jun	23 Jun	30 Jun	13 Jun	22 Jul	3 Jul	19 Jun	19 Jul	12 Jun
	<i>Erigeron peregrinus</i>	7 Jul	2 Jul	6 Jul	29 Jun	-	19 Jul	7 Jul	9 Aug	13 Jul
	<i>Anaphalis margaritacea</i>	-	-	29 Jul	25 Jul	18 Aug	12 Aug	14 Jul	17 Aug	4 Aug
	<i>Solidago multiradiata</i>	-	1 Aug	-	22 Aug	-	-	16 Aug	-	5 Aug

Table 105 (continued). First flowering dates of plants identified on Aiktak 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 found, but for which no flowering data are available, are denoted by an "X". Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in 2015 or 2020.

Family	Species	2012	2013	2014	2016	2017	2018	2019	2021
Scrophulariaceae	<i>Mimulus guttatus</i>	20 Jul	20 Jul	19 Jun	19 Jun	2 Jul	1 Jul	23 Jun	30 Jun
	<i>Pedicularis langsdoeffii</i>	14 Jul	3 Jul	6 Jun	7 Jun	4 Jul	30 May	8 Jun	14 Jun
	<i>Veronica stelleri</i>	2 Jul	-	-	-	-	-	-	-
	<i>Veronica wormskjoldii</i>	-	-	-	-	-	-	-	-
	<i>Veronica serpyllifolia</i>	-	-	-	-	9 Jun	29 May	5 Jun	8 Jun
	<i>Castilleja unalaschcenis</i>	25 Jun	3 Jun	27 May	1 Jun	31 May	30 May	-	3 Jun
	<i>Rhinanthus minor boreales</i>	12 Aug	28 Jul	25 Jul	24 Jul	22 Jul	30 Jul	1 Jul	20 Jul
	<i>Lagotis glauca</i>	28 Jun	24 Jun	23 May	24 May	8 Jun	26 May	31 May	26 May
Rubiaceae	<i>Galium aparine</i>	11 Jul	-	20 Jul	25 Jun	30 Jun	30 Jun	7 Jul	9 Jul
	<i>Galium triflorum</i>	-	-	-	-	-	16 Jul	8 Jul	3 Jul
Campanulaceae	<i>Campanula lasiocarpa</i>	24 Jul	late Jul	4 Jul	15 Jul	-	17 Aug	18 Aug	15 Jul
	<i>Campanula chamissonis</i>	25 Jun	-	-	-	10 Aug	19 Jul	6 Jul	-
Asteraceae	<i>Petasites frigidus</i>	29 May	28 May	23 May	24 May	19 May	26 May	29 May	26 May
	<i>Achillea borealis</i>	8 Jul	3 Jul	10 Jun	7 Jun	20 Jun	12 Jun	18 Jun	14 Jun
	<i>Senecio pseudo-arnica</i>	20 Jul	11 Jul	20 Jun	20 Jun	9 Jul	16 Jun	15 Jun	3 Jul
	<i>Taraxacum trigonolobum</i>	20 Jul	9 Jul	6 Jun	24 May	5 Jun	1 Jun	30 May	7 Jun
	<i>Erigeron peregrinus</i>	10 Jul	9 Jul	6 Jun	19 Jun	4 Jun	18 Jun	16 Jun	22 Jun
	<i>Anaphalis margaritacea</i>	9 Aug	early Aug	11 Jul	24 Jul	5 Aug	30 Jul	11 Aug	27 Jul
	<i>Solidago multiradiata</i>	18 Aug	17 Aug	1 Jul	13 Jul	4 Jul	7 Jul	1 Jul	20 Jul



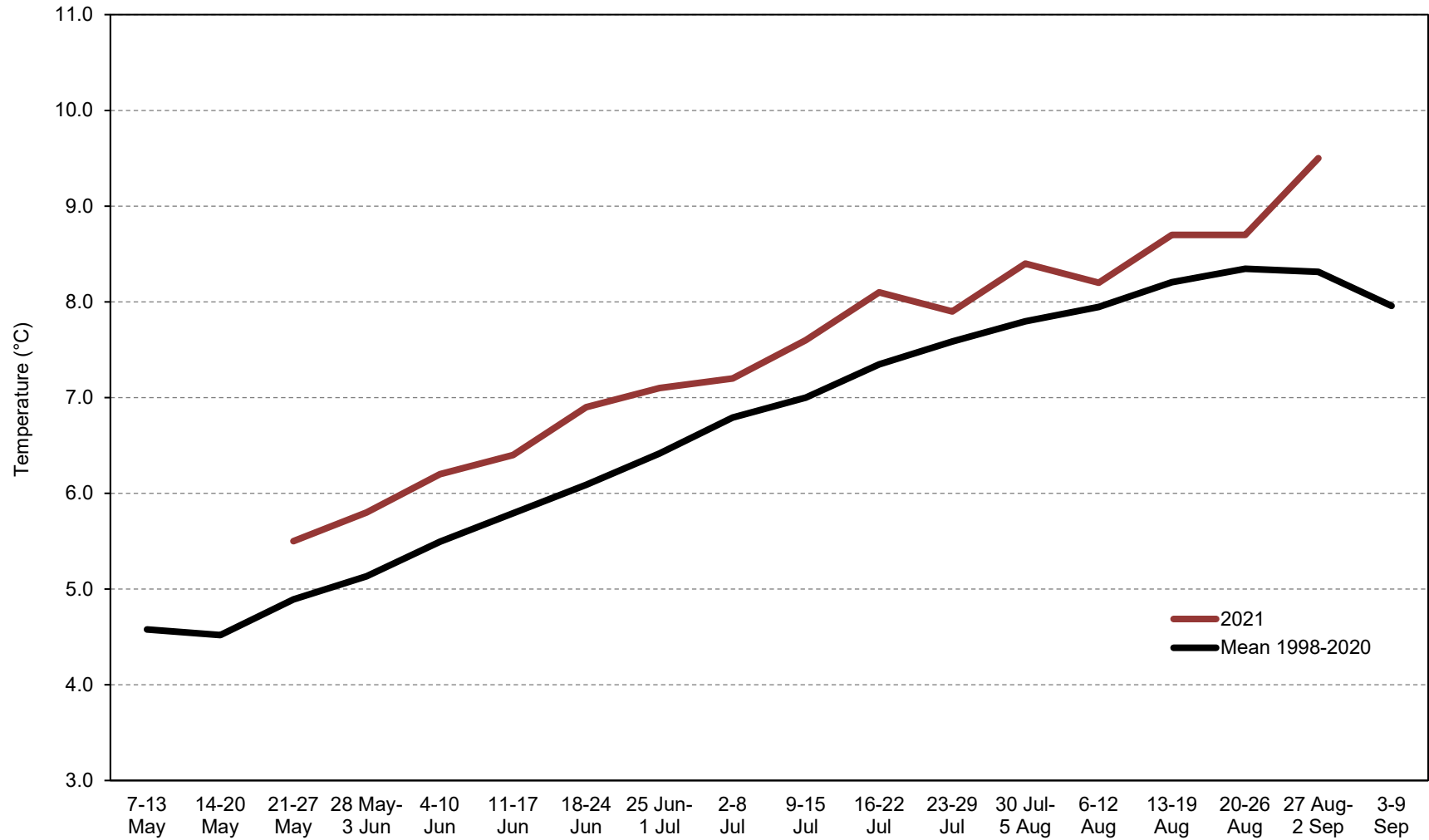


Figure 57. Mean weekly sea surface temperatures (°C) at Aiktak Island, Alaska. No data were collected in 2001 or 2020.

Table 106. Mean weekly sea surface temperatures (°C) at Aiktak Island, Alaska. No data were collected in 2001 or 2020.

Week	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
7-13 May	-	-	-	4.4	-	4.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-20 May	4.8	-	-	4.5	5.3	4.8	-	4.1	-	-	3.6	3.8	-	-	-	-	-	-	5.2	-	-	-
21-27 May	5.1	-	-	4.8	5.5	5.1	-	4.5	3.7	3.8	3.8	4.1	4.9	3.5	4.3	5.7	5.8	6.4	5.2	5.6	6.2	5.5
28 May-3 Jun	5.4	4.1	-	5.2	6.2	5.4	-	5.0	3.9	4.1	4.1	4.5	5.2	3.6	4.5	5.6	6.2	6.7	5.6	5.7	6.6	5.8
4-10 Jun	5.6	4.4	-	5.7	6.5	5.5	-	5.4	4.3	4.3	4.4	5.1	5.3	4.0	5.0	6.5	6.4	7.0	5.9	6.2	6.8	6.2
11-17 Jun	5.8	4.8	5.2	5.9	6.5	6.0	-	5.6	4.6	4.8	5.3	5.3	5.8	4.5	5.3	6.5	6.7	7.2	6.4	6.4	7.3	6.4
18-24 Jun	6.2	4.9	5.3	6.3	6.9	6.0	-	5.7	5.2	5.0	5.4	5.6	6.0	4.9	5.7	6.6	7.3	7.5	7.2	6.7	7.5	6.9
25 Jun-1 Jul	6.6	5.2	5.7	6.7	7.1	6.8	-	6.1	5.2	5.3	5.7	5.8	6.1	5.2	6.1	7.4	7.6	7.9	6.8	7.0	8.0	7.1
2-8 Jul	7.1	5.8	6.0	7.3	7.2	6.9	-	6.8	5.9	5.6	5.9	6.7	6.3	5.5	6.2	7.9	7.9	8.2	7.3	7.5	8.0	7.2
9-15 Jul	7.1	6.2	6.4	7.0	7.7	7.5	-	7.0	6.0	5.8	6.4	6.6	6.6	5.9	6.4	8.0	8.1	8.3	7.3	7.3	8.5	7.6
16-22 Jul	7.6	6.3	6.4	7.6	8.1	7.6	7.5	7.5	7.2	6.0	6.4	6.9	6.8	6.1	6.8	8.4	8.3	8.9	7.8	7.5	8.7	8.1
23-29 Jul	7.7	6.5	7.2	7.5	8.3	7.9	8.2	7.7	6.9	6.6	6.6	7.0	7.0	6.5	7.2	8.5	8.3	8.9	7.9	8.0	9.0	7.9
30 Jul-5 Aug	8.3	6.3	6.9	8.6	8.7	7.4	8.4	7.8	6.9	6.7	6.9	7.5	7.2	6.6	8.0	8.5	8.9	8.8	8.6	7.8	9.0	8.4
6-12 Aug	8.5	6.4	7.2	8.3	8.9	8.1	7.8	7.8	7.6	8.0	7.2	7.2	7.4	6.7	8.1	8.4	9.0	8.9	8.3	8.2	8.9	8.2
13-19 Aug	8.2	7.1	7.7	8.9	8.9	8.1	8.7	8.0	7.8	8.3	6.9	7.6	7.8	7.7	7.9	9.3	9.1	9.4	8.4	7.7	8.9	8.7
20-26 Aug	8.1	7.0	7.7	8.5	8.8	8.8	8.7	8.2	8.0	7.7	7.2	7.8	7.7	7.4	8.5	9.4	9.3	9.2	8.6	8.4	10.3	8.7
27 Aug-2 Sep	-	7.0	7.4	8.8	8.9	-	-	8.6	7.8	7.8	7.0	8.2	7.6	7.7	8.4	8.9	9.2	9.7	8.2	8.3	10.1	9.5
3-9 Sep	-	-	7.9	8.2	9.3	-	-	-	-	-	6.9	-	7.5	-	-	-	-	-	-	-	-	-
10-16 Sep	-	-	7.6	-	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Species	Recipient	Diet type	Years	In 2021 annual report
Black oystercatcher	Chick	Prey pile	2013-2019, 2021	Y
Common murre	Adult	Stomach	1983, 1991, 1993-1995	N
Thick-billed murre	Adult	Stomach	1983, 1993, 1994, 1998	N
Pigeon guillemot	Adult	Stomach	1993, 1995	N
Pigeon guillemot	Chick	Bill load	2000, 2005	N
Cassin's auklet	Adult	Stomach	2005	N
Horned puffin	Adult	Stomach	1993-1995	N
Horned puffin	Chick	Bill load	2000, 2005, 2010, 2012, 2014, 2016-2018	Y
Tufted puffin	Adult	Stomach	1990-1995	N
Tufted puffin	Chick	Bill load	1986-1987, 1990-2002, 2004-2019, 2021	Y
Glaucous-winged gull	Adult	Stomach	1995	Y
Glaucous-winged gull	Adult	Pellet	2008-2019, 2021	Y
Glaucous-winged gull	Chick	Bolus, Regurgitation, Unknown	1996-2002, 2004-2009, 2015-2019, 2021	Y
Fork-tailed storm-petrel	Chick	Regurgitation	1997-2001, 2004-2014, (2015-2019, 2021)	Y
Leach's storm-petrel	Chick	Regurgitation	1997-1998, 2000-2002, 2004, 2006-2013, (2015-2019)	Y
Double-crested cormorant	Adult	Stomach	1991, 1993, 1994	N
Double-crested cormorant	Chick	Regurgitation	2000	N
Bald eagle	Unknown	Bolus	2004	N
Short-eared owl	Adult	Pellet	2004	N