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BIOLOGICAL MONITORING AT BULDIR ISLAND, ALASKA IN 2012

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East Cape, Buldir viewed from the seabird productivity plots at Spike camp

"I should mention also the great scientific value [of Buldir]; a strictly isolated island with an isolated fauna in which the elements may interact unhindered. This will be of great value and interest to the biologist of the future"

- Olaus Murie, 1936
  in Biological investigations of the Aleutian Islands and southwestern Alaska

"We were a weather station, but in reality we soon realized that they did not care about our weather reports. They were getting them from other places, but if we failed to come on the air they could assume the Japanese had returned…Our group [of 5] which was there for 7 months had to have the other radio operator relieved. Went a bit balmy and we were afraid he was going to take a gun to us…"

- Dave Grehl, 1943
  U.S. Army weatherman stationed on Buldir Island

"The cliffs of Buldir are forbidding; marine erosion is rapidly and steadily removing the island by peripheral attack."

- Robert Coats, 1953
  in The Geology of Buldir Island, Alaska

"We hope the weather gods allow a landing [at Buldir]"

- Robert D. Jones, 1961
  Refuge Manager, Aleutian Islands National Wildlife Refuge

"It is the writer's intent to convey the impression of land, sea, and sky alive with birds in all of their activities. Such a concentration of birds produces an immense volume of sound. Add to this the grunting and roaring of about 10,000 Steller's sea lions and you have the *bedlam of Buldir*."

- Robert D. Jones, ~1964
  Refuge Manager, Aleutian Islands National Wildlife Refuge

"Every blade of grass [on Buldir] holds a quart of water…"

- G. Vernon Byrd, 1975
  Quote from the film *Chain of Life*

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INTRODUCTION

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

Buldir Island, in the western Aleutian Islands, has been an annual monitoring site since 1988 (Byrd and Climo 1988; Byrd and Douglas 1989; Hipfner et al. 1991; Williams and Byrd 1992; Williams et al. 1997a,b, 1998, 2001, 2002; Moore et al. 2001, Williams and Daniels 2001, Andersen and Barrett 2005, Barrett et al. 2005, Jones et al. 2005, Orben et al. 2006, Andersen 2007, Paine 2008, Freeman et al. 2010, Tucker et al. 2011, Warzybok 2011). Additional historical data exist from as early as 1974 (e.g., Byrd and Trapp 1977, Byrd 1978, Byrd and Day 1986, Trapp 1979), particularly for storm-petrels and auklets. Buldir is almost unique among Aleutian Islands in that it escaped the widespread introduction of arctic foxes (Bailey 1993) and rats, both of which apply heavy predation pressure on breeding seabirds. The island's isolation and difficulty of access, as well as the absence of non-native predators, have made Buldir the most diverse (21 nesting species) and possibly largest seabird colony in Alaska (perhaps 4,000,000 individuals; Byrd 1978, Byrd and Day 1986, Byrd and Williams 1994).

The specific monitoring goals in 2012 were to estimate productivity and/or population parameters for 14 indicator species representing four major feeding guilds: 1) diving fish-feeders (pelagic and red-faced cormorants [*Phalacrocorax pelagicus* and *P. urile*], common and thick-billed murres [*Uria aalge* and *U. lomvia*], and horned and tufted puffins [*Fratercula corniculata* and *F. cirrhata*]), 2) surface fish-feeders (black-legged and red-legged kittiwakes [*Rissa tridactyla* and *R. brevirostris*], 3) diving plankton feeders (parakeet, least, whiskered, and crested auklets [*Aethia psittacula, A. pusilla, A. pygmaea, and A. cristatella*]), and 4) surface plankton feeders (Leach's and fork-tailed storm-petrels [*Oceanodroma furcata* and O. *leucorhoa*]). Similar data were also collected on flexible-foraging glaucous-winged gulls (*Larus glaucescens*). Additional monitoring goals include the description of breeding chronology, food habits, and adult survival for one or more of the above species.

Detailed results of the 2012 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. 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

Buldir Island (52º21' N, 176º56' E) is the westernmost island in the Rat Islands group of the Aleutian chain (see Figure 1). This 2000-ha island is approximately 6.4 km long and 3.2 km wide. Located about 110 km from both Shemya to the west and Kiska to the east, it is the most isolated island in the Aleutians, providing the only landfall in a 220 km-wide pass.

The weather is typical of a northern maritime climate, with moderate year-round temperatures and strong winds. Fog and rain are characteristic, and violent storms occur frequently. The average temperature at sea level is about 7.7ºC in the summer and 3.7ºC annually. Precipitation averages 80.6 cm annually. Snow accumulation at sea level rarely exceeds 0.5 m, however passes and higher elevations can have drifts in excess of 10 m. There is no permafrost. (Data for Shemya Island from Western Region Climate Center).

Buldir Island is a few thousand years old and composed of basalts and basaltic andesites from two volcanic cones: the older Buldir Volcano and newer East Cape Volcano. These two volcanic centers, each of which had two main eruptive periods, were separated by considerable time and later subjected to intense marine erosion continuing to the present day. There are no historic records of eruptions and the island is considered inactive. Only portions of each volcano remain today.

The highest point on the island, Buldir Eccentric (655 m), is part of a rim of an old summit tuff cone of Buldir Volcano. The center of the volcano, only a remnant of which is left today, was about 800m in diameter and centered about 800 m south of Buldir Eccentric's summit. Glissade Valley is a fault line that separates the older portion of Buldir Volcano, represented by Buldir Eccentric, from the later parasitic cone of Buldir Volcano known today as Owl Knob. Kittiwake Lake is not the main crater of this later parasitic cone, but rather a small maar blasted from the side of the cone. Most of the main part of Owl Knob was eroded prior to the later eruption of East Cape Volcano. The rocks of Buldir Volcano are chiefly olivine basalts and olivine hypersthene basalts.

The East Cape Volcano consists of two parts: the older principle eruptive center of Slide Mountain and a smaller flank eruption volcanic dome of Round Mountain. Round Mountain is the most recent manifestation of eruptive activity on the island. Much of the cone of East Cape Volcano is mantled by a chaotic crumble breccia derived from the underlying plug dome of hypersthene-bearing hornblende basalts and basaltic andesites. This chaotic crumble breccia, a mixture of boulders in a dirt matrix, is especially evident at beach cliffs that are actively undergoing marine erosion. The northern portion of Slide Mountain is believed to have slid into the ocean during one of many earthquakes. The high ridgeline of East Cape sweeps northeasterly off the flanks of Round Mountain and is believed to be a lava flow now nearly removed by erosion.

There are only two areas of alluvial deposit on Buldir because of its mountainous nature and incessant marine erosion. The primary area is the valley containing North Marsh and South Marsh. This flat area is composed of sand, gravel, reworked cinders and ash and is retreating rapidly as evidenced by its vertical cliff face at the beach. At the time of deposition this area was most likely protected by now eroded portions of Buldir Volcano and its parasitic cone (Owl Knob). The other area is an area known as "The Dip" which was formed by material collected behind a bar formed by a landslide off Round Mountain (all geologic information from Coats 1953).

Vegetation on the island is composed of two distinct plant complexes: lowland tall-plant and upland short-plant (Byrd 1984). The lowland tall-plant complex is found generally below 300 m and contains eight recognizable plant communities, over 90% of which consists of only three communities Leymus-umbel, Leymus-umbel-fern, and Carex-fescue meadow. The upland short-plant complex is composed of four communities of which the moss-willow tundra is most widespread. Over 119 plants have been identified on the island, fewer than on most other Aleutian Islands. There are no erect trees or shrubs.

Buldir Island is surrounded by deep water and is representative of a pelagic seabird colony where prey is diverse and availability is variable among years (Springer et al. 1996). Most prey species taken by birds

are members of the Oceanic and Outer-shelf Zooplankton community (Cooney 1981), or are deep-dwelling vertical migrants (e.g., squid and Myctophids). The shallow water surrounding Buldir, Middle and Tahoma reefs to the southeast and south serve as surrogate meso-scale continental shelf-like habitats for coastal marine fauna in this otherwise deep water environment. The three reefs are important feeding areas for many birds breeding on Buldir (Dragoo and Byrd 1999). In particular, the juxtaposition of the Buldir reef escarpment (60-100 m) to the Buldir Depression, an 18 x 55 km basin with depths to 2000 m, creates a physiographic structure conducive to foraging by a wide variety of seabirds. Sea surface temperatures measured in North Bight are normally 3-4ºC in late May and rise to 6-7ºC in late August. Occasionally, anomalous events occur such as in 1998 when sea surface temperature rose to an unusually high 12ºC.

Humans have occupied Buldir since at least 800 AD. The midden site on North Bight Beach is large and contains evidence of substantial-sized houses. Although there was a relatively long period of use in the late prehistoric period, occupation of the site was typically intermittent with long breaks between uses. According to Corbett et al. (1997), it is unclear why Aleuts used Buldir at all. The site does not appear to have been a seasonal hunting camp in an annual subsistence cycle and the resources were not unusually rich. Inhabitants fed mainly on Steller's sea lions. Large numbers of birds, primarily alcids, were taken by inhabitants for food, clothing or decorations on clothing.

Buldir has been designated a federal Research Natural Area (RNA). RNAs are reserves where natural processes are allowed to dominate and where management is designed to preserve a given ecosystem or feature. There are three characteristics shared by most RNAs: 1) minimal human interference and a reasonable assurance of long-term existence, 2) the availability of diverse or multiple data sets for analysis of factor interrelationships or temporal sequences, and 3) the association of scientists of different disciplines leading toward scientific discoveries unlikely to occur without such association.

Buldir is also a component of the Aleutian Islands Biosphere Reserve under UNESCO's Man and the Biosphere program (MAB). Biosphere reserves are areas intended to conserve the diversity and integrity of biotic plants and animals in the natural ecosystem and to safeguard their genetic diversity. Biosphere Reserves also provide areas for ecological and environmental research and baseline studies.

METHODS

Personnel: The USFWS field crew at Buldir Island in 2012 consisted of John Warzybok (25 May to 30 August), Matt Henschen (25 May to 30 August) and Ronan Dugan (25 May to 11 August). Two students from Memorial University in Newfoundland, Jill Robinson (25 May to 11 August), Carley Schacter (25 May to 11 August), their advisor Ian Jones (25 May to 11 August) and field assistant Michelle Goh (25 May to 11 August), conducted auklet resightings, retrieved geolocators deployed on crested auklets in 2011 and deployed geolocators on parakeet auklets to track their winter movements.

Data Collection and Analysis: Data collection and analysis methods were followed as outlined in Williams *et al*. (2002) with the following exceptions:

- A prolonged stretch of unfavorable weather prevented us from conducting the Alaska Off-road Breeding Bird Survey within the appropriate range of dates.

- In many years, pigeon guillemots are counted during a circumnavigation survey of the island. These counts could not be conducted in 2012 due to the lack of a skiff.

- Four black-legged kittiwakes and three red-legged kittiwakes were accidently banded with duplicate color combinations that had been used in 2011. Attempts will be made in future years to recapture these birds and replace their color bands with unique combinations.

- Marine debris surveys were conducted following NOAA Marine Debris Shoreline Survey Field Guide protocol for accumulation, with the modification that marine debris was not removed from the site. Data were stored in AMNWR files, and submitted to the NOAA Marine Debris Program.

Over the past four years, AMNWR has been developing a database to analyze reproductive success and chronology data automatically, which both reduces human calculation errors and ensure consistency across sites and years. This database uses slightly different conventions to calculate nest fate than previous hand-calculated summaries in that it includes the interval between nest checks as part of the uncertainty around hatch and fledge events rather using Julian midpoints (see Williams et al. 2002). As of present, the system can analyze reproductive success and chronology data for kittiwakes, murres, auklets, and puffins.

In spring 2012, historic data for the applicable species were reanalyzed using the database and these values are presented in this report for the first time. The new summary numbers differ from those presented previously to a small degree, mostly due to differences in which nests are included or excluded from analysis due to excess uncertainty and correction of prior errors or inconsistent analyses. Data for 1976 could not be resummarized because raw nest observation data were not available.

Eventually the refuge hopes to expand the database to include all other species and parameters monitored by the refuge. Until then, these data are summarized by hand following methods outlined in the Buldir Island protocols.

INTERESTING OBSERVATIONS

- A Eurasian oystercatcher (Figures 75 and 76) was seen along North Bight Beach on 26 May and remained until 13 June. This marks the first record of this species in North America.

- A bittern of unidentified species (Figures 70-72) was seen briefly in South Marsh on 13 and 25 June. It is believed that this may have potentially been a Eurasian bittern but photos were inconclusive and the secretive nature of the bird made extended observations and a definite identification impossible.

- A female northern fur seal was seen swimming just offshore of North Bight Beach on 24 August.

ACKNOWLEDGMENTS

This monitoring program would not exist without the guiding influences and vision of Vernon Byrd and Jeff Williams who have tirelessly shaped and molded the program over the years. We would also like to thank all other staff members of Alaska Maritime NWR in both Homer and Adak - field camps would accomplish very little without their support. Thanks to Jill Robinson, Michelle Goh, Carley Schacter and Ian Jones for their assistance with data collection and camp maintenance and making life on the island even more

interesting and enjoyable. Finally, we would like to thank the crew of the M/V *Tiĝlax̂* for safe transport to and from the island.

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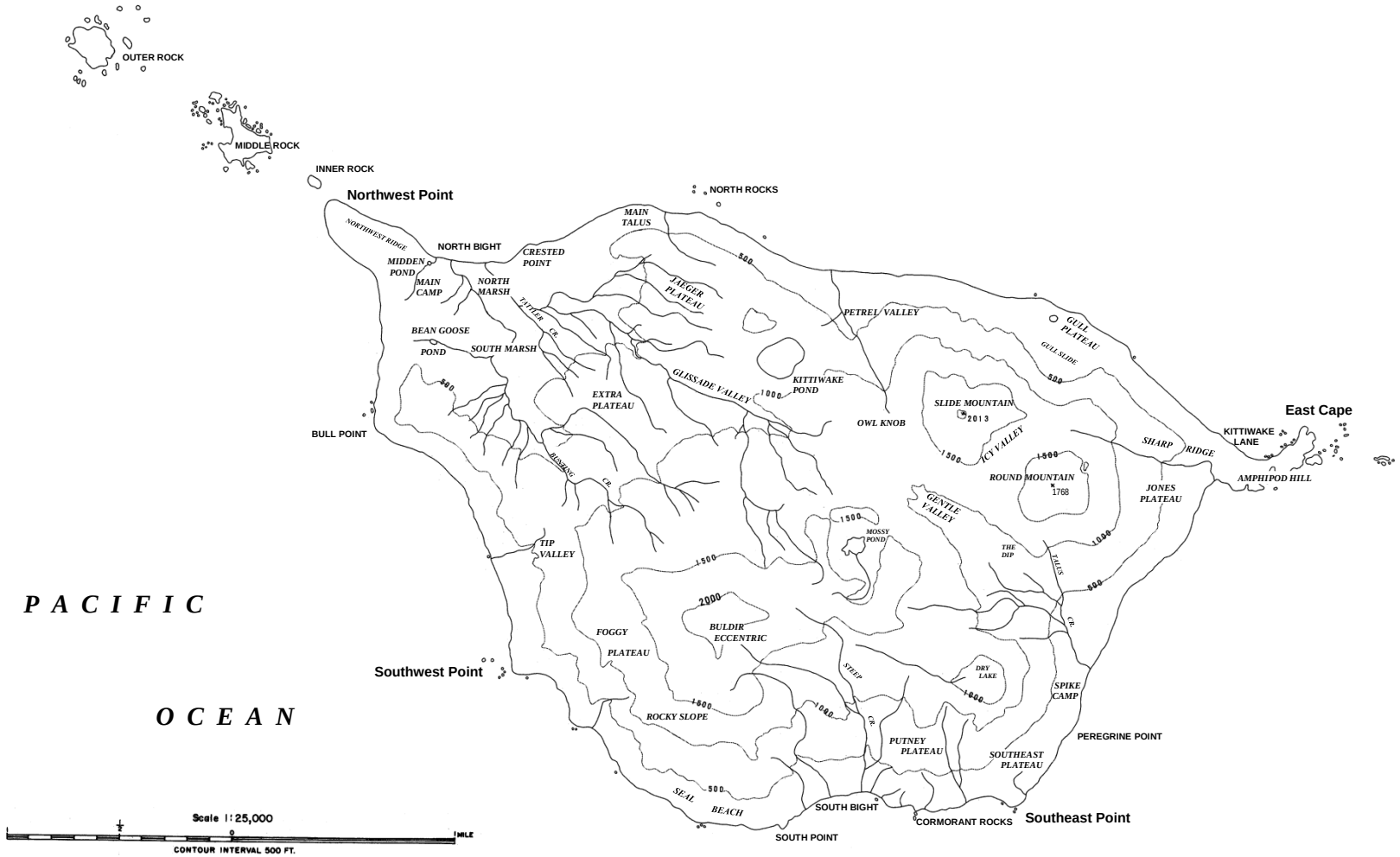

Figure 1. Map of Buldir Island, Alaska.

FIGURES AND TABLES

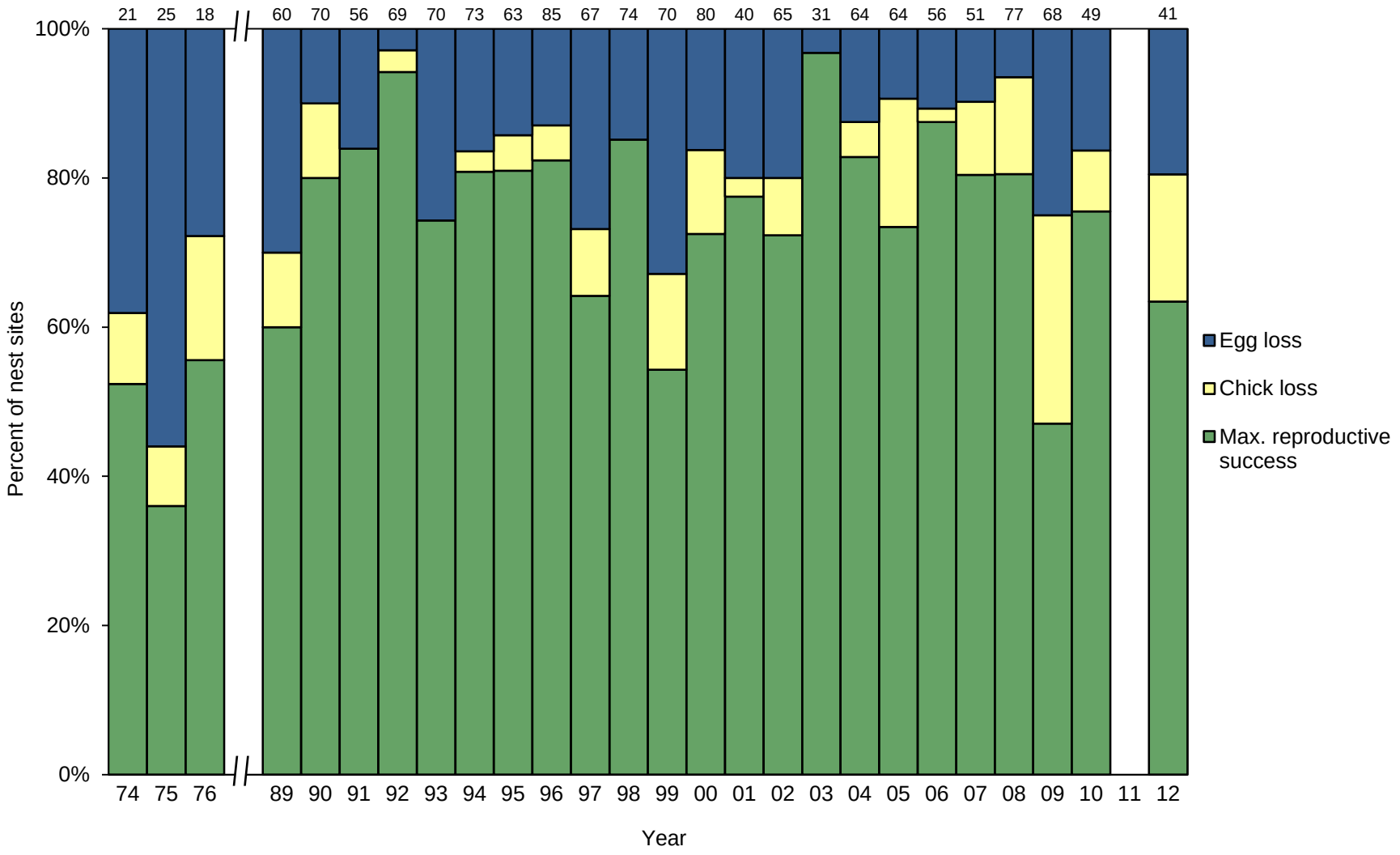

Figure 2. Reproductive performance of fork-tailed storm-petrels at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Maximum reproductive success=Fmax/B, where B=nest sites with eggs, D=nest sites with chicks; Fmax=maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 1. Reproductive performance of fork-tailed storm-petrels at Buldir Island, Alaska. Measures of success are based on only a few nest checks during the early, middle, and late periods of the season (usually intervals of about 30 days). Most chicks are too young to fledge by the time of last visit so fledging success and reproductive success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in 1977-1988.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Max. nest sites w/ chicks fledged (Fmax)[a]	Nest sites w/ viable eggs at last visit[b]	Nesting success (D/B)[c]	Maximum fledging success (Fmax/D)[d]	Maximum reproductive success (Fmax/B)
1974	21	13	11	-	0.62	0.85	0.52
1975	25	11	9	-	0.44	0.82	0.36
1976	18	13	10	-	0.72	0.77	0.56
1989	60	42	36	7	0.70	0.86	0.60
1990	70	63	56	4	0.90	0.89	0.80
1991	56	47	47	11	0.84	1.00	0.84
1992	69	67	65	4	0.97	0.97	0.94
1993	70	52	52	11	0.74	1.00	0.74
1994	73	61	59	5	0.84	0.97	0.81
1995	63	54	51	11	0.86	0.94	0.81
1996	85	74	70	5	0.87	0.95	0.82
1997	67	49	43	2	0.73	0.88	0.64
1998	74	63	63	4	0.85	1.00	0.85
1999	70	47	38	1	0.67	0.81	0.54
2000	80	67	58	1	0.84	0.87	0.73
2001	40	32	31	0	0.80	0.97	0.78
2002	65	52	47	0	0.80	0.90	0.72
2003	31	30	30	0	0.97	1.00	0.97
2004	64	56	53	0	0.88	0.95	0.83
2005	64	58	47	0	0.91	0.81	0.73
2006	56	50	49	1	0.89	0.98	0.88
2007	51	46	41	4	0.90	0.89	0.80
2008	77	72	62	0	0.94	0.86	0.81
2009	68	51	32	3	0.75	0.63	0.47
2010	49	41	37	2	0.84	0.90	0.76
2011	59	-	-	-	-	-	-
2012	41	33	26	0	0.80	0.79	0.63

[a]Fmax=maximum number of chicks potentially fledged and includes both fledged chicks and all chicks still present at last check, regardless of age.

[b]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.

[c]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).

[d]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).

Table 2. Standard deviation in reproductive performance parameters of fork-tailed storm-petrels at Buldir Island, Alaska. Sampling for storm-petrels is clustered by plot except when sample sizes per plot are too small or plot data are not available. No data were collected in 1977-1988.

Year	No. plots	Nest sites w/ eggs	Sampling design[a]	Nesting success	Fledging success	Reproductive success
1974	xx[a]	21	xx	xx	xx	xx
1975	xx	25	xx	xx	xx	xx
1976	xx	18	xx	xx	xx	xx
1989	xx	60	xx	xx	xx	xx
1990	xx	70	xx	xx	xx	xx
1991	xx	56	xx	xx	xx	xx
1992	xx	69	xx	xx	xx	xx
1993	xx	70	xx	xx	xx	xx
1994	xx	73	xx	xx	xx	xx
1995	xx	63	xx	xx	xx	xx
1996	xx	85	xx	xx	xx	xx
1997	xx	67	xx	xx	xx	xx
1998	xx	74	xx	xx	xx	xx
1999	xx	70	xx	xx	xx	xx
2000	xx	80	xx	xx	xx	xx
2001	xx	40	xx	xx	xx	xx
2002	xx	65	xx	xx	xx	xx
2003	xx	31	xx	xx	xx	xx
2004	xx	64	xx	xx	xx	xx
2005	xx	64	xx	xx	xx	xx
2006	xx	56	xx	xx	xx	xx
2007	xx	51	xx	xx	xx	xx
2008	xx	77	xx	xx	xx	xx
2009	5	68	Cluster by plot	0.09	0.17	0.13
2010	5	49	Cluster by plot	0.05	0.04	0.07
2011	5	59	-	-	-	-
2012	5	41	Cluster by plot	0.05	0.08	0.08

[a]For sampling clustered by plot, values are calculated using ratio estimator spreadsheets based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1-\rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

[b]xx indicates data potentially exist but have not yet been summarized.

Table 3. Reproductive performance of fork-tailed storm-petrels at Buldir Island, Alaska in 2012.

Parameter	Plot					Total	SD[a]
	1	2	3	4	7		
Nest sites w/ eggs (B)	3	5	7	15	11	41	-
Nest sites w/ chicks (D)	2	4	6	11	10	33	-
Max. nest sites w/ chicks fledged (Fmax)[b]	1	4	3	9	9	26	-
Nest sites w/ viable eggs at last visit[c]	0	0	0	0	0	0	-
Nesting success (D/B)[d]	0.67	0.80	0.86	0.73	0.90	0.80	0.05
Maximum fledging success (Fmax/D)[e]	0.50	1.00	0.50	0.82	0.90	0.79	0.08
Maximum reproductive success (Fmax/B)	0.33	0.80	0.43	0.60	0.82	0.63	0.08

[a]Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

[b]Fmax=maximum number of chicks potentially fledged and includes both fledged chicks and all chicks still present at last check, regardless of age.

[c]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.

[d]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).

[e]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).

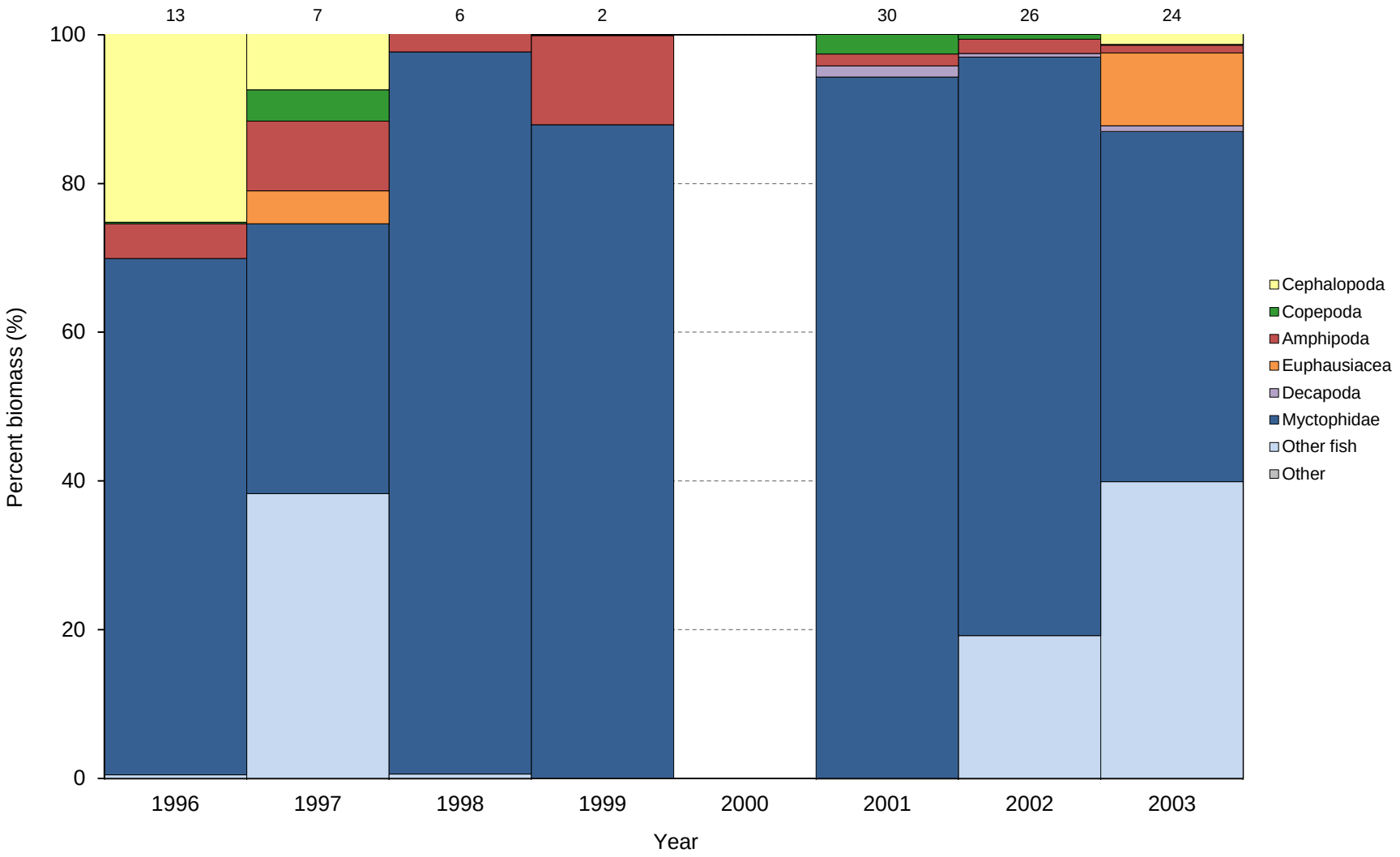

Figure 3. Relative biomass of prey in diets of fork-tailed storm-petrel chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2004-2012 but have not yet been summarized.

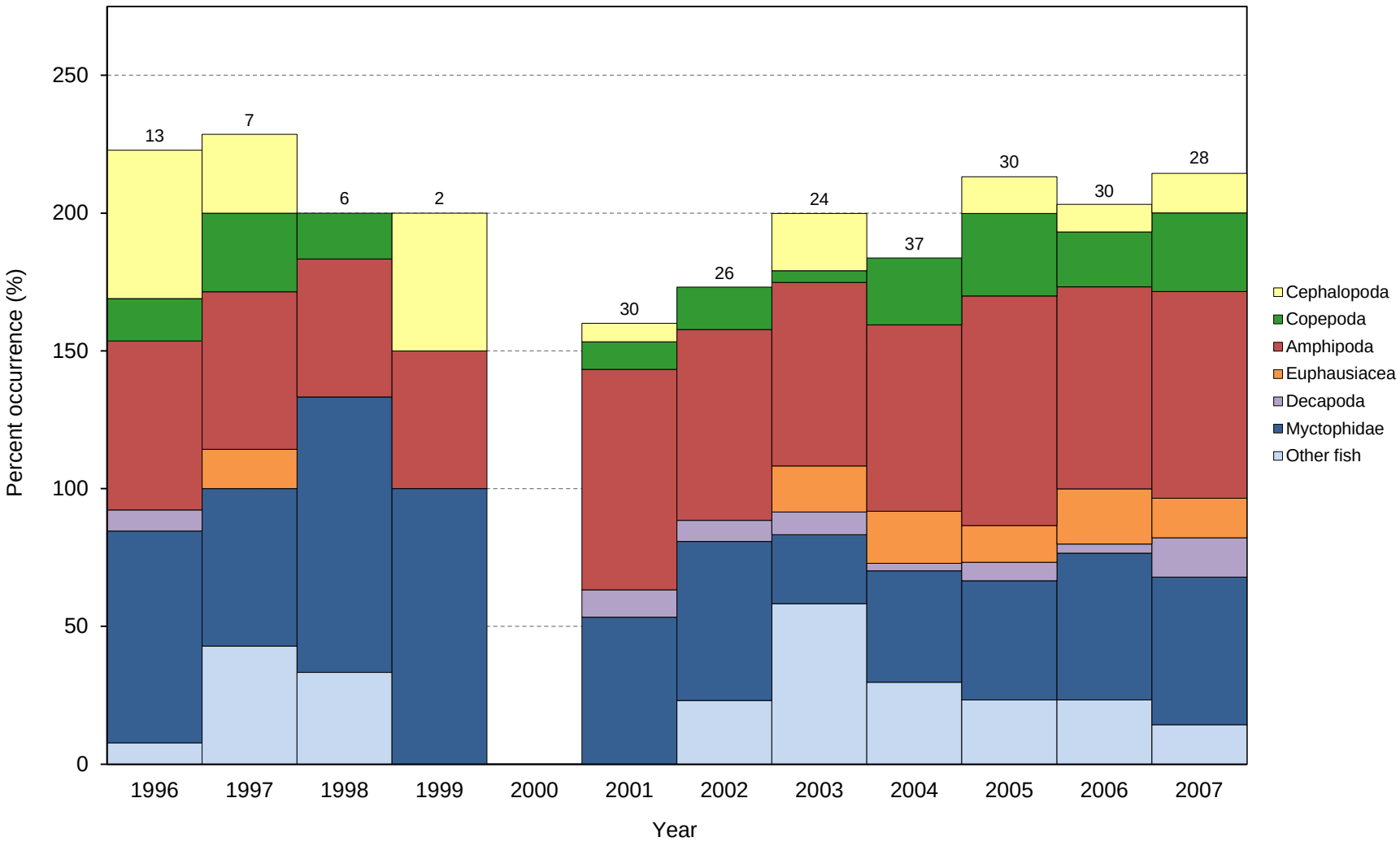

Figure 4. Frequency of occurrence of prey in diets of fork-tailed storm-petrel chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2008-2012 but have not yet been summarized.

Table 4. Relative biomass of prey in diets of fork-tailed storm-petrel chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2004-2012 but have not yet been summarized.

Prey	1996	1997	1998	1999	2000	2001	2002	2003
No. samples[a]	13	7	6	2	*no samples*	30	26	24
Total mass (g)	101.7	24.8	53.2	15.0		35.6	40.5	26.8
Invertebrates	**30.1**	**25.4**	**2.4**	**12.1**	**-**	**5.7**	**3.1**	**13.0**
Cephalopoda	**27.5**	**12.1**	**0.0**	**0.1**	**-**	**0.3**	**0.0**	**1.8**
Decabrachia	**27.5**	**12.1**	**-**	**0.1**	**-**	**0.3**	**-**	**1.8**
Unid. squid	27.5	12.1	-	0.1	-	0.3	-	1.8
Copepoda	**0.2**	**4.2**	**0.5**	**0.0**	**-**	**3.1**	**1.1**	**0.1**
Neocalanus cristatus	-	-	-	-	-	0.1	<0.1	-
N. plumchrus/flemingeri	0.2	4.2	0.5	-	-	2.8	1.1	0.1
Calanoid spp.	-	-	-	-	-	0.2	<0.1	-
Amphipoda	**4.7**	**9.4**	**3.8**	**12.0**	**-**	**1.6**	**1.9**	**1.1**
Hyperiidea	**0.1**	**-**	**-**	**-**	**-**	**-**	**1.1**	**-**
Hyperoche medusarum	<0.1	-	-	-	-	-	-	-
Themisto pacifica	0.1	-	-	-	-	-	1.1	0.1
Themisto spp.	-	-	-	-	-	<0.1	-	-
Gammaridea	**2.3**	**4.7**	**1.9**	**-**	**-**	**0.8**	**0.4**	**0.5**
Unid. Lysianassidae	2.3	4.7	1.9	-	-	0.8	0.4	0.5
Unid. amphipod	-	-	-	12.0	-	-	<0.1	-
Euphausiacea	**-**	**4.4**	**-**	**-**	**-**	**-**	**-**	**9.8**
Thysanoessa spp.	-	-	-	-	-	-	-	9.2
Unid. euphausiid	-	4.4	-	-	-	-	-	0.7
Decapoda	**<0.1**	**-**	**-**	**-**	**-**	**1.5**	**0.5**	**0.8**
Pandalid shrimp	-	-	-	-	-	1.1	-	-
Unid. shrimp zoea	<0.1	-	-	-	-	-	-	-
Unid. shrimp	-	-	-	-	-	0.1	0.5	0.2
Atelecyclidae megalopa	-	-	-	-	-	0.3	-	-
Unid. crab megalopa	-	-	-	-	-	-	-	0.56
Fish	**69.9**	**74.6**	**97.7**	**87.9**	**-**	**94.3**	**97.0**	**87.0**
Myctophidae	**69.4**	**36.3**	**97.1**	**87.9**	**-**	**94.3**	**77.8**	**47.1**
Stenobrachius leucopsarus	-	8.1	97.1	-	-	-	-	-
Unid. Myctophidae[b]	69.4	28.2	-	87.9	-	94.3	77.8	47.1
Hexagrammidae	**-**	**24.2**	**-**	**-**	**-**	**-**	**-**	**-**
Hexagrammos spp.	-	24.2	-	-	-	-	-	-
Unid. Teleostei	0.5	14.1	0.6	-	-	-	19.2	39.9

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 5) and some prey types may not appear in biomass data although they were present in diet samples.

[b]Most, if not all, of the unidentified Myctophids are likely *Stenobrachius leucopsarus*.

Table 5. Frequency of occurrence of prey in diets of fork-tailed storm-petrel chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2008-2012 but have not yet been summarized.

Prey	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
No. samples	13	7	6	2	*no samples*	30	26	24	37	30	30	28
Invertebrates	**76.9**	**85.7**	**66.7**	**50.0**	**-**	**86.7**	**73.1**	**83.3**	**81.1**	**90.0**	**83.3**	**89.3**
Cephalopoda	**53.8**	**28.6**	**-**	**50.0**	**-**	**6.7**	**-**	**20.8**	**-**	**13.3**	**10.0**	**14.3**
Decabrachia	**53.8**	**28.6**	**-**	**50.0**	**-**	**6.7**	**-**	**20.8**	**-**	**13.3**	**10.0**	**14.3**
Unid. squid	53.8	28.6	-	50.0	-	6.7	-	20.8	-	13.3	10.0	14.3
Copepoda	**15.4**	**28.6**	**16.7**	**-**	**-**	**10.0**	**15.4**	**4.2**	**24.3**	**30.0**	**20.0**	**28.6**
Neocalanus cristatus	-	-	-	-	-	6.7	3.8	-	5.0	10.0	16.7	7.1
N. plumchrus/flemingeri	15.4	28.6	16.7	-	-	6.7	11.5	4.2	18.9	23.3	6.7	28.6
Calanoid spp.	-	-	-	-	-	6.7	3.8	-	18.9	26.7	13.3	21.4
Amphipoda	**61.3**	**57.1**	**50.0**	**50.0**	**-**	**80.0**	**69.2**	**66.7**	**67.6**	**83.3**	**73.3**	**75.0**
Hyperiidea	**23.1**	**-**	**-**	**-**	**-**	**3.3**	**19.2**	**-**	**18.9**	**6.7**	**3.3**	**7.1**
Hyperoche medusarum	7.7	-	-	-	-	-	-	-	-	-	-	-
Themisto pacifica	15.4	-	-	-	-	-	19.2	8.3	8.1	6.7	-	7.1
Themisto spp.	-	-	-	-	-	3.3	-	-	10.8	-	3.3	-
Gammaridea	**46.2**	**57.1**	**50.0**	**-**	**-**	**80.0**	**65.4**	**62.5**	**56.8**	**76.7**	**66.7**	**67.9**
Paracallisoma alberti	-	-	-	-	-	-	-	-	-	-	16.7	46.4
Unid. Lysianassidae	46.2	57.1	50.0	-	-	80.0	65.4	62.5	56.8	76.7	50.0	21.4
Unid. amphipod	-	-	-	50.0	-	-	7.7	-	2.7	10.0	6.7	3.6
Euphausiacea	**-**	**14.3**	**-**	**-**	**-**	**-**	**-**	**16.7**	**18.9**	**13.3**	**20.0**	**14.3**
Thysanoessa spp.	-	-	-	-	-	-	-	4.2	10.8	13.3	13.3	7.1
Unid. euphausiid	-	14.3	-	-	-	-	-	12.5	8.1	-	10.0	7.1
Decapoda	**7.7**	**-**	**-**	**-**	**-**	**10.0**	**7.7**	**8.2**	**2.7**	**6.7**	**3.3**	**14.3**
Pandalid shrimp	-	-	-	-	-	3.3	-	-	-	-	-	3.6
Unid. shrimp zoea	7.7	-	-	-	-	-	-	-	-	-	-	-
Unid. shrimp	-	-	-	-	-	3.3	7.7	4.2	-	-	3.3	7.1
Atelecyclidae megalopa	-	-	-	-	-	3.3	-	-	2.7	6.7	-	3.6
Unid. crab megalopa	-	-	-	-	-	-	-	4.2	-	-	-	-
Unid. crustacean	-	14.3	-	-	-	-	-	-	-	-	-	-
Fish	**84.6**	**100.0**	**100.0**	**100.0**	**-**	**53.3**	**80.8**	**83.3**	**73.0**	**63.3**	**76.7**	**67.9**
Myctophidae	**76.9**	**57.1**	**100.0**	**100.0**	**-**	**53.3**	**57.7**	**25.0**	**40.5**	**43.3**	**53.3**	**53.6**
Stenobrachius leucopsarus	-	14.3	100.0	-	-	-	-	-	-	-	-	3.6
Unid. Myctophidae[A]	76.9	42.9	-	100.0	-	53.3	57.7	25.0	40.5	43.3	53.3	50.0
Hexagrammidae	**-**	**14.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hexagrammos spp.	-	14.3	-	-	-	-	-	-	-	-	-	-
Ammodytidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.3**	**-**	**-**
Ammodytes hexapterus	-	-	-	-	-	-	-	-	-	3.3	-	-
Unid. Teleostei	7.7	28.6	33.3	-	-	-	23.1	58.3	29.7	16.7	23.3	14.3
Other	**-**	**14.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Plastic	-	14.3	-	-	-	-	-	-	-	-	-	-

[A]Most, if not all, of the unidentified Myctophids are likely *Stenobrachius leucopsarus*.

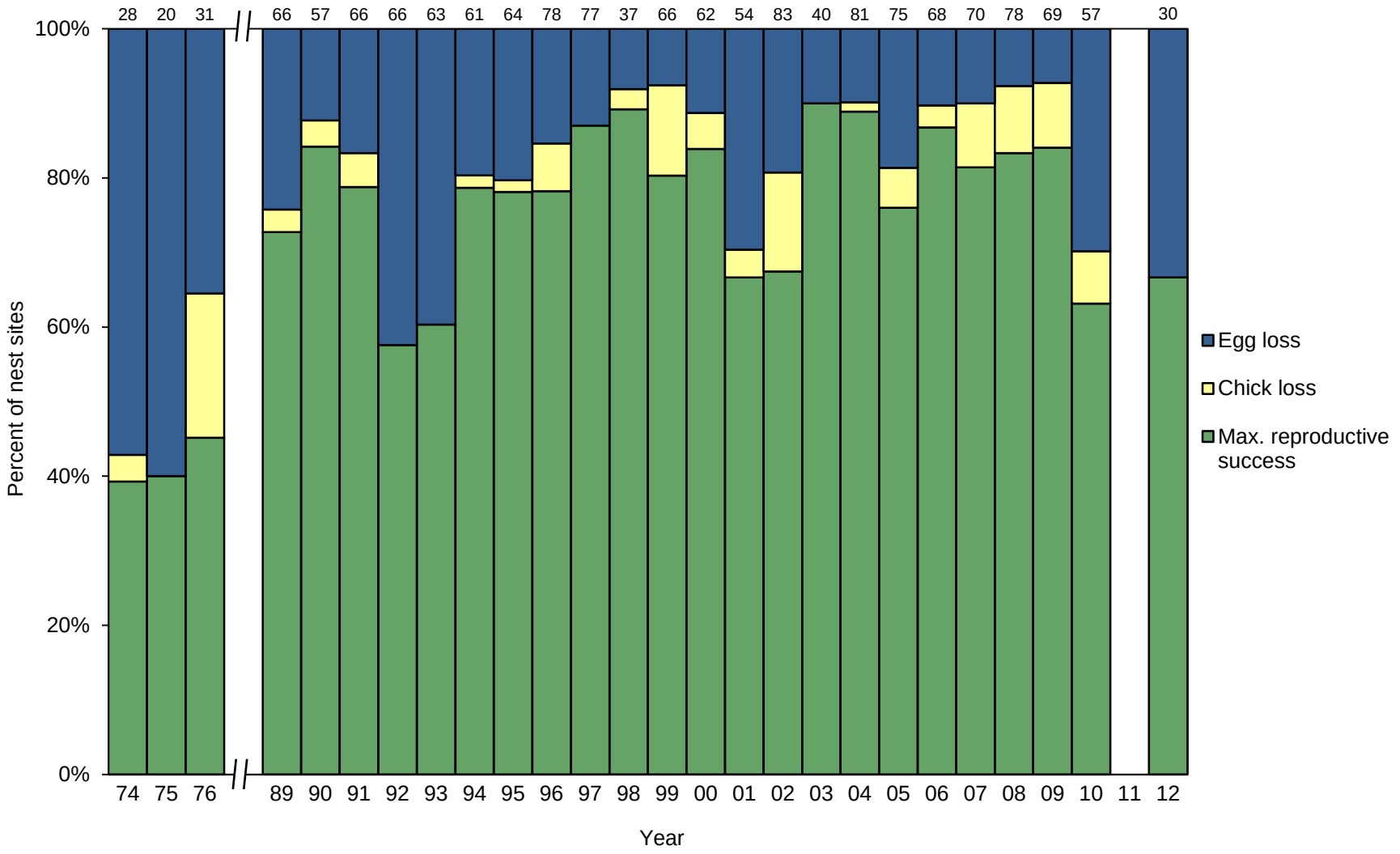

Figure 5. Reproductive performance of Leach's storm-petrels at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Maximum reproductive success=Fmax/B, where B=nest sites with eggs, D=nest sites with chicks; Fmax=maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 6. Reproductive performance of Leach's storm-petrels at Buldir Island, Alaska. Measures of success are based on only a few nest checks during the early, middle, and late periods of the season (usually intervals of about 30 days). Most chicks are too young to fledge by the time of last visit so fledging success and reproductive success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in 1977-1988.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Max. nest sites w/ chicks fledged (Fmax)[a]	Nest sites w/ viable eggs at last visit[b]	Nesting success (D/B)[c]	Maximum fledging success (Fmax/D)[d]	Maximum reproductive success (Fmax/B)
1974	28	12	11	-	0.43	0.92	0.39
1975	20	8	8	-	0.40	1.00	0.40
1976	31	20	14	-	0.65	0.70	0.45
1989	66	50	48	18	0.76	0.96	0.73
1990	57	50	48	18	0.88	0.96	0.84
1991	66	55	52	18	0.83	0.95	0.79
1992	66	38	38	16	0.58	1.00	0.58
1993	63	38	38	39	0.60	1.00	0.60
1994	61	49	48	11	0.80	0.98	0.79
1995	64	51	50	11	0.80	0.98	0.78
1996	78	66	61	10	0.85	0.92	0.78
1997	77	67	67	7	0.87	1.00	0.87
1998	37	34	33	14	0.92	0.97	0.89
1999	66	61	53	17	0.92	0.87	0.80
2000	62	55	52	7	0.89	0.95	0.84
2001	54	38	36	1	0.70	0.95	0.67
2002	83	67	56	2	0.81	0.84	0.67
2003	40	36	36	0	0.90	1.00	0.90
2004	81	73	72	4	0.90	0.99	0.89
2005	75	61	57	2	0.81	0.93	0.76
2006	68	61	59	4	0.90	0.97	0.87
2007	70	63	57	2	0.90	0.90	0.81
2008	78	72	65	0	0.92	0.90	0.83
2009	69	64	58	10	0.93	0.91	0.84
2010	57	40	36	4	0.70	0.90	0.63
2011	49	-	-	-	-	-	-
2012	30	20	20	4	0.67	1.00	0.67

[a]Fmax=maximum number of chicks potentially fledged and includes both fledged chicks and all chicks still present at last check, regardless of age.

[b]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.

[c]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).

[d]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).

Table 7. Standard deviation in reproductive performance parameters of Leach's storm-petrels at Buldir Island, Alaska. Data include only non-chronology plots monitored on an interval of about 14 days. Sampling for storm-petrels is clustered by plot except when sample sizes per plot are too small or plot data are not available. No data were collected in 1977-1988.

Year	No. plots	Nest sites w/ eggs	Sampling design[a]	Nesting success	Fledging success	Reproductive success
1974	xx[a]	28	xx	xx	xx	xx
1975	xx	20	xx	xx	xx	xx
1976	xx	31	xx	xx	xx	xx
1989	xx	66	xx	xx	xx	xx
1990	xx	57	xx	xx	xx	xx
1991	xx	66	xx	xx	xx	xx
1992	xx	66	xx	xx	xx	xx
1993	xx	63	xx	xx	xx	xx
1994	xx	61	xx	xx	xx	xx
1995	xx	64	xx	xx	xx	xx
1996	xx	78	xx	xx	xx	xx
1997	xx	77	xx	xx	xx	xx
1998	xx	37	xx	xx	xx	xx
1999	xx	66	xx	xx	xx	xx
2000	xx	62	xx	xx	xx	xx
2001	xx	54	xx	xx	xx	xx
2002	xx	83	xx	xx	xx	xx
2003	xx	40	xx	xx	xx	xx
2004	xx	81	xx	xx	xx	xx
2005	xx	75	xx	xx	xx	xx
2006	xx	68	xx	xx	xx	xx
2007	xx	70	xx	xx	xx	xx
2008	xx	78	xx	xx	xx	xx
2009	5	69	Cluster by plot	0.09	0.11	0.15
2010	5	57	Cluster by plot	0.11	0.06	0.13
2011	5	49	-	-	-	-
2012	5	30	Cluster by plot	0.06	0.00	0.06

[a]For sampling clustered by plot, values are calculated using ratio estimator spreadsheets based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1-\rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

[b]xx indicates data potentially exist but have not yet been summarized.

Table 8. Reproductive performance of Leach's storm-petrels at Buldir Island, Alaska in 2012.

Parameter	Plot					Total	SD[a]
	1	2	3	4	7		
Nest sites w/ eggs (B)	3	5	1	15	6	30	-
Nest sites w/ chicks (D)	1	4	0	11	4	20	-
Max. nest sites w/ chicks fledged (Fmax)[b]	1	4	0	11	4	20	-
Nest sites w/ viable eggs at last visit[c]	1	0	0	2	1	4	-
Nesting success (D/B)[d]	0.33	0.80	0.00	0.73	0.67	0.67	0.06
Maximum fledging success (Fmax/D)[e]	1.00	1.00	0.00	1.00	1.00	1.00	0.00
Maximum reproductive success (Fmax/B)	0.33	0.80	0.00	0.73	0.67	0.67	0.06

[a]Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

[b]Fmax=maximum number of chicks potentially fledged and includes both fledged chicks and all chicks still present at last check, regardless of age.

[c]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.

[d]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).

[e]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).

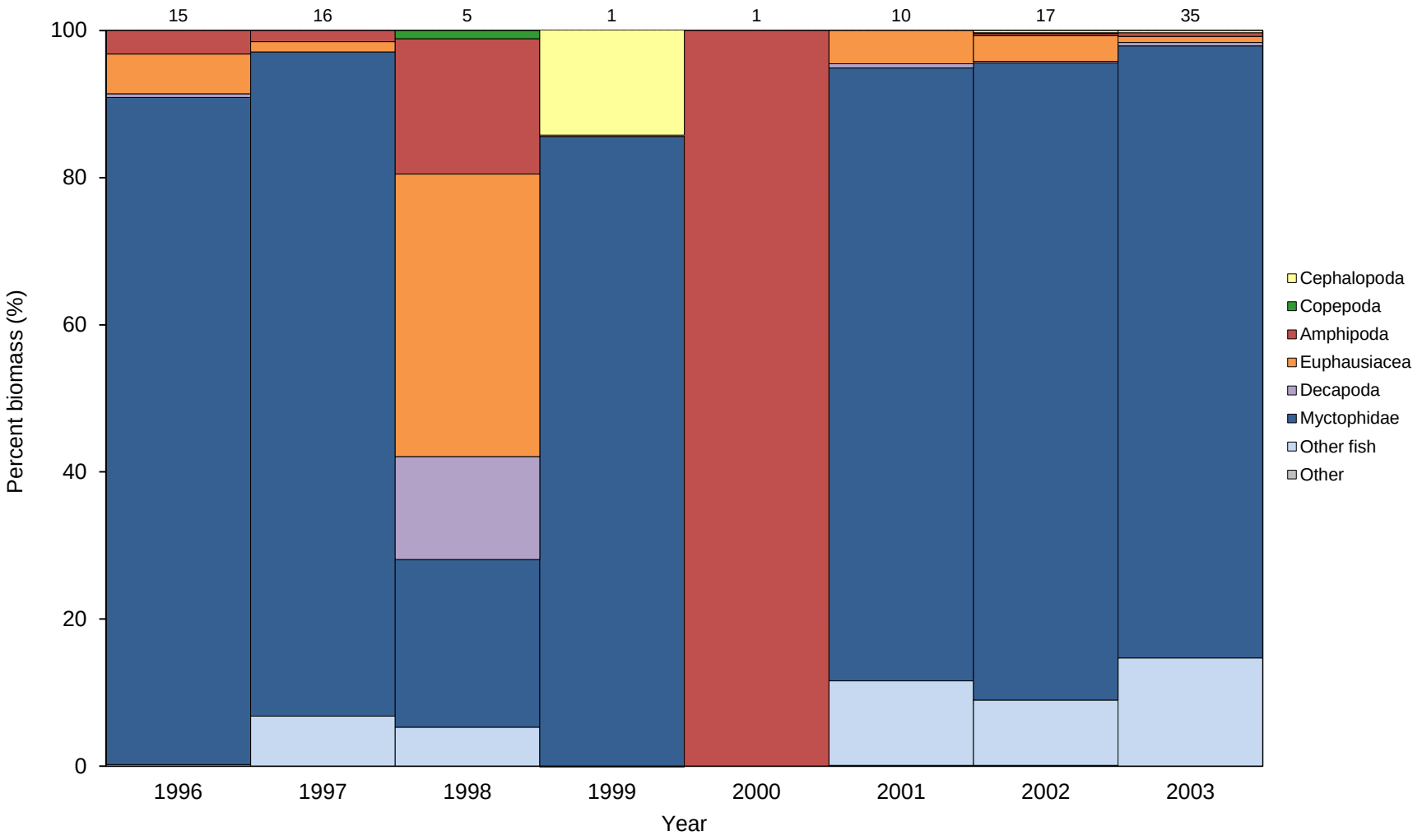

Figure 6. Percent biomass of prey in diets of Leach's storm-petrel chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2004-2012 but have not yet been summarized.

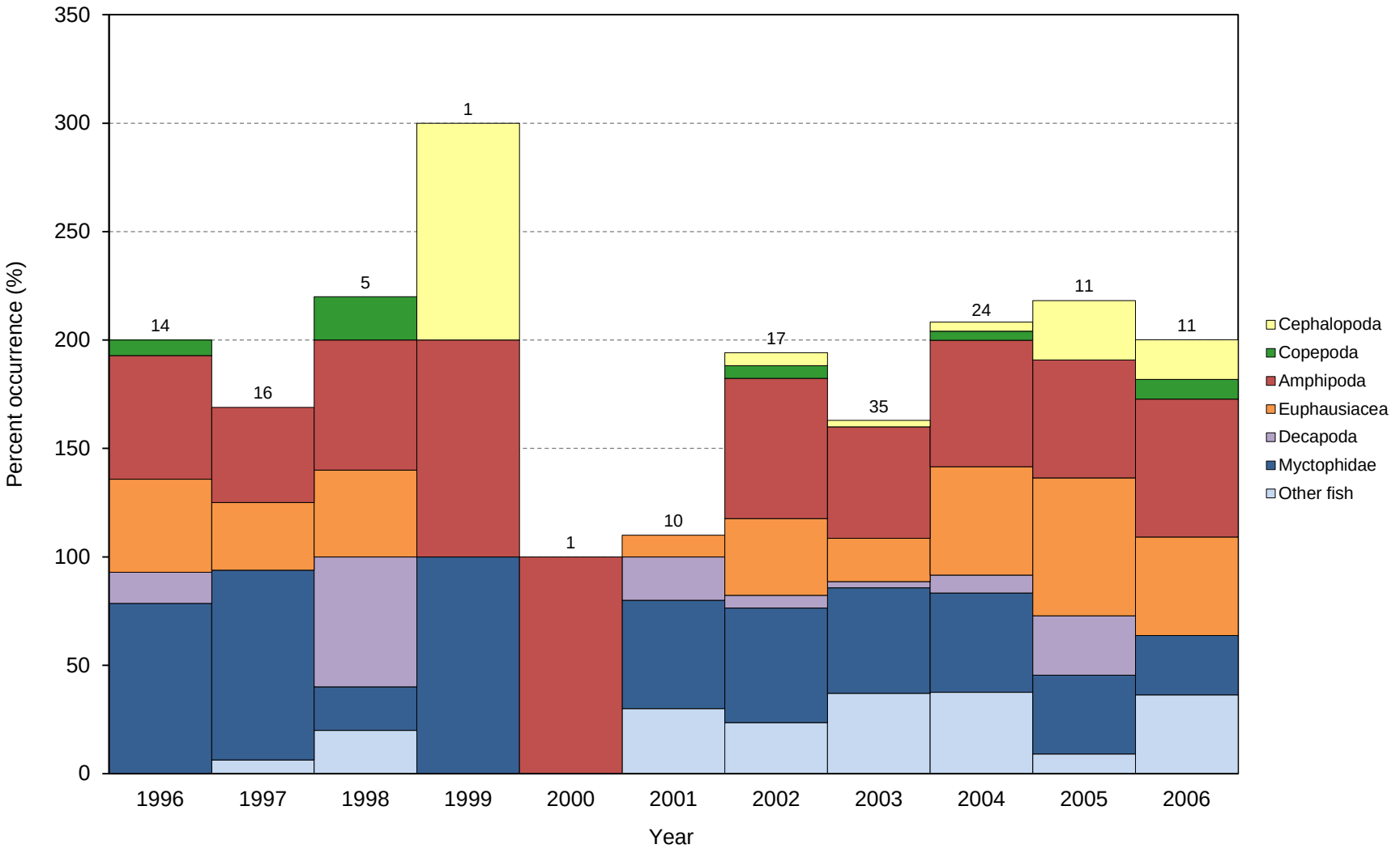

Figure 7. Frequency of occurrence of prey in diets of Leach's storm-petrel chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2007-2012 but have not yet been summarized.

Table 9. Relative biomass of prey in diets of Leach's storm-petrel chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2004-2012 but have not yet been summarized.

Prey	1996	1997	1998	1999	2000	2001	2002	2003
No. samples[a]	14	16	5	1	1	10	17	35
Total mass (g)	55.1	146.8	5.7	10.5	<1.0	12.6	21.8	42.9
Invertebrates	**9.1**	**2.9**	**71.9**	**14.5**	**100.0**	**5.1**	**4.4**	**2.1**
Cephalopoda	**-**	**-**	**-**	**14.3**	**-**	**-**	**0.3**	**0.3**
Decabrachia	**-**	**-**	**-**	**14.3**	**-**	**-**	**0.3**	**0.3**
Unid. squid	-	-	-	14.3	-	-	0.3	0.3
Copepoda	**<0.1**	**-**	**1.1**	**-**	**-**	**-**	**0.1**	**-**
Neocalanus cristatus	<0.1	-	1.1	-	-	-	0.1	-
Amphipoda	**3.2**	**1.5**	**18.4**	**0.2**	**100.0**	**-**	**0.3**	**0.5**
Hyperiidea	**0.3**	**-**	**-**	**-**	**-**	**-**	**<0.1**	**-**
Hyperoche medusarum	0.2	-	-	-	-	-	-	-
Themisto pacifica	0.1	-	-	-	-	-	<0.1	-
Gammaridea	**2.9**	**1.5**	**18.4**	**-**	**100.0**	**-**	**0.3**	**0.5**
Calliopius spp.	-	-	-	-	-	-	-	<0.1
Unid. Lysianassidae	2.9	1.5	17.5	-	100.0	-	0.3	0.5
Unid. Gammaridae	-	-	0.9	-	-	-	-	-
Unid amphipod	-	-	-	0.2	-	-	<0.1	-
Euphausiacea	**5.4**	**1.4**	**38.4**	**-**	**-**	**4.5**	**3.5**	**0.8**
Thysanoessa spp.	-		-	-	-	-	-	-
Unid. euphausiid	5.4	1.4	38.4	-	-	4.5	3.5	0.8
Decapoda	**0.5**	**-**	**14.0**	**-**	**-**	**0.6**	**0.2**	**0.5**
Unid. shrimp zoea	<0.1	-	-	-	-	-	-	-
Unid. shrimp	0.5	-		-	-	0.4	0.2	-
Unid. crab zoea	<0.1	-	-	-	-	-	-	-
Atelecyclidae megalopa	-	-	14.0	-	-	0.2	-	0.5
Fish	**90.7**	**97.1**	**28.1**	**85.6**	**-**	**94.8**	**95.5**	**97.9**
Myctophidae	**90.7**	**90.3**	**22.8**	**85.6**	**-**	**83.3**	**86.6**	**83.2**
Stenobrachius leucopsarus	-	33.7	22.8	-	-	-	-	-
Myctophid, not *S. leucopsarus*	-	15.7	-	-	-	-	-	-
Unid. Myctophidae[b]	90.7	40.9	-	85.6	-	83.3	86.6	83.2
Gadidae								
Unid. Gadidae						11.5	-	-
Unid. Teleostei	-	6.8	5.3	-	-	-	8.9	14.7

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 10) and some prey types may not appear in biomass data although they were present in diet samples.

[b]Most, if not all, of the unidentified Myctophids are likely *Stenobrachius leucopsarus*.

Table 10. Frequency of occurrence of prey in diets of Leach's storm-petrel chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2007-2012 but have not yet been summarized.

Prey	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. samples	14	16	5	1	1	10	17	35	24	11	11
Invertebrates	**71.4**	**68.8**	**80.0**	**100.0**	**100.0**	**30.0**	**76.5**	**57.1**	**83.3**	**100.0**	**81.8**
Cephalopoda	**-**	**-**	**-**	**100.0**	**-**	**-**	**5.9**	**2.9**	**4.2**	**27.3**	**18.2**
Decabrachia	**-**	**-**	**-**	**100.0**	**-**	**-**	**5.9**	**2.9**	**4.2**	**27.3**	**18.2**
Unid. squid	-	-	-	100.0	-	-	5.9	2.9	4.2	27.3	18.2
Copepoda	**7.1**	**-**	**20.0**	**-**	**-**	**-**	**5.9**	**-**	**4.2**	**-**	**9.1**
Neocalanus cristatus	7.1	-	20.0	-	-	-	5.9	-	4.2	-	-
Calanoid spp.	-	-	-	-	-	-	-	-	-	-	9.1
Amphipoda	**57.1**	**43.8**	**60.0**	**100.0**	**100.0**	**-**	**64.7**	**51.4**	**58.3**	**54.5**	**63.6**
Hyperiidea	**35.7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hyperoche medusarum	21.4	-	-	-	-	-	-	-	-	-	-
Themisto pacifica	21.4	-	-	-	-	-	5.9	-	-	-	-
Gammaridea	**21.4**	**43.8**	**40.0**	**-**	**100.0**	**-**	**58.8**	**48.6**	**54.2**	**45.5**	**63.6**
Calliopius laeviuculus	-	-	-	-	-	-	-	-	-	9.1	-
Calliopius spp.	-	-	-	-	-	-	-	8.6	-	-	-
Paracallisoma alberti	-	-	-	-	-	-	-	-	-	-	54.5
Unid. Lysianassidae	21.4	43.8	60.0	-	100.0	-	58.8	42.9	54.2	36.4	-
Unid. Gammaridae	-	-	20.0	-	-	-	-	-	-	-	-
Unid amphipod	-	-	-	100.0	-	-	5.9	-	8.3	9.1	9.1
Euphausiacea	**42.9**	**31.3**	**40.0**	**-**	**-**	**10.0**	**35.3**	**20.0**	**50.0**	**63.6**	**45.5**
Thysanoessa spp.	-		-	-	-	-	-	-	29.2	18.2	9.1
Unid. euphausiid	42.9	31.3	40.0	-	-	10.0	35.3	20.0	20.8	54.5	36.4
Decapoda	**14.3**	**-**	**60.0**	**-**	**-**	**20.0**	**5.9**	**2.9**	**8.3**	**27.3**	**-**
Unid. shrimp zoea	7.1	-	-	-	-	-	-	-	-	-	-
Unid. shrimp	7.1	-	-	-	-	10.0	5.9	-	4.2	-	-
Unid. crab zoea	7.1	-	-	-	-	-	-	-	-	-	-
Atelecyclidae megalopa	-	-	60.0	-	-	10.0	-	2.9	4.2	27.3	-
Fish	**78.6**	**93.8**	**40.0**	100.0	-	**80.0**	**70.6**	**85.7**	**83.3**	**45.5**	**63.6**
Osmeridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**4.2**	**-**	**-**
Unid. Osmeridae	-	-	-	-	-	-	-	-	4.2	-	-
Myctophidae	**78.6**	**87.5**	**20.0**	**100.0**	**-**	**50.0**	**52.9**	**48.6**	**45.8**	**36.4**	**27.3**
Stenobrachius leucopsarus	-	25.0	20.0	-	-	-	-	-	-	-	-
S. nannochir	-	-	-	-	-	-	-	-	-	9.1	-
S. regale	-	-	-	-	-	-	-	-	-	9.1	-
Myctophid, not *S. leucopsarus*	-	6.3	-	-	-	-	-	-	-	-	-
Unid. Myctophidae[a]	78.6	56.3	-	100.0	-	50.0	52.9	48.6	45.8	18.2	27.3
Gadidae	**-**	**-**	**-**	**-**	**-**	**30.0**	**-**	**-**	**-**	**-**	**-**
Unid. Gadidae	-	-	-	-	-	30.0	-	-	-	-	-
Unid. Teleostei	-	6.3	20.0	-	-	-	23.5	37.1	37.5	9.1	36.4

[a]Most, if not all, of the unidentified Myctophids are likely *Stenobrachius leucopsarus*.

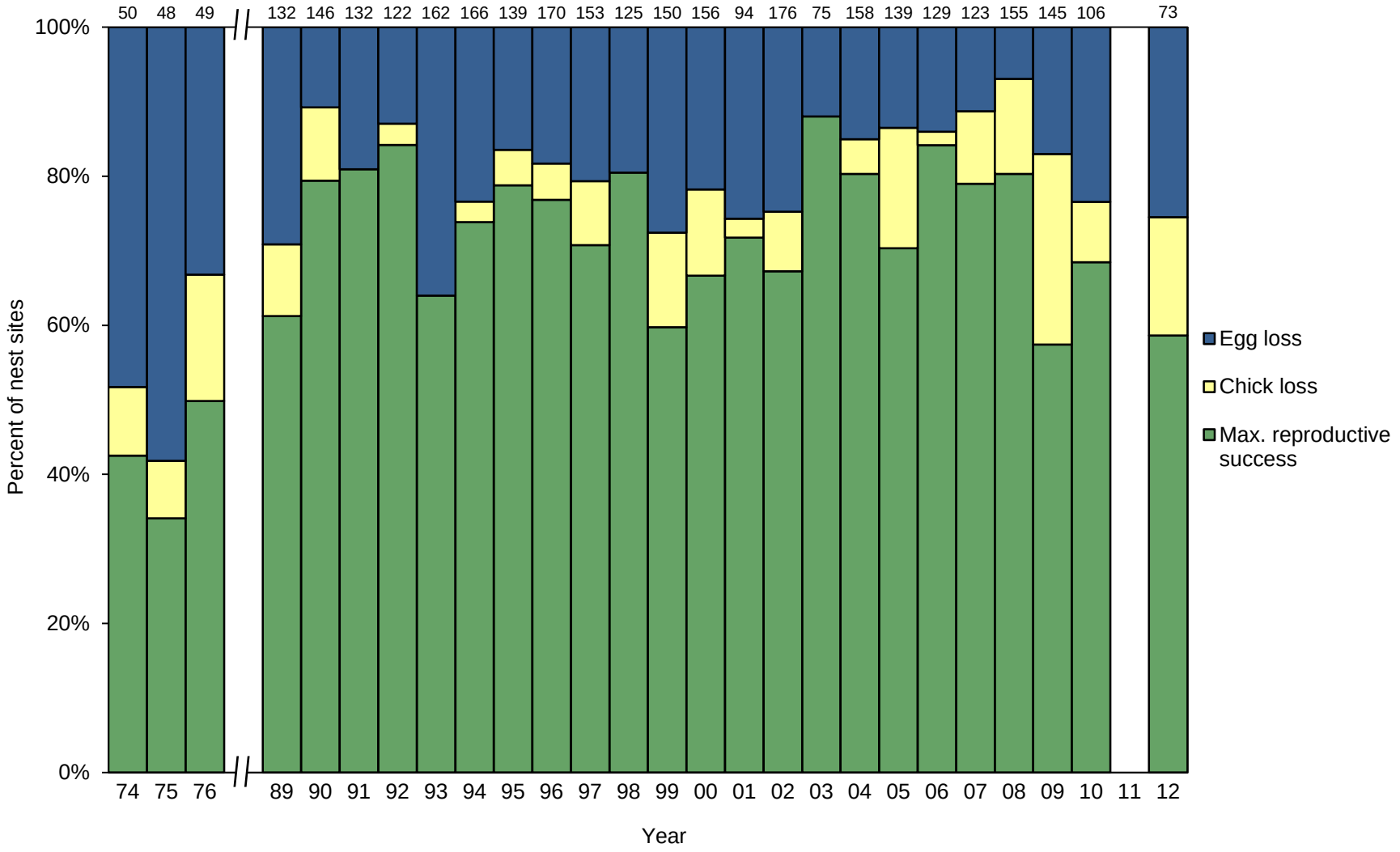

Figure 8. Reproductive performance of all storm-petrels (fork-tailed, Leach's, and unknown storm-petrel species) at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Maximum reproductive success=Fmax/B, where B=nest sites with eggs, D=nest sites with chicks; Fmax=maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 11. Reproductive performance of all storm-petrels (fork-tailed, Leach's, and unknown storm-petrel species) at Buldir Island, Alaska. Measures of success are based on only a few nest checks during the early, middle, and late periods of the season (usually intervals of about 30 days). Most chicks are too young to fledge by the time of last visit so fledging success and reproductive success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge. No data were collected in 1977-1988.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Max. nest sites w/ chicks fledged (Fmax)[a]	Nest sites w/ viable eggs at last visit[b]	Nesting success (D/B)[c]	Maximum fledging success (Fmax/D)[d]	Maximum reproductive success (Fmax/B)
1974	50	25	22	-	0.50	0.88	0.44
1975	48	19	17	-	0.40	0.89	0.35
1976	49	33	24	7	0.67	0.73	0.49
1989	132	92	84	4	0.70	0.91	0.64
1990	146	130	118	0	0.89	0.91	0.81
1991	132	107	106	0	0.81	0.99	0.80
1992	122	106	104	1	0.87	0.98	0.85
1993	162	104	103	0	0.64	0.99	0.64
1994	166	127	123	0	0.77	0.97	0.74
1995	139	116	110	7	0.83	0.95	0.79
1996	170	140	126	17	0.82	0.90	0.74
1997	153	120	113	9	0.78	0.94	0.74
1998	125	101	99	20	0.81	0.98	0.79
1999	150	108	91	16	0.72	0.84	0.61
2000	156	123	101	8	0.79	0.82	0.65
2001	94	70	67	1	0.74	0.96	0.71
2002	176	134	114	3	0.76	0.85	0.65
2003	75	66	66	0	0.88	1.00	0.88
2004	158	134	128	5	0.85	0.96	0.81
2005	139	119	104	2	0.86	0.87	0.75
2006	129	111	108	5	0.86	0.97	0.84
2007	123	109	98	7	0.89	0.90	0.80
2008	155	144	127	0	0.93	0.88	0.82
2009	145	118	91	15	0.81	0.77	0.63
2010	113	81	73	6	0.72	0.90	0.72
2011	118	-	-	-	-	-	-
2012	73	53	46	4	0.72	0.87	0.63

[a]Fmax=maximum number of chicks potentially fledged and includes both fledged chicks and all chicks still present at last check, regardless of age.

[b]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.

[c]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).

[d]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).

Table 12. Standard deviation in reproductive performance parameters of all storm-petrels (fork-tailed, Leach's, and unknown storm-petrel species) at Buldir Island, Alaska. Sampling for storm-petrels is clustered by plot except when sample sizes per plot are too small or plot data are not available. No data were collected in 1977-1988.

Year	No. plots	Nest sites w/ eggs	Sampling design[a]	Nesting success	Fledging success	Reproductive success
1974	xx[a]	50	xx	xx	xx	xx
1975	xx	48	xx	xx	xx	xx
1976	xx	49	xx	xx	xx	xx
1989	xx	132	xx	xx	xx	xx
1990	xx	146	xx	xx	xx	xx
1991	xx	132	xx	xx	xx	xx
1992	xx	122	xx	xx	xx	xx
1993	xx	162	xx	xx	xx	xx
1994	xx	166	xx	xx	xx	xx
1995	xx	139	xx	xx	xx	xx
1996	xx	170	xx	xx	xx	xx
1997	xx	153	xx	xx	xx	xx
1998	xx	125	xx	xx	xx	xx
1999	xx	150	xx	xx	xx	xx
2000	xx	156	xx	xx	xx	xx
2001	xx	94	xx	xx	xx	xx
2002	xx	176	xx	xx	xx	xx
2003	xx	75	xx	xx	xx	xx
2004	xx	158	xx	xx	xx	xx
2005	xx	139	xx	xx	xx	xx
2006	xx	129	xx	xx	xx	xx
2007	xx	123	xx	xx	xx	xx
2008	xx	155	xx	xx	xx	xx
2009	5	145	Cluster by plot	0.07	0.12	0.15
2010	5	113	Cluster by plot	0.07	0.04	0.09
2011	5	118	-	-	-	-
2012	5	73	Cluster by plot	0.04	0.06	0.06

[a]For sampling clustered by plot, values are calculated using ratio estimator spreadsheets based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1-\rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

[b]xx indicates data potentially exist but have not yet been summarized.

Table 13. Reproductive performance of all storm-petrels (fork-tailed, Leach's, and unknown storm-petrel species) at Buldir Island, Alaska in 2012.

Parameter	Plot					Total	SD[a]
	1	2	3	4	7		
Nest sites w/ eggs (B)	7	11	8	30	17	73	-
Nest sites w/ chicks (D)	3	8	6	22	14	53	-
Max. nest sites w/ chicks fledged (Fmax)[b]	2	8	3	20	13	46	-
Nest sites w/ viable eggs at last visit[c]	1	0	0	2	1	4	-
Nesting success (D/B)[d]	0.43	0.73	0.75	0.73	0.82	0.72	0.04
Maximum fledging success (Fmax/D)[e]	0.67	1.00	0.50	0.91	0.93	0.87	0.06
Maximum reproductive success (Fmax/B)	0.29	0.73	0.38	0.67	0.76	0.63	0.06

[a]Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

[b]Fmax=maximum number of chicks potentially fledged and includes both fledged chicks and all chicks still present at last check, regardless of age.

[c]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.

[d]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).

[e]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).

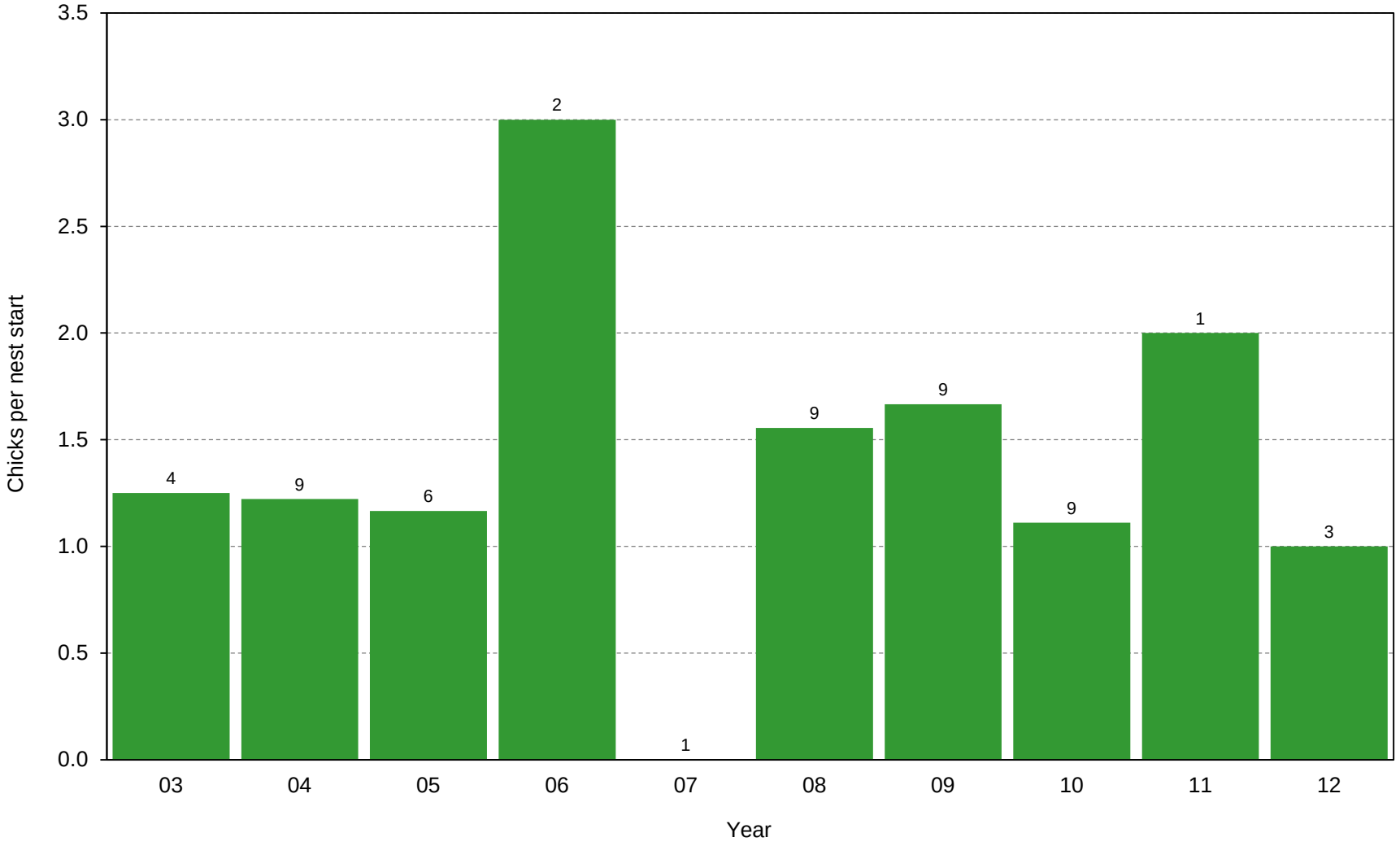

Figure 9. Reproductive performance of red-faced cormorants at Buldir Island, Alaska. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A).

Table 14. Reproductive performance of red-faced cormorants at Buldir Island, Alaska. Success is determined by a Boom or Bust methodology, using 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.

Year	Total nest starts	Nest sites w/ x chicks[a]:					Nest sites w/ chicks	Total chicks	Mean brood size	Prop. nest sites w/ chicks	Chicks/ nest start	Date(s) of max. nest count	Date(s) of max. chick count
	(A)	0	1	2	3	4	(D)	(E)	(E/D)	(D/A)[b]	(E/A)[b]		
2003	4	1	1	2	0	0	3	5	1.7	0.75	1.25	19 Jun	25 Jun
2004	9	2	1	2	2	0	5	11	2.2	0.55	1.22	17 Jun	3 Aug
2005	6	1	1	1	1	0	3	7	2.3	0.50	1.17	8 Jun	2 Aug
2006	2	0	0	0	2	0	2	6	3.0	1.00	3.00	17 Jun	4 Aug
2007	1	1	0	0	0	0	0	0	-	0.00	0.00	-	-
2008	9	4	0	1	4	0	5	14	2.8	0.55	1.56	10 Jun	22 Aug
2009	9	3	0	0	5	0	5	15	3.0	0.55	1.67	4 Jul	6 Aug
2010	9	5	0	2	2	0	5	10	2.0	0.55	1.11	17 Jul	7 Aug
2011	1	0	0	1	0	0	1	2	2.0	1.00	2.00	11 Jun	31 Jul
2012	3	2	0	0	1	0	1	3	3.0	0.33	1.00	7 Jun	29 Jul

[a]Numbers of chicks may represent a minimum count as not all may have been visible.
[b]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.

Table 15. Reproductive performance of red-faced cormorants at Buldir Island, Alaska in 2012.

Date	Total nest starts	Nest sites w/ x chicks[a]:					Nest sites w/ chicks	Total chicks
	(A)	0	1	2	3	4	(D)	(E)
1 Jun	1	1	0	0	0	0	0	0
7 Jun	3	3	0	0	0	0	0	0
15 Jun	3	3	0	0	0	0	0	0
29 Jul	1	0	0	0	1	0	1	3
5 Aug	1	0	0	1	0	0	1	2
15 Aug	1	0	1	0	0	0	1	1

[a]Numbers of chicks may represent a minimum count as not all may have been visible.

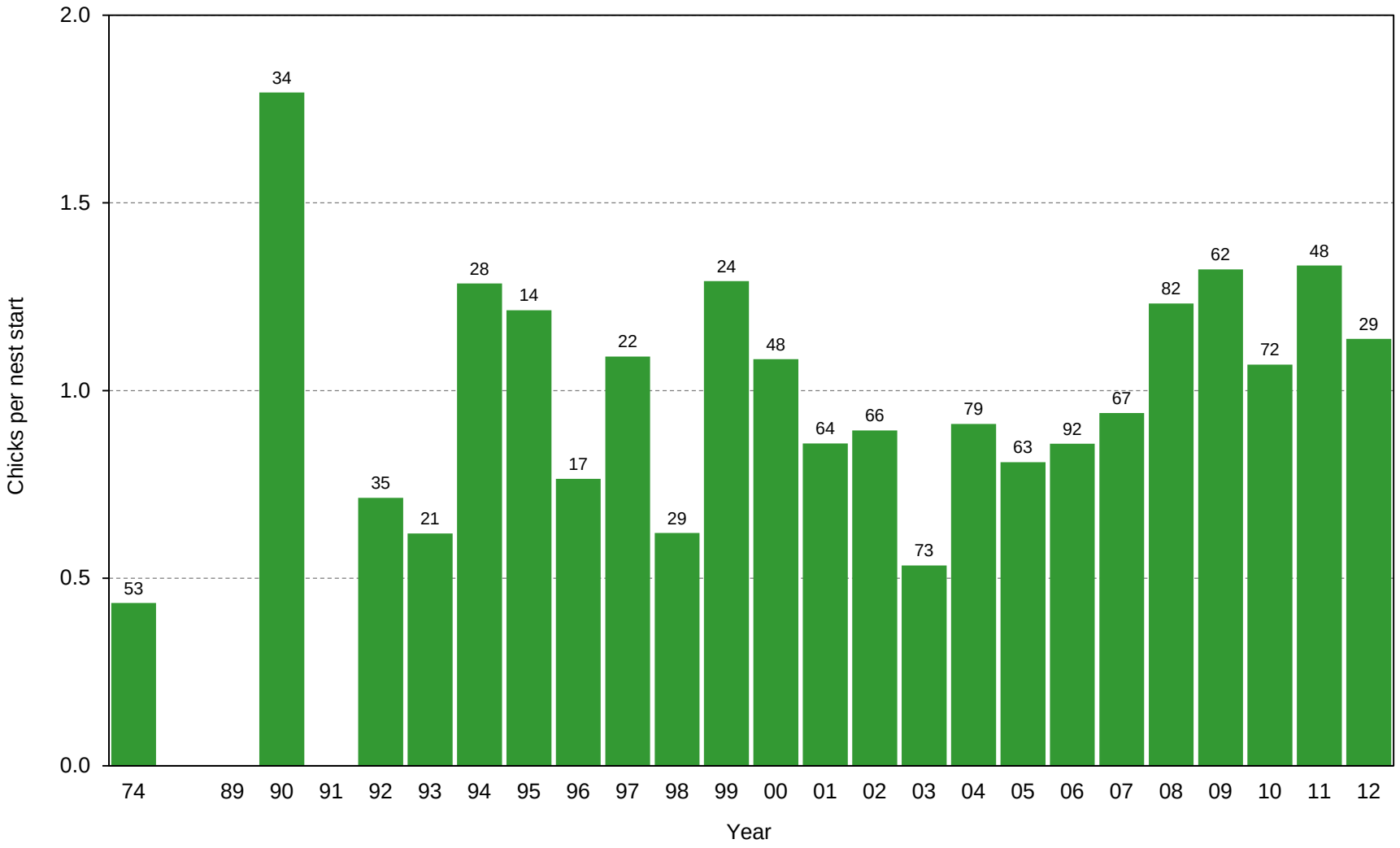

Figure 10. Reproductive performance of pelagic cormorants at Buldir Island, Alaska. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A).

Table 16. Reproductive performance of pelagic cormorants at Buldir Island, Alaska. Success is determined by a Boom or Bust methodology, using 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. Data include only cormorant nests from East Main Talus through Kittiwake Lane. No data were collected between 1975 and 1988.

Year	Total nest starts	Nest sites w/ x chicks[a]:					Nest sites w/ chicks	Total chicks	Mean brood size	Prop. nest sites w/ chicks	Chicks/ nest start	Date(s) of max. nest count	Date(s) of max. chick count
	(A)	0	1	2	3	4	(D)	(E)	(E/D)	(D/A)[b]	(E/A)[b]		
1974[c]	53	-	-	-	-	-	-	23	-	0.69[d]	0.43	?	19 Aug
1989[c]	37	-	-	-	-	-	-	-	-	-	-	16 Jun	-
1990	34	7	4	12	11	0	27	61	2.3	0.79	1.79	13 Aug	13 Aug
1991	*no data*	-	-	-	-	-	-	-	-	-	-	-	-
1992	35	25	0	5	5	0	10	25	2.5	0.29	0.71	11 Jun	2 Aug
1993	21	14	3	2	2	0	7	13	1.9	0.33	0.62	12 Jun	19 Aug
1994	28	10	6	6	6	0	18	36	2.0	0.64	1.29	15 Jun	9 Aug
1995	14	5	3	4	2	0	9	17	1.9	0.64	1.21	13 Jun	10 Aug
1996	17	9	3	5	0	0	8	13	1.6	0.47	0.76	1 Aug	5 Aug
1997	22	13	0	3	6	-	9	24	2.7	0.41	1.09	25 May	10 Aug
1998	29	14	0	6	2	-	8	18	2.3	0.28	0.62	22 Jun	7 Aug
1999	24	7	2	8	5	-	15	31	2.1	0.63	1.29	24 Jun	12 Aug
2000	48	3	8	10	0	-	25	52	2.1	0.52	1.08	6 Jun	4 Aug
2001	64	18	9	18	3	-	33	55	1.7	0.52	0.86	10 Jun	29 Aug
2002	66	0	9	19	4	-	32	59	1.8	0.48	0.89	16 Jun	5 Jul
2003	73	26	8	11	3	-	22	39	1.8	0.30	0.53	13 Jun	1 Aug
2004	79	17	2	15	12	1	30	72	2.4	0.38	0.91	27 Jun	3 Aug
2005	63	20	4	10	4	-	23	51	2.2	0.37	0.81	8 Jun	7 Aug
2006	92	9	8	17	11	1	37	79	2.1	0.40	0.86	17 Jun	4 Aug
2007	67	6	6	9	10	0	25	63	2.5	0.37	0.94	25 May	14 Aug
2008	82	4	2	25	15	1	47	101	2.1	0.57	1.23	10 Jun	6 Aug
2009	62	14	2	12	14	0	34	82	2.4	0.55	1.32	23 Jun	11 Aug
2010	72	8	5	17	10	0	33	77	2.3	0.46	1.07	23 Jun	12 Aug
2011	48	15	6	14	10	0	30	64	2.1	0.63	1.33	11 Jun	15 Aug
2012	29	13	4	7	5	0	16	33	2.1	0.55	1.14	7 Jun	5 Aug

[a]Numbers of chicks may represent a minimum count as not all may have been visible.

[b]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.

[c]Nest contents were not recorded in 1974 or 1989; data from 1974 from Byrd (1978).

[d]From a subsample of 16 nests.

Table 17. Reproductive performance of pelagic cormorants at Buldir Island, Alaska in 2012. Data include only cormorant nests from East Main Talus through Kittiwake Lane.

Date	Total nest starts	Nest sites w/ x chicks[a]:					Nest sites w/ chicks	Total chicks
	(A)	0	1	2	3	4	(D)	(E)
1 Jun	28	28	0	0	0	0	0	0
7 Jun	29	29	0	0	0	0	0	0
15 Jun	29	29	0	0	0	0	0	0
29 Jul	21	1	5	7	3	0	16	28
5 Aug	21	4	7	5	5	0	16	32
15 Aug	21	7	4	8	3	0	14	29

[a]Numbers of chicks may represent a minimum count as not all may have been visible.

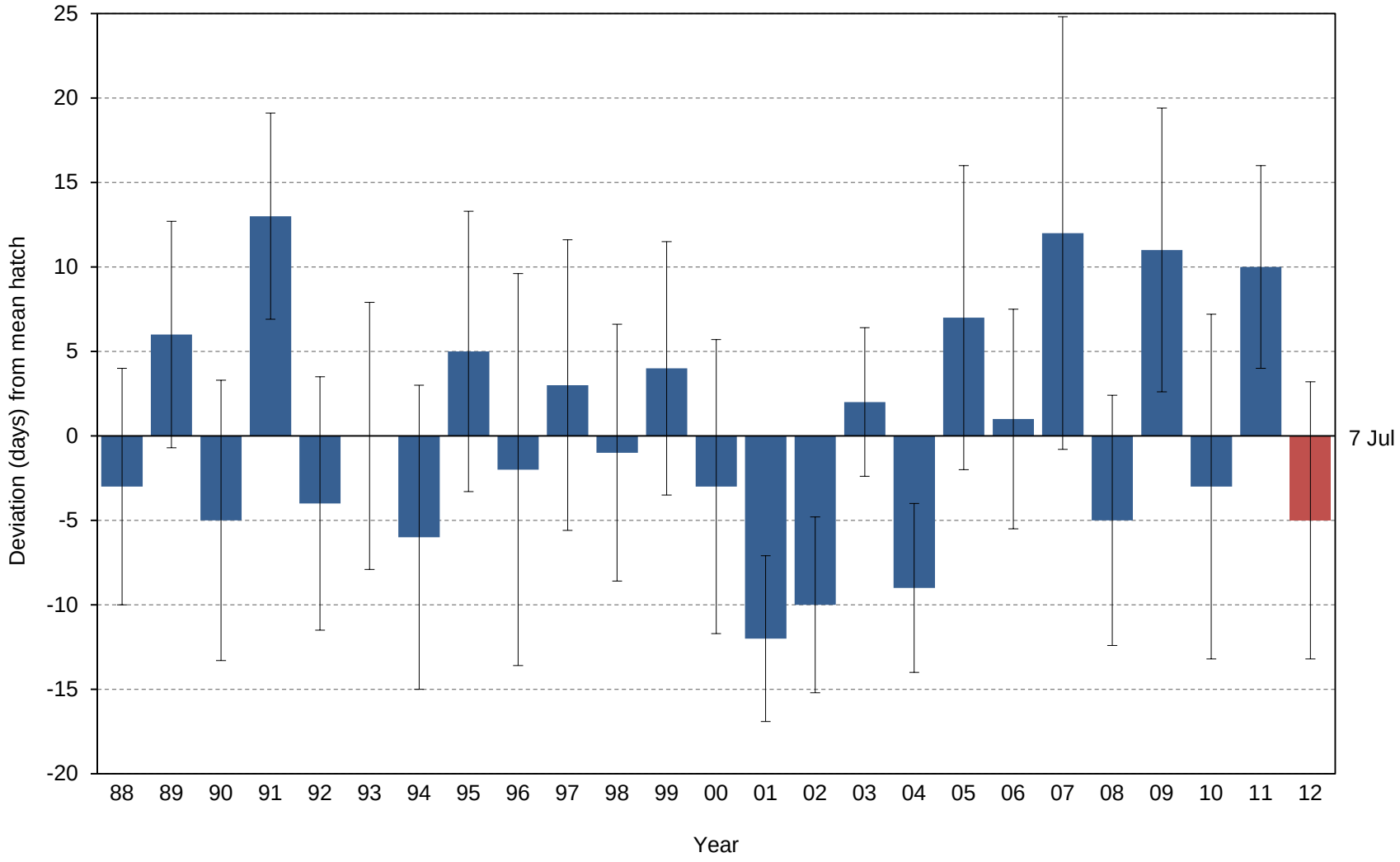

Figure 11. Yearly hatch date deviation (from the 1988-2011 average of 7 July) for black-legged kittiwakes at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 18. Breeding chronology of black-legged kittiwakes at Buldir Island, Alaska. Data represent the date of the first egg laid and the first chick hatched in each nest.

Year	Mean lay[a]	SD	*n*[b]	Mean hatch	SD	*n*[c]	First lay[a]	First hatch	Last hatch	First fledge[d]
1988	-	-	-	3 Jul	7.0	236	<21 Jun	23 Jun	24 Jul	>14 Aug
1989	-	-	-	13 Jul	6.7	32	<10 Jun	1 Jul	29 Jul	13 Jul
1990	-	-	-	2 Jul	8.3	192	<3 Jun	14 Jun	29 Jul	28 Jul
1991	-	-	-	20 Jul	6.1	67	<14 Jun	24 Jun	10 Aug	>13 Aug
1992	-	-	-	2 Jul	7.5	348	<4 Jun	14 Jun	5 Aug	27 Jul
1993	-	-	-	7 Jul	7.9	105	<7 Jun	26 Jun	23 Jul	16 Aug
1994	-	-	-	1 Jul	9.0	117	<15 Jun	19 Jun	6 Aug	12 Aug
1995	-	-	-	12 Jul	8.3	40	<15 Jun	29 Jun	8 Aug	17 Aug
1996	-	-	-	4 Jul	11.6	217	<12 Jun	16 Jun	7 Aug	2 Aug
1997	-	-	-	10 Jul	8.6	280	<9 Jun	17 Jun	7 Aug	31 Jul
1998	-	-	-	6 Jul	7.6	157	<14 Jun	16 Jun	29 Jul	4 Aug
1999	-	-	-	11 Jul	7.5	27	<24 Jun	28 Jun	4 Aug	15 Aug
2000	-	-	-	3 Jul	8.7	176	<11 Jun	12 Jun	1 Aug	1 Aug
2001	-	-	-	25 Jun	4.9	15	<17 Jun	17 Jun	5 Jul	-
2002	-	-	-	27 Jun	5.2	149	<6 Jun	15 Jun	11 Jul	26 Jul
2003	-	-	-	9 Jul	4.4	22	<17 Jun	2 Jul	19 Jul	11 Aug
2004	-	-	-	27 Jun	5.0	32	<14 Jun	17 Jun	8 Jul	15 Aug
2005	-	-	-	14 Jul	9.0	5	<15 Jun	3 Jul	25 Jul	10 Aug
2006	-	-	-	8 Jul	6.5	90	<13 Jun	23 Jun	25 Jul	4 Aug
2007	-	-	-	19 Jul	12.8	5	<15 Jun	2 Jul	10 Aug	15 Aug
2008	-	-	-	1 Jul	7.4	87	<15 Jun	18 Jun	19 Jul	31 Jul
2009	-	-	-	18 Jul	8.4	61	<12 Jun	27 Jun	4 Aug	11 Aug
2010	-	-	-	4 Jul	10.2	71	<15 Jun	18 Jun	29 Jul	2 Aug
2011	-	-	-	17 Jul	6.0	79	<18 Jun	27 Jun	31 Jul	17 Aug
2012	-	-	-	1 Jul	8.2	83	<5 Jun	14 Jun	20 Jul	30 Jul

[a]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.

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

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

[d]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 19. Frequency distribution of hatch dates for black-legged kittiwakes at Buldir Island, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date												
	88	89	90	91	92	93	94	95	96	97	98	99	00
164	-	-	-	-	-	-	-	-	-	-	-	-	1
165	-	-	1	-	-	-	-	-	-	-	-	-	-
166	-	-	-	-	6	-	-	-	-	-	-	-	-
167	-	-	-	-	-	-	-	-	-	-	2	-	-
168	-	-	-	-	-	-	-	-	11	2	-	-	4
169	-	-	-	-	-	-	-	-	-	-	-	-	-
170	-	-	-	-	-	-	2	-	-	-	-	-	-
171	-	-	-	-	15	-	10	-	2	-	3	-	-
172	-	-	-	-	-	-	-	-	15	-	-	-	1
173	-	-	-	-	-	-	-	-	-	-	-	-	-
174	-	-	3	-	-	-	-	-	-	5	-	-	16
175	15	-	-	1	1	-	-	-	-	-	-	-	-
176	3	-	-	-	38	-	36	-	34	-	14	-	-
177	3	-	1	-	-	13	-	-	-	-	-	-	1
178	8	-	84	-	-	-	-	-	-	-	-	-	-
179	8	-	-	-	-	-	-	-	-	20	-	2	54
180	56	-	32	-	2	-	-	3	33	-	-	-	-
181	1	-	22	-	-	-	37	-	-	-	-	-	-
182	22	2	8	1	130	31	-	-	-	1	37	-	1
183	15	-	-	-	-	-	-	-	1	-	-	-	1
184	-	-	-	-	-	-	-	1	31	-	-	-	-
185	1	-	-	-	3	-	-	-	-	82	4	4	30
186	22	-	1	-	82	1	19	5	-	-	34	-	-
187	5	-	-	-	-	-	-	-	1	-	-	-	-
188	21	-	5	-	-	19	-	1	-	1	-	-	-
189	14	5	-	-	-	-	-	-	13	1	-	-	2
190	-	-	-	-	4	-	-	8	-	72	1	9	-
191	2	2	2	-	-	-	-	-	-	-	-	-	-
192	9	-	-	-	33	2	-	-	-	1	38	-	44
193	7	-	11	-	-	-	-	1	-	2	-	1	-
194	5	19	-	-	-	21	-	12	-	41	-	9	-
195	-	-	-	-	3	-	-	-	23	-	-	-	-
196	3	-	-	1	18	-	-	-	-	-	17	-	-
197	-	-	1	-	-	1	2	-	-	1	-	-	9
198	2	-	-	34	-	-	-	5	-	-	-	-	-
199	-	-	-	-	-	9	1	-	-	-	-	-	-
200	4	-	-	-	-	-	4	-	30	22	-	-	1
201	-	-	-	-	-	-	-	-	-	-	3	-	-
202	-	-	16	8	6	-	-	-	-	-	-	-	10
203	-	-	-	10	-	2	-	-	-	1	-	-	-
204	7	-	-	-	-	6	1	2	15	-	-	-	-
205	2	-	-	-	1	-	-	-	-	-	-	-	-
206	1	-	4	-	4	-	3	-	-	16	2	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	10	-	-	-	-	6	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-	-	-
210	-	4	1	-	-	-	1	-	-	2	2	1	-
211	-	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	1	1	-	-	-	-	7	-	-	-
213	-	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	-	-	-	-	-	1
215	-	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-	1	-	-	1	-
217	-	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	-	1	-	1	-	-	-	-	-	-
219	-	-	-	-	-	-	-	-	-	3	-	-	-
220	-	-	-	-	-	-	-	2	1	-	-	-	-
221	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	1	-	-	-	-	-	-	-	-	-
n	236	32	192	67	348	105	117	40	217	280	157	27	176

[a]Julian dates are adjusted by one day in leap years.

Table 19 (continued). Frequency distribution of hatch dates for black-legged kittiwakes at Buldir Island, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date											
	01	02	03	04	05	06	07	08	09	10	11	12
164	-	-	-	-	-	-	-	-	-	-	-	-
165	-	-	-	-	-	-	-	-	-	-	-	-
166	-	1	-	-	-	-	-	-	-	-	-	1
167	-	-	-	-	-	-	-	-	-	-	-	-
168	2	-	-	-	-	-	-	-	-	-	-	-
169	-	1	-	1	-	-	-	-	-	1	-	-
170	-	8	-	1	-	-	-	2	-	-	-	4
171	3	22	-	-	-	-	-	-	-	-	-	-
172	-	-	-	-	-	-	-	2	-	1	-	-
173	-	2	-	-	-	-	-	-	-	-	-	-
174	-	4	-	10	-	1	-	16	-	12	-	-
175	-	18	-	-	-	-	-	-	-	-	-	-
176	-	3	-	-	-	-	-	-	-	-	-	22
177	7	2	-	-	-	-	-	2	-	-	-	-
178	-	12	-	-	-	-	-	-	1	14	1	-
179	-	-	-	-	-	-	-	-	-	-	-	2
180	1	35	-	13	-	13	-	17	-	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-
182	1	5	-	-	-	-	-	2	-	-	-	23
183	-	4	2	-	-	1	1	-	-	-	4	-
184	-	26	1	5	2	19	-	22	1	17	-	-
185	-	-	-	-	-	-	-	-	-	-	-	-
186	1	1	-	-	-	-	-	-	-	-	-	-
187	-	-	-	-	-	-	-	-	-	1	-	-
188	-	4	1	-	-	21	-	-	-	6	4	20
189	-	-	11	-	-	-	-	-	2	-	-	-
190	-	-	-	2	-	1	-	12	9	-	-	-
191	-	-	-	-	-	1	-	-	-	-	-	-
192	-	1	-	-	-	15	-	-	1	3	3	-
193	-	-	-	-	-	1	-	1	-	-	-	2
194	-	-	5	-	-	-	1	-	8	-	-	-
195	-	-	-	-	-	1	-	9	8	-	-	-
196	-	-	-	-	-	-	-	-	-	6	3	-
197	-	-	-	-	-	10	-	-	-	-	-	-
198	-	-	-	-	1	1	1	-	1	-	40	3
199	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	2	-	-	-	-	-	9	-	3	1
201	-	-	-	-	1	-	-	2	-	-	-	-
202	-	-	-	-	-	3	1	-	-	6	6	5
203	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	1	-	10	-
205	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	1	2	-	-	6	2	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	1	-	4	-
209	-	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	11	2	-	-
211	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	-	-	-	-	1	-
213	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	-	-	-	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-	2	-	-	-
217	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	-	-	-	-	-	-	-	-	-
219	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-	-	-	-	-
221	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	1	-	-	-	-	-
n	15	149	22	32	5	90	5	87	61	71	79	83

[a]Julian dates are adjusted by one day in leap years.

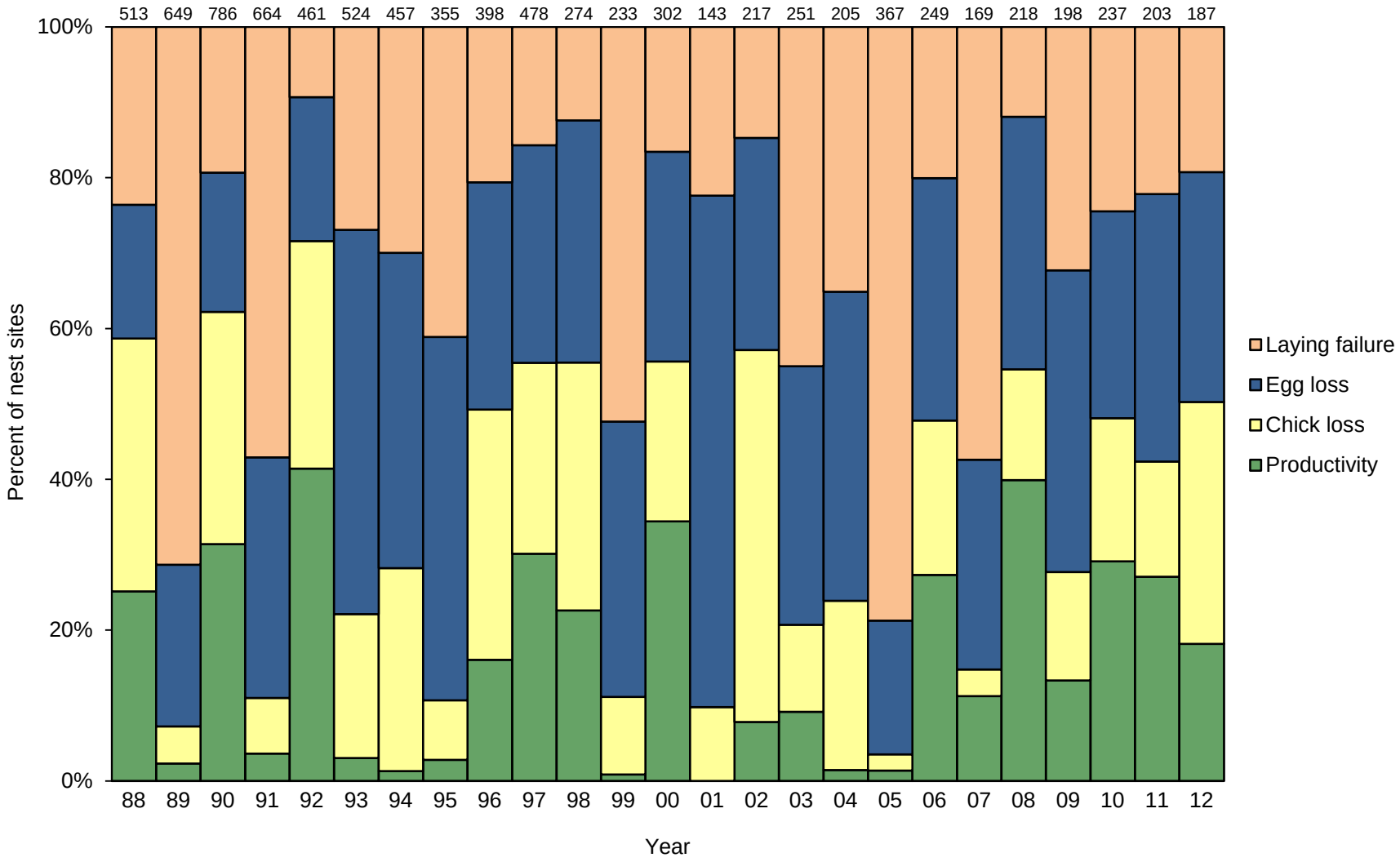

Figure 12. Reproductive performance of black-legged kittiwakes at Buldir Island, Alaska. Laying failure=(A-B)/A; Egg loss=(B-D)/A; Chick loss=(D-F)/A; Productivity=F/A, where A=total nest sites; B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (A).

Table 20. Reproductive performance of black-legged kittiwakes at Buldir Island, Alaska. No data were collected in 1977-1987.

Year	Total nest starts (A)	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)	Laying success (B/A)	Mean clutch size (C/B)	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 start (G/A)	Prod. (F/A)
1976[a]	-	74	-	-	-	-	-	-	1.6	-	-	-	-	-	-	-	-
1988	513	392	688	301	400	129	130	0.76	1.8	0.77	0.58	0.33	0.19	0.43	0.33	0.25	0.25
1989	649	186	235	47	52	15	15	0.29	1.3	0.25	0.22	0.29	0.06	0.32	0.08	0.02	0.02
1990	786	634	1140	489	655	247	247	0.81	1.8	0.77	0.57	0.38	0.22	0.51	0.39	0.31	0.31
1991	664	285	383	73	88	24	24	0.43	1.3	0.26	0.23	0.27	0.06	0.33	0.08	0.04	0.04
1992	461	418	754	330	493	191	192	0.91	1.8	0.79	0.65	0.39	0.25	0.58	0.46	0.42	0.41
1993	524	383	621	116	152	16	16	0.73	1.6	0.30	0.24	0.11	0.03	0.14	0.04	0.03	0.03
1994	457	320	532	129	162	6	6	0.70	1.7	0.40	0.30	0.04	0.01	0.05	0.02	0.01	0.01
1995	355	209	294	38	50	10	10	0.59	1.4	0.18	0.17	0.20	0.03	0.26	0.05	0.03	0.03
1996	398	316	535	196	266	64	64	0.79	1.7	0.62	0.50	0.24	0.12	0.33	0.2	0.16	0.16
1997	478	403	694	265	383	144	144	0.84	1.7	0.66	0.55	0.38	0.21	0.54	0.36	0.30	0.30
1998	274	240	416	152	207	62	66	0.88	1.7	0.63	0.50	0.32	0.16	0.41	0.26	0.24	0.23
1999	233	111	166	26	33	2	2	0.48	1.5	0.23	0.20	0.06	0.01	0.08	0.02	0.01	0.01
2000	302	252	451	168	244	104	105	0.83	1.8	0.67	0.54	0.43	0.23	0.62	0.41	0.35	0.34
2001	143	111	167	14	14	0	0	0.78	1.5	0.13	0.08	0.00	0.00	0.00	0.00	0.00	0.00
2002	217	185	337	124	178	17	17	0.85	1.8	0.67	0.53	0.10	0.05	0.14	0.09	0.08	0.08
2003	251	138	187	52	57	23	23	0.55	1.4	0.38	0.30	0.40	0.12	0.44	0.17	0.09	0.09
2004	205	133	215	49	55	3	3	0.65	1.6	0.37	0.26	0.05	0.01	0.06	0.02	0.01	0.01
2005	367	78	90	13	13	5	5	0.21	1.2	0.17	0.14	0.38	0.06	0.38	0.06	0.01	0.01
2006	249	199	302	119	135	68	69	0.80	1.5	0.60	0.45	0.51	0.23	0.57	0.34	0.28	0.27
2007	169	72	101	25	25	19	19	0.43	1.4	0.35	0.25	0.76	0.19	0.76	0.26	0.11	0.11
2008	218	192	306	119	146	87	89	0.88	1.6	0.62	0.48	0.61	0.29	0.73	0.45	0.41	0.40
2009	198	132	196	54	65	26	26	0.68	1.5	0.41	0.33	0.40	0.13	0.48	0.20	0.13	0.13
2010	237	179	286	114	146	69	70	0.76	1.6	0.64	0.51	0.48	0.24	0.61	0.39	0.30	0.29
2011	203	158	240	86	102	55	56	0.78	1.5	0.54	0.43	0.55	0.23	0.64	0.35	0.28	0.27
2012	187	151	254	94	124	34	34	0.81	1.7	0.62	0.49	0.27	0.13	0.36	0.23	0.18	0.18

[a]Data from Byrd and Day (1986).

Table 21. Standard deviation in reproductive performance parameters of black-legged kittiwakes at Buldir Island, Alaska. Sampling for kittiwakes is clustered by plot except when sample sizes per plot are too small or plot data are not available. No data were collected in 1977-1987.

Year	No. plots[a]	Total nest starts	Sampling design[b]	Laying success	Mean clutch size	Nesting success	Hatching success	Chick success	Egg success	Fledging success	Reprod. success	Fledglings /nest start	Prod.
1976	-	-	Simple random	-	0.11	-	-	-	-	-	-	-	-
1988	24	513	Cluster by plot	0.03	0.02	0.02	0.03	0.03	0.02	0.04	0.03	0.03	0.03
1989	23	649	Cluster by plot	0.05	0.04	0.08	0.07	0.08	0.03	0.09	0.04	0.01	0.01
1990	27	786	Cluster by plot	0.05	0.02	0.02	0.01	0.03	0.02	0.03	0.03	0.03	0.03
1991	30	664	Cluster by plot	0.05	0.04	0.04	0.04	0.06	0.02	0.08	0.03	0.01	0.01
1992	16	461	Cluster by plot	0.02	0.02	0.02	0.03	0.03	0.02	0.04	0.04	0.04	0.04
1993	9	524	Cluster by plot	0.03	0.05	0.06	0.04	0.02	0.01	0.02	0.01	0.01	0.01
1994	17	457	Cluster by plot	0.04	0.03	0.03	0.02	0.02	0.01	0.02	0.01	0.01	0.01
1995	15	355	Cluster by plot	0.03	0.04	0.06	0.05	0.06	0.02	0.08	0.02	0.01	0.01
1996	16	398	Cluster by plot	0.03	0.02	0.04	0.03	0.03	0.02	0.03	0.03	0.03	0.03
1997	23	478	Cluster by plot	0.03	0.02	0.04	0.03	0.02	0.02	0.03	0.03	0.03	0.03
1998	10	274	Cluster by plot	0.02	0.04	0.02	0.02	0.04	0.02	0.05	0.03	0.03	0.02
1999	8	233	Cluster by plot	0.08	0.06	0.10	0.08	0.04	0.01	0.05	0.02	0.01	0.01
2000	8	302	Cluster by plot	0.04	0.03	0.07	0.06	0.01	0.03	0.03	0.06	0.07	0.06
2001	5	143	Cluster by plot	0.07	0.08	0.08	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2002	7	217	Cluster by plot	0.03	0.03	0.05	0.04	0.03	0.01	0.04	0.02	0.02	0.02
2003	11	251	Cluster by plot	0.11	0.07	0.10	0.08	0.08	0.05	0.08	0.06	0.03	0.03
2004	7	205	Cluster by plot	0.05	0.04	0.04	0.05	0.05	0.01	0.06	0.02	0.01	0.01
2005	9	367	Cluster by plot	0.05	0.04	0.08	0.07	0.10	0.04	0.10	0.04	0.01	0.01
2006	6	249	Cluster by plot	0.03	0.11	0.04	0.05	0.08	0.06	0.10	0.08	0.07	0.07
2007	6	169	Cluster by plot	0.08	0.10	0.17	0.12	0.09	0.11	0.09	0.15	0.07	0.07
2008	7	218	Cluster by plot	0.03	0.04	0.04	0.04	0.06	0.03	0.06	0.04	0.05	0.04
2009	7	198	Cluster by plot	0.06	0.08	0.11	0.07	0.08	0.04	0.10	0.07	0.06	0.06
2010	7	237	Cluster by plot	0.05	0.09	0.04	0.04	0.03	0.03	0.07	0.06	0.05	0.05
2011	7	203	Cluster by plot	0.08	0.07	0.07	0.05	0.06	0.04	0.08	0.07	0.08	0.08
2012	7	187	Cluster by plot	0.08	0.11	0.05	0.05	0.03	0.02	0.05	0.04	0.05	0.05

[a]Plots that are combined for analysis are counted as a single "plot".

[b]For sampling clustered by plot, values are calculated using ratio estimator spreadsheets based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1-\rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

Table 22. Clutch sizes of black-legged kittiwakes at Buldir Island, Alaska. Sample units consist of total nest sites, not plots.

Year	Total nest starts	Nest sites w/ x eggs:				Nest sites w/ eggs	Total eggs	Mean clutch size
	(A)	0	1	2	3	(B)	(C)	(C/B)
1976[a]	-	-	-	-	-	74	-	1.6
1988	513	121	97	294	1	392	688	1.7
1989	649	463	137	49	0	186	235	1.3
1990	786	152	135	492	7	634	1140	1.8
1991	664	379	187	98	0	285	383	1.3
1992	461	43	84	332	2	418	754	1.8
1993	524	141	145	238	0	383	621	1.6
1994	457	137	108	212	0	320	532	1.7
1995	355	146	124	85	0	209	294	1.4
1996	398	82	98	217	1	316	535	1.7
1997	478	75	112	291	0	403	694	1.7
1998	274	34	66	172	2	240	416	1.7
1999	233	122	56	55	0	111	166	1.5
2000	302	50	54	197	1	252	451	1.8
2001	143	32	55	56	0	111	167	1.5
2002	217	32	34	150	1	185	337	1.8
2003	251	113	89	49	0	138	187	1.4
2004	205	72	51	82	0	133	215	1.6
2005	367	289	66	12	0	78	90	1.2
2006	249	50	98	99	2	199	302	1.5
2007	169	97	43	29	0	72	101	1.4
2008	218	26	79	112	1	192	306	1.6
2009	198	66	69	62	1	132	196	1.5
2010	237	58	72	107	0	179	286	1.6
2011	203	45	76	82	0	158	240	1.5
2012	187	36	48	103	0	151	254	1.7

[a]Data from Byrd and Day (1986).

Table 23. Reproductive performance of black-legged kittiwakes at Buldir Island, Alaska in 2012. All plots in 2012 were located at Spike Camp.

Parameter	Plot							Total	SD[a]
	36	37	39	40A	40B	45	46		
Total nest starts (A)	3	29	25	6	42	43	39	187	-
Nest sites w/ eggs (B)	3	26	25	4	26	42	25	151	-
Total eggs (C)	4	50	36	7	36	80	41	254	-
Nest sites w/ chicks (D)	3	19	19	1	13	26	13	94	-
Total chicks (E)	4	29	24	2	14	35	16	124	-
Nest sites w/ chicks fledged (F)	0	9	5	1	3	12	4	34	-
Total chicks fledged (G)	0	9	5	1	3	12	4	34	-
Laying success (B/A)	1.00	0.90	1.00	0.67	0.62	0.98	0.64	0.81	0.08
Mean clutch size (C/B)	1.3	1.9	1.4	1.8	1.4	1.9	1.6	1.7	0.11
Nesting success (D/B)	1.00	0.73	0.76	0.25	0.50	0.62	0.52	0.62	0.05
Hatching success (E/C)	1.00	0.58	0.67	0.29	0.39	0.44	0.39	0.49	0.05
Chick success (G/E)	0.00	0.31	0.21	0.50	0.21	0.34	0.25	0.27	0.03
Egg success (G/C)	0.00	0.18	0.14	0.14	0.08	0.15	0.10	0.13	0.02
Fledging success (F/D)	0.00	0.47	0.26	1.00	0.23	0.46	0.31	0.36	0.05
Reproductive success (F/B)	0.00	0.35	0.20	0.25	0.12	0.29	0.16	0.23	0.04
Fledglings/nest start (G/A)	0.00	0.31	0.20	0.17	0.07	0.28	0.10	0.18	0.05
Productivity (F/A)	0.00	0.31	0.20	0.17	0.07	0.28	0.10	0.18	0.05

[a]Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

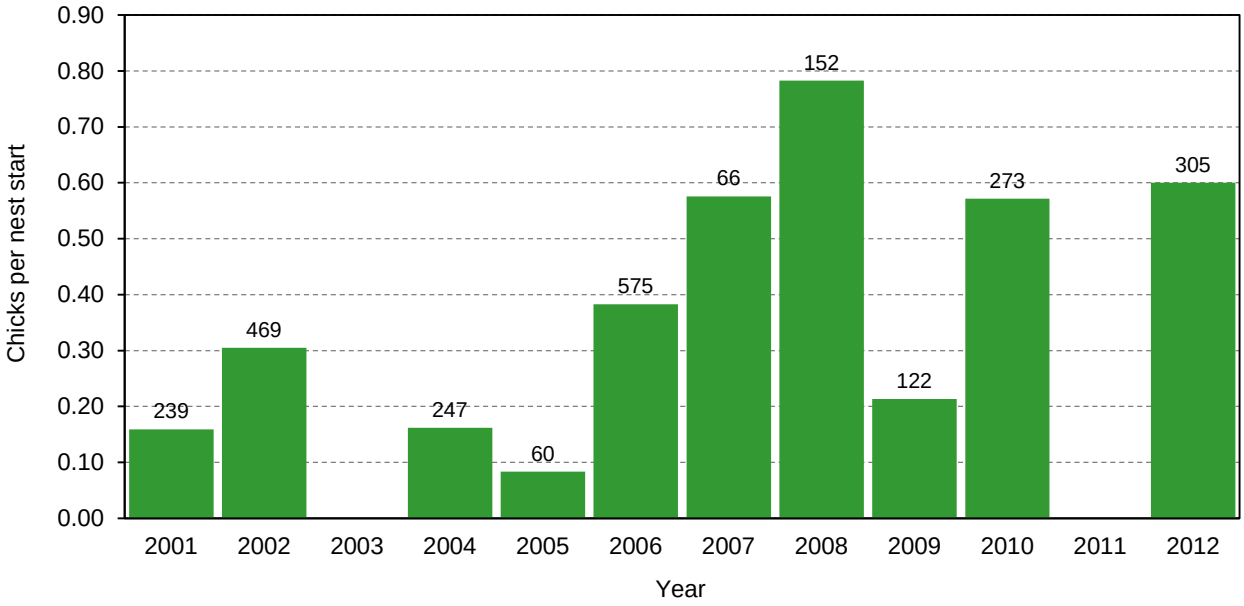

Figure 13. Maximum reproductive performance of black-legged kittiwakes at Kittiwake Lane, Buldir Island, Alaska, as determined by a Boom or Bust methodology. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A).

Table 24. Reproductive performance of black-legged kittiwakes at Kittiwake Lane, Buldir 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.

Year	Total plots monitored	Total nest starts (A)	Total chicks (E)	Chicks/ nest start (E/A)[a]	Date(s) of nest count	Date(s) of chick count
2001	3	239	38	0.15	26 Jun	29 Jul
2002	3	469	143	0.30	9 Jun	27 Jul
2003	*no data*	-	-	-	-	-
2004	2	247	40	0.16	17 Jun	3 Aug
2005	2	60	5	0.08	23 Jun	7 Aug
2006	3	575	220	0.38	23 Jun	9 Aug
2007	3	66	38	0.58	19 Jun	8 Aug
2008	7	152	119	0.78	18 Jun	19 Jul+12 Aug
2009	7	122	26	0.21	16 Jun	11 Aug+21 Aug
2010[b]	7	273	156	0.57	6 Jul	28 Jul
2011	*no data*	-	-	-	-	-
2012	13	305	183	0.60	15 Jun	29 Jul

[a]Chicks/nest start (E/A) may be considered a maximum potential value of success [fledglings/nest start (G/A)] based on the assumption that all chicks counted eventually fledge.

[b]Data represent maximum count of nests and chicks from 15 counts between 13 June and 22 August.

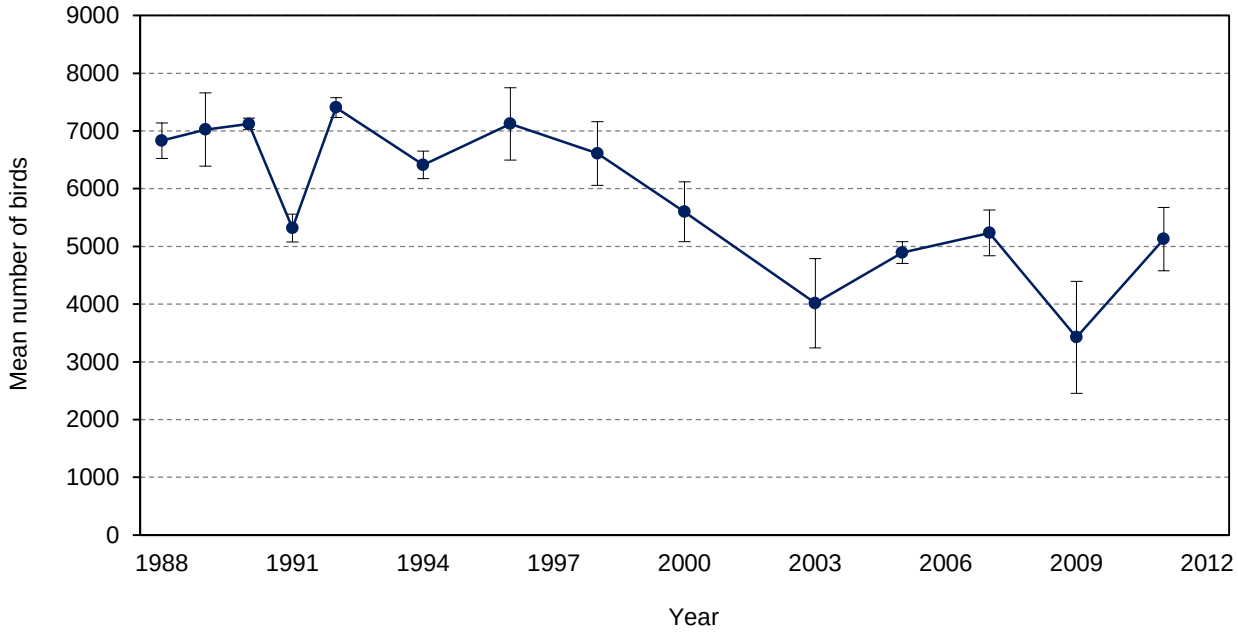

Figure 14. Mean numbers of black-legged kittiwakes counted on index plots at Buldir Island, Alaska. Error bars represent standard deviation.

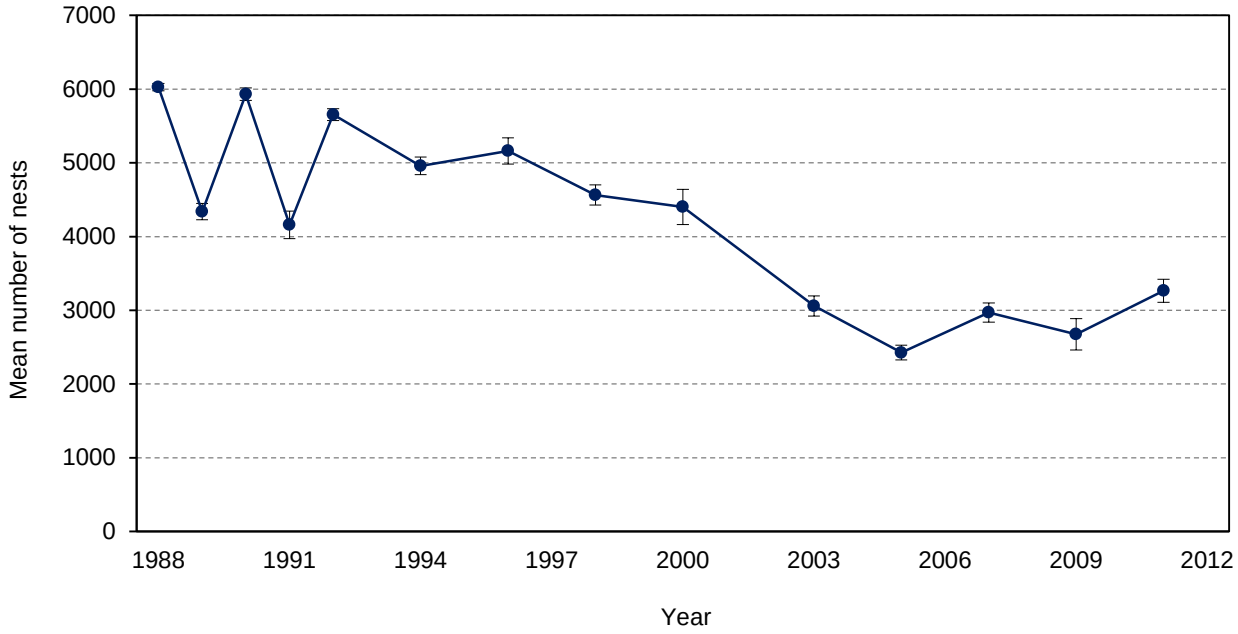

Figure 15. Mean numbers of black-legged kittiwake nests counted on index plots at Buldir Island, Alaska. Error bars represent standard deviation.

Table 25. Numbers of black-legged kittiwakes counted on index plots at Buldir Island, Alaska. Data represent combined totals from Spike (The Dip) and Kittiwake Lane. No counts were conducted during years not listed.

Replicate	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005	2007	2009	2011
1	6797	6534	6977	5125	7226	6185	6072	5821	5272	4848	5096	5004	4275	4981
2	6998	6276	7042	5671	7607	6721	7036	6969	6020	4157	4719	5193	4608	4579
3	6418	7048	7423	5145	7302	6463	7382	7263	5150	4084	4891	5161	2332	5583
4	7115	7812	7141	5177	7484	6271	7483	6398	5267	2979	5111	4901	3046	5816
5	-	7450	7019	5468	-	-	7639	6600	6291	-	4649	5913	2871	4678
Mean	6832	7024	7120	5317	7405	6410	7122	6610	5600	4017	4893	5234	3426	5127
n	4	5	5	5	4	4	5	5	5	4	5	5	5	5
SD	306	633	99	242	173	238	628	553	518	773	189	397	970	549
First count	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 Jun	29 Jun	8 Jul
Last count	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul	23 Jul	31 Jul	26 Jul

Table 26. Numbers of black-legged kittiwake nests counted on index plots at Buldir Island, Alaska. Data represent combined totals from Spike (The Dip) and Kittiwake Lane. No counts were conducted during years not listed.

Replicate	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005	2007	2009	2011
1	5972	4452	5844	4079	5569	5106	4966	4393	4464	3122	2531	2952	2881	3124
2	6070	4194	5845	4432	5663	5004	5246	4697	4786	3028	2561	3098	2930	3134
3	6013	4403	6020	4254	5757	4867	5329	4711	4179	3200	2354	3098	2571	3417
4	-	4247	6012	3949	5625	4856	4969	4545	4339	2885	2365	2899	2521	3447
5	-	4393	5934	4088	-	-	5297	4471	4246	-	2324	2803	2478	3202
Mean	6027	4338	5931	4160	5654	4958	5161	4564	4403	3059	2427	2970	2676	3265
Max.	6070	4452	6020	4432	5757	5106	5329	4711	4786	3200	2561	3098	2930	3447
n	3	5	5	5	4	4	5	5	5	4	5	5	5	5
SD	50	111	86	187	79	119	180	138	239	136	99	129	213	156
First count	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 Jun	29 Jun	8 Jul
Last count	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul	23 Jul	31 Jul	26 Jul

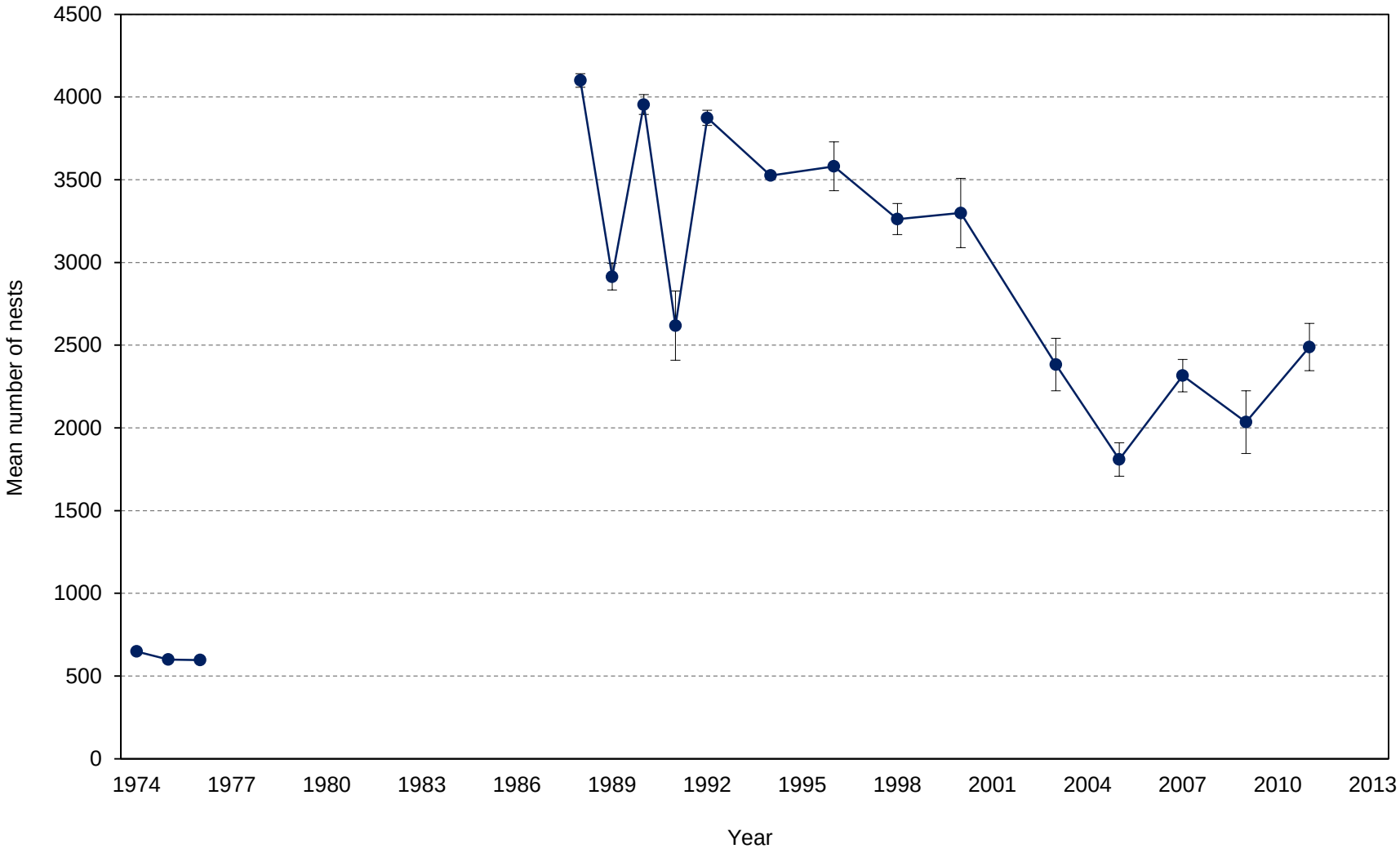

Figure 16. Mean numbers of black-legged kittiwake nests counted on index plots at Kittiwake Lane, Buldir Island, Alaska. Data include only plots in Kittiwake Lane East (15-18) and Kittiwake Lane West (19-29) and are a subset of total counts on all index plots. Error bars represent standard deviation.

Table 27. Mean numbers of black-legged kittiwake nests counted on index plots at Kittiwake Lane, Buldir Island, Alaska. Plot values represent the average count of nests in that plot each year; total values and standard deviations are based on the average total count across all plots each year (as opposed to the sum of plot means). Data include only plots in Kittiwake Lane East (15-18) and Kittiwake Lane West (19-29); these data are a subset of total counts on all index plots (Table 26) but are presented separately for comparison with historic counts from 1974-1976. No counts were conducted during years not listed.

Plot (segment)	1974	1975	1976	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005	2007	2009	2011
15 (1)	-	137	-	563	424	542	241	515	344	352	338	300	256	176	22	2	44
16 (2)	-	133	-	637	510	580	296	595	509	415	460	351	317	236	309	256	373
17 (3)	-	76	-	728	568	642	378	586	566	515	405	381	297	320	315	365	483
18 (4)	-	123	-	628	271	474	351	449	448	436	401	335	255	268	413	305	441
19 (5)	-	63	-	368	237	361	300	346	376	360	268	281	159	175	209	201	243
20 (6)	-	39	-	284	180	298	230	297	301	280	202	209	101	122	158	123	137
21 (7)	-	24	-	341	215	290	256	324	299	325	279	274	185	139	193	148	171
22 (8)	-	5	-	264	236	343	277	329	244	317	297	303	213	130	185	145	153
23 (9)	-	0	-	219	230	344	251	355	264	244	238	268	153	89	207	185	188
24 (10)	-	0	-	10	9	26	11	23	43	114	115	185	90	30	81	86	83
25 (11)	-	0	-	7	5	11	9	12	35	48	52	90	69	41	77	69	58
26 (12)	-	0	-	18	11	19	8	7	19	49	77	163	121	28	63	74	61
27 (13)	-	0	-	15	9	4	1	14	29	52	58	71	86	39	45	40	35
28 (14)	-	0	-	18	9	20	9	22	49	74	71	84	64	11	38	36	20
29 (15)	-	0	-	0	0	0	0	0	0	0	0	4	17	3	0	1	0
Total	649[a]	600	597	4100	2914	3954	2618	3874	3526	3581	3262	3299	2383	1809	2316	2035	2489
n	1	1	1	3	5	5	5	4	4	5	5	5	4	5	5	5	5
SD	-	-	-	41	80	60	209	46	20	148	94	209	158	101	98	189	143
First count	Jul[b]	Jul[b]	Jul[b]	5 Jul	29 Jun	30 Jun	8 Jul	6 Jul	4 Jul	28 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 Jun	29 Jun	8 Jul
Last count	-	-	-	27 Jul	16 Jul	18 Jul	18 Jul	20 Jul	19 Jul	18 Jul	24 Jul	20 Jul	25 Jul	18 Jul	14 Jul	31 Jul	26 Jul

[a]Includes 44 unspecified *Rissa* spp.
[b]Data come from single counts made early to mid-July 1974, 1975, and 1976; from Byrd (1978).

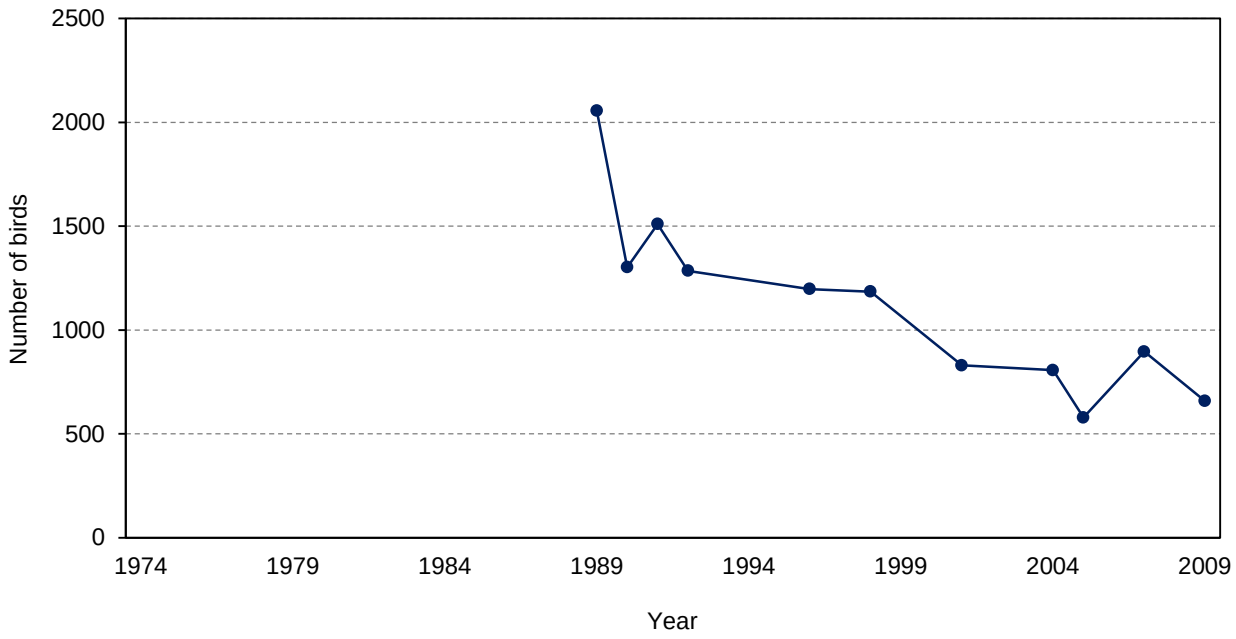

Figure 17. Numbers of black-legged kittiwakes counted at Middle Rock, Buldir Island, Alaska. Counts at Middle Rock are separate from island-wide population counts on index plots. Data do not include 1988 because birds were not identified to species.

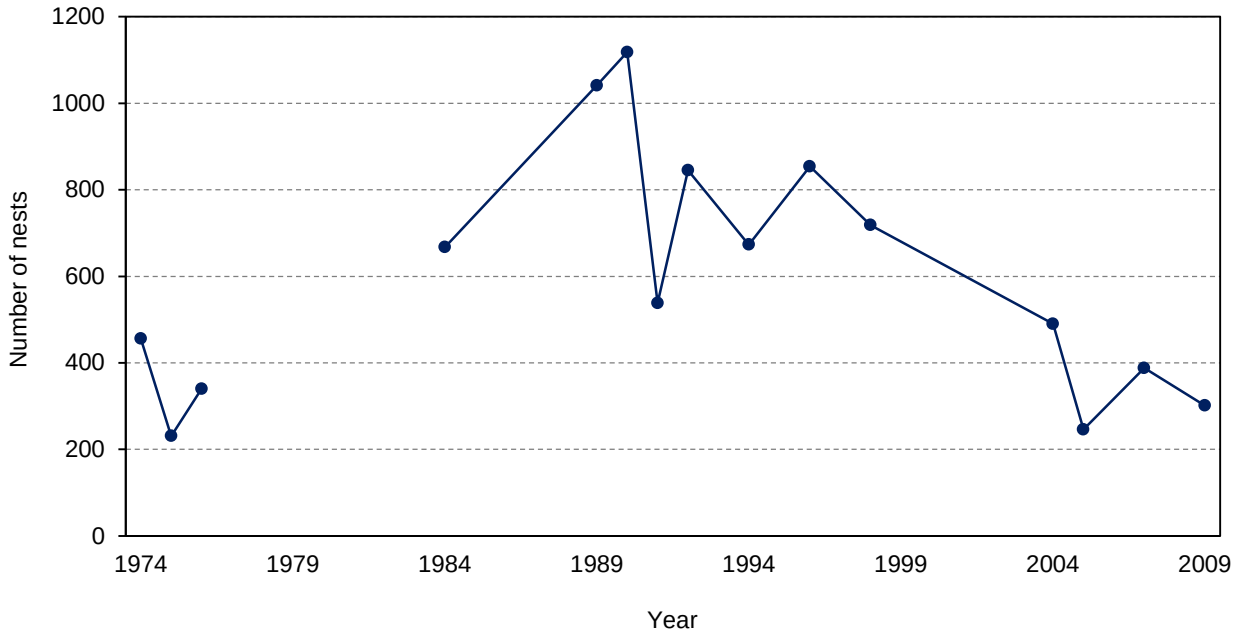

Figure 18. Numbers of black-legged kittiwake nests counted at Middle Rock, Buldir Island, Alaska. Counts at Middle Rock are separate from island-wide population counts on index plots. Data do not include 1988 because birds were not identified to species and 2001 because all areas were not counted.

Table 28. Numbers of black-legged kittiwakes counted at Middle Rock, Buldir Island, Alaska. Counts at Middle Rock are separate from island-wide population counts on index plots; numbers are not included in population count totals (Table 25) and counts are not always conducted in the same years. No counts were conducted during years not listed.

Segment	1974	1975	1976	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005	2007	2009
I	*no count*	*no count*	*no count*	*no count*	206	342	211	229	239	*no count*	161	125	136	122	76	163	86
II					135	225	128	111	120		96	111	139	132	49	82	63
III	-	-	-	-	241	175	125	68	106	-	40	102	0	0	0	6	0
IV	-	-	-	-	210	97	80	85	34	-	92	51	30	11	1	22	52
V	-	-	-	-	135	402	232	263	211	-	201	210	109	137	54	87	21
VI	-	-	-	-	300	296	203	309	236	-	241	271	94	92	76	130	98
VII	-	-	-	-	428	519	323	445	339	-	366	315	322	313	323	406	328
Total	-	-	-	-	1655[a]	2056	1302	1510	1285	-	1197	1185	830	807	579	896	658
Date(s)	-	-	-	-	19 Jul	20 Jul	19-26 Jul	17 Jul	26 Jul	-	22 Jul	1 Jul	6 Jul	13 Jul	25 Jul	23 Jul	22 Jul

[a]Count included both kittiwake species.

Table 29. Numbers of black-legged kittiwake nests counted at Middle Rock, Buldir Island, Alaska. Counts at Middle Rock are separate from island-wide population counts on index plots; numbers are not included in population count totals (Table 26) and counts are not always conducted in the same years. No counts were conducted during years not listed.

Segment	1974	1975	1976	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005	2007	2009
I	161	50	-	177	139	139	187	58	134	25	107	60	85	75	21	68	26
II	60	20	-	72	75	95	101	34	73	40	62	50	111	33	10	25	33
III	81	70	-	107	150	120	116	43	82	59	36	72	1	0	0	3	0
IV	95	11	-	155	94	60	67	18	26	108	75	32	46	19	0	14	36
V	59	80	-	106	87	183	211	96	151	61	139	118	78	95	64	45	13
VI	0	-	-	50	172	170	186	99	163	182	168	186	-	61	37	55	27
VII	0	-	-	0	313	274	250	190	216	198	267	200	160	207	114	178	166
Total	456	231	340	667	1030[a]	1041	1118	538	845	673	854	718	481[b]	490	246	388	301
Date(s)	9 Aug	4 Jun	19 Jul	17 Jun	19 Jul	20 Jul	19-26 Jul	17 Jul	26 Jul	23-24 Jul	22 Jul	1 Jul	6 Jul	13 Jul	25 Jul	23 Jul	22 Jul

[a]Count included both kittiwakes species.
[b]Partial count, not for comparison.

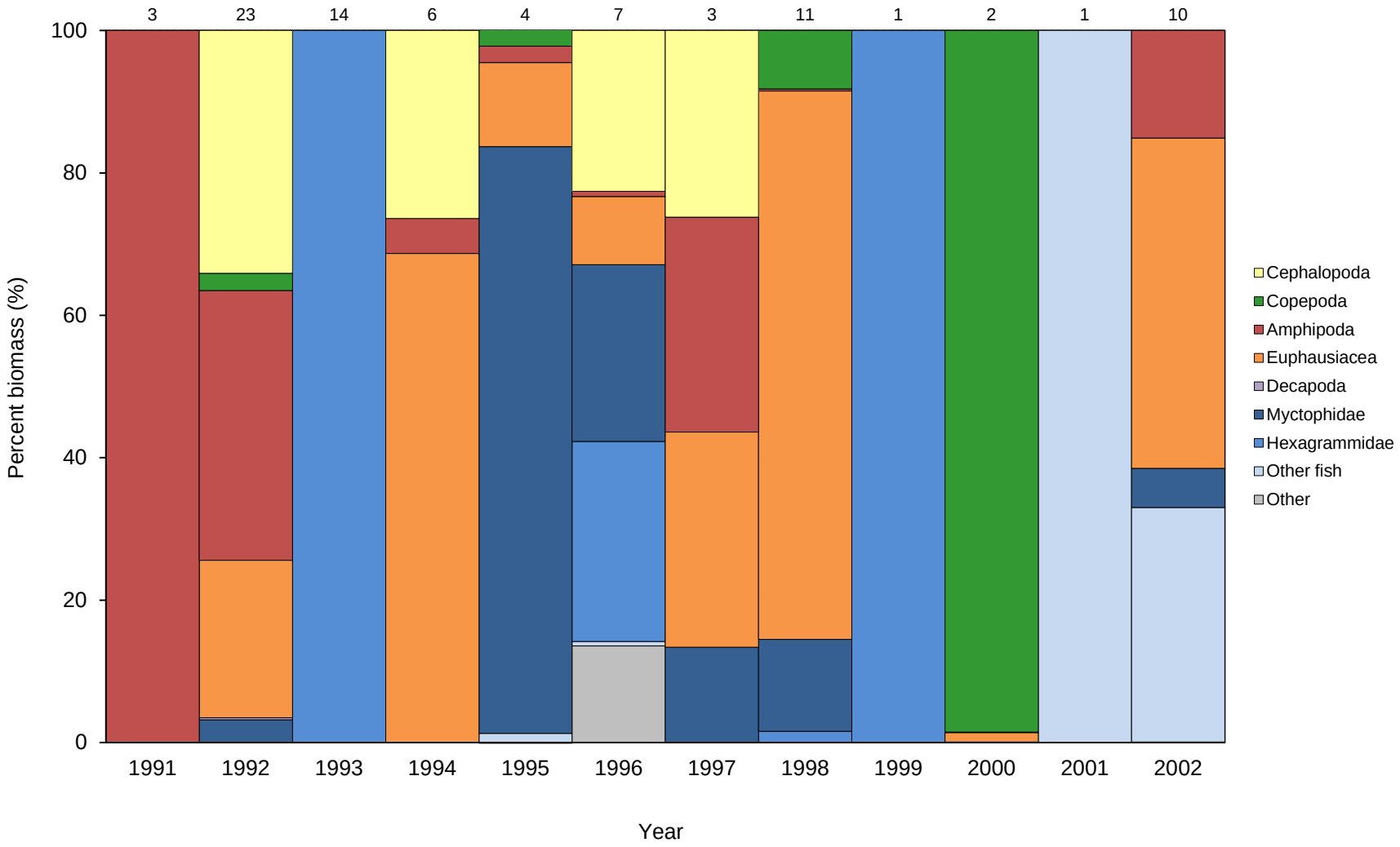

Figure 19. Relative biomass of prey in diets of black-legged kittiwake chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2004-2012 but have not yet been summarized.

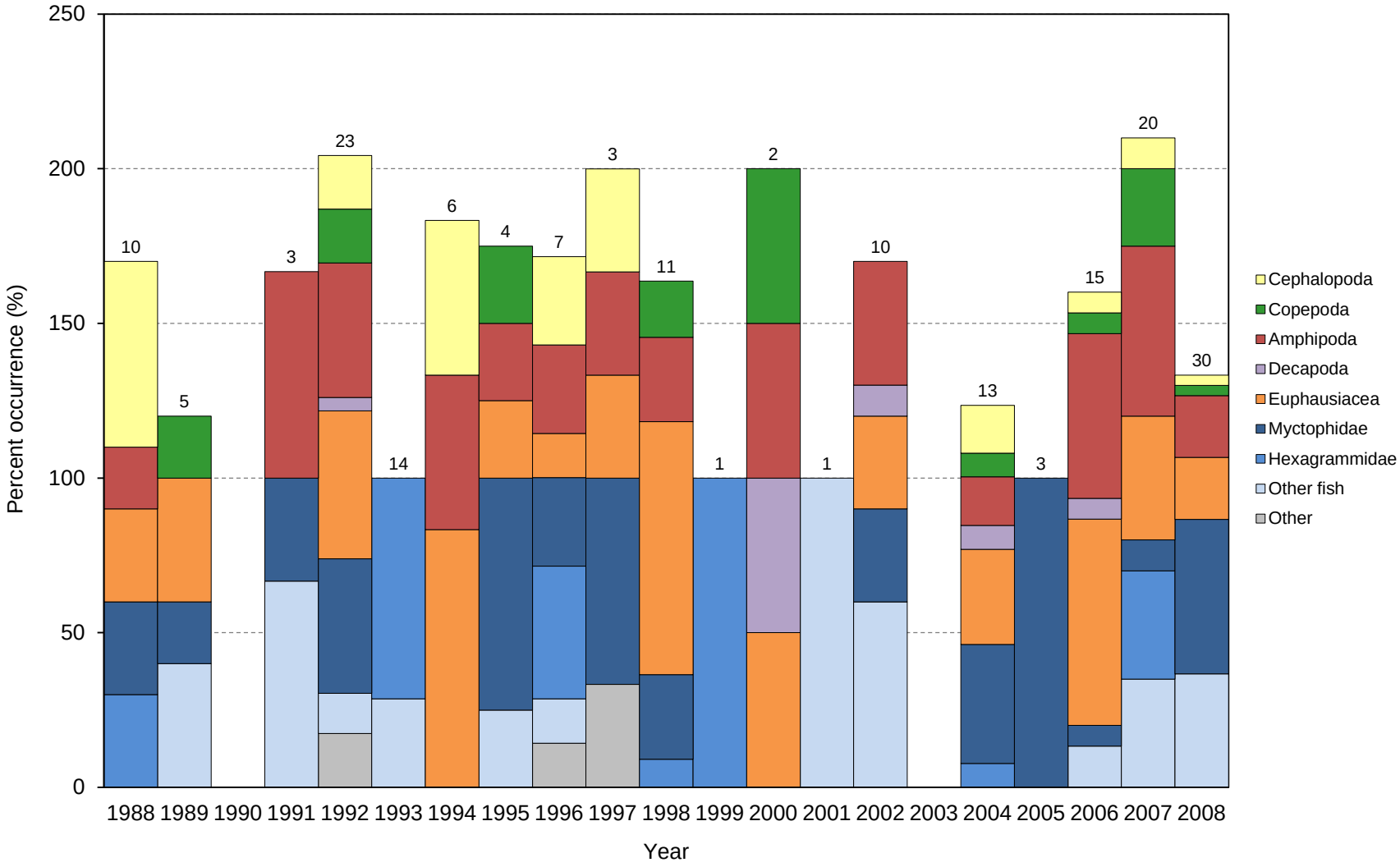

Figure 20. Frequency of occurrence of prey in diets of black-legged kittiwake chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2009-2012 but have not yet been summarized.

Table 30. Relative biomass of prey in diets of black-legged kittiwake chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks and regurgitations from chicks themselves; all prey was identified and measured in the laboratory. Data do not include samples collected in 1988 and 1989 because mass data are not available. Diet samples were collected in 2004-2012 but have not yet been summarized.

Prey	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
No. samples[a]	3	23	14	6	4	7	3	11	1	2	1	10
Total mass (g)	0.9	158.4	249.0	104.1	118.9	181.7	30.5	309.5	49.0	52.2	23.6	113.8
Invertebrates	**100.0**	**100.0**	**100.0**	**100.0**	**98.8**	**85.8**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**97.8**
Cephalopoda	**-**	**34.1**	**-**	**26.4**	**-**	**22.6**	**26.2**	**-**	**-**	**-**	**-**	**-**
Decabrachia	**-**	**34.1**	**-**	**26.4**	**-**	**22.6**	**26.2**	**-**	**-**	**-**	**-**	**-**
Unid. squid	-	34.1	-	26.4	-	22.6	26.2	-	-	-	-	-
Copepoda	**-**	**2.4**	**-**	**-**	**2.3**	**-**	**-**	**8.2**	**-**	**98.5**	**-**	**-**
Neocalanus cristatus	-	2.4	-	-	-	-	-	8.2	-	93.4	-	-
N. plumchrus/flemengeri	-	-	-	-	2.3	-	-	-	-	-	-	-
Neocalanus spp.	-	-	-	-	-	-	-	-	-	5.1	-	-
Amphipoda	**100.0**	**37.9**	**-**	**4.9**	**2.3**	**0.7**	**30.2**	**0.3**	**-**	**0.1**	**-**	**15.1**
Hyperiidea	**43.2**	**36.3**	**-**	**4.9**	**2.3**	**0.6**	**30.2**	**0.2**	**-**	**0.1**	**-**	**15.1**
Themisto pacifica	-	23.3	-	4.9	2.3	0.6	30.2	0.2	-	0.1	-	15.1
Themisto spp.	43.2	13.0	-	-	-	-	-	-	-	-	-	-
Gammaridea	**56.8**	**0.3**	**-**	**-**	**-**	**0.1**	**-**	**0.1**	**-**	**-**	**-**	**-**
Unid. Lysianassidae	56.8	0.3	-	-	-	0.1	-	0.1	-	-	-	<0.1
Unid. amphipod	-	1.3	-	-	-	-	-	-	-	-	-	-
Euphausiacea	**-**	**22.1**	**-**	**68.7**	**11.8**	**9.6**	**30.2**	**77.0**	**-**	**1.3**	**-**	**46.4**
Thysanoessa spp.	-	22.1		68.7	11.8	-	30.2	-	-	-	-	-
Unid. euphausiid	-	-	-	-	-	9.6	-	77.0	-	1.3	-	46.4
Decapoda	**-**	**0.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.1**	**-**	**<0.1**
Pandalid zoea	-	-	-	-	-	-	-	-	-	0.1	-	-
Unid. shrimp	-	0.3	-	-	-	-	-	-	-	-	-	<0.1
Fish	**-**	**3.2**	**100.0**	**-**	**83.7**	**53.5**	**13.4**	**14.5**	**100.0**	**-**	**100.0**	**38.4**
Myctophidae	**-**	**3.2**	**-**	**-**	**82.4**	**24.8**	**13.4**	**12.9**	**-**	**-**	**-**	**5.5**
Stenobrachius leucopsarus	-	-	-	-	-	-	13.4	12.9	-	-	-	-
Unid. Myctophidae	-	3.2	-	-	82.4	24.8	-	-	-	-	-	5.5
Gadidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**100.0**	**-**
Unid. Gadidae	-	-	-	-	-	-	-	-	-	-	100.0	-
Hexagrammidae	**-**	**-**	**100.0**	**-**	**-**	**28.1**	**-**	**1.6**	**100.0**	**-**	**-**	**-**
Hexagrammos spp.	-	-	100.0	-	-	28.1	-	1.6	100.0	-	-	-
Ammodytidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**30.8**
Ammodytes hexapterus	-	-	-	-	-	-	-	-	-	-	-	30.8
Unid. Teleostei	-	-	-	-	1.3	0.6	-	-	-	-	-	2.1
Other	**-**	**-**	**-**	**-**	**-**	**13.8**	**-**	**-**	**-**	**-**	**-**	**-**
Offal	-	-	-	-	-	13.8	-	-	-	-	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 31) and some prey types may not appear in biomass data although they were present in diet samples.

Table 31. Frequency of occurrence of prey in diets of black-legged kittiwake chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks and regurgitations from chicks themselves; all prey was identified and measured in the laboratory. Diet samples were collected in 2009-2012 but have not yet been summarized.

Prey	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
No. samples	10	5	*no samples*	3	23	14	6	4	7	3	11
Invertebrates	**60.0**	**60.0**	**-**	**66.7**	**73.9**	**-**	**100.0**	**25.0**	**57.1**	**66.7**	**90.9**
Cephalopoda	**60.0**	**-**	**-**	**-**	**17.4**	**-**	**50.0**	**-**	**28.6**	**33.3**	**-**
Decabrachia	**60.0**	**-**	**-**	**-**	**17.4**	**-**	**50.0**	**-**	**28.6**	**33.3**	**-**
Unid. squid	60.0	-	-	-	17.4	-	50.0	-	28.6	33.3	-
Copepoda	**-**	**20.0**	**-**	**-**	**17.4**	**-**	**-**	**25.0**	**-**	**-**	**18.2**
Neocalanus cristatus	-	-	-	-	13.0	-	-	-	-	-	18.2
N. plumchrus/flemengeri	-	20.0	-	-	-	-	-	25.0	-	-	-
Calanoid spp.	-	-	-	-	-	-	-	-	-	-	-
Unid. copepod	-	-	-	-	4.3	-	-	-	-	-	-
Amphipoda	**20.0**	**-**	**-**	**66.7**	**43.5**	**-**	**50.0**	**25.0**	**28.6**	**33.3**	**27.3**
Hyperiidea	**10.0**	**-**	**-**	**33.3**	**30.4**	**-**	**50.0**	**25.0**	**14.3**	**33.3**	**18.2**
Themisto pacifica	-	-	-	-	13.0	-	50.0	25.0	14.3	33.3	18.2
Themisto spp.	10.0	-	-	33.3	17.4	-	-	-	-	-	-
Gammaridea	**10.0**	**-**	**-**	**33.3**	**4.3**	**-**	**-**	**-**	**14.3**	**-**	**9.1**
Paracallisoma alberti	-	-	-	-	-	-	-	-	-	-	-
Unid. Lysianassidae	10.0	-	-	33.3	4.3	-	-	-	14.3	-	9.1
Unid. amphipod	-	-	-	-	8.7	-	-	-	-	-	-
Euphausiacea	**30.0**	**40.0**	**-**	**-**	**47.8**	**-**	**83.3**	**25.0**	**14.3**	**33.3**	**81.8**
Euphausia pacifica	-	-	-	-	-	-	-	-	-	-	-
Thysanoessa spp.	-	-	-	-	47.8	-	83.3	-	-	33.3	-
Unid. euphausiid	30.0	40.0	-	-	-	-	-	25.0	14.3	-	81.8
Decapoda	**-**	**-**	**-**	**-**	**4.3**	**-**	**-**	**-**	**-**	**-**	**-**
Pandalid zoea	-	-	-	-	-	-	-	-	-	-	-
Unid. shrimp	-	-	-	-	4.3	-	-	-	-	-	-
Polychaeta	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Nereididae	-	-	-	-	-	-	-	-	-	-	-
Fish	**60.0**	**60.0**	**-**	**66.7**	**52.2**	**100.0**	**-**	**100.0**	**71.4**	**66.7**	**36.4**
Myctophidae	**30.0**	**20.0**	**-**	**33.3**	**43.5**	**-**	**-**	**75.0**	**28.6**	**66.7**	**27.3**
Stenobrachius leucopsarus	-	-	-	-	-	-	-	-	-	66.7	27.3
S. nannochir	-	-	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	30.0	20.0	-	33.3	43.5	-	-	75.0	28.6	-	-
Gadidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Gadidae	-	-	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Sebastes spp.	-	-	-	-	-	-	-	-	-	-	-
Hexagrammidae	**30.0**	**-**	**-**	**-**	**-**	**71.4**	**-**	**-**	**42.9**	**-**	**9.1**
Pleurogrammus monopterygius	30.0	-	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	-	-	-	-	-	71.4	-	-	42.9	-	9.1
Ammodytidae	**-**	**-**	**-**	**33.3**	**8.7**	**-**	**-**	**-**	**-**	**-**	**-**
Ammodytes hexapterus	-	-	-	33.3	8.7	-	-	-	-	-	-
Clupeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Clupea pallasii	-	-	-	-	-	-	-	-	-	-	-
Unid. Teleostei	-	40.0	-	33.3	4.3	28.6	-	25.0	14.3	-	-
Other	**-**	**-**	**-**	**-**	**17.4**	**-**	**-**	**-**	**14.3**	**33.3**	**-**
Offal	-	-	-	-	17.4	-	-	-	14.3	33.3	-

Table 31 (continued). Frequency of occurrence of prey in diets of black-legged kittiwake chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks and regurgitations from chicks themselves; all prey was identified and measured in the laboratory. Diet samples were collected in 2009-2012 but have not yet been summarized.

Prey	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. samples	1	2	1	10	*no samples*	13	3	15	20	30
Invertebrates	**-**	**100.0**	**-**	**50.0**	**-**	**69.2**	**-**	**86.7**	**70.0**	**33.3**
Cephalopoda	**-**	**-**	**-**	**-**	**-**	**15.4**	**-**	**6.7**	**10.0**	**3.3**
Decabrachia	**-**	**-**	**-**	**-**	**-**	**15.4**	**-**	**6.7**	**10.0**	**3.3**
Unid. squid	-	-	-	-	-	15.4	-	6.7	10.0	3.3
Copepoda	**-**	**50.0**	**-**	**-**	**-**	**7.7**	**-**	**6.7**	**25.0**	**3.3**
Neocalanus cristatus	-	50.0	-	-	-	-	-	-	-	3.3
N. plumchrus/flemengeri	-	-	-	-	-	-	-	6.7	25.0	-
Calanoid spp.	-	-	-	-	-	7.7	-	6.7	25.0	-
Unid. copepod	-	50.0	-	-	-	-	-	-	-	-
Amphipoda	**-**	**50.0**	**-**	**40.0**	**-**	**15.7**	**-**	**53.3**	**55.0**	**20.0**
Hyperiidea	**-**	**50.0**	**-**	**30.0**	**-**	**15.4**	**-**	**46.7**	**40.0**	**6.7**
Themisto pacifica	-	50.0	-	30.0	-	-	-	-	-	6.7
Themisto spp.	-	-	-	-	-	15.4	-	46.7	40.0	-
Gammaridea	**-**	**-**	**-**	**10.0**	**-**	**-**	**-**	**6.7**	**15.0**	**16.7**
Paracallisoma alberti	-	-	-	-	-	-	-	6.7	5.0	10.0
Unid. Lysianassidae	-	-	-	10.0	-	-	-	-	10.0	6.7
Unid. amphipod	-	-	-	-	-	-	-	6.7	-	-
Euphausiacea	**-**	**50.0**	**-**	**30.0**	**-**	**30.8**	**-**	**66.7**	**40.0**	**20.0**
Euphausia pacifica	-	-	-	-	-	-	-	-	-	6.7
Thysanoessa spp.	-	-	-	-	-	23.1	-	-	5.0	6.7
Unid. euphausiid	-	50.0	-	30.0	-	7.7	-	66.7	35.0	13.3
Decapoda	**-**	**50.0**	**-**	**10.0**	**-**	**7.7**	**-**	**6.7**	**-**	**-**
Pandalid zoea	-	50.0	-	-	-	7.7	-	-	-	-
Unid. shrimp	-	-	-	10.0	-	-	-	6.7	-	-
Polychaeta	**-**	**-**	**-**	**-**	**-**	**7.7**	**-**	**-**	**-**	**-**
Unid. Nereididae	-	-	-	-	-	7.7	-	-	-	-
Fish	**100.0**	**-**	**100.0**	**80.0**	**-**	**61.5**	**100.0**	**20.0**	**80.0**	**86.7**
Myctophidae	**-**	**-**	**-**	**30.0**	**-**	**38.5**	**100.0**	**6.7**	**10.0**	**50.0**
Stenobrachius leucopsarus	-	-	-	-	-	7.7	66.7	-	5.0	10.0
S. nannochir	-	-	-	-	-	7.7	-	-	5.0	23.3
Unid. Myctophidae	-	-	-	30.0	-	30.8	66.7	6.7	-	20.0
Gadidae	**-**	**-**	**100.0**	**-**	**-**	**7.7**	**-**	**-**	**-**	**16.7**
Unid. Gadidae	-	-	100.0	-	-	7.7	-	-	-	16.7
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**20.0**
Sebastes spp.	-	-	-	-	-	-	-	-	-	20.0
Hexagrammidae	**100.0**	**-**	**-**	**-**	**-**	**7.7**	**-**	**-**	**35.0**	**-**
Pleurogrammus monopterygius	-	-	-	-	-	-	-	-	35.0	-
Hexagrammos spp.	100.0	-	-	-	-	7.7	-	-	-	-
Ammodytidae	**-**	**-**	**-**	**20.0**	**-**	**7.7**	**-**	**-**	**-**	**-**
Ammodytes hexapterus	-	-	-	20.0	-	7.7	-	-	-	-
Clupeidae	**-**	**-**	**-**	**40.0**	**-**	**-**	**-**	**-**	**10.0**	**20.0**
Clupea pallasii	-	-	-	40.0	-	-	-	-	10.0	20.0
Unid. Teleostei	-	-	-	10.0	-	-	-	13.3	25.0	-
Other	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Offal	-	-	-	-	-	-	-	-	-	-

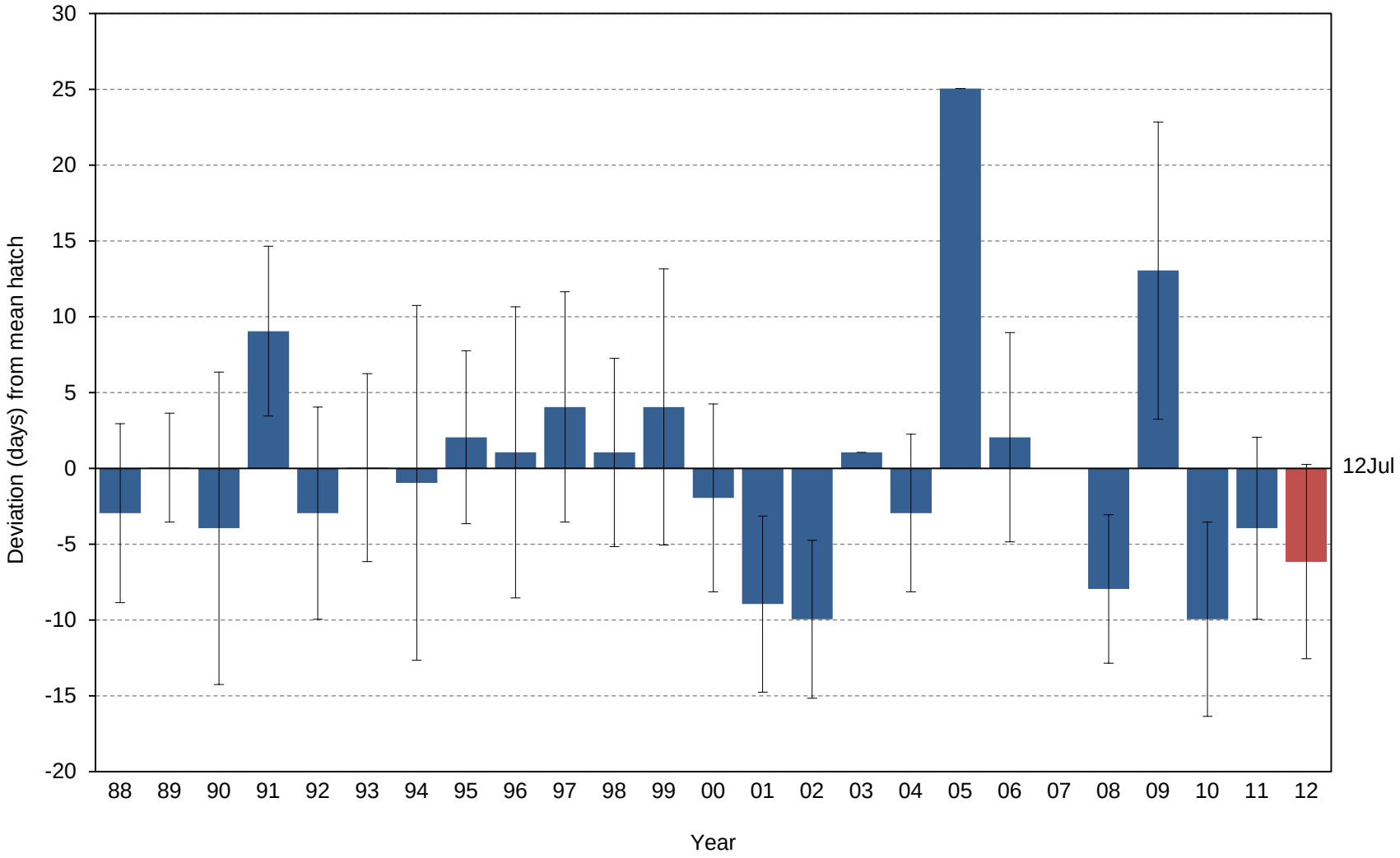

Figure 21. Yearly hatch date deviation (from the 1988-2011 average of 12 July) for red-legged kittiwakes at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 32. Breeding chronology of red-legged kittiwakes at Buldir Island, Alaska. Data represent the dates of the first egg laid and the first chick hatched in each nest.

Year	Mean lay[a]	SD	*n*[b]	Mean hatch	SD	*n*[c]	First lay[a]	First hatch	Last hatch	First fledge[d]
1988	-	-	-	8 Jul	5.9	57	<21 Jun	28 Jun	25 Jul	>11 Aug
1989	-	-	-	12 Jul	3.6	33	<12 Jun	8 Jul	29 Jul	>15 Aug
1990	-	-	-	8 Jul	10.3	40	<3 Jun	27 Jun	31 Jul	31 Jul
1991	-	-	-	21 Jul	5.6	25	<14 Jun	17 Jul	10 Aug	10 Aug
1992	-	-	-	8 Jul	7.0	133	<4 Jun	20 Jun	30 Jul	3 Aug
1993	-	-	-	12 Jul	6.2	35	<7 Jun	1 Jul	23 Jul	16 Aug
1994	-	-	-	11 Jul	11.7	18	<15 Jun	25 Jun	6 Aug	17 Aug
1995	-	-	-	14 Jul	5.7	30	<15 Jun	7 Jul	8 Aug	>17 Aug
1996	-	-	-	12 Jul	9.6	62	<14 Jun	24 Jun	3 Aug	15 Aug
1997	-	-	-	16 Jul	7.6	75	<9 Jun	28 Jun	31 Jul	13 Aug
1998	-	-	-	13 Jul	6.2	61	<14 Jun	1 Jul	29 Jul	13 Aug
1999	-	-	-	16 Jul	9.1	15	<24 Jun	4 Jul	4 Aug	>19 Aug
2000	-	-	-	9 Jul	6.2	69	<11 Jun	27 Jun	27 Jul	19 Aug
2001	-	-	-	3 Jul	5.8	14	<17 Jun	23 Jun	17 Jul	-
2002	-	-	-	2 Jul	5.2	23	<6 Jun	23 Jun	19 Jul	1 Aug
2003	-	-	-	13 Jul	0.0	1	<17 Jun	13 Jul	-	>29 Aug
2004	-	-	-	8 Jul	5.2	7	<14 Jun	2 Jul	18 Jul	>18 Aug
2005	-	-	-	6 Aug	0.0	1	<20 Jun	6 Aug	-	10 Aug
2006	-	-	-	14 Jul	6.9	22	<13 Jun	3 Jul	28 Jul	19 Aug
2007	-	-	-	-	-	-	<15 Jun	-	-	>24 Aug
2008	-	-	-	3 Jul	4.9	13	<16 Jun	28 Jun	13 Jul	6 Aug
2009	-	-	-	25 Jul	9.8	8	<12 Jun	9 Jul	11 Aug	>20 Aug
2010	-	-	-	2 Jul	6.4	6	<15 Jun	27 Jun	15 Jul	12 Aug
2011	-	-	-	8 Jul	6.0	8	<18 Jun	27 Jun	17 Jul	22 Aug
2012	-	-	-	5 Jul	6.4	19	<5 Jun	24 Jun	20 Jul	9 Aug

[a]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.

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

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

[d]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 33. Frequency distribution of hatch dates for red-legged kittiwakes at Buldir Island, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date												
	88	89	90	91	92	93	94	95	96	97	98	99	00
172	-	-	-	-	1	-	-	-	-	-	-	-	-
173	-	-	-	-	-	-	-	-	-	-	-	-	-
174	-	-	-	-	-	-	-	-	-	-	-	-	-
175	-	-	-	-	-	-	-	-	-	-	-	-	-
176	-	-	-	-	3	-	2	-	2	-	-	-	-
177	-	-	-	-	-	-	-	-	-	-	-	-	-
178	-	-	7	-	-	-	-	-	-	-	-	-	-
179	-	-	-	-	-	-	-	-	-	1	-	-	4
180	4	-	9	-	-	-	-	-	5	-	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-	-
182	1	-	2	-	15	1	-	-	1	-	1	-	1
183	3	-	-	-	-	-	-	-	-	-	-	-	1
184	-	-	-	-	-	-	-	-	8	-	-	-	-
185	-	-	-	-	2	-	-	-	-	5	-	2	13
186	11	-	-	-	43	1	9	-	1	-	11	-	-
187	-	-	-	-	-	-	-	-	1	-	-	-	-
188	7	-	1	-	-	14	1	2	-	1	-	-	-
189	8	7	-	-	-	-	-	-	8	-	2	-	1
190	-	-	-	-	5	-	-	4	3	13	1	4	-
191	-	2	4	-	-	-	-	-	-	-	-	-	-
192	2	-	-	-	27	1	-	1	-	4	20	-	39
193	10	-	6	-	-	-	-	-	-	3	-	-	-
194	-	23	2	-	-	5	-	12	-	17	-	3	-
195	-	-	-	-	3	-	-	-	5	-	1	-	-
196	7	-	-	-	21	-	-	4	2	-	15	-	1
197	-	-	-	-	-	1	1	-	-	1	-	-	3
198	-	-	-	14	-	-	-	4	2	2	-	-	-
199	-	-	-	-	1	7	-	-	-	-	-	-	-
200	1	-	1	-	1	-	-	1	11	9	-	-	1
201	-	-	-	-	-	-	-	-	-	-	5	-	-
202	-	-	4	3	6	-	-	-	-	2	-	-	2
203	-	-	-	2	-	2	-	-	-	1	-	-	-
204	2	-	-	-	-	3	-	1	8	-	-	4	-
205	-	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	2	1	2	-	3	-	-	10	2	-	-
207	1	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	4	-	-	-	-	2	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	1	-	3
210	-	1	-	-	1	-	1	-	-	-	2	1	-
211	-	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	2	-	2	-	-	-	2	6	-	-	-
213	-	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	-	-	-	-	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-	1	-	-	1	-
217	-	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	-	-	-	1	-	-	-	-	-	-
219	-	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	1	-	-	-	-	-
221	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	1	-	-	-	-	-	-	-	-	-
223	-	-	-	-	-	-	-	-	-	-	-	-	-
n	57	33	40	25	133	35	18	30	62	75	61	15	69

[a]Julian dates are adjusted by one day in leap years.

Table 33 (continued). Frequency distribution of hatch dates for red-legged kittiwakes at Buldir Island, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date											
	01	02	03	04	05	06	07	08	09	10	11	12
172	-	-	-	-	-	-	*no*	-	-	-	-	-
173	-	-	-	-	-	-	*data*	-	-	-	-	-
174	2	2	-	-	-	-	-	-	-	-	-	-
175	-	-	-	-	-	-	-	-	-	-	-	-
176	-	-	-	-	-	-	-	-	-	-	-	2
177	-	-	-	-	-	-	-	-	-	-	-	-
178	-	2	-	-	-	-	-	-	-	3	1	-
179	-	-	-	-	-	-	-	-	-	-	-	-
180	-	4	-	-	-	-	-	5	-	-	-	1
181	-	-	-	-	-	-	-	-	-	-	-	-
182	6	1	-	-	-	-	-	-	-	-	-	4
183	-	-	-	-	-	-	-	-	-	-	1	-
184	-	10	-	2	-	2	-	3	-	2	-	-
185	-	-	-	-	-	-	-	-	-	-	-	-
186	4	-	-	-	-	-	-	-	-	-	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-
188	-	3	-	-	-	3	-	1	-	-	3	7
189	-	-	-	-	-	1	-	-	-	-	-	-
190	1	-	-	3	-	-	-	3	1	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	6	-	-	-	-	1	-
193	-	-	-	-	-	1	-	-	-	-	-	4
194	-	-	1	1	-	-	-	-	-	-	-	-
195	-	-	-	-	-	-	-	1	1	-	1	-
196	-	-	-	-	-	-	-	-	-	1	-	-
197	-	-	-	-	-	3	-	-	-	-	-	-
198	1	-	-	-	-	-	-	-	-	-	1	-
199	-	-	-	-	-	-	-	-	-	-	-	-
200	-	1	-	1	-	1	-	-	-	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	2	-	-	-	-	-	1
203	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	-	2	-	-	4	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-	-	-	-
209	-	-	-	-	-	1	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	-	-	-	-
211	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	-	-	-	-	-	-
213	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	-	-	-	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-	1	-	-	-
217	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	-	1	-	-	-	-	-	-	-
219	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-	-	-	-	-
221	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	-	-	-	-	-
223	-	-	-	-	-	-	-	-	1	-	-	-
n	14	23	1	7	1	22	-	13	8	6	8	19

[a]Julian dates are adjusted by one day in leap years.

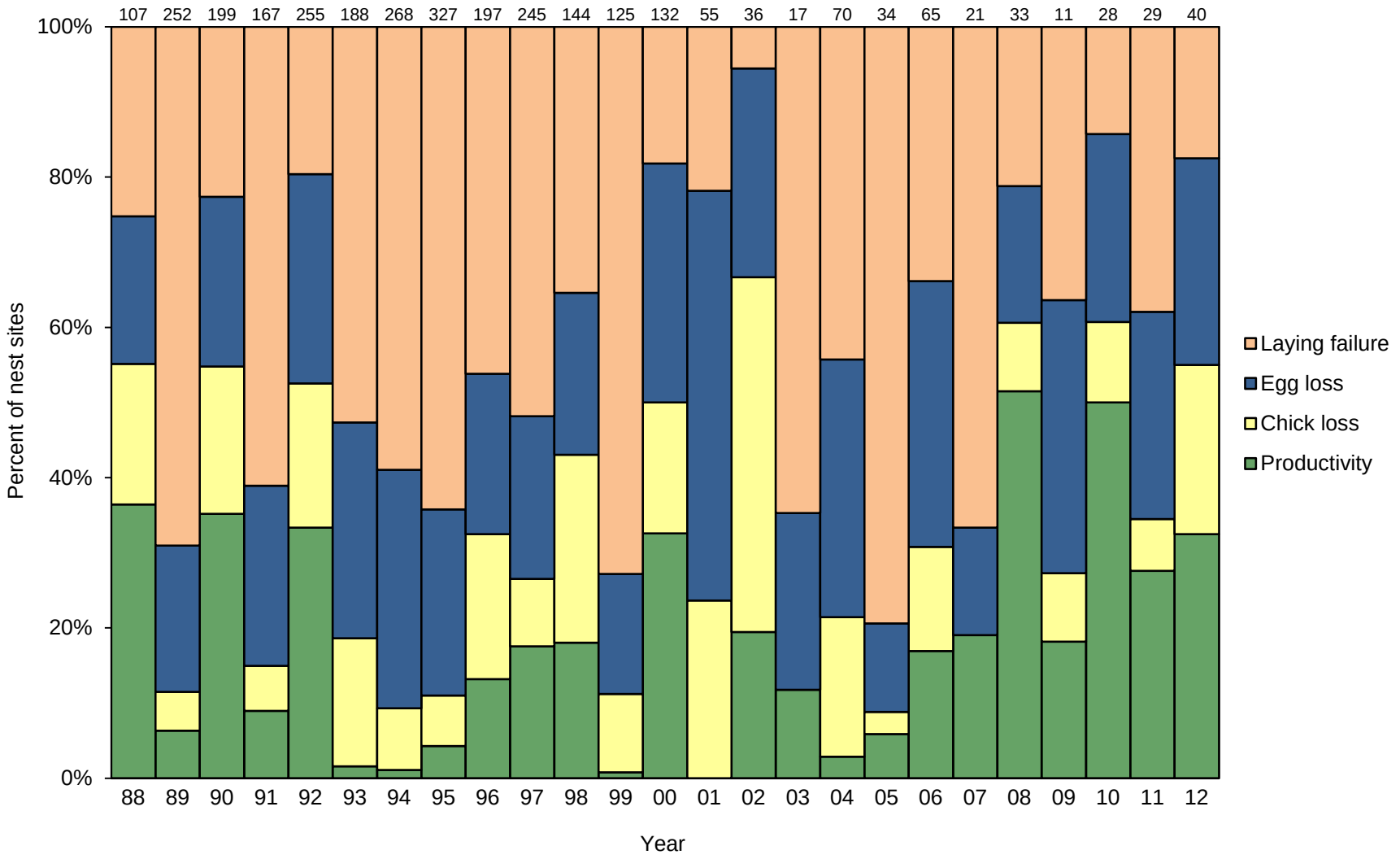

Figure 22. Reproductive performance of red-legged kittiwakes at Buldir Island, Alaska. Laying failure=(A-B)/A; Egg loss=(B-D)/A; Chick loss=(D-F)/A; Productivity=F/A, where A=total nest sites; B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (A).

Table 34. Reproductive performance of red-legged kittiwakes at Buldir Island, Alaska.

Year	Total nest starts (A)	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)	Laying success (B/A)	Mean clutch size (C/B)	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 start (G/A)	Prod. (F/A)
1988	107	80	80	59	59	39	39	0.75	1.0	0.74	0.74	0.66	0.49	0.66	0.49	0.36	0.36
1989	252	78	80	29	30	16	16	0.31	1.0	0.37	0.38	0.53	0.20	0.55	0.21	0.06	0.06
1990	199	154	165	109	111	70	70	0.77	1.1	0.71	0.67	0.63	0.42	0.64	0.45	0.35	0.35
1991	167	65	67	25	26	15	15	0.39	1.0	0.38	0.39	0.58	0.22	0.60	0.23	0.09	0.09
1992	255	205	211	134	135	85	85	0.80	1.0	0.65	0.64	0.63	0.40	0.63	0.41	0.33	0.33
1993	188	89	92	35	35	3	3	0.47	1.0	0.39	0.38	0.09	0.03	0.09	0.03	0.02	0.02
1994	268	110	110	25	25	3	3	0.41	1.0	0.23	0.23	0.12	0.03	0.12	0.03	0.01	0.01
1995	327	117	117	36	36	14	14	0.36	1.0	0.31	0.31	0.39	0.12	0.39	0.12	0.04	0.04
1996	197	106	107	64	64	26	26	0.54	1.0	0.60	0.60	0.41	0.24	0.41	0.25	0.13	0.13
1997	245	118	118	65	65	43	43	0.48	1.0	0.55	0.55	0.66	0.36	0.66	0.36	0.18	0.18
1998	144	93	94	62	62	26	26	0.65	1.0	0.67	0.66	0.42	0.28	0.42	0.28	0.18	0.18
1999	125	34	34	14	14	1	1	0.27	1.0	0.41	0.41	0.07	0.03	0.07	0.03	0.01	0.01
2000	132	108	119	66	69	43	44	0.82	1.1	0.61	0.58	0.64	0.37	0.65	0.40	0.33	0.33
2001	55	43	45	13	13	0	0	0.78	1.1	0.30	0.29	0.00	0.00	0.00	0.00	0.00	0.00
2002	36	34	34	24	24	7	7	0.94	1.0	0.71	0.71	0.29	0.21	0.29	0.21	0.19	0.19
2003	17	6	6	2	2	2	2	0.35	1.0	0.33	0.33	1.00	0.33	1.00	0.33	0.12	0.12
2004	70	39	40	15	15	2	2	0.56	1.0	0.38	0.38	0.13	0.05	0.13	0.05	0.03	0.03
2005	34	7	7	3	3	2	2	0.21	1.0	0.43	0.43	0.67	0.29	0.67	0.29	0.06	0.06
2006	65	43	43	20	20	11	11	0.66	1.0	0.47	0.47	0.55	0.26	0.55	0.26	0.17	0.17
2007	21	7	7	4	4	4	4	0.33	1.0	0.57	0.57	1.00	0.57	1.00	0.57	0.19	0.19
2008	33	26	26	20	20	17	17	0.79	1.0	0.77	0.77	0.85	0.65	0.85	0.65	0.52	0.52
2009	11	7	7	3	3	2	2	0.64	1.0	0.43	0.43	0.67	0.29	0.67	0.29	0.18	0.18
2010	28	24	24	17	17	14	14	0.86	1.0	0.71	0.71	0.82	0.58	0.82	0.58	0.50	0.50
2011	29	18	18	10	10	8	8	0.62	1.0	0.56	0.56	0.80	0.44	0.80	0.44	0.28	0.28
2012	40	33	33	22	22	13	13	0.83	1.0	0.67	0.67	0.59	0.39	0.59	0.39	0.33	0.33

Table 35. Standard deviation in reproductive performance parameters of red-legged kittiwakes at Buldir Island, Alaska. Sampling for kittiwakes is clustered by plot except when sample sizes per plot are too small or plot data are not available.

Year	No. plots[a]	Total nest starts	Sampling design[b]	Laying success	Mean clutch size	Nesting success	Hatching success	Chick success	Egg success	Fledging success	Reprod. success	Fledglings /nest start	Prod.
1988	13	107	Simple random	0.04	0.00	0.05	0.05	0.06	0.06	0.06	0.06	0.05	0.05
1989	15	252	Simple random	0.03	0.02	0.05	0.05	0.09	0.04	0.09	0.05	0.01	0.01
1990	15	199	Simple random	0.03	0.02	0.04	0.04	0.05	0.04	0.05	0.04	0.03	0.03
1991	18	167	Simple random	0.04	0.02	0.06	0.06	0.10	0.05	0.10	0.05	0.02	0.02
1992	19	255	Simple random	0.03	0.01	0.03	0.03	0.04	0.03	0.04	0.03	0.03	0.03
1993	9	188	Simple random	0.04	0.02	0.05	0.05	0.05	0.02	0.05	0.02	0.01	0.01
1994	13	268	Simple random	0.03	0.00	0.04	0.04	0.06	0.02	0.06	0.02	0.01	0.01
1995	17	327	Simple random	0.03	0.00	0.04	0.04	0.08	0.03	0.08	0.03	0.01	0.01
1996	14	197	Simple random	0.04	0.01	0.05	0.05	0.06	0.04	0.06	0.04	0.02	0.02
1997	21	245	Simple random	0.03	0.00	0.05	0.05	0.06	0.04	0.06	0.04	0.02	0.02
1998	9	144	Simple random	0.04	0.01	0.05	0.05	0.06	0.05	0.06	0.05	0.03	0.03
1999	8	125	Simple random	0.04	0.00	0.08	0.08	0.07	0.03	0.07	0.03	0.01	0.01
2000	9	132	Simple random	0.03	0.03	0.05	0.05	0.06	0.04	0.06	0.05	0.04	0.04
2001	4	55	Simple random	0.06	0.03	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00
2002	4	36	Simple random	0.04	0.00	0.08	0.08	0.09	0.07	0.09	0.07	0.07	0.07
2003	8	17	Simple random	0.12	0.00	0.19	0.19	0.00	0.19	0.00	0.19	0.08	0.08
2004	7	70	Simple random	0.06	0.03	0.08	0.08	0.09	0.03	0.09	0.03	0.02	0.02
2005	5	34	Simple random	0.07	0.00	0.19	0.19	0.27	0.17	0.27	0.17	0.04	0.04
2006	7	65	Simple random	0.06	0.00	0.08	0.08	0.11	0.07	0.11	0.07	0.05	0.05
2007	3	21	Simple random	0.10	0.00	0.19	0.19	0.00	0.19	0.00	0.19	0.09	0.09
2008	5	33	Simple random	0.07	0.00	0.08	0.08	0.08	0.09	0.08	0.09	0.09	0.09
2009	3	11	Simple random	0.14	0.00	0.19	0.19	0.27	0.17	0.27	0.17	0.12	0.12
2010	4	28	Simple random	0.07	0.00	0.09	0.09	0.09	0.10	0.09	0.10	0.09	0.09
2011	4	29	Simple random	0.09	0.00	0.12	0.12	0.13	0.12	0.13	0.12	0.08	0.08
2012	4	40	Simple random	0.06	0.00	0.08	0.08	0.10	0.08	0.10	0.08	0.07	0.07

[a]Plots that are combined for analysis are counted as a single "plot".

[b]For sampling clustered by plot, values are calculated using ratio estimator spreadsheets based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1-\rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

Table 36. Clutch sizes of red-legged kittiwakes at Buldir Island, Alaska. Sample units consist of total nest sites, not plots.

Year	Total nest starts	Nest sites w/ x eggs:			Nest sites w/ eggs	Total eggs	Mean clutch size
	(A)	0	1	2	(B)	(C)	(C/B)
1988	107	27	80	0	80	80	1.0
1989	252	174	76	2	78	80	1.0
1990	199	45	143	11	154	165	1.1
1991	167	102	63	2	65	67	1.0
1992	255	50	199	6	205	211	1.0
1993	188	99	86	3	89	92	1.0
1994	268	158	110	0	110	110	1.0
1995	327	210	117	0	117	117	1.0
1996	197	91	105	1	106	107	1.0
1997	245	127	118	0	118	118	1.0
1998	144	51	92	1	93	94	1.0
1999	125	91	34	0	34	34	1.0
2000	132	24	97	11	108	119	1.1
2001	55	12	41	2	43	45	1.1
2002	36	2	34	0	34	34	1.0
2003	17	11	6	0	6	6	1.0
2004	70	31	38	1	39	40	1.0
2005	34	27	7	0	7	7	1.0
2006	65	22	43	0	43	43	1.0
2007	21	14	7	0	7	7	1.0
2008	33	7	26	0	26	26	1.0
2009	11	4	7	0	7	7	1.0
2010	28	4	24	0	24	24	1.0
2011	29	11	18	0	18	18	1.0
2012	40	7	33	0	33	33	1.0

Table 37. Reproductive performance of red-legged kittiwakes at Buldir Island, Alaska in 2012. All plots in 2012 were located at Spike Camp.

Parameter	Plot				Total	SD[a]
	37	40A	45	46		
Total nest starts (A)	1	3	26	10	40	-
Nest sites w/ eggs (B)	1	1	22	9	33	-
Total eggs (C)	1	1	22	9	33	-
Nest sites w/ chicks (D)	0	0	14	8	22	-
Total chicks (E)	0	0	14	8	22	-
Nest sites w/ chicks fledged (F)	0	0	10	3	13	-
Total chicks fledged (G)	0	0	10	3	13	-
Laying success (B/A)	1.00	0.33	0.85	0.90	0.83	0.06
Mean clutch size (C/B)	1.0	1.0	1.0	1.0	1.0	0.00
Nesting success (D/B)	0.00	0.00	0.64	0.89	0.67	0.08
Hatching success (E/C)	0.00	0.00	0.64	0.89	0.67	0.08
Chick success (G/E)	-	-	0.71	0.38	0.59	0.10
Egg success (G/C)	0.00	0.00	0.45	0.33	0.39	0.08
Fledging success (F/D)	-	-	0.71	0.38	0.59	0.10
Reproductive success (F/B)	0.00	0.00	0.45	0.33	0.39	0.08
Fledglings/nest start (G/A)	0.00	0.00	0.38	0.30	0.33	0.07
Productivity (F/A)	0.00	0.00	0.38	0.30	0.33	0.07

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

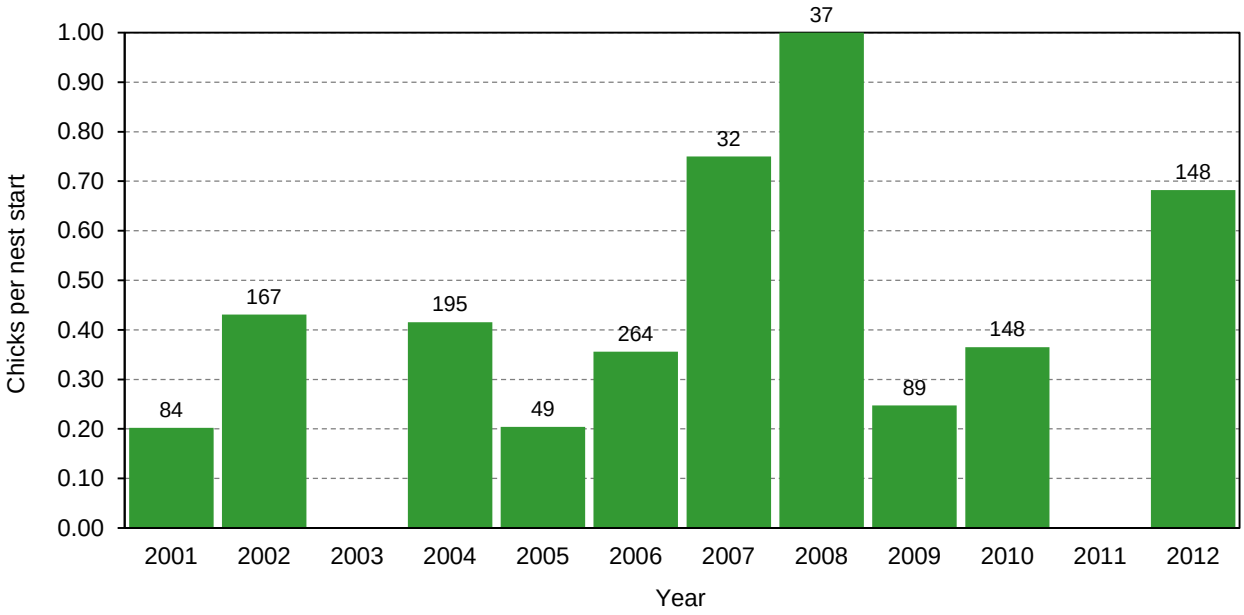

Figure 23. Maximum reproductive performance of red-legged kittiwakes at Kittiwake Lane, Buldir Island, Alaska, as determined by a Boom or Bust methodology. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A).

Table 38. Reproductive performance of red-legged kittiwakes at Kittiwake Lane, Buldir 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.

Year	Total plots monitored	Total nest starts (A)	Total chicks (E)	Chicks/ nest start (E/A)[a]	Date(s) of nest count	Date(s) of chick count
2001	3	84	17	0.20	26 Jun	29 Jul
2002	3	167	72	0.43	9 Jun	27 Jul
2003	*no data*	-	-	-	-	-
2004	4	195	81	0.42	17 Jun	3 Aug
2005	2	49	10	0.20	23 Jun	7 Aug
2006	3	264	94	0.36	23 Jun	9 Aug
2007	3	32	24	0.75	19 Jun	8 Aug
2008	7	37	37	0.66	18 Jun	19 Jul+12 Aug
2009	7	89	22	0.25	16 Jun	11+21 Aug
2010[b]	7	148	54	0.36	13 Jun	22 Jul
2011	*no data*	-	-	-	-	-
2012	13	148	101	0.68	15 Jun	29 Jul

[a]Chicks/nest start (E/A) may be considered a maximum potential value of success [fledglings/nest start (G/A)] based on the assumption that all chicks counted eventually fledge.

[b]Data represent maximum count of nests and chicks from 15 counts between 13 June and 22 August.

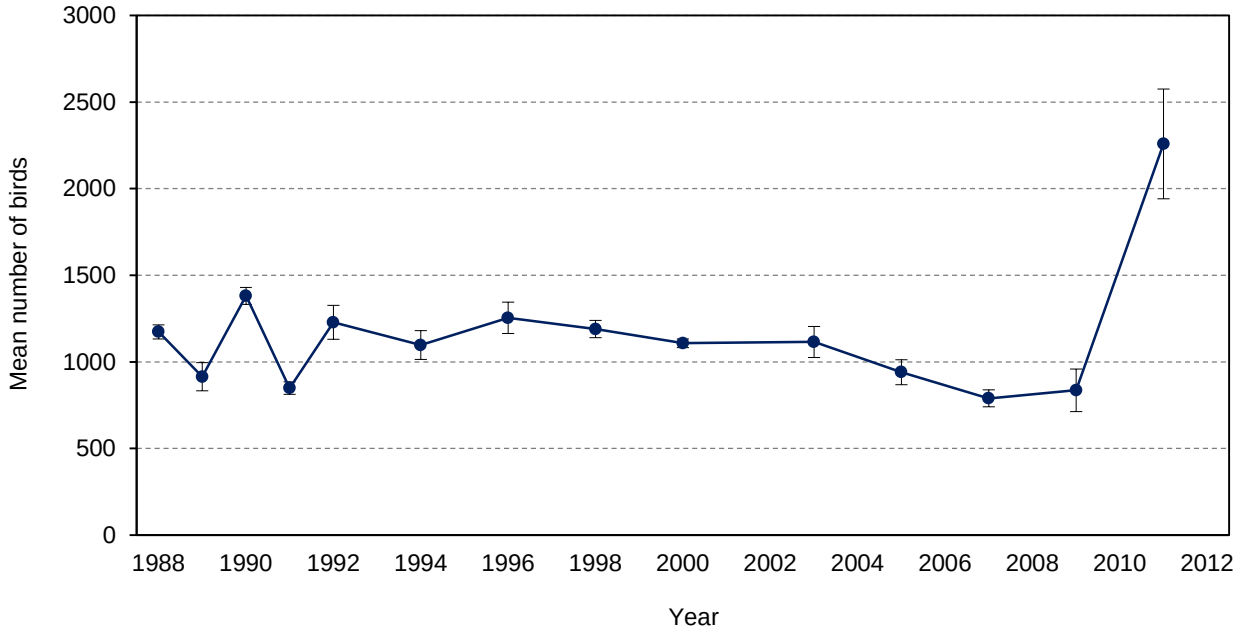

Figure 24. Mean numbers of red-legged kittiwakes counted on index plots at Buldir Island, Alaska. Error bars represent standard deviation.

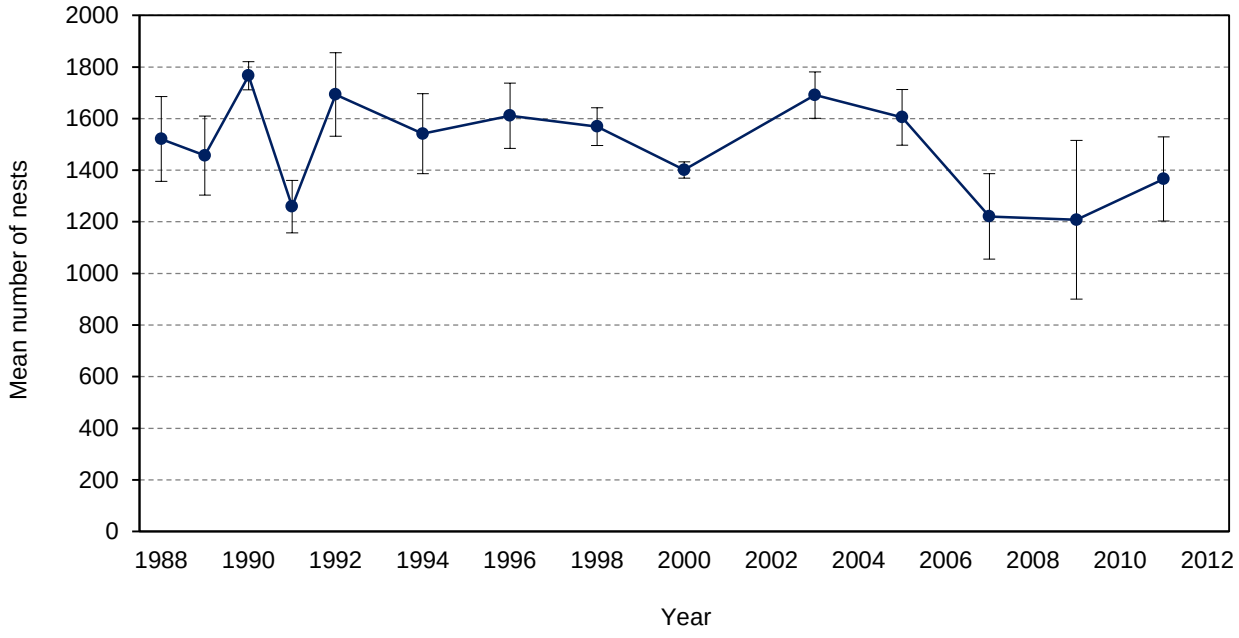

Figure 25. Mean numbers of red-legged kittiwake nests counted on index plots at Buldir Island, Alaska. Error bars represent standard deviation.

Table 39. Numbers of red-legged kittiwakes counted on index plots at Buldir Island, Alaska. Data represent combined totals from Spike (The Dip) and Kittiwake Lane. No counts were conducted during years not listed.

Replicate	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005	2007	2009	2011
1	1182	826	1441	806	1094	1030	1133	1168	1120	984	829	729	753	1873
2	1130	828	1415	835	1237	1060	1196	1112	1147	1139	954	803	848	1987
3	1208	973	1315	874	1251	1082	1299	1239	1092	1156	937	819	675	2554
4	-	957	1366	828	1330	1217	1366	1210	1084	1179	956	748	971	2557
5	-	988	1367	895	-	-	1274	1215	1099	-	1030	854	933	2324
Mean	1173	914	1381	848	1228	1097	1254	1189	1108	1115	941	789	836	2259
n	3	5	5	5	4	4	5	5	5	4	5	5	5	5
SD	40	81	49	36	98	83	91	50	25	89	72	49	123	317
First count	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 Jun	29 Jun	8 Jul
Last count	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul	23 Jul	31 Jul	26 Jul

Table 40. Numbers of red-legged kittiwake nests counted on index plots at Buldir Island, Alaska. Data represent combined totals from Spike (The Dip) and Kittiwake Lane. No counts were conducted during years not listed.

Replicate	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005	2007	2009	2011
1	1279	1220	1823	1139	1470	1387	1422	1506	1396	1630	1488	1026	1067	1538
2	1558	1389	1727	1165	1752	1466	1565	1487	1394	1790	1612	1110	1156	1546
3	1614	1533	1695	1320	1695	1565	1625	1582	1371	1742	1503	1229	808	1291
4	1633	1560	1774	1320	1854	1747	1747	1605	1389	1602	1707	1289	1603	1210
5	-	1585	1811	1373	-	-	1697	1664	1455	-	1714	1453	1409	1245
Mean	1521	1457	1766	1259	1693	1541	1611	1569	1401	1691	1605	1221	1208	1366
Max.	1633	1585	1823	1373	1854	1747	1747	1664	1455	1790	1714	1453	1603	1546
n	4	5	5	5	4	4	5	5	5	4	5	5	5	5
SD	164	153	55	102	162	155	126	73	32	90	108	165	308	163
First count	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 Jun	29 Jun	8 Jul
Last count	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul	23 Jul	31 Jul	26 Jul

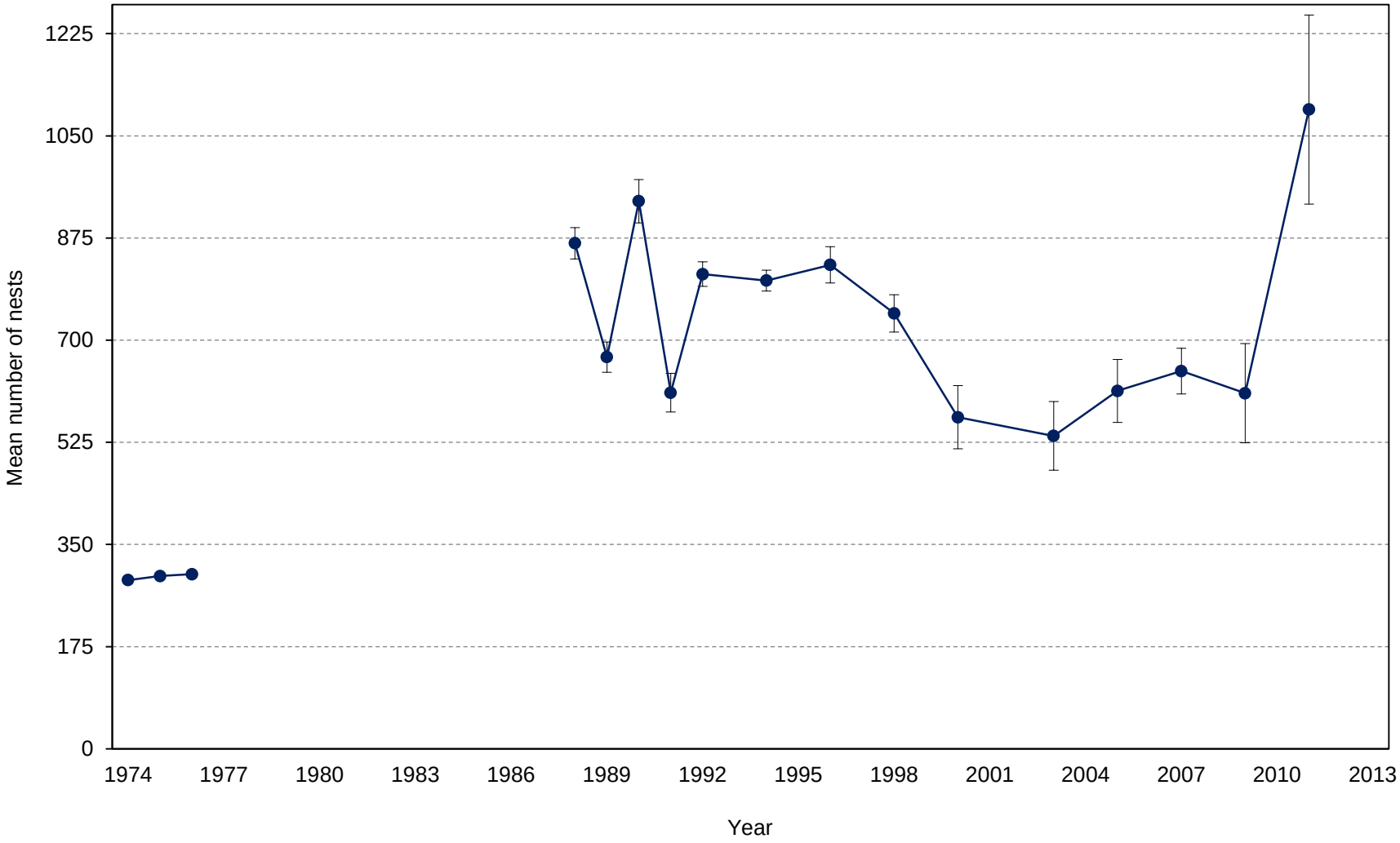

Figure 26. Mean numbers of red-legged kittiwake nests counted on index plots at Kittiwake Lane, Buldir Island, Alaska. Data include only plots in Kittiwake Lane East (15-18) and Kittiwake Lane West (19-29) and are a subset of total counts on all index plots. Error bars represent standard deviation.

Table 41. Mean numbers of red-legged kittiwake nests counted on index plots at Kittiwake Lane, Buldir Island, Alaska. Plot values represent the average count of nests in that plot each year; total values and standard deviations are based on the average total count across all plots each year (as opposed to the sum of plot means). Data include only plots in Kittiwake Lane East (15-18) and Kittiwake Lane West (19-29); these data are a subset of total counts on all index plots (Table 40) but are presented separately for comparison with historic counts from 1974-1976. No counts were conducted during years not listed.

Plot (segment)	1974	1975	1976	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005	2007	2009	2011
15 (1)	-	80	-	127	95	145	75	96	81	88	81	46	69	46	1	0	3
16 (2)	-	89	-	110	83	108	75	98	95	68	70	37	33	31	92	63	149
17 (3)	-	46	-	149	125	129	63	87	80	79	56	57	53	88	89	75	146
18 (4)	-	49	-	167	75	114	85	123	137	171	135	93	81	141	79	117	315
19 (5)	-	12	-	52	51	75	34	62	66	59	49	46	43	52	41	71	112
20 (6)	-	20	-	109	72	117	44	95	94	81	81	83	38	45	54	48	66
21 (7)	-	0	-	49	49	76	73	70	86	95	95	70	63	68	92	65	90
22 (8)	-	0	-	56	56	78	79	88	82	66	69	31	48	44	64	54	74
23 (9)	-	0	-	46	63	87	80	90	57	44	37	27	31	59	46	61	86
24 (10)	-	0	-	1	1	6	2	4	7	17	26	24	12	4	12	19	29
25 (11)	-	0	-	0	0	0	0	0	5	11	10	11	22	24	15	21	15
26 (12)	-	0	-	0	0	0	0	0	2	12	14	18	28	7	12	14	9
27 (13)	-	0	-	0	0	0	0	0	1	10	8	13	10	3	2	0	0
28 (14)	-	0	-	0	1	3	0	0	9	28	15	12	3	1	1	0	1
29 (15)	-	0	-	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Total	289	296	299	866	671	938	610	813	802	829	746	568	536	613	647	609	1095
n	1	1	1	3	5	5	5	4	4	5	5	5	4	5	5	5	5
SD	-	-	-	27	26	37	33	21	18	31	32	54	59	54	39	85	162
First count	Jul[a]	Jul[a]	Jul[a]	5 Jul	29 Jun	30 Jun	8 Jul	6 Jul	4 Jul	28 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 Jun	29 Jun	8 Jul
Last count	-	-	-	27 Jul	16 Jul	18 Jul	18 Jul	20 Jul	19 Jul	18 Jul	24 Jul	20 Jul	25 Jul	18 Jul	14 Jul	31 Jul	26 Jul

[a]Data come from single counts made early to mid-July 1974, 1975, and 1976; from Byrd (1978).

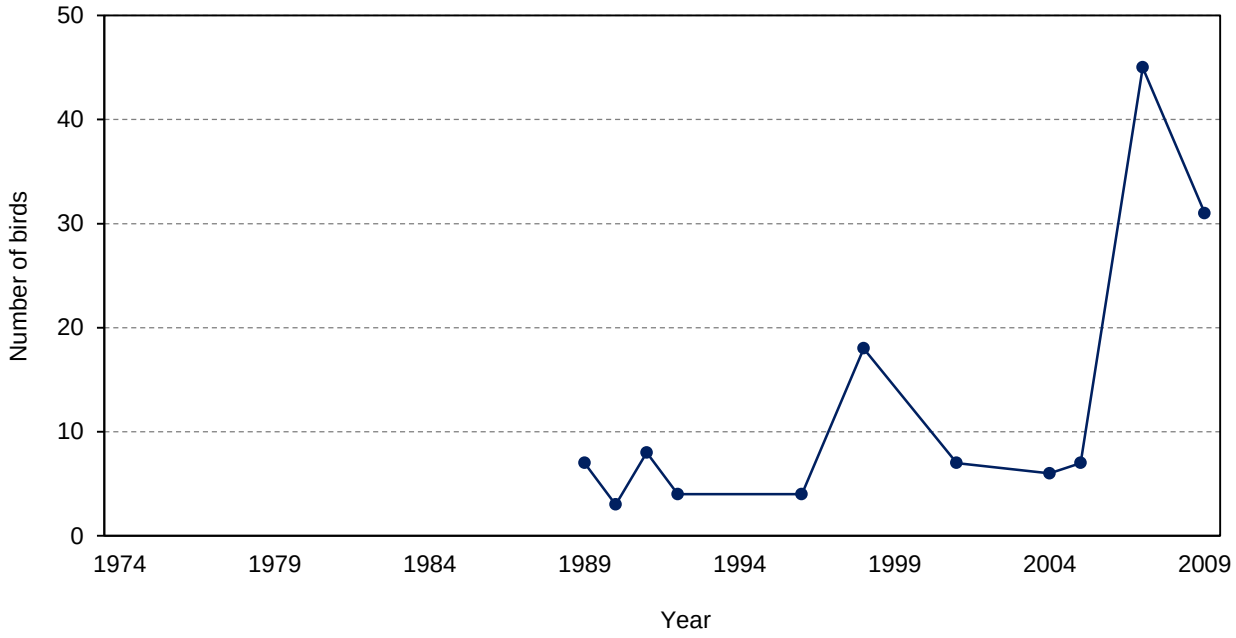

Figure 27. Numbers of red-legged kittiwakes counted at Middle Rock, Buldir Island, Alaska. Counts at Middle Rock are separate from island-wide population counts on index plots. Data do not include 1988 because birds were not identified to species.

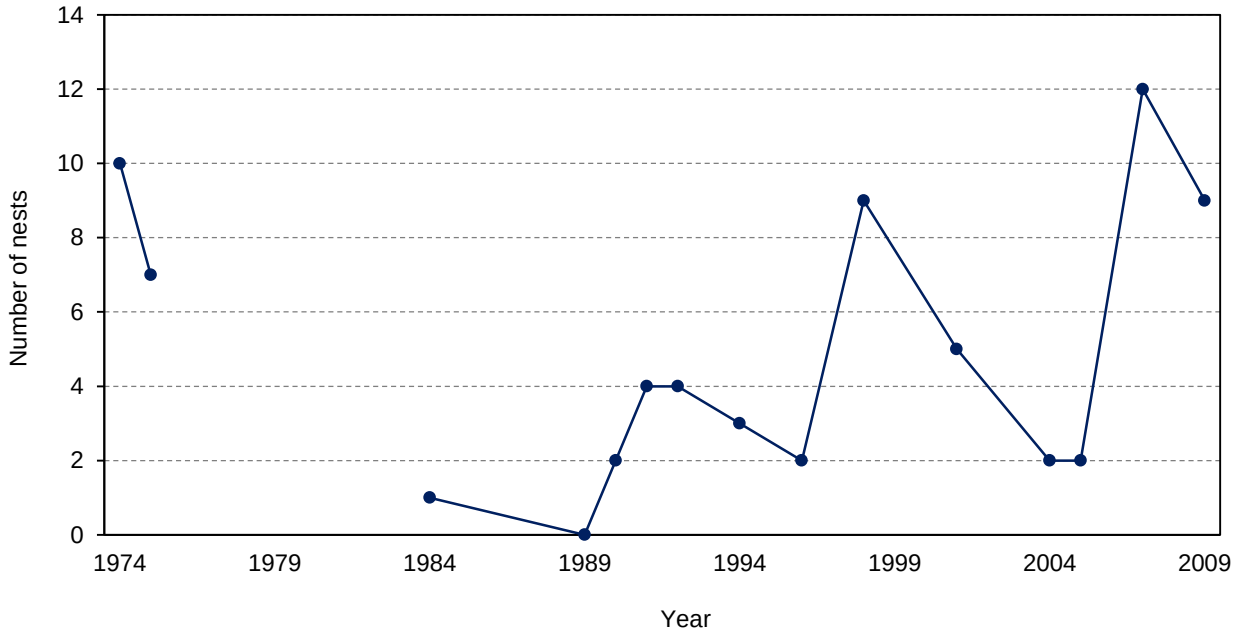

Figure 28. Numbers of red-legged kittiwake nests counted at Middle Rock, Buldir Island, Alaska. Counts at Middle Rock are separate from island-wide population counts on index plots. Data do not include 1988 because birds were not identified to species.

Table 42. Numbers of red-legged kittiwakes counted at Middle Rock, Buldir Island, Alaska. Counts at Middle Rock are separate from island-wide population counts on index plots; numbers are not included in population count totals (Table 39) and counts are not always conducted in the same years. No counts were conducted during years not listed.

Segment	1974	1975	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005	2007	2009
I	*no count*	*no count*	*no count*	-	0	0	0	0	*no count*	0	0	0	0	4	0	0
II				-	0	0	0	0		0	0	2	0	0	0	0
III	-	-	-	-	0	0	0	0	-	0	0	0	0	0	0	0
IV	-	-	-	-	0	0	0	0	-	0	0	0	0	0	0	0
V	-	-	-	-	3	0	0	0	-	0	5	1	0	0	2	0
VI	-	-	-	-	0	0	0	0	-	1	13	0	0	3	23	21
VII	-	-	-	-	4	3	8	4	-	3	0	4	6	0	20	10
Total	-	-	-	-[a]	7	3	8	4	-	4	18	7	6	7	45	31
Date(s)	-	-	-	19 Jul	20 Jul	19-26 Jul	17 Jul	26 Jul	-	22 Jul	1 Jul	6 Jul	13 Jul	25 Jul	23 Jul	22 Jul

[a]Count in 1988 not broken down to species, see black-legged kittiwakes counts (Table 30).

Table 43. Numbers of red-legged kittiwake nests counted at Middle Rock, Buldir Island, Alaska. Counts at Middle Rock are separate from island-wide population counts on index plots; numbers are not included in population count totals (Table 40) and counts are not always conducted in the same years. No counts were conducted during years not listed.

Segment	1974	1975	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005	2007	2009
I	9	5	0	-	0	0	0	0	0	0	0	0	0	2	0	0
II	0	0	0	-	0	0	0	0	1	0	0	2	0	0	0	0
III	0	0	0	-	0	0	0	0	2	0	0	0	0	0	0	0
IV	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	2
V	1	2	1	-	0	0	0	0	0	0	0	1	0	0	1	0
VI	0	0	0	-	0	0	0	0	0	1	9	0	0	0	5	5
VII	0	0	0	-	0	2	4	4	0	1	0	2	2	0	6	2
Total	10	7	1	-[a]	0	2	4	4	3	2	9	5	2	2	12	9
Date(s)	9 Aug	4 Jun	17 Jun	19 Jul	20 Jul	19-26 Jul	17 Jul	26 Jul	23-24 Jul	22 Jul	1 Jul	6 Jul	13 Jul	25 Jul	23 Jul	22 Jul

[a]Count in 1988 not broken down to species, see black-legged kittiwakes counts (Table 31).

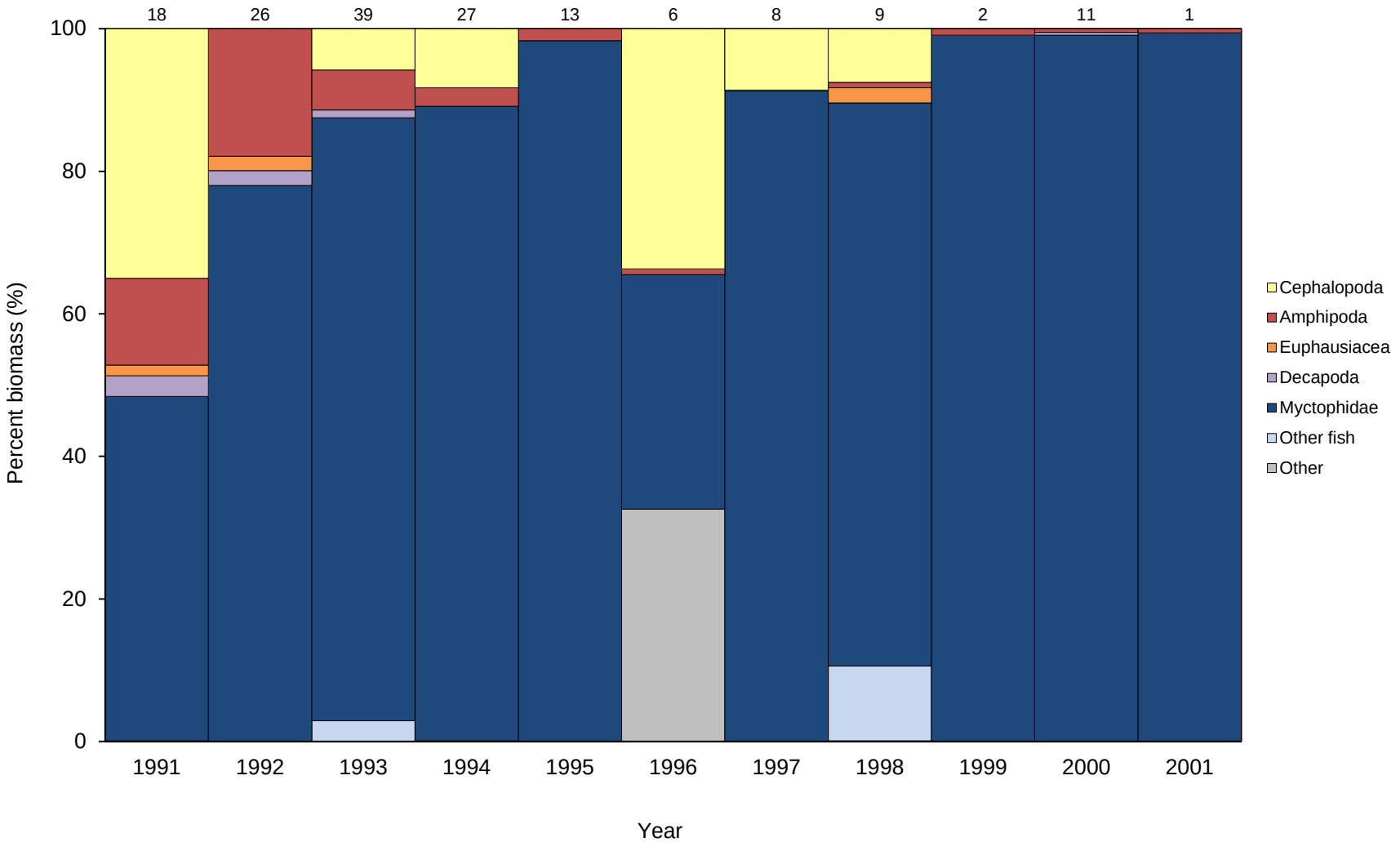

Figure 29. Relative biomass of prey in diets of red-legged kittiwake chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2002-2012 but have not yet been summarized.

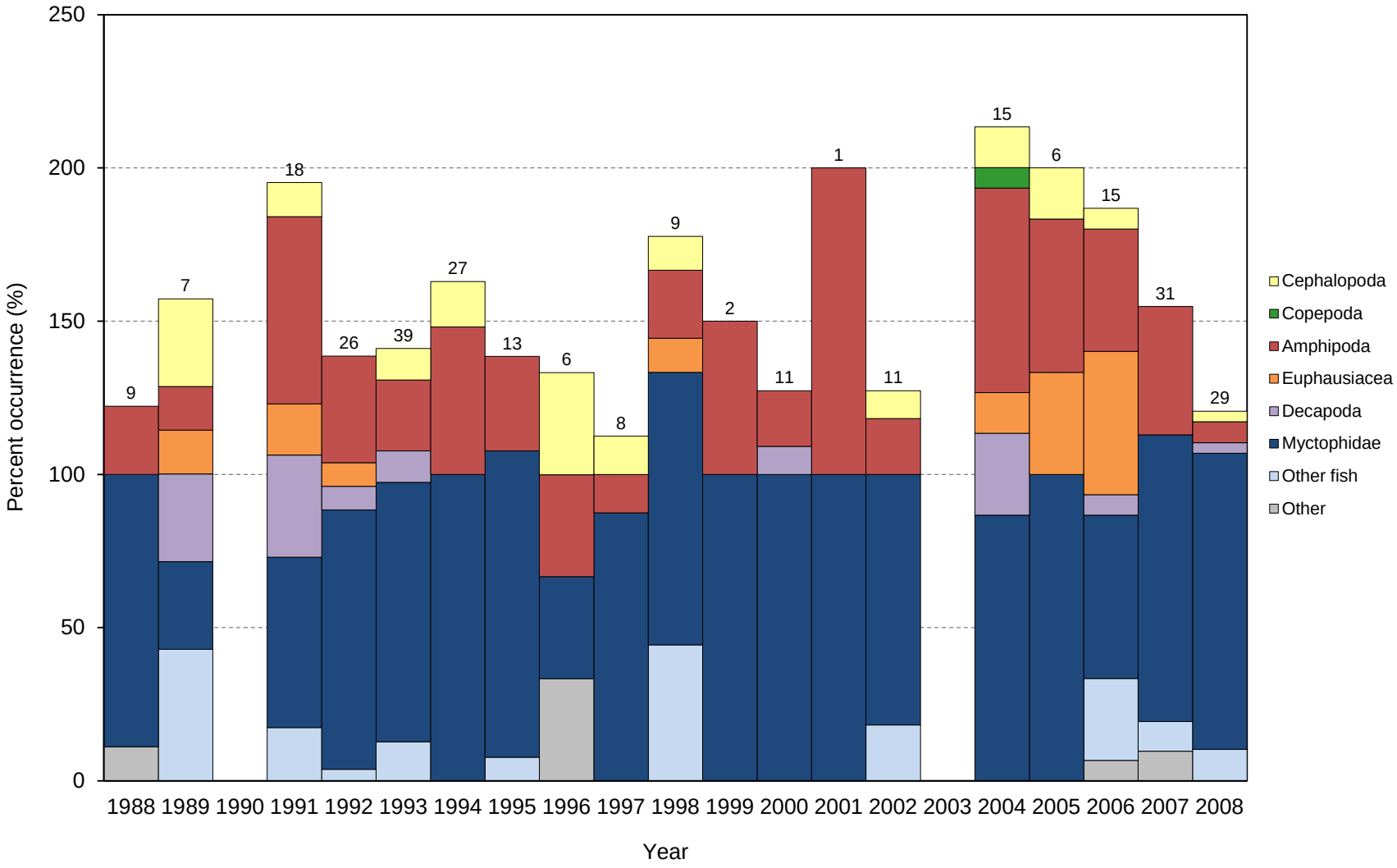

Figure 30. Frequency of occurrence of prey in diets of red-legged kittiwake chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2009-2012 but have not yet been summarized.

Table 44. Relative biomass of prey in diets of red-legged kittiwake chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks and regurgitations from chicks themselves; all prey was identified and measured in the laboratory. Data do not include samples collected in 1988 and 1989 because mass data are not available. Diet samples were collected in 2002-2012 but have not yet been summarized.

Prey	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
No. samples[a]	18	26	39	27	13	6	8	9	2	11	1
Total mass (g)	171.5	47.9	189.8	389.3	145.5	136.6	174.4	238.9	57.0	127.0	2.1
Invertebrates	**51.6**	**22.0**	**12.5**	**10.9**	**1.7**	**34.5**	**8.7**	**10.4**	**0.9**	**0.9**	**0.6**
Cephalopoda	**35.0**	**-**	**5.8**	**8.3**	**-**	**33.7**	**8.6**	**7.5**	**-**	**-**	**-**
Decabrachia	**35.0**	**-**	**5.8**	**8.3**	**-**	**33.7**	**8.6**	**7.5**	**-**	**-**	**-**
Unid. squid	35.0	-	5.8	8.3	-	33.7	8.6	7.5	-	-	-
Amphipoda	**12.2**	**17.9**	**5.6**	**2.6**	**1.7**	**0.8**	**0.1**	**0.8**	**0.9**	**0.5**	**0.6**
Hyperiidea	**-**	**3.3**	**0.6**	**0.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Themisto pacifica	-	-	-	0.2	-	-	-	-	-	-	-
Themisto spp.	-	3.3	0.6	-	-	-	-	-	-	-	-
Gammaridea	**9.6**	**10.4**	**5.0**	**2.4**	**1.7**	**0.8**	**0.1**	**0.8**	**0.9**	**0.5**	**0.6**
Unid. Lysianassidae	9.6	10.4	5.0	2.4	1.7	0.8	0.1	0.8	0.9	0.5	0.6
Unid. amphipod	2.6	4.2	-	-	-	-	-	-	-	-	-
Euphausiacea	**1.5**	**2.0**	**-**	**-**	**-**	**-**	**-**	**2.1**	**-**	**-**	**-**
Thysanoessa spp.	1.5	2.0	-	-	-	-	-	-	-	-	-
Unid. euphausiid	-	-	-	-	-	-	-	2.1	-	-	-
Decapoda	**2.9**	**2.1**	**1.1**	**-**	**-**	**-**	**-**	**-**	**-**	**0.4**	**-**
Unid. shrimp	2.9	2.1	1.1	-	-	-	-	-	-	0.4	-
Fish	**48.3**	**78.0**	**87.5**	**89.0**	**98.3**	**32.9**	**91.3**	**89.5**	**99.1**	**99.1**	**99.4**
Osmeridae	**-**	**-**	**1.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Osmeridae	-	-	1.3	-	-	-	-	-	-	-	-
Myctophidae	**48.3**	**78.0**	**84.6**	**89.0**	**98.3**	**32.9**	**91.3**	**79.0**	**99.1**	**99.1**	**99.4**
Stenobrachius leucopsarus	-	-	84.6	-	-	-	91.3	69.0	-	-	-
Unid. Myctophidae	48.3	78.0	-	89.0	98.3	32.9	-	10.0	99.1	99.1	99.4
Hexagrammidae	**-**	**-**	**1.1**	**-**	**-**	**-**	**-**	**10.5**	**-**	**-**	**-**
Hexagrammos spp.	-	-	1.1	-	-	-	-	10.5	-	-	-
Unid. Teleostei	-	-	0.5	-	-	-	-	-	-	-	-
Other	**-**	**-**	**-**	**-**	**-**	**32.6**	**-**	**-**	**-**	**-**	**-**
Offal	-	-	-	-	-	32.6	-	-	-	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 45) and some prey types may not appear in biomass data although they were present in diet samples.

Table 45. Frequency of occurrence of prey in diets of red-legged kittiwake chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks and regurgitations from chicks themselves; all prey was identified and measured in the laboratory. Diet samples were collected in 2009-2012 but have not yet been summarized.

Prey	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
No. samples	9	7	*no samples*	18	26	39	27	13	6	8	9
Invertebrates	**33.3**	**42.9**	**-**	**88.9**	**42.3**	**41.0**	**55.6**	**30.8**	**50.0**	**25.0**	**33.3**
Cephalopoda	**-**	**28.6**	**-**	**11.1**	**-**	**10.3**	**14.8**	**-**	**33.3**	**12.5**	**11.1**
Decabrachia	**-**	**28.6**	**-**	**11.1**	**-**	**10.3**	**14.8**	**-**	**33.3**	**12.5**	**11.1**
Unid. squid	-	28.6	-	11.1	-	10.3	14.8	-	33.3	12.5	11.1
Copepoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Neocalanus plumchrus/flemengeri	-	-	-	-	-	-	-	-	-	-	-
Calanoid spp.	-	-	-	-	-	-	-	-	-	-	-
Amphipoda	**22.2**	**14.3**	**-**	**61.1**	**34.8**	**23.1**	**48.1**	**30.8**	**33.3**	**12.5**	**22.2**
Hyperiidea	**-**	**14.3**	**-**	**-**	**15.4**	**7.7**	**7.4**	**-**	**-**	**-**	**-**
Themisto pacifica	-	14.3	-	-	-	-	7.4	-	-	-	-
Themisto spp.	-	-	-	-	15.4	7.7	-	-	-	-	-
Gammaridea	**22.2**	**-**	**-**	**44.4**	**19.2**	**20.5**	**40.7**	**30.8**	**33.3**	**12.5**	**22.2**
Paracallisoma alberti	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Lysianassidae	22.2	-	-	44.4	19.2	20.5	40.7	30.8	33.3	12.5	22.2
Unid. amphipod	-	-	-	16.7	3.8	-	-	-	-	-	-
Euphausiacea	**-**	**14.3**	**-**	**16.7**	**7.7**	**-**	**-**	**-**	**-**	**-**	**11.1**
Thysanoessa spp.	-	-	-	16.7	7.7	-	-	-	-	-	-
Unid. euphausiid	-	14.3	-	-	-	-	-	-	-	-	11.1
Decapoda	**-**	**28.6**	**-**	**33.3**	**7.7**	**10.3**	**-**	**-**	**-**	**-**	**-**
Pandalid shrimp	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. shrimp	-	28.6	-	33.3	7.7	10.3	-	-	-	-	-
Lophogastrida	**11.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gnathophausia gigas	11.1	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Fish	**88.9**	**71.4**	**-**	**77.8**	**88.5**	**94.9**	**100.0**	**100.0**	**33.3**	**87.5**	**100.0**
Osmeridae	**-**	**-**	**-**	**-**	**-**	**2.6**	**-**	**-**	**-**	**-**	**-**
Unid. Osmeridae	-	-	-	-	-	2.6	-	-	-	-	-
Myctophidae	**88.9**	**28.6**	**-**	**55.6**	**84.6**	**84.6**	**100.0**	**100.0**	**33.3**	**87.5**	**88.9**
Nannobrachium regale	-	-	-	-	-	-	-	-	-	-	-
Stenobrachius leucopsarus	-	-	-	-	-	82.1	-	-	-	87.5	88.9
S. nannochir	-	-	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	88.9	28.6	-	55.6	84.6	2.6	100.0	100.0	33.3	-	22.2
Gadidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Gadidae	-	-	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Sebastes spp.	-	-	-	-	-	-	-	-	-	-	-
Hexagrammidae	**-**	**-**	**-**	**-**	**-**	**2.6**	**-**	**-**	**-**	**-**	**44.4**
Pleurogrammus monopterygius	-	-	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	-	-	-	-	-	2.6	-	-	-	-	44.4
Ammodytidae	**-**	**-**	**-**	**5.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ammodytes hexapterus	-	-	-	5.6	-	-	-	-	-	-	-
Clupeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Clupea pallasii	-	-	-	-	-	-	-	-	-	-	-
Melamphaidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Poromitra crassiceps	-	-	-	-	-	-	-	-	-	-	-
Unid. Teleostei	-	42.9	-	16.7	3.8	10.3	-	7.7	-	-	-
Other	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**33.3**	**-**	**-**
Offal		-	-	-	-	-	-	-	33.3	-	-

Table 45 (continued). Frequency of occurrence of prey in diets of red-legged kittiwake chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks and regurgitations from chicks themselves; all prey was identified and measured in the laboratory. Diet samples were collected in 2009-2012 but have not yet been summarized.

Prey	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. samples	2	11	1	11	*no samples*	15	6	15	31	29
Invertebrates	**50.0**	**27.3**	**100.0**	**27.3**	**-**	**86.7**	**50.0**	**60.0**	**41.9**	**13.8**
Cephalopoda	**-**	**-**	**-**	**9.1**	**-**	**13.3**	**16.7**	**6.7**	**-**	**3.4**
Decabrachia	**-**	**-**	**-**	**9.1**	**-**	**13.3**	**16.7**	**6.7**	**-**	**3.4**
Unid. squid	-	-	-	9.1	-	13.3	16.7	6.7	-	3.4
Copepoda	**-**	**-**	**-**	**-**	**-**	**6.7**	**-**	**-**	**-**	**-**
Neocalanus plumchrus/flemengeri	-	-	-	-	-	6.7	-	-	-	-
Calanoid spp.	-	-	-	-	-	6.7	-	-	-	-
Amphipoda	**50.0**	**18.2**	**100.0**	**18.2**	**-**	**66.7**	**50.0**	**40.0**	**41.9**	**6.9**
Hyperiidea	**-**	**-**	**-**	**-**	**-**	**20.0**	**33.3**	**6.7**	**9.7**	**3.4**
Themisto pacifica	-	-	-	-	-	6.7	33.3	6.7	9.7	-
Themisto spp.	-	-	-	-	-	13.3	-	-	-	3.4
Gammaridea	**50.0**	**18.2**	**100.0**	**18.2**	**-**	**46.7**	**33.3**	**26.7**	**38.7**	**3.4**
Paracallisoma alberti	**-**	**-**	**-**	**-**	**-**	**-**	**-**	20.0	16.1	3.4
Unid. Lysianassidae	50.0	18.2	100.0	18.2	-	46.7	33.3	6.7	22.6	-
Unid. amphipod	-	-	-	-	-	6.7	-	6.7	-	-
Euphausiacea	**-**	**-**	**-**	**-**	**-**	**13.3**	**33.3**	**46.7**	**-**	**-**
Thysanoessa spp.	-	-	-	-	-	6.7	16.7	6.7	-	-
Unid. euphausiid	-	-	-	-	-	6.7	33.3	40.0	-	-
Decapoda	**-**	**9.1**	**-**	**-**	**-**	**26.7**	**-**	**6.7**	**-**	**3.4**
Pandalid shrimp	**-**	**-**	**-**	**-**	**-**	26.7	**-**	**-**	**-**	**-**
Unid. shrimp	-	9.1	-	-	-	-	-	6.7	-	3.4
Lophogastrida	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gnathophausia gigas	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Fish	**100.0**	**100.0**	**100.0**	**90.9**	**-**	**86.7**	**100.0**	**80.0**	**100.0**	**100.0**
Osmeridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Osmeridae	-	-	-	-	-	-	-	-	-	-
Myctophidae	**100.0**	**100.0**	**100.0**	**81.8**	**-**	**86.7**	**100.0**	**53.3**	**93.5**	**96.6**
Nannobrachium regale	-	-	-	-	-	-	-	-	-	3.4
Stenobrachius leucopsarus	-	-	-	-	-	80.0	66.7	-	19.4	44.8
S. nannochir	-	-	-	-	-	6.7	33.3	-	19.4	24.1
Unid. Myctophidae	100.0	100.0	100.0	81.8	-	20.0	16.7	53.3	64.5	62.1
Gadidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6.9**
Unid. Gadidae	-	-	-	-	-	-	-	-	-	6.9
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.4**
Sebastes spp.	-	-	-	-	-	-	-	-	-	3.4
Hexagrammidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.2**	**-**
Pleurogrammus monopterygius	-	-	-	-	-	-	-	-	3.2	-
Hexagrammos spp.	-	-	-	-	-	-	-	-	-	-
Ammodytidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ammodytes hexapterus	-	-	-	-	-	-	-	-	-	-
Clupeidae	**-**	**-**	**-**	**9.1**	**-**	**-**	**-**	**-**	**-**	**-**
Clupea pallasii	-	-	-	9.1	-	-	-	-	-	-
Melamphaidae	**-**	**-**	**-**	**9.1**	**-**	**-**	**-**	**-**	**-**	**3.4**
Poromitra crassiceps	-	-	-	9.1	-	-	-	-	-	3.4
Unid. Teleostei	-	-	-	-	-	-	-	26.7	6.5	-
Other	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6.7**	**9.7**	**-**
Offal	-	-	-	-	-	-	-	6.7	9.7	-

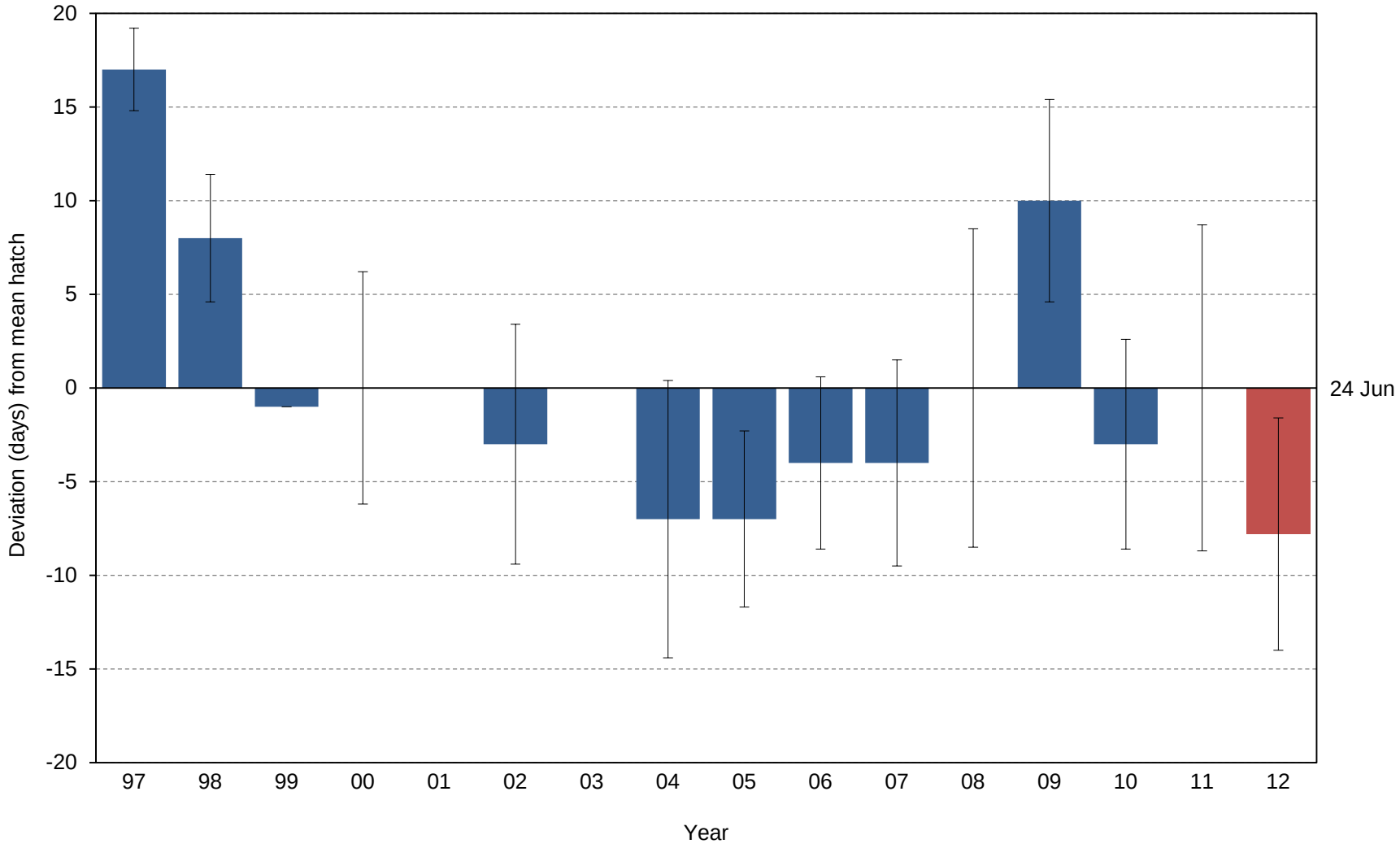

Figure 31. Yearly hatch date deviation (from the 1997-2011 average of 24 June) for glaucous-winged gulls at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 46. Breeding chronology of glaucous-winged gulls at Buldir Island, Alaska. Data represent the date of the first chick hatched in each nest.

Year	Mean lay[a]	SD	*n*[b]	Mean hatch	SD	*n*[c]	First lay[a]	First hatch	Last hatch
1997	xx[d]	xx	xx	11 Jul	2.2	5	xx	27 May[e]	9 Jul
1998	xx	xx	xx	2 Jul	3.4	13	xx	25 Jun	5 Jul
1999	xx	xx	xx	23 Jun	-	1	xx	23 Jun	23 Jun
2000	xx	xx	xx	23 Jun	6.2	7	xx	16 Jun	10 Jul
2001	xx	xx	xx	-	-	-	-	<26 Jun	-
2002	xx	xx	xx	21 Jun	6.4	14	xx	13 Jun	15 Jul
2003	xx	xx	xx	-[f]	-	-	-	<13 Jun	23 Jun
2004	xx	xx	xx	16 Jun	7.4	18	xx	8 Jun	30 Jun
2005	xx	xx	xx	17 Jun	4.7	13	xx	9 Jun	23 Jun
2006	xx	xx	xx	20 Jun	4.6	14	xx	14 Jun	30 Jun
2007	xx	xx	xx	20 Jun	5.5	22	xx	13 Jun	29 Jun
2008	xx	xx	xx	23 Jun	8.5	22	xx	8 Jun	9 Jul
2009	xx	xx	xx	4 Jul	5.4	10	xx	25 Jun	15 Jul
2010	xx	xx	xx	21 Jun	5.6	29	xx	9 Jun	3 Jul
2011	xx	xx	xx	24 Jun	8.7	3	-	18 Jun	4 Jul
2012	-	-	-	15 Jun	6.2	27	<29 May	6 Jun	25 Jun

[a]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.
[b]Sample sizes for mean lay dates are a sub-sample of total nests for which no egg to egg interval is ≤ 7 days.
[c]Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.
[b]xx indicates data potentially exist but have not yet been summarized.
[e]Outlier not included in mean hatch calculation.
[f]Chicks present at first check in 2003 so mean and distribution of hatch dates could not be determined.

Table 47. Frequency distribution of hatch dates for glaucous-winged gulls at Buldir Island, Alaska. Data represent the date of the first chick hatched in each nest and include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date															
	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
158	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
159	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
160	-	-	-	-	*no data*	-	*no data*	6	-	-	-	2	-	2	-	-
161	-	-	-	-		-		-	-	-	-	-	-	-	-	1
162	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
163	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
164	-	-	-	-	-	4	-	-	-	-	6	-	-	-	-	-
165	-	-	-	-	-	-	-	1	2	3	-	-	-	1	-	5
166	-	-	-	-	-	-	-	-	-	-	-	5	-	2	-	-
167	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-
168	-	-	-	2	-	1	-	-	-	1	-	-	-	3	-	3
169	-	-	-	-	-	-	-	-	-	5	-	-	-	1	1	-
170	-	-	-	-	-	-	-	2	2	-	4	-	-	4	-	1
171	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-
172	-	-	-	-	-	-	-	-	-	1	2	3	-	1	-	3
173	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
174	-	-	1	2	-	-	-	-	3	-	4	-	-	3	-	1
175	-	-	-	-	-	2	-	-	-	2	-	-	-	1	-	-
176	-	1	-	-	-	-	-	2	-	1	-	-	1	5	-	4
177	-	-	-	-	-	-	-	-	-	-	4	-	-	1	-	1
178	-	1	-	-	-	7	-	-	-	-	-	7	-	-	-	-
179	-	-	-	2	-		-	-	-	-	-	-	-	1	-	-
180	-	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-
181	-	3	-	-	-	-	-	-	-	1	-	-	2	-	-	-
182	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-
183	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184	-	1	-	-	-	-	-	-	-	-	-	4	-	1	-	-
185	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1	-
186	-	6	-	-	-	-	-	-	-	-	-	-	2	-	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
193		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
n	5	13	1	7	-	14	-	18	12	14	22	22	10	29	3	27

[a]Julian dates are adjusted by one day in leap years.

Table 48. Reproductive performance of glaucous-winged gulls at Buldir Island, Alaska, as determined by a nest-monitoring methodology (also called the Nest Method). Measures of success are based on frequent monitoring of individual nests (as opposed to count methodology presented in Table 49). Data include gull nests in both beach (between East Main Talus and East Kittiwake Lane) and inland areas.

Year	Total nest starts	Nest sites w/ x eggs:					Nest sites w/ eggs	Total eggs	Nest sites w/ x chicks:			Nest sites w/ chicks	Total chicks	Laying success	Mean clutch size	Mean brood size	Nesting success	Hatching success	Prop. nest sites w/ chicks	Chicks/ nest start
	(A)[a]	0	1	2	3	4	(B)	(C)	1	2	3	(D)	(E)	(B/A)	(C/B)	(E/D)	(D/B)	(E/C)	(D/A)[b]	(E/A)[b]
1997	47	37	2	4	4	0	10	22	3	4	1	8	14	0.21	2.2	1.8	0.80	0.64	0.17	0.30
1998	30	4	3	19	9	0	26	58	4	7	1	12	19	0.87	2.2	1.6	0.46	0.33	0.40	0.63
1999	20	17	0	2	1	0	3	7	-	-	-	1	2	0.15	2.3	2.0	0.33	0.29	0.05	0.10
2000	28	4	2	5	17	0	24	63	3	6	1	10	18	0.86	2.6	1.8	0.42	0.29	0.36	0.64
2001	*no data*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002	37	6	0	4	27	0	31	89	6	12	9	27	57	0.84	2.9	2.1	0.87	0.64	0.73	1.54
2003[c]	23	1	3	4	15	0	22	56	6	10	4	20	38	0.96	2.5	1.9	0.91	0.68	0.87	1.65
2004	34	6	1	4	23	0	28	78	3	10	5	18	38	0.82	2.8	2.1	0.64	0.49	0.53	1.12
2005	39	15	4	4	16	0	24	60	13	2	0	15	17	0.62	2.5	1.1	0.63	0.28	0.38	0.44
2006	-[d]	-[d]	3	7	13	0	23	56	1	9	6	16	37	-[d]	2.4	2.3	0.70	0.66	-[d]	-[d]
2007	69	20	5	17	27	0	49	120	6	7	1	14	23	0.71	2.4	1.6	0.29	0.19	0.20	0.33
2008	50	23	2	13	12	0	27	64	8	9	5	22	41	0.54	2.4	1.9	0.81	0.64	0.44	0.82
2009	40	28	0	9	3	0	12	27	1	9	0	10	19	0.30	2.3	1.9	0.83	0.70	0.25	0.48
2010[e]	-[d]	-[d]	1	5	32	0	38	107	7	15	6	28	55	-[d]	2.8	2.0	0.74	0.51	-[d]	-[d]
2011	40	19	3	10	8	0	21	49	2	1	0	3	4	0.53	2.3	1.3	0.14	0.08	0.08	0.10
2012	53	8	0	5	40	0	45	130	11	11	2	24	39	0.85	2.9	1.6	0.53	0.30	0.45	0.74

[a]Number of nests represents maximum number of nests during the season.
[b]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.
[c]Chicks were present on the first visit in 2003.
[d]Empty nest bowls were not counted in 2006 and 2010.
[e]Gull nests were monitored between North Bight Beach and West Main Talus in 2010.

Table 49. Reproductive performance of glaucous-winged gulls at Buldir Island, Alaska, as determined by a count methodology (also called the Egg Method). Measures of success are based on count of nests and eggs at varying intervals during the nesting period (as opposed to nest-monitoring methodology presented in Table 48); numbers of nests, eggs, and chicks represent maximum counts each year. Data include only gull nests on the beach between East Main Talus and East Kittiwake Lane. No data were collected 1980-1991. Although monitoring individual nests is considered a better way to measure gull reproductive performance, data is collected and presented using count methodology to allow for comparisons with historic data.

Year	Total nest starts	Nest sites w/ x eggs:				Nest sites w/ eggs	Total eggs	Nest sites w/ chicks	Total chicks	Laying success	Mean clutch size	Mean brood size	Nesting success	Hatching success	Prop. nest sites w/ chicks	Chicks/ nest start
	(A)[a]	1	2	3	4	(B)	(C)	(D)	(E)	(B/A)	(C/B)	(E/D)	(D/B)	(E/C)	(D/A)[b]	(E/A)[b]
1979[b]	-	1	10	56	0	67	-	-	-	-	2.8	-	-	-	-	-
1992	209	28	48	84	0	160	376	-	122	0.77	2.4	-	-	0.32	-	0.58
1993	199	26	35	72	0	133	312	-	35	0.67	2.3	-	-	0.11	-	0.18
1994	180	15	40	75	1	131	324	-	49	0.73	2.5	-	-	0.15	-	0.27
1995	133	5	20	26	0	51	123	-	34	0.38	2.4	-	-	0.28	-	0.26
1996	175	15	35	85	0	135	340	-	83	0.77	2.5	-	-	0.24	-	0.47
1997	88	6	10	9	0	25	53	-	28	0.28	2.1	-	-	0.53	-	0.32
1998	75	8	26	22	0	56	126	-	28	0.75	2.3	-	-	0.22	-	0.37
1999	20	0	2	1	0	3	7	-	2	0.15	2.3	-	-	0.29	-	0.10
2000	54	3	10	30	0	43	113	-	17	0.80	2.6	-	-	0.15	-	0.31
2001	40	3	12	19	0	34	84	-	12	0.85	2.5	-	-	0.14	-	0.30
2002	38	0	6	23	0	29	81	-	33	0.76	2.8	-	-	0.41	-	0.87
2003	23	3	4	14	0	21	53	-	22	0.91	2.5	-	-	0.42	-	0.96
2004	31	1	5	21	0	27	74	-	23	0.87	2.7	-	-	0.31	-	0.74
2005	39	3	3	15	0	21	54	-	17	0.54	2.6	-	-	0.31	-	0.44
2006	9	2	0	3	0	5	11	-	5	0.56	2.2	-	-	0.45	-	0.56
2007[c]	4	0	0	3	0	3	9	-	-	0.75	3.0	-	-	-	-	-
2008	38	3	11	10	0	24	55	-	33	0.63	2.3	-	-	0.60	-	0.87
2009[d]	19	0	3	1	0	4	9	3	6	0.21	2.3	2.0	0.75	0.67	0.16	0.32
2010[d]	-[e]	0	2	16	0	18	52	15	27	-[e]	2.9	1.8	0.83	0.52	-[e]	-[e]
2011	7	1	2	3	0	6	14	0	0	0.86	2.3	0.0	0.00	0.00	0.00	0.00
2012	17	0	2	9	0	11	31	-	-	0.65	2.8	-	-	-	-	-

[a]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.

[b]Data for 1979 were collected at plots located in inland areas(Day et al. 1980) and are comparable with other years only for estimates of clutch size.

[c]In 2007, only three active nests were present between E. Main Talus and E. Kittiwake Lane; nest counts were not conducted after 5 June because field crews redirected monitoring efforts to inland areas (Table 48).

[d]Values from 2009 and 2010 come from data collected by frequent nest monitoring within transect area (East Main Talus to East Kittiwake Lane) and not from simple counts of nests.

[e]Empty nest bowls were not counted in 2006 and 2010.

Table 50. Reproductive performance of glaucous-winged gulls at Buldir Island, Alaska in 2012, as determined by a count methodology. Data come from counts of nests and eggs on the beach between East Main Talus and East Kittiwake Lane throughout the nesting period.

Date	Total nest starts	Nest sites w/ x eggs:			Nest sites w/ eggs	Total eggs	Total chicks
	(A)	1	2	3	(B)	(C)	(D)
1 Jun	17	0	2	8	10	28	-
7 Jun	17	0	2	9	11	31	-
15 Jun	15	1	1	7	9	24	-
24 Jun	13	3	0	4	7	15	-
30 Jun	16	1	0	1	2	4	-
5 Jul	16	0	0	0	0	0	-

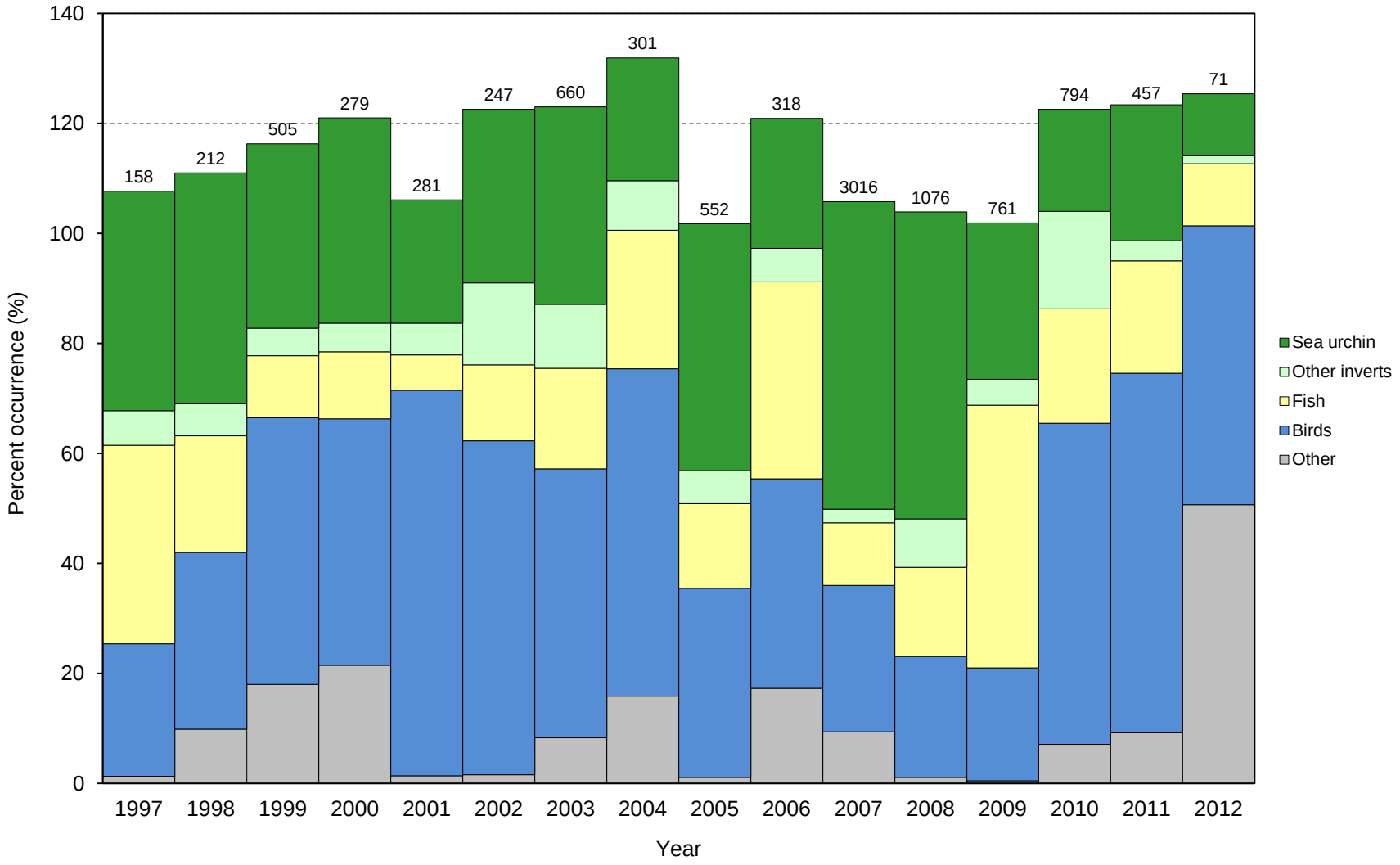

Figure 32. Frequency of occurrence of food items in regurgitated pellets of glaucous-winged gull adults at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

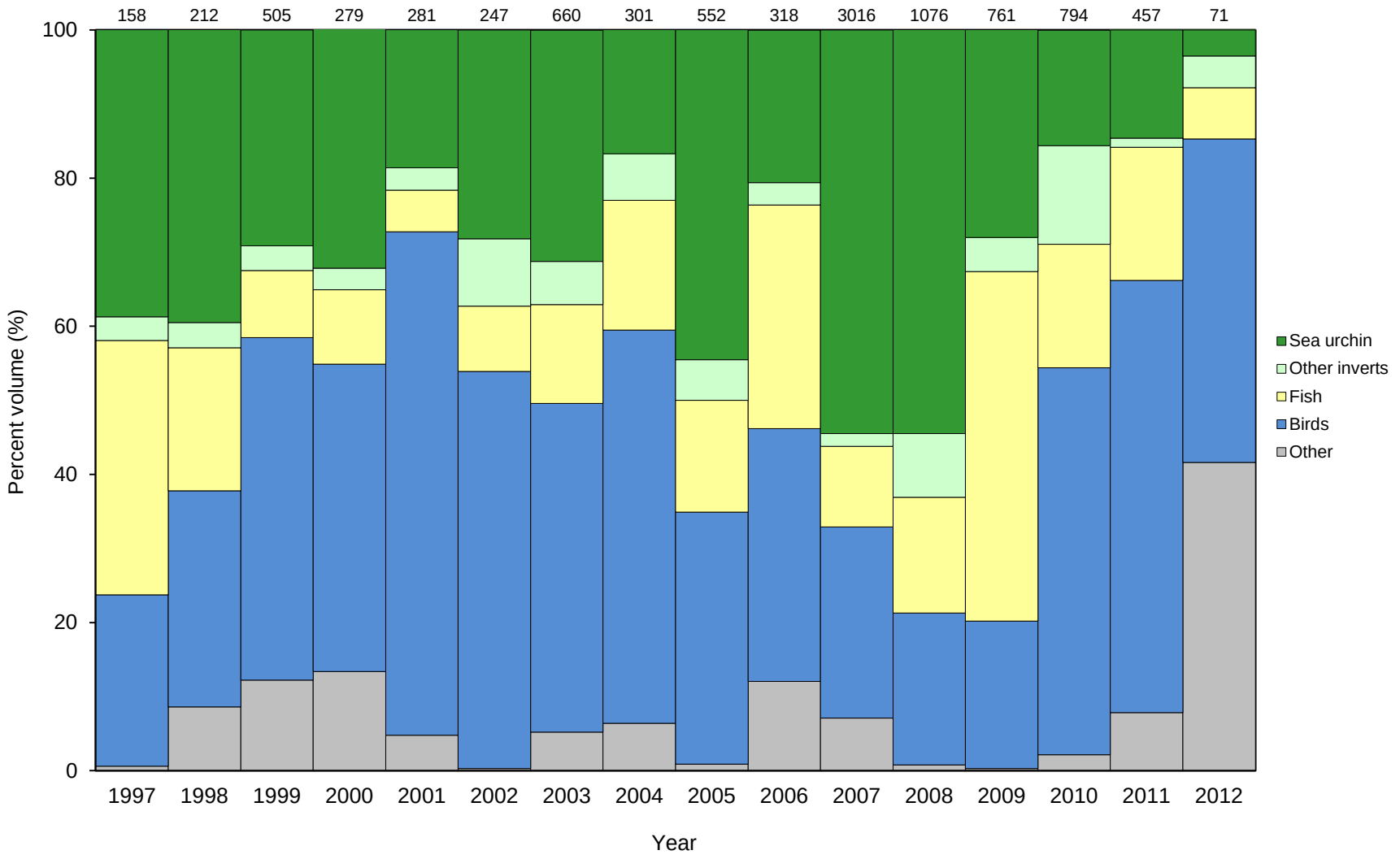

Figure 33. Percent volume of food items in regurgitated pellets of glaucous-winged gull adults at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 51. Frequency of occurrence of prey in regurgitated pellets of glaucous-winged gull adults at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. All prey was identified in the field.

Prey	1974-76[a]	1997	1998	1999	2000	2001	2002	2003	2004
No. samples	655	158	212	505	279	281	247	660	301
Invertebrates	**1.9**	**46.2**	**48.1**	**38.4**	**42.3**	**28.1**	**46.6**	**47.4**	**31.2**
Sea urchin	1.1	39.9	42.0	33.5	37.3	22.4	31.6	35.9	22.3
Blue mussel	-	3.2	2.4	2.4	2.9	2.1	3.2	2.4	3.7
Snail	-	0.6	1.0	0.2	1.1	0.4	4.0	0.5	-
Limpet	-	1.3	-	1.0	0.4	1.8	4.5	6.7	1.3
Chiton	-	-	1.9	0.2	0.4	-	0.8	-	3.7
Crab	-	0.6	0.5	0.2	0.4	0.4	-	0.3	-
Unid. bivalve	-	0.6	-	0.4	-	0.7	-	-	0.3
Unid. shellfish	-	-	-	0.2	-	0.4	1.2	1.7	-
Amphipod	-	-	-	0.2	-	-	0.4	-	-
Beetle	-	-	-	0.2	-	-	-	-	-
Unid. kelp fly	0.1	-	-	-	-	-	-	-	-
Unid. euphausiid	-	-	-	-	-	-	0.8	-	-
Fish	**19.5**	**36.1**	**21.2**	**11.3**	**12.2**	**6.4**	**13.8**	**18.3**	**25.2**
<10 cm	-	8.9	10.8	6.5	2.5	1.8	6.1	12.1	9.3
10-20 cm	-	12.0	6.5	4.2	6.1	3.9	6.1	0.2	14.6
>20 cm	-	15.2	4.2	0.6	3.6	0.7	1.6	1.5	0.3
Unknown size	-	-	-	-	-	-	-	4.5	0.7
Birds	**79.2**	**24.1**	**32.1**	**48.5**	**44.8**	**70.1**	**60.7**	**48.9**	**59.5**
Aleutian cackling goose gosling	-	-	-	0.2	0.4	-	0.8	-	-
Aleutian cackling goose egg	-	-	-	-	-	-	-	1.2	-
Fork-tailed storm-petrel	40.0	7.0	5.2	22.2	16.1	29.5	18.2	9.1	18.6
Leach's storm-petrel	20.0	1.3	3.8	15.4	14.3	26.3	16.2	16.1	14.3
Unid. storm-petrel	0.8	1.9	3.8	2.2	-	-	2.0	1.5	-
Black-legged kittiwake	-	-	-	-	-	-	-	1.2	7.6
Unid. kittiwake	-	-	-	-	-	-	-	-	0.3
Unid. kittiwake chick	-	-	-	-	-	-	-	-	-
Glaucous-winged gull	-	-	-	-	-	0.4	-	-	-
Glaucous-winged gull egg	-	-	-	-	-	-	-	1.4	-
Unid. murre chick	0.2	-	-	-	-	-	0.4	-	-
Unid. murre egg	-	-	-	-	-	-	-	-	-
Ancient murrelet	10.1	-	0.5	0.2	2.9	14.3	6.9	2.0	1.0
Cassin's auklet	0.2	-	0.5	-	0.4	-	-	0.9	-
Crested auklet	2.9	6.3	1.4	2.4	3.6	0.7	4.0	3.8	8.6
Least auklet	1.4	1.3	1.4	1.4	1.8	0.4	1.6	1.2	1.7
Whiskered auklet	-	-	-	0.2	0.4	0.4	-	-	-
Parakeet auklet	-	-	0.5	0.2	2.5	1.1	1.6	2.7	0.7
Unid. small auklet[b]	-	1.3	-	-	0.7	-	-	0.2	-
Unid. med. auklet[b]	-	1.3	-	0.4	-	-	-	-	0.7
Unid. auklet	1.4	3.8	0.5	0.4	0.7	0.7	3.6	-	1.0
Tufted puffin	0.2	-	-	-	-	-	0.8	-	-
Unid. puffin	-	-	-	-	-	-	-	0.2	-
Unid. small bird	0.3	0.6	13.2	1.4	1.1	5.3	0.8	6.4	1.0
Unid. bird egg	1.7	-	1.4	2.0	-	1.4	4.0	1.2	4.0
Other	**6.8**	**1.3**	**9.9**	**18.0**	**21.5**	**1.4**	**1.6**	**8.3**	**15.9**
Terrestrial vegetation	2.5	-	-	0.4	2.2	-	-	0.5	0.3
Unid. marine algae	-	1.3	5.7	15.8	15.1	3.9	2.0	7.4	13.0
Pebbles	0.8	-	4.2	1.8	1.4	1.9	0.8	0.3	2.3
Sea lion hair	3.5	-	-	-	-	-	-	-	-
Plastic	-	-	-	-	2.9	-	2.0	0.2	0.3

[a]Data from Trapp (1979).
[b]Unidentified small auklet probably a least or whiskered auklet; unidentified medium auklet probably a parakeet or crested auklet.

Table 51 (continued). Frequency of occurrence of prey in regurgitated pellets of glaucous-winged gull adults at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. All prey was identified in the field.

Prey	2005	2006	2007	2008	2009	2010	2011	2012
No. samples	552	318	3016	1079	761	794	457	71
Invertebrates	**50.9**	**29.9**	**58.5**	**64.6**	**33.1**	**36.5**	**28.2**	**19.7**
Sea urchin	44.9	23.6	55.9	55.6	28.4	18.6	24.7	11.3
Blue mussel	2.0	1.9	1.8	0.8	0.5	0.8	0.7	8.5
Snail	-	0.9	0.2	0.3	2.8	11.3	0.2	-
Limpet	4.0	0.9	0.3	1.1	1.3	4.5	0.4	-
Chiton	-	0.3	-	-	-	-	-	-
Crab	-	-	0.1	0.1	0.1	-	-	-
Unid. bivalve	-	0.3	0.1	0.3	-	-	0.2	-
Unid. shellfish	-	0.9	-	0.6	-	0.1	1.5	-
Amphipod	-	0.3	-	5.8	-	0.6	-	-
Beetle	-	-	-	-	-	0.3	0.7	-
Unid. kelp fly	-	-	-	-	-	-	-	-
Unid. euphausiid	-	0.6	-	-	-	0.1	-	-
Fish	**15.4**	**35.8**	**11.4**	**16.1**	**47.8**	**20.8**	**20.4**	**6.9**
<10 cm	0.7	6.0	5.3	2.4	3.7	3.1	-	-
10-20 cm	14.5	28.0	4.4	10.9	10.1	5.2	-	-
>20 cm	0.2	1.6	1.1	2.8	33.0	0.6	-	-
Unknown size	-	0.3	0.7	-	1.1	11.8	20.4	6.9
Birds	**34.4**	**38.1**	**26.6**	**22.0**	**20.5**	**58.4**	**65.4**	**50.7**
Aleutian cackling goose gosling	-	-	-	-	-	-	-	-
Aleutian cackling goose egg	-	-	-	-	-	-	-	-
Fork-tailed storm-petrel	15.0	12.3	10.9	2.9	2.1	13.2	3.7	1.4
Leach's storm-petrel	10.3	9.7	7.6	2.5	2.6	4.4	1.8	1.4
Unid. storm-petrel	-	1.6	0.2	0.2	2.8	5.3	32.6	25.4
Black-legged kittiwake	-	-	-	-	-	-	-	-
Unid. kittiwake	-	-	-	-	-	1.0	-	-
Unid. kittiwake chick	-	-	<0.1	-	-	-	-	-
Glaucous-winged gull	-	-	-	-	-	-	-	-
Glaucous-winged gull egg	-	-	<0.1	0.2	-	0.5	-	-
Unid. murre chick	-	-	-	-	-	-	-	-
Unid. murre egg	-	-	-	12.1	2.8	0.4	3.3	-
Ancient murrelet	-	0.6	0.6	0.3	0.1	0.4	1.1	-
Cassin's auklet	-	-	0.2	-	-	-	0.2	-
Crested auklet	4.0	3.1	1.3	0.5	0.1	1.1	1.3	14.1
Least auklet	2.4	1.9	1.1	-	0.1	0.3	1.3	2.8
Whiskered auklet	-	-	-	-	-	1.5	0.2	-
Parakeet auklet	0.4	0.3	0.3	1.0	0.3	3.5	2.4	1.4
Unid. small auklet[b]	0.2	-	0.6	0.6	0.8	0.1	1.1	-
Unid. med. auklet[b]	-	1.6	0.5	0.6	1.2	1.3	5.7	-
Unid. auklet	-	4.7	1.5	0.1	3.3	7.3	4.2	4.2
Tufted puffin	-	-	-	-	-	-	-	-
Unid. puffin	-	-	-	-	-	-	-	-
Unid. small bird	1.8	1.9	0.7	-	2.6	16.8	3.9	-
Unid. bird egg	0.4	0.3	0.4	0.6	1.7	1.4	2.6	-
Other	**1.1**	**17.3**	**9.4**	**1.1**	**0.5**	**7.1**	**9.2**	**50.7**
Terrestrial vegetation	0.2	-	0.2	0.1	-	0.6	0.2	-
Unid. marine algae	0.9	15.4	8.7	0.7	0.4	4.5	14.0	50.7
Pebbles	-	1.6	0.5	0.3	0.1	1.1	2.8	-
Sea lion hair	-	-	-	-	-	-	-	-
Plastic	-	0.3	<0.1	-	-	0.8	-	-

[a]Data from Trapp (1979).
[b]Unidentified small auklet probably a least or whiskered auklet; unidentified medium auklet probably a parakeet or crested auklet.

Table 52. Percent volume of prey in regurgitated pellets of glaucous-winged gull adults at Buldir Island, Alaska. Values represent the average percent composition of a prey item in all pellets (sums to 100% each year); values in bold are totals for those taxa. All prey was identified in the field.

Prey	1997	1998	1999	2000	2001	2002	2003	2004
No. samples	158	212	505	279	281	247	660	301
Invertebrates	**42.0**	**42.9**	**32.6**	**35.1**	**21.7**	**37.3**	**37.1**	**23.0**[a]
Sea urchin	38.7	39.6	29.1	32.3	18.6	28.2	31.2	16.8
Blue mussel	2.3	1.9	1.9	1.5	1.0	2.2	0.8	2.5
Snail	<0.1	0.5	0.2	1.1	<0.1	1.9	0.2	-
Limpet	0.8	-	0.8	0.2	1.3	3.2	3.9	0.9
Chiton	-	0.8	0.2	0.1	-	0.6	-	2.9
Crab	<0.1	0.1	<0.1	<0.1	0.3	-	-	-
Unid. bivalve	0.1	-	0.2	-	0.4	-	-	-
Unid. shellfish	-	0.1	<0.1	-	<0.1	0.4	0.9	-
Amphipod	-	-	-	-	-	<0.1	-	-
Beetle	-	-	<0.1	-	-	-	-	-
Unid. kelp fly	-	-	-	-	-	-	-	-
Unid. euphausiid	-	-	-	-	-	0.8	-	-
Fish	**34.3**	**19.3**	**9.0**	**10.0**	**5.6**	**8.8**	**13.3**	**17.5**
<10 cm	7.4	9.9	4.8	1.6	1.0	4.8	9.4	5.4
10-20 cm	11.7	5.1	3.8	5.2	3.9	3.4	0.1	11.5
>20 cm	15.2	4.2	0.4	3.2	0.7	0.6	1.3	0.3
Unknown size	-	-	-	-	-	-	2.4	0.4
Birds	**23.1**	**29.2**	**46.2**	**41.5**	**67.9**	**53.6**	**44.4**	**53.1**
Aleutian cackling goose gosling	-	-	0.2	0.4	-	0.5	-	-
Aleutian cackling goose egg	-	-	-	-	-	-	1.0	-
Fork-tailed storm-petrel	6.7	5.2	21.7	15.1	29.0	17.5	9.0	17.4
Leach's storm-petrel	1.3	3.8	14.2	13.6	25.5	15.6	15.5	13.5
Unid. storm-petrel	1.9	3.8	2.0	-	-	1.3	1.4	-
Black-legged kittiwake	-	-	-	-	-	-	1.1	7.5
Unid. kittiwake	-	-	-	-	-	-	-	0.3
Unid. kittiwake chick	-	-	-	-	-	-	-	-
Glaucous-winged gull	-	-	-	-	<0.1	-	-	-
Glaucous-winged gull egg	-	-	-	-	-	-	1.4	-
Unid. murre chick	-	-	-	-	-	0.4	-	-
Unid. murre egg	-	-	-	-	-	-	-	-
Ancient murrelet	-	0.5	0.2	2.7	4.0	6.2	2.0	0.9
Cassin's auklet	-	0.5	-	0.4	-	-	0.8	-
Crested auklet	6.0	1.4	2.4	3.3	0.7	3.5	3.6	8.0
Least auklet	1.3	1.4	1.4	1.8	0.4	1.4	1.2	1.4
Whiskered auklet	-	-	0.2	0.4	0.4	-	-	-
Parakeet auklet	-	0.5	0.2	2.5	1.1	1.4	2.6	0.7
Unid. small auklet[a]	0.3	-	-	<0.1	-	-	-	-
Unid. med. auklet[a]	0.6	-	0.4	-	-	-	-	0.6
Unid. auklet	4.4	0.5	0.4	0.7	0.7	3.6	-	1.0
Tufted puffin	-	-	-	-	-	1.0	-	-
Unid. puffin	-	-	-	-	-	-	0.1	-
Unid. small bird	0.6	11.0	1.3	0.7	5.0	0.1	4.3	0.4
Unid. bird egg	-	0.8	1.6	-	1.2	0.5	0.4	1.4
Other	**0.6**	**8.5**	**12.0**	**13.4**	**4.9**	**0.4**	**5.2**	**6.0**
Terrestrial vegetation	-	-	0.2	1.1	-	-	0.1	0.3
Unid. marine algae	0.6	4.9	11.1	11.6	2.2	0.2	5.0	5.2
Pebbles	-	3.6	0.7	0.6	2.7	<0.1	0.1	0.5
Sea lion hair	-	-	-	-	-	-	-	-
Plastic	-	-	-	0.2	-	0.1	-	-

[a]Unidentified small auklet probably a least or whiskered auklet; unidentified medium auklet probably a parakeet or crested auklet.

Table 52 (continued). Percent volume of prey in regurgitated pellets of glaucous-winged gull adults at Buldir Island, Alaska. Values represent the average percent composition of a prey item in all pellets (sums to 100% each year); values in bold are totals for those taxa. All prey was identified in the field.

Prey	2005	2006	2007	2008	2009	2010	2011	2012
No. samples	552	318	3016	1079	761	794	457	71
Invertebrates	**50.0**	**23.7**	**56.3**	**63.2**	**32.7**	**28.9**	**15.4**	**19.7**
Sea urchin	44.5	20.6	54.5	54.7	28.1	15.6	14.1	3.5
Blue mussel	1.9	1.1	1.3	0.7	0.4	0.3	0.3	2.7
Snail	-	0.4	-	0.3	2.8	10.0	<0.1	-
Limpet	3.6	0.3	0.2	1.1	1.3	2.7	0.2	-
Chiton	-	0.3	-	-	-	-	-	-
Crab	-	-	0.1	0.1	0.1	-	-	-
Unid. bivalve	-	<0.1	0.1	0.3	-	-	0.1	-
Unid. shellfish	-	0.1	-	0.4	-	0.1	0.5	-
Amphipod	-	0.2	-	5.8	-	0.2	-	-
Beetle	-	-	-	-	-	-	0.2	-
Unid. kelp fly	-	-	-	-	-	-	-	-
Unid. euphausiid	-	0.6	-	-	-	-	-	-
Fish	**15.1**	**30.2**	**10.9**	**15.7**	**47.2**	**16.7**	**18.0**	**6.9**
<10 cm	0.5	4.5	4.8	2.1	3.6	2.5	-	-
10-20 cm	14.5	24.0	4.3	10.8	9.8	4.2	-	-
>20 cm	0.2	1.6	1.1	2.8	32.9	0.6	-	-
Unknown size	-	<0.1	0.6	-	1.0	9.4	18.0	6.9
Birds	**34.0**	**34.1**	**25.8**	**20.6**	**19.9**	**52.2**	**58.3**	**43.7**
Aleutian cackling goose gosling	-	-	-	-	-	-	-	-
Aleutian cackling goose egg	-	-	-	-	-	-	-	-
Fork-tailed storm-petrel	15.0	11.8	10.7	2.8	2.1	13.1	3.6	1.4
Leach's storm-petrel	10.3	9.5	7.4	2.4	2.6	4.3	1.6	1.4
Unid. storm-petrel	-	0.6	0.2	0.2	2.5	5.1	31.2	21.1
Black-legged kittiwake	-	-	-	-	-	-	-	-
Unid. kittiwake	-	-	-	-	-	-	-	-
Unid. kittiwake chick	-	-	-	-	-	0.9	-	-
Glaucous-winged gull	-	-	-	-	-	-	-	-
Glaucous-winged gull egg	-	-	-	0.2	-	0.5	-	-
Unid. murre chick	-	-	-	-	-	-	-	-
Unid. murre egg	-	-	-	11.3	2.7	0.3	2.6	-
Ancient murrelet	-	0.6	0.6	0.3	0.1	0.4	1.1	-
Cassin's auklet	-	-	0.2	-	-	-	0.2	-
Crested auklet	4.0	3.1	1.2	0.5	0.1	1.1	1.1	12.5
Least auklet	2.4	1.8	1.1	-	0.1	0.3	1.3	1.7
Whiskered auklet	-	-	-	-	-	1.5	0.2	-
Parakeet auklet	0.4	0.3	0.3	1.0	0.3	3.5	2.4	1.4
Unid. small auklet[a]	0.2	-	0.6	0.6	0.8	0.1	1.1	-
Unid. med. auklet[a]	-	1.6	0.5	0.6	1.2	1.3	5.4	-
Unid. auklet	-	3.6	1.4	0.1	3.2	7.0	3.9	4.2
Tufted puffin	-	-	-	-	-	-	-	-
Unid. puffin	-	-	-	-	-	-	-	-
Unid. small bird	1.6	1.1	0.6	-	2.5	12.3	1.9	-
Unid. bird egg	0.2	<0.1	0.2	0.5	1.7	0.5	0.8	-
Other	**0.9**	**11.1**	**7.1**	**0.8**	**0.3**	**2.1**	**7.9**	**41.6**
Terrestrial vegetation	-	-	0.1	0.1	-	0.1	<0.1	-
Unid. marine algae	0.8	10.7	6.9	0.6	0.2	1.6	7.3	41.6
Pebbles	-	0.4	0.1	0.1	<0.1	0.3	0.5	-
Sea lion hair	-	-	-	-	-	-	-	-
Plastic	-	-	<0.1	-	-	<0.1	-	-

[a]Unidentified small auklet probably a least or whiskered auklet; unidentified medium auklet probably a parakeet or crested auklet

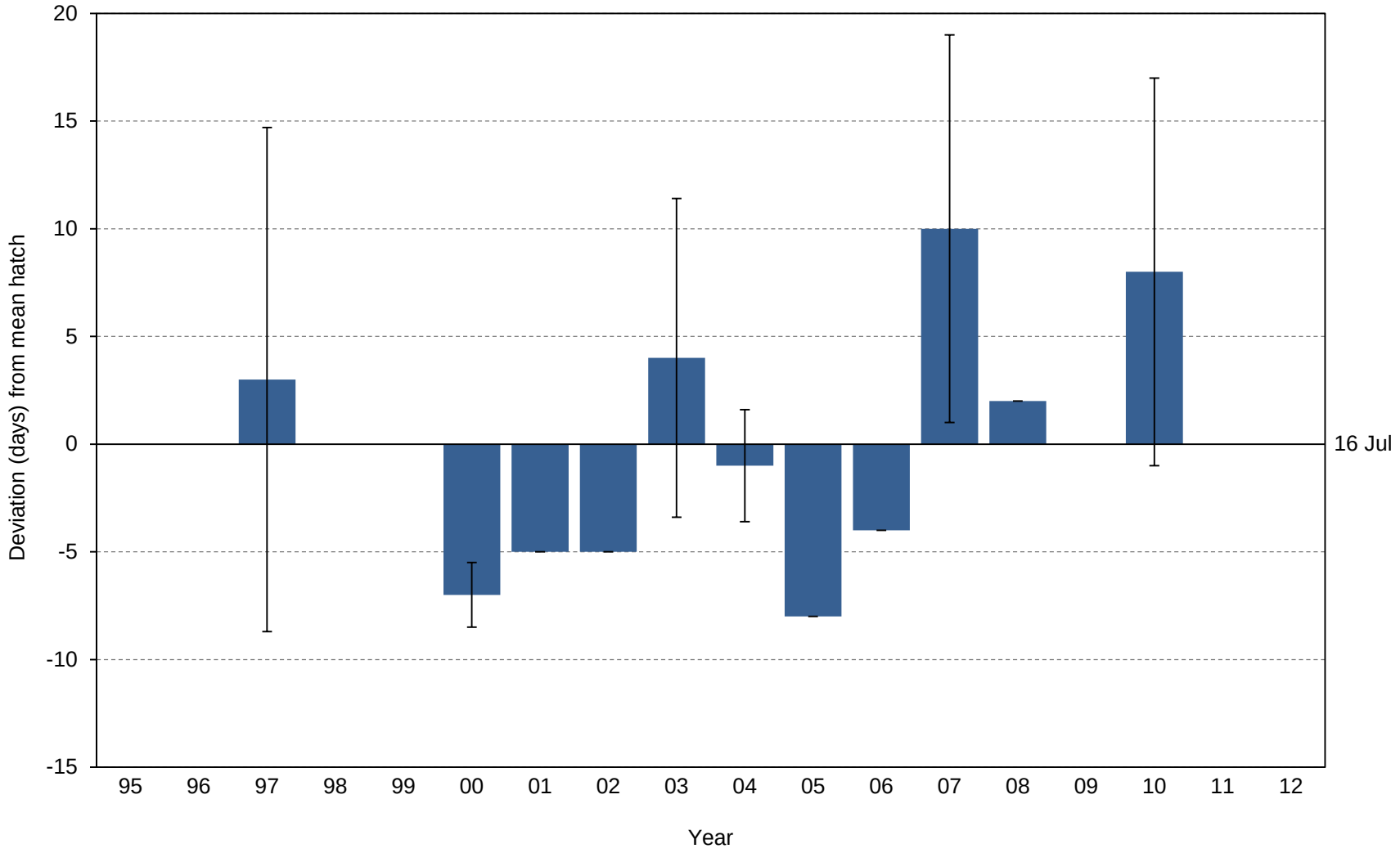

Figure 34. Yearly hatch date deviation (from the 1995-2011 average of 16 July) for common murres at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; no data exist for the current year.

Table 53. Breeding chronology of common murres at Buldir Island, Alaska.

Year	Mean hatch	SD	*n*[a]	First hatch	Last hatch	First "jump"[b]
1989	-	-	-	-	-	13 Aug
1990	*no data (no eggs hatched in plots)*			-	-	-
1991	*no data (no known hatch dates)*			-	-	-
1992	*no data (no eggs hatched in plots)*			-	-	-
1993	*no data (no eggs hatched in plots)*			-	-	-
1994	-	-	-	-	-	3 Aug
1995	19 Jul	3.3	3	15 Jul	23 Jul	6 Aug
1996	*no data (no nests monitored)*			-	-	-
1997	19 Jul	11.7	7	11 Jul	16 Aug	26 Jul
1998	-	-	-	-	-	17 Aug
1999	*no data (no known hatch dates)*			-	-	-
2000	8 Jul	1.5	2	6 Jul	9 Jul	23 Jul
2001	11 Jul	0.0	1	11 Jul	-	1 Aug
2002	11 Jul	0.0	1	11 Jul	-	23 Jul
2003	20 Jul	7.4	8	13 Jul	31 Jul	5 Aug
2004	14 Jul	2.6	4	12 Jul	18 Jul	20 Aug
2005	8 Jul	0.0	1	8 Jul	-	5 Aug
2006	12 Jul	0.0	4	12 Jul	-	30 Jul
2007	26 Jul	9.0	2	17 Jul	4 Aug	9 Aug
2008	17 Jul	0.0	1	17 Jul	-	31 Jul
2009	-	-	-	-	-	>20 Aug
2010	24 Jul	9.0	2	15 Jul	2 Aug	2 Aug
2011	*no data (no eggs hatched in plots)*			-	-	-
2012	*no data (no known hatch dates)*			-	-	-

[a]Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.
[b]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 54. Frequency distribution of hatch dates for common murres at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date																	
	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
188	-	*no data*	-	*no data*	*no data*	1	-	-	-	-	-	-	-	-	*no data*	-	*no data*	*no data*
189	-		-			-	-	-	-	-	1	-	-	-		-		
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	2	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-
195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196	1	-	3	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
200	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
202	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
204	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
211	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
213	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
217	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
219	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
221	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
223	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
n	3	-	7	-	-	2	1	1	8	4	1	4	2	1	-	2	-	-

[a]Julian dates are adjusted by one day in leap years.

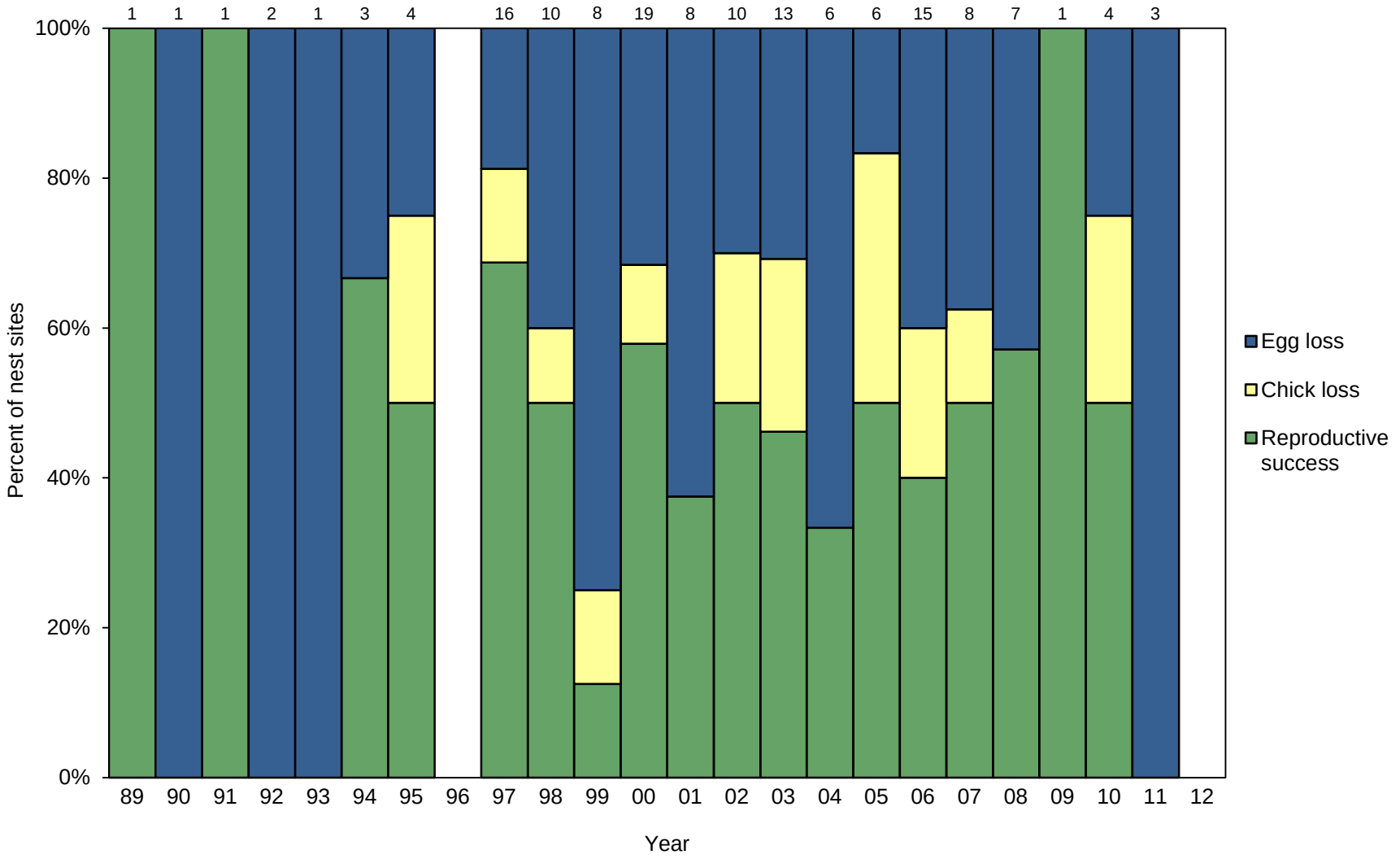

Figure 35. Reproductive performance of common murres at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 55. Reproductive performance of common murres at Buldir Island, Alaska.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Nesting success (D/B)[a]	Fledging success (F/D)[b]	Reproductive success (F/B)
1989	1	1	1	1.00	1.00	1.00
1990	1	0	0	0.00	0.00	0.00
1991	1	1	1	1.00	1.00	1.00
1992	2	0	0	0.00	0.00	0.00
1993	1	0	0	0.00	0.00	0.00
1994	3	2	2	0.67	1.00	0.67
1995	4	3	2	0.75	0.67	0.50
1996	*no data*	-	-	-	-	-
1997	16	13	11	0.81	0.85	0.69
1998	10	6	5	0.60	0.83	0.50
1999	8	2	1	0.25	0.50	0.13
2000	19	13	11	0.68	0.85	0.58
2001	8	3	3	0.38	1.00	0.38
2002	10	7	5	0.70	0.71	0.50
2003	13	9	6	0.69	0.67	0.46
2004	6	2	2	0.33	1.00	0.33
2005	6	5	3	0.83	0.60	0.50
2006	15	9	6	0.60	0.67	0.40
2007	8	5	4	0.63	0.80	0.50
2008	7	4	4	0.57	1.00	0.57
2009	1	1	1	1.00	1.00	1.00
2010	4	3	2	0.75	0.67	0.50
2011	3	0	0	0.00	0.00	0.00
2012	*no data*	-	-	-	-	-

[a]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).

[b]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).

Table 56. Standard deviation in reproductive performance parameters of common murres at Buldir Island, Alaska. Sampling for murres is clustered by plot except when sample sizes per plot are too small or plot data are not available.

Year	No. plots[a]	Nest sites w/ eggs	Sampling design[b]	Nesting success	Fledging success	Reproductive success
1989	1	1	Simple random	0.00	0.00	0.00
1990	1	1	Simple random	0.00	-	0.00
1991	1	1	Simple random	0.00	0.00	0.00
1992	1	2	Simple random	0.00	-	0.00
1993	1	1	Simple random	0.00	-	0.00
1994	2	3	Simple random	0.27	0.00	0.27
1995	1	4	Simple random	0.22	0.27	0.25
1996	*no data*	-	-	-	-	-
1997	2	16	Simple random	0.10	0.10	0.12
1998	2	10	Simple random	0.15	0.15	0.16
1999	2	8	Simple random	0.15	0.35	0.12
2000	3	19	Simple random	0.11	0.10	0.11
2001	1	8	Simple random	0.17	0.00	0.17
2002	1	10	Simple random	0.14	0.17	0.16
2003	1	13	Simple random	0.13	0.16	0.14
2004	2	6	Simple random	0.19	0.00	0.19
2005	1	6	Simple random	0.15	0.22	0.20
2006	2	15	Simple random	0.13	0.16	0.13
2007	1	8	Simple random	0.17	0.18	0.18
2008	2	7	Simple random	0.19	0.00	0.19
2009	1	1	Simple random	0.00	0.00	0.00
2010	1	4	Simple random	0.22	0.27	0.25
2011	1	3	Simple random	0.00	-	0.00
2012	*no data*	-	-	-	-	-

[a]Plots that are combined for analysis are counted as a single "plot".

[b]For sampling clustered by plot, values are calculated using ratio estimator spreadsheets based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1-\rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

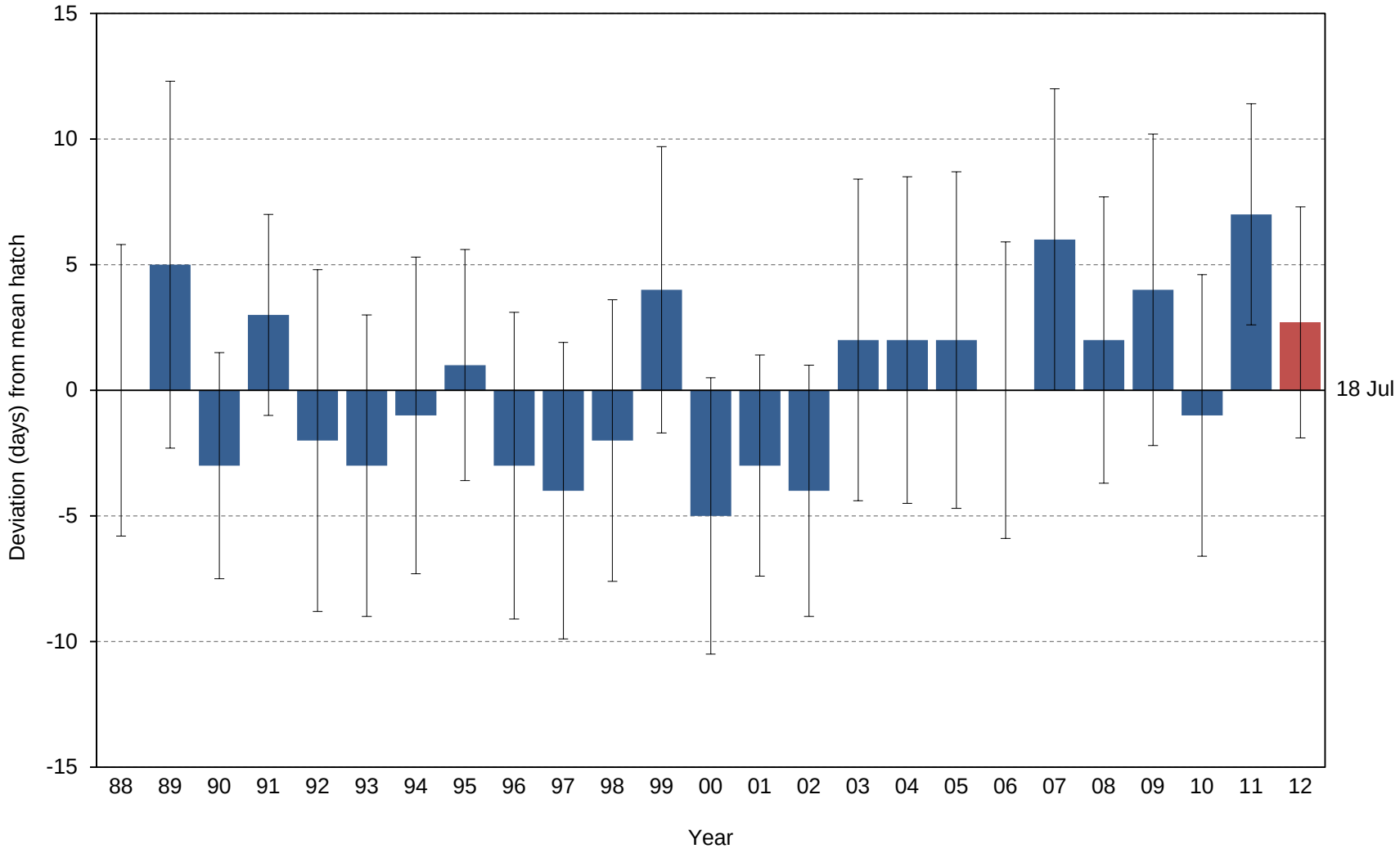

Figure 36. Yearly hatch date deviation (from the 1988-2011 average of 18 July) for thick-billed murres at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 57. Breeding chronology of thick-billed murres at Buldir Island, Alaska.

Year	Mean hatch	SD	*n*[a]	First hatch	Last hatch	First "jump"
1988	17 Jul	5.8	86	10 Jul	18 Aug	2 Aug
1989	23 Jul	7.3	19	10 Jul	10 Aug	9 Aug
1990	15 Jul	4.5	23	13 Jul	3 Aug	24 Jul
1991	21 Jul	4.0	26	15 Jul	27 Jul	10 Aug
1992	15 Jul	6.8	35	4 Jul	3 Aug	29 Jul
1993	15 Jul	6.0	93	5 Jul	8 Aug	24 Jul
1994	17 Jul	6.3	40	5 Jul	3 Aug	29 Jul
1995	19 Jul	4.6	180	11 Jul	10 Aug	1 Aug
1996	14 Jul	6.1	198	2 Jul	12 Aug	21 Jul
1997	14 Jul	5.9	173	2 Jul	11 Aug	26 Jul
1998	16 Jul	5.6	56	5 Jul	29 Jul	24 Jul
1999	22 Jul	5.7	31	16 Jul	12 Aug	1 Aug
2000	12 Jul	5.5	35	3 Jul	28 Jul	19 Jul
2001	15 Jul	4.4	58	9 Jul	27 Jul	27 Jul
2002	14 Jul	5.0	57	7 Jul	9 Aug	28 Jul
2003	20 Jul	6.4	138	7 Jul	11 Aug	30 Jul
2004	19 Jul	6.5	88	8 Jul	9 Aug	27 Jul
2005	20 Jul	6.7	76	8 Jul	16 Aug	31 Jul
2006	18 Jul	5.9	143	7 Jul	4 Aug	30 Jul
2007	24 Jul	6.0	59	13 Jul	10 Aug	9 Aug
2008	19 Jul	5.7	84	13 Jul	6 Aug	25 Jul
2009	22 Jul	6.2	123	9 Jul	14 Aug	4 Aug
2010	17 Jul	5.6	133	7 Jul	2 Aug	29 Jul
2011	25 Jul	4.4	68	17 Jul	6 Aug	6 Aug
2012	20 Jul	4.6	135	11 Jul	5 Aug	30 Jul

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

Table 58. Frequency distribution of hatch dates for thick-billed murres at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date												
	88	89	90	91	92	93	94	95	96	97	98	99	00
183	-	-	-	-	-	-	-	-	-	1	-	-	-
184	-	-	-	-	-	-	-	-	5	2	-	-	-
185	-	-	-	-	-	-	-	-	-	-	-	-	3
186	-	-	-	-	1	4	1	-	1	-	3	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	2	15	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	8	-	59	1	-	-	-
191	-	1	-	-	-	28	-	-	-	-	-	-	16
192	3	-	-	-	10	-	-	10	3	70	12	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-	-
194	3	-	11	-	-	1	2	1	-	1	-	-	1
195	-	1	7	-	-	-	-	1	-	3	-	-	-
196	29	-	-	3	15	37	6	45	60	48	29	-	7
197	8	-	-	-	-	-	-	-	-	-	-	6	-
198	12	-	-	4	-	-	-	3	-	-	-	-	-
199	-	1	-	-	-	1	-	2	3	-	-	-	-
200	5	5	4	-	-	-	16	70	46	-	-	1	-
201	1	-	-	-	5	-	-	-	-	-	3	-	6
202	3	1	-	12	-	14	-	2	1	23	-	17	-
203	-	-	-	-	-	-	-	2	-	-	-	-	1
204	15	-	-	-	-	-	-	31	11	-	-	-	-
205	2	-	-	-	-	-	-	-	-	-	-	1	-
206	1	7	-	-	1	-	4	-	-	-	6	-	-
207	-	-	-	-	-	1	-	-	-	-	-	-	-
208	-	1	-	7	-	5	-	-	2	5	-	3	-
209	-	-	-	-	-	-	-	8	-	-	-	-	-
210	1	-	-	-	-	-	2	-	-	-	3	-	1
211	-	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	1	-	-	1	1	-	-	-
213	-	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	4	-	-	-	2	-
215	1	-	1	-	-	-	1	-	-	-	-	-	-
216	-	-	-	-	3	-	-	-	2	-	-	-	-
217	-	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	-	-	-	-	-	-	2	-	-	-
219	1	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	1	-	-	1	-	-	-	-
221	-	1	-	-	-	-	-	-	-	-	-	-	-
222	-	1	-	-	-	-	-	1	-	-	-	-	-
223	-	-	-	-	-	-	-	-	-	1	-	-	-
224	-	-	-	-	-	-	-	-	-	-	-	1	-
225	-	-	-	-	-	-	-	-	1	-	-	-	-
226	-	-	-	-	-	-	-	-	-	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	-	-	-	-	-	-	-	-	-
229	-	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	-	-	-	-	-
231	1	-	-	-	-	-	-	-	-	-	-	-	-
n	86	19	23	26	35	93	40	180	198	173	56	31	35

[a]Julian dates are adjusted by one day in leap years.

Table 58 (continued). Frequency distribution of hatch dates for thick-billed murres at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date											
	01	02	03	04	05	06	07	08	09	10	11	12
183	-	-	-	-	-	-	-	-	-	-	-	-
184	-	-	-	-	-	-	-	-	-	-	-	-
185	-	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	-	-	-	-	-	-	-	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-
188	-	3	2	-	-	1	-	-	-	3	-	-
189	-	-	3	-	2	8	-	-	-	-	-	-
190	13	1	-	2	3	-	-	-	1	3	-	-
191	-	1	-	-	-	-	-	-	-	2	-	-
192	-	28	-	-	1	5	-	-	-	20	-	-
193	-	-	-	-	-	23	-	-	-	-	-	3
194	19	1	30	17	4	3	2	-	5	5	-	-
195	-	-	-	2	4	-	-	24	6	2	-	2
196	1	12	-	-	3	-	-	-	-	52	-	-
197	-	-	-	1	1	39	-	-	-	-	-	-
198	18	-	-	1	-	2	8	-	4	-	5	44
199	-	-	-	-	-	-	-	1	-	2	-	-
200	-	9	64	30	18	-	-	-	63	2	-	5
201	-	-	-	-	21	-	-	37	1	-	1	2
202	-	-	-	-	-	43	23	-	-	24	22	56
203	-	-	-	1	-	-	-	-	2	-	-	-
204	6	1	2	21	-	-	-	2	1	1	3	-
205	-	-	-	-	2	-	-	-	-	-	-	1
206	-	-	22	-	12	10	1	-	22	7	1	-
207	-	-	-	-	-	-	14	13	-	-	-	-
208	1	-	-	-	-	-	-	-	1	-	25	14
209	-	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	6	-	1	-	-	4	8	-	-
211	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	12	-	2	4	6	-	-	-	10	5
213	-	-	-	-	-	-	-	5	1	1	-	-
214	-	-	-	3	-	-	-	-	-	1	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	4	3	-	10	-	-	-
217	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	2	-	-	-	-	-	-	1	3
219	-	-	-	-	-	-	-	2	-	-	-	-
220	-	-	-	1	-	-	-	-	-	-	-	-
221	-	1	-	-	-	-	-	-	-	-	-	-
222	-	-	2	1	2	-	2	-	-	-	-	-
223	-	-	1	-	-	-	-	-	1	-	-	-
224	-	-	-	-	-	-	-	-	-	-	-	-
225	-	-	-	-	-	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	-	1	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	1	-	-	-	-	-	-	-
229	-	-	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	-	-	-	-
231	-	-	-	-	-	-	-	-	-	-	-	-
n	58	57	138	88	76	143	59	84	123	133	68	135

[a]Julian dates are adjusted by one day in leap years.

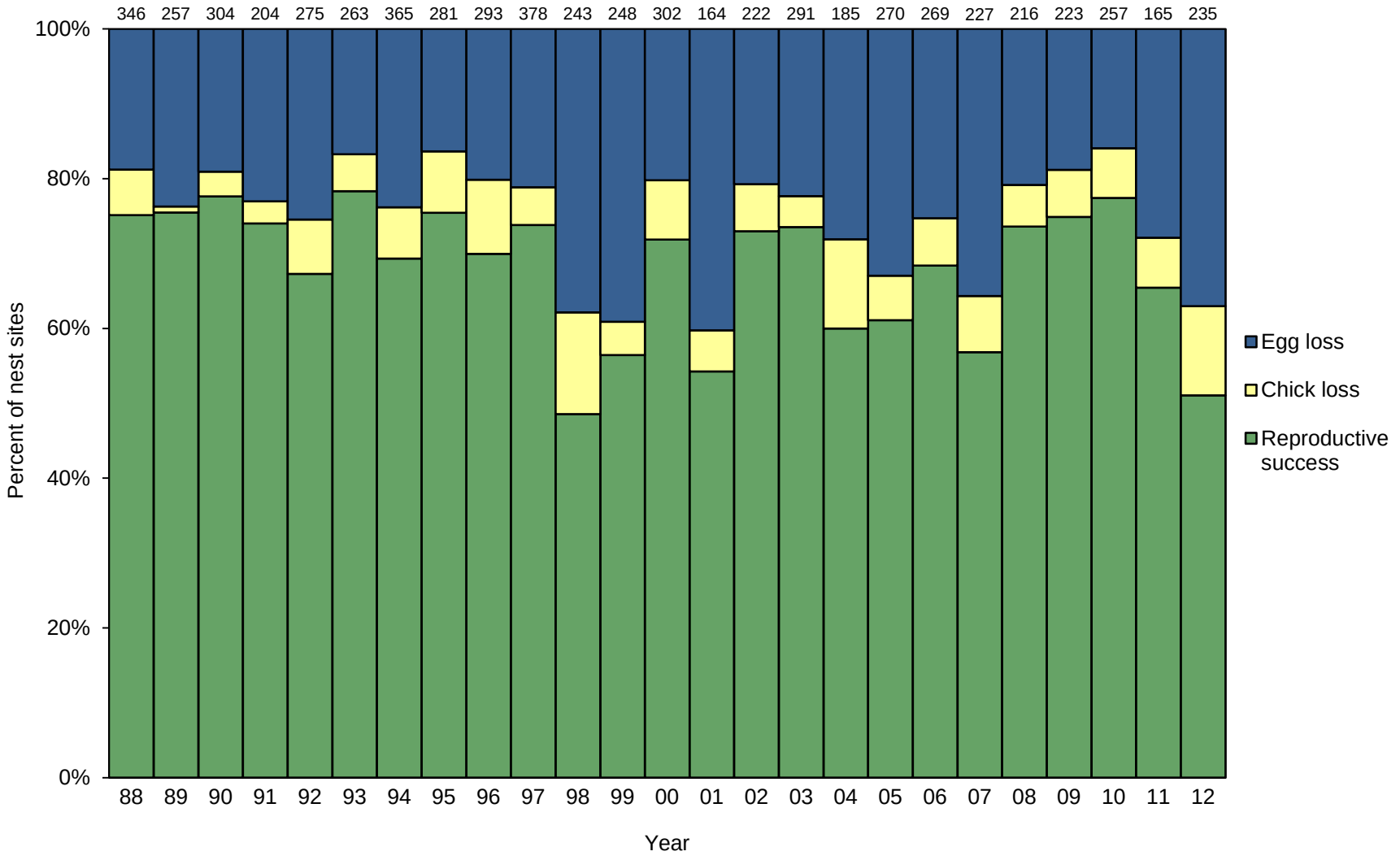

Figure 37. Reproductive performance of thick-billed murres at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 59. Reproductive performance of thick-billed murres at Buldir Island, Alaska.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Nesting success (D/B)[a]	Fledging success (F/D)[b]	Reproductive success (F/B)
1988	346	281	260	0.81	0.93	0.75
1989	257	196	194	0.76	0.99	0.75
1990	304	246	236	0.81	0.96	0.78
1991	204	157	151	0.77	0.96	0.74
1992	275	205	185	0.75	0.90	0.67
1993	263	219	206	0.83	0.94	0.78
1994	365	278	253	0.76	0.91	0.69
1995	281	235	212	0.84	0.90	0.75
1996	293	234	205	0.80	0.88	0.70
1997	378	298	279	0.79	0.94	0.74
1998	243	151	118	0.62	0.78	0.49
1999	248	151	140	0.61	0.93	0.56
2000	302	241	217	0.80	0.90	0.72
2001	164	98	89	0.60	0.91	0.54
2002	222	176	162	0.79	0.92	0.73
2003	291	226	214	0.78	0.95	0.74
2004	185	133	111	0.72	0.83	0.60
2005	270	181	165	0.67	0.91	0.61
2006	269	201	184	0.75	0.92	0.68
2007	227	146	129	0.64	0.88	0.57
2008	216	171	159	0.79	0.93	0.74
2009	223	181	167	0.81	0.92	0.75
2010	257	216	199	0.84	0.92	0.77
2011	165	119	108	0.72	0.91	0.65
2012	235	148	120	0.63	0.81	0.51

[a]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).

[b]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).

Table 60. Standard deviation in reproductive performance parameters of thick-billed murres at Buldir Island, Alaska. Sampling for murres is clustered by plot except when sample sizes per plot are too small or plot data are not available.

Year	No. plots[a]	Nest sites w/ eggs	Sampling design[b]	Nesting success	Fledging success	Reproductive success
1988	12	346	Cluster by plot	0.04	0.02	0.05
1989	12	257	Cluster by plot	0.03	0.01	0.03
1990	12	304	Cluster by plot	0.04	0.01	0.03
1991	12	204	Cluster by plot	0.04	0.01	0.04
1992	12	275	Cluster by plot	0.03	0.04	0.05
1993	7	263	Cluster by plot	0.02	0.01	0.02
1994	10	365	Cluster by plot	0.04	0.02	0.05
1995	11	281	Cluster by plot	0.02	0.03	0.04
1996	9	293	Cluster by plot	0.04	0.02	0.04
1997	7	378	Cluster by plot	0.03	0.01	0.03
1998	9	243	Cluster by plot	0.06	0.03	0.06
1999	8	248	Cluster by plot	0.04	0.02	0.04
2000	9	302	Cluster by plot	0.05	0.03	0.06
2001	6	164	Cluster by plot	0.04	0.02	0.04
2002	7	222	Cluster by plot	0.05	0.02	0.05
2003	13	291	Cluster by plot	0.03	0.01	0.03
2004	8	185	Cluster by plot	0.03	0.04	0.04
2005	9	270	Cluster by plot	0.06	0.02	0.06
2006	8	269	Cluster by plot	0.05	0.02	0.05
2007	9	227	Cluster by plot	0.09	0.03	0.09
2008	9	216	Cluster by plot	0.05	0.02	0.05
2009	8	223	Cluster by plot	0.03	0.02	0.04
2010	8	257	Cluster by plot	0.03	0.03	0.04
2011	8	165	Cluster by plot	0.04	0.03	0.04
2012	8	235	Cluster by plot	0.03	0.03	0.03

[a]Plots that are combined for analysis are counted as a single "plot".

[b]For sampling clustered by plot, values are calculated using ratio estimator spreadsheets based on plot as a sample unit; for simple random sampling, values are calculated using $\sqrt{\rho * (1-\rho)/n}$, where ρ is the success rate and n is the sample size of individual nests.

Table 61. Reproductive performance of thick-billed murres at Buldir Island, Alaska in 2012.

Parameter	Plot								Total	SD[a]
	36	37	38	39	40A	40B	45	46		
Nest sites w/ eggs (B)	29	48	10	43	14	59	18	14	235	-
Nest sites w/ chicks (D)	19	30	4	27	6	41	14	7	148	-
Nest sites w/ chicks fledged (F)	15	27	3	24	3	32	11	5	120	-
Nesting success (D/B)[b]	0.66	0.63	0.40	0.63	0.43	0.69	0.78	0.50	0.63	0.03
Fledging success (F/D)[c]	0.79	0.90	0.75	0.89	0.50	0.78	0.79	0.71	0.81	0.03
Reproductive success (F/B)	0.52	0.56	0.30	0.56	0.21	0.54	0.61	0.36	0.51	0.03

[a]Standard deviations are calculated from ratio estimator spreadsheets, based on plot as a sample unit.

[b]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).

[c]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).

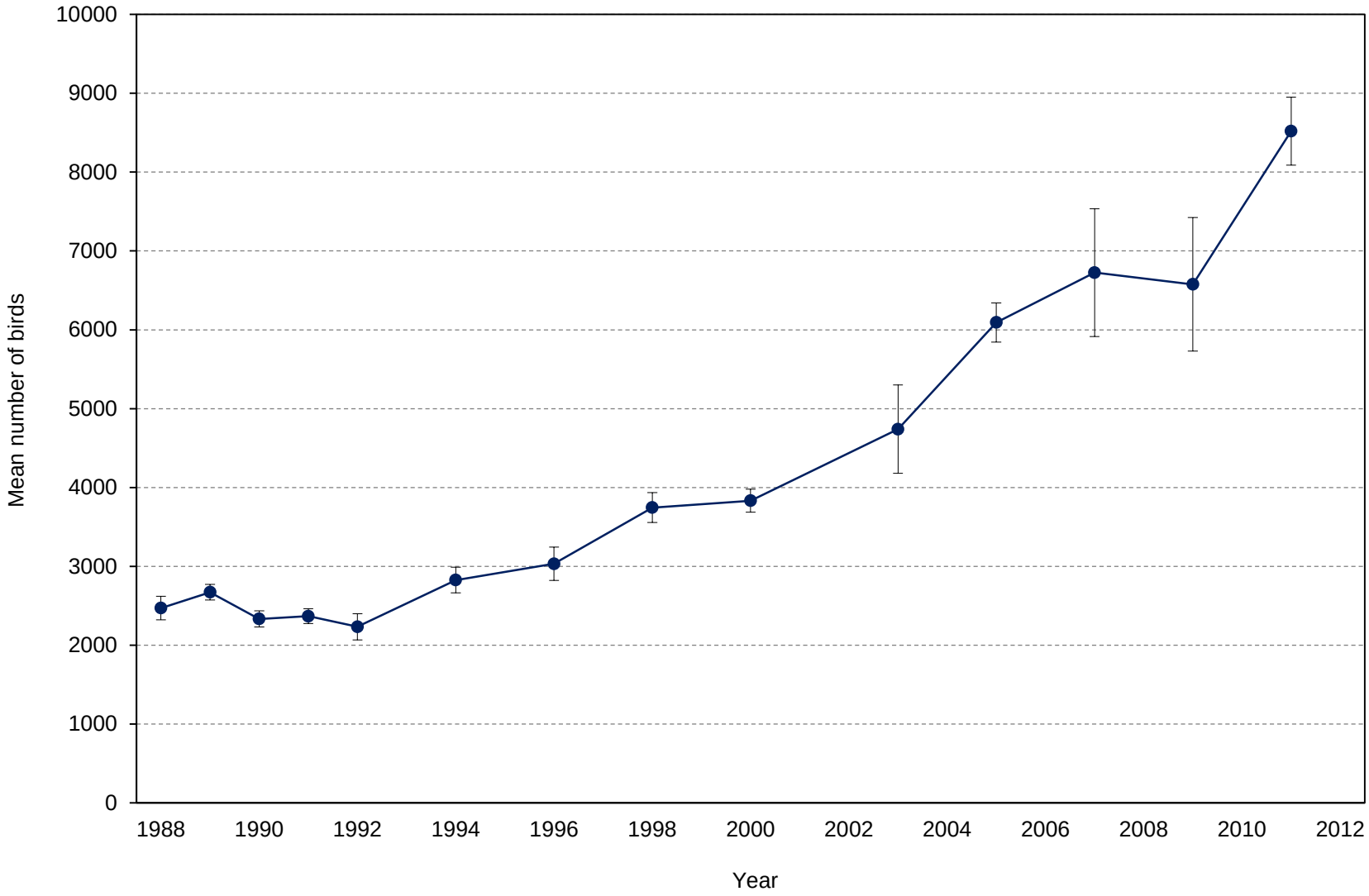

Figure 38. Mean numbers of murres counted on index plots at Buldir Island, Alaska. Values include both common and thick-billed murres but individuals could not be identified to species in most cases. Error bars represent standard deviation.

Table 62. Numbers of murres counted on index plots at Buldir Island, Alaska. Values include both common and thick-billed murres but individuals could not be identified to species in most cases. Data represent combined totals from Spike (The Dip) and Kittiwake Lane. No counts were conducted during years not listed.

Replicate	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005	2007	2009	2011
1	2224	2637	2306	2245	2127	3046	3177	3575	3787	4362	5768	5537	6452	8667
2	2487	2529	2379	2504	2195	2662	2863	3970	3791	4544	5958	6450	7834	7823
3	2602	2798	2488	2354	2476	2758	3064	3812	3704	4482	6397	6743	5489	8801
4	2464	2704	2237	2350	2135	2837	2775	3848	4086	5572	6075	7241	6760	8901
5	2577	2692	2254	2386	-	-	3283	3522	3796	-	6268	7658	6342	8409
Mean	2471	2672	2333	2368	2233	2826	3032	3745	3833	4740	6093	6726	6576	8520
n	5	5	5	5	4	4	5	5	5	4	5	5	5	5
SD	150	99	103	93	165	163	212	190	147	560	249	810	847	431
First count	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 Jun	29 Jun	8 Jul
Last count	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul	15 Jul	31 Jul	26 Jul

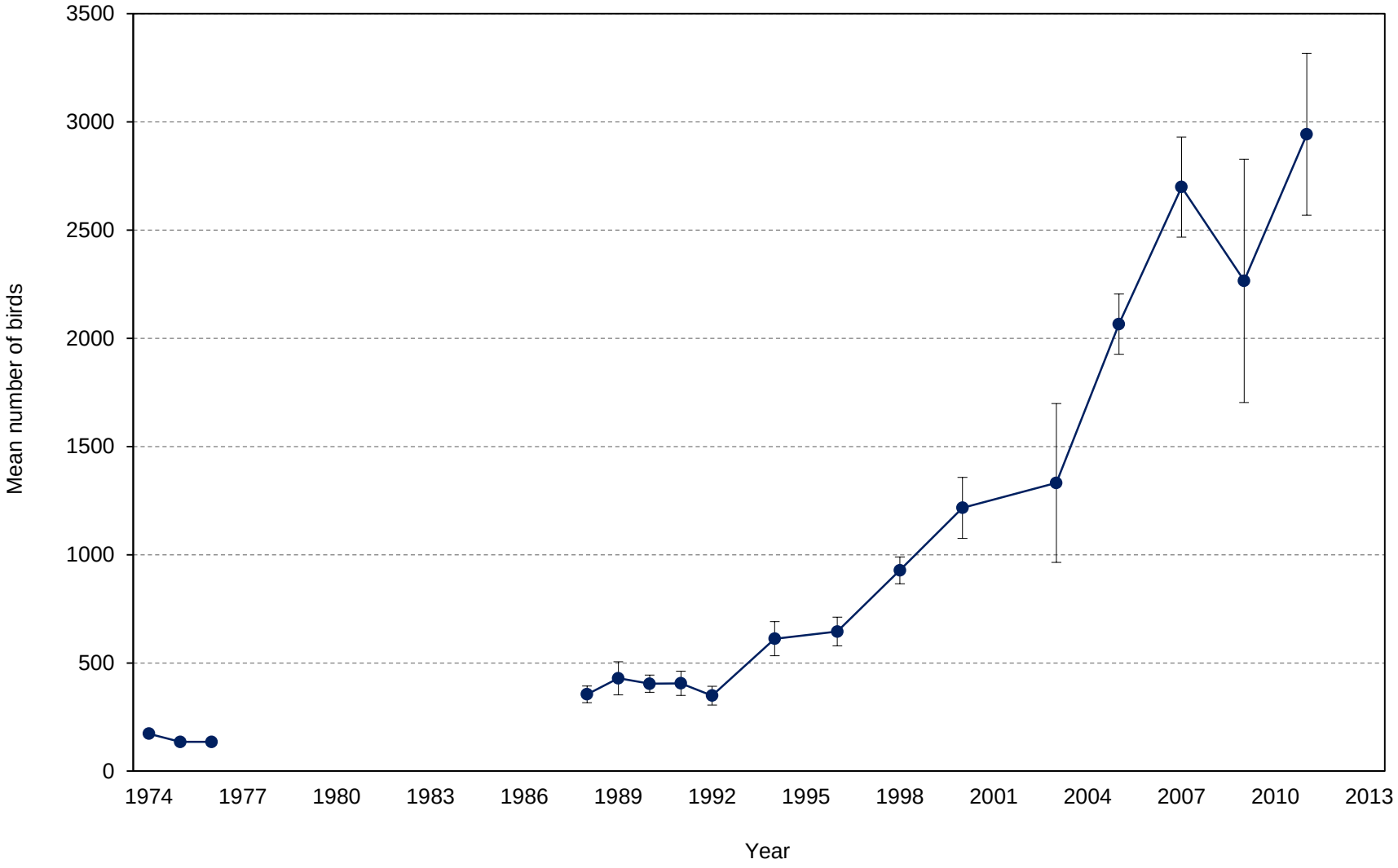

Figure 39. Mean numbers of murres counted on index plots at Kittiwake Lane, Buldir Island, Alaska. Values include both common and thick-billed murres but individuals could not be identified to species in most cases. Data include only plots in Kittiwake Lane East (15-18) and Kittiwake Lane West (19-29) and are a subset of total counts on all index plots. Error bars represent standard deviation.

Table 63. Mean numbers of murres counted on index plots at Kittiwake Lane, Buldir Island, Alaska. Values include both common and thick-billed murres but individuals could not be identified to species in most cases. Plot values represent the average count of nests in that plot each year; total values and standard deviations are based on the average total count across all plots each year (as opposed to the sum of plot means). Data include only plots in Kittiwake Lane East (15-18) and Kittiwake Lane West (19-29); these data are a subset of total counts on all index plots (Table 62) but are presented separately for comparison with historic counts from 1974-1976. No counts were conducted during years not listed.

Plot (segment)	1974	1975	1976	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005	2007	2009	2011
15 (1)	-	20	-	73	70	93	65	73	85	88	163	116	146	220	0	0	36
16 (2)	-	43	-	99	167	144	126	119	195	158	370	407	343	412	703	271	343
17 (3)	-	37	-	113	125	112	116	78	145	136	101	230	273	375	347	377	435
18 (4)	-	35	-	71	67	55	85	57	121	149	94	145	114	176	228	160	197
19 (5)	-	0	-	0	0	0	0	0	0	0	31	81	119	211	360	331	534
20 (6)	-	0	-	0	0	0	13	22	42	46	88	135	99	181	303	298	346
21 (7)	-	0	-	0	0	0	0	0	0	0	0	0	16	95	162	204	250
22 (8)	-	0	-	0	0	0	0	0	0	0	0	0	11	94	129	171	213
23 (9)	-	0	-	0	0	0	0	0	0	0	0	0	0	6	41	56	72
24 (10)	-	0	-	0	0	0	0	0	0	0	0	0	0	0	0	2	29
25 (11)	-	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 (12)	-	0	-	0	0	0	0	0	0	0	0	0	0	13	43	71	73
27 (13)	-	0	-	0	0	0	0	0	0	0	0	0	0	4	12	16	31
28 (14)	-	0	-	0	0	0	0	0	24	67	82	103	190	236	298	237	299
29 (15)	-	0	-	0	0	0	0	0	0	0	0	0	21	42	72	72	86
Total	173	135	135	355	429	404	406	349	612	645	928	1217	1332	2066	2699	2266	2943
n	1	1	1	6	5	5	5	4	4	5	5	5	4	5	5	5	5
SD	-	-	-	39	76	40	56	43	79	66	62	141	367	139	231	562	374
First count	Jul[a]	Jul[a]	Jul[a]	5 Jul	29 Jun	30 Jun	8 Jul	6 Jul	4 Jul	28 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 Jun	29 Jun	8 Jul
Last count	-	-	-	27 Jul	16 Jul	18 Jul	18 Jul	20 Jul	19 Jul	18 Jul	24 Jul	20 Jul	25 Jul	18 Jul	14 Jul	31 Jul	26 Jul

[a]Data come from single counts made early to mid-July 1974, 1975, and 1976; from Byrd (1978).

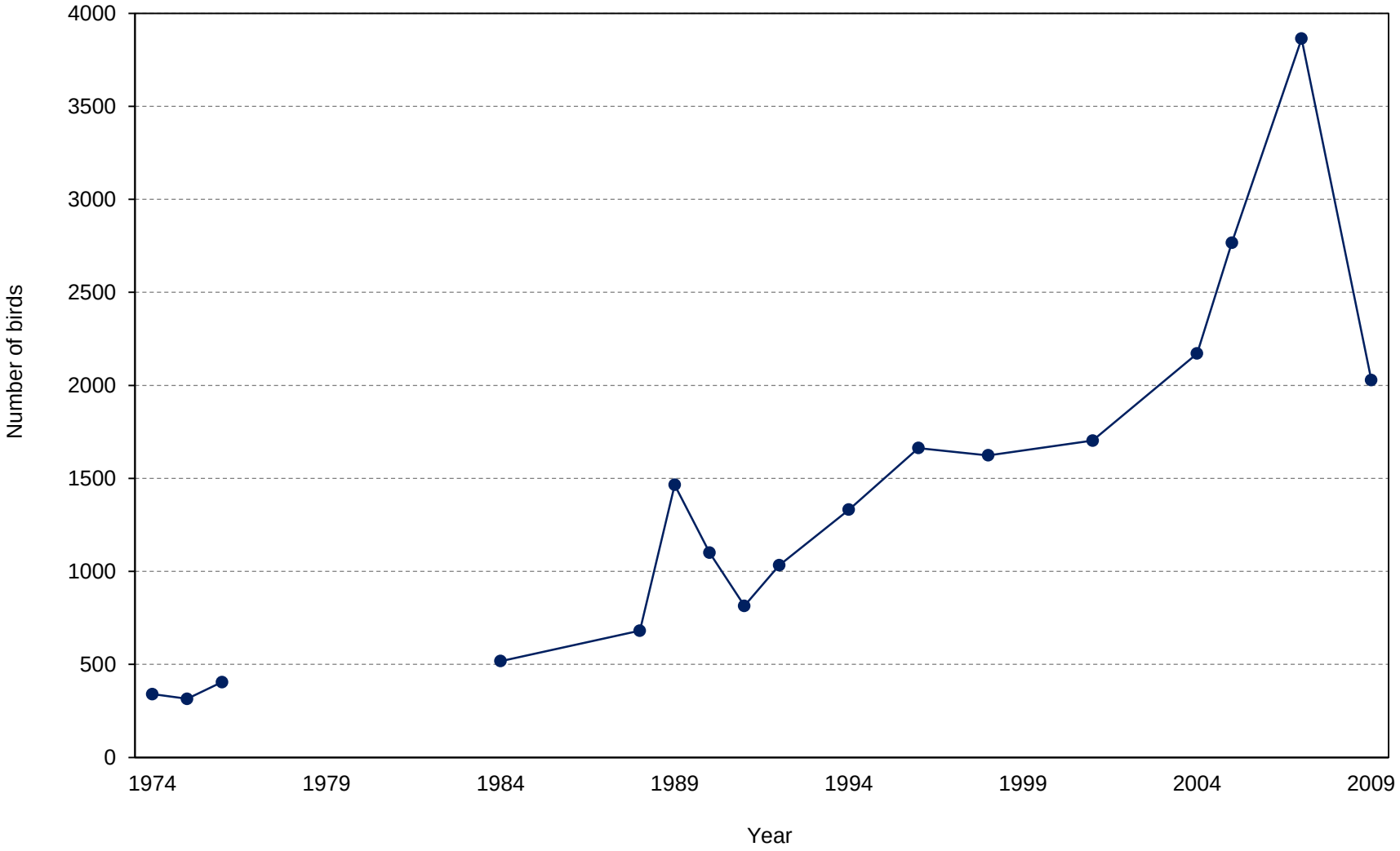

Figure 40. Numbers of murres counted at Middle Rock, Buldir Island, Alaska. Values include both common and thick-billed murres but individuals could not be identified to species in most cases. Counts at Middle Rock are separate from island-wide population counts on index plots.

Table 64. Numbers of murres counted at Middle Rock, Buldir Island, Alaska. Values include both common and thick-billed murres but individuals could not be identified to species in most cases. Counts at Middle Rock are separate from island-wide population counts on index plots; numbers are not included in population count totals (Table 62) and counts are not always conducted in the same years. No counts were conducted during years not listed.

Segment	1974	1975	1976	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005	2007	2009
I	-	170	-	208[a]	147[b]	306	194	170	241	309	398	307	266	476	530	881	590
II	-	70	-	69	74	133	85	51	63	115	155	132	244	283	522	355	219
III	-	10	-	69	47	34	37	0	24	46	20	61	42	31	46	141	56
IV	-	0	-	149	28	111	104	39	62	253	188	196	184	162	249	549	287
V	-	65	-	23	0	72	58	34	56	42	172	129	146	282	293	355	102
VI	-	0	-	0	44	69	56	65	67	82	89	102	120	114	148	229	155
VII	-	0	-	0	341	740	566	456	520	485	641	697	701	823	979	1354	619[c]
Total	340[d]	315	405[e]	518	681	1465	1100	815	1033	1332	1663	1624	1703	2171	2767	3864	2028
Date(s)	9 Aug	4 Jun	19 Jul	17 Jun	19 Jul	20 Jul	19-26 Jul	17 Jul	26 Jul	23-24 Jul	22 Jul	1 Jul	6 Jul	13 Jul	25 Jul	23 Jul	22 Jul

[a]In addition, 31 common murres observed in segment I.
[b]In addition, 35 common murres observed in segment I.
[c]In addition,103 common murres were observed in segment VII.
[d]In addition, 22 common murres were observed.
[e]In addition, 28 common murres were observed.

Table 65. Numbers of pigeon guillemots counted during boat-based circumnavigation surveys at Buldir Island, Alaska. No counts were conducted in 1973-1978, 1980-1996, and 2010-2012.

Segment	1972	1979	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
A-B	-	15	13	8	18	5	11	9	*no count*	*no count*	5	1	6	4	1
B-C	-	9	10	3	15	4	4	15			4	1	19	1	9
C-D	-	19	1	6	11	5	7	3	-	-	NC[a]	7	6	2	0
D-E	-	8	11	8	9	2	7	9	-	-	NC[a]	0	6	1	4
E-F	-	8	20	6	4	6	7	14	-	-	NC[a]	9	5	10	7
F-A	-	14	12	5	18	7	6	14	-	-	3[a]	7	11	3	1
Total	60[b]	73	67	36	75	29	42	64	-	-	-[a]	25	43	21	22
Date	-[b]	24 Jun	3 Jun	13 Jun	1 Jul	20 Jun	5 Jun	2 Jul	-	-	10 Jun	7 Jun	2 Jun	3 Jun	3 Jun
Start time[c]	xx[d]	xx	xx	xx	xx	xx	xx	xx	-	-	xx	xx	xx	xx	xx
End time[c]	xx	xx	xx	xx	xx	xx	xx	xx	-	-	xx	xx	xx	xx	xx

[a]Survey incomplete in 2005 because of technical difficulties: segments C-D, D-E, and E-F were not counted (NC) and segment F-A includes only the beginning of section A to Bull Point. Total count is not comparable with other years.

[b]Count combined boat-based count on south side of island on 7 July (50 individuals) and counts along the north shore 30 June-8 July (10 individuals); Byrd (1972).

[c]Times are Aleutian Standard Time (-1 hr from Alaska Standard Time).

[d]xx indicates data potentially exist but have not yet been summarized.

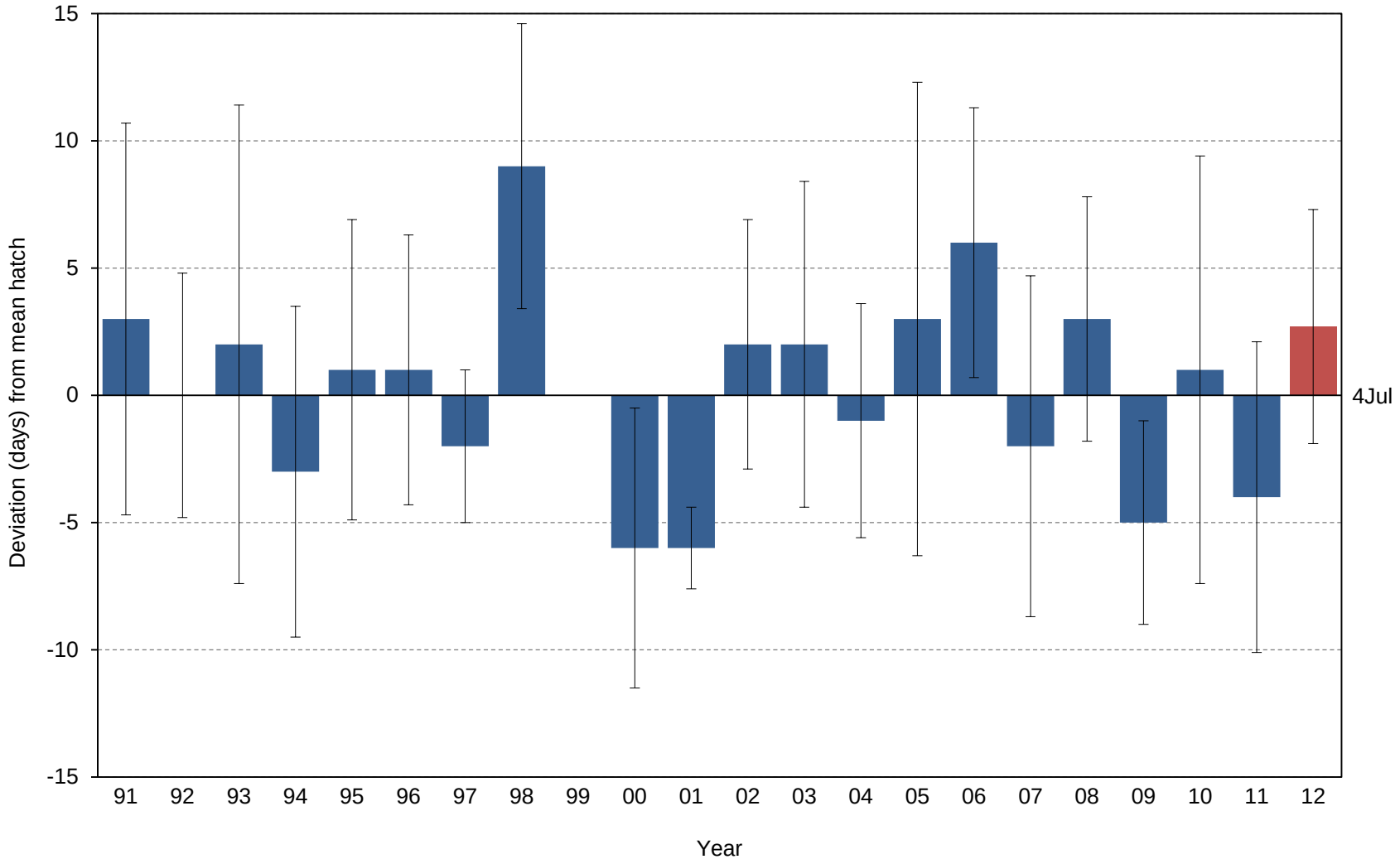

Figure 41. Yearly hatch date deviation (from the 1991-2011 average of 4 July) for parakeet auklets at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 66. Breeding chronology of parakeet auklets at Buldir Island, Alaska.

Year	Mean hatch	SD	*n*[a]	First hatch	Last hatch	First fledge
1991	7 Jul	7.7	6	26 Jun	16 Jul	3 Aug
1992	3 Jul	4.8	7	25 Jun	10 Jul	9 Aug
1993	6 Jul	9.4	7	19 Jun	15 Jul	27 Jul
1994	1 Jul	6.5	41	20 Jun	23 Jul	23 Jul
1995	5 Jul	5.9	38	21 Jun	17 Jul	30 Jul
1996	4 Jul	5.3	32	22 Jun	20 Jul	1 Aug
1997	2 Jul	3.0	8	26 Jun	7 Jul	27 Jul
1998	13 Jul	5.6	31	4 Jul	29 Jul	30 Jul
1999	*no data*	-	-	-	-	-
2000	27 Jun	5.5	20	12 Jun	9 Jul	23 Jul
2001	28 Jun	1.6	5	25 Jun	29 Jun	-
2002	6 Jul	4.9	20	29 Jun	22 Jul	28 Jul
2003	6 Jul	6.4	6	29 Jun	19 Jul	25 Jul
2004	2 Jul	4.6	11	24 Jun	8 Jul	4 Aug
2005	7 Jul	9.3	9	27 Jun	27 Jul	25 Jul
2006	10 Jul	5.3	16	1 Jul	21 Jul	9 Aug
2007	2 Jul	6.7	10	25 Jun	21 Jul	22 Jul
2008	6 Jul	4.8	21	30 Jun	19 Jul	29 Jul
2009	29 Jun	4.0	29	21 Jun	8 Jul	24 Jul
2010	5 Jul	8.4	15	17 Jun	23 Jun	22 Jul
2011	30 Jun	6.1	11	21 Jun	9 Jul	27 Jul
2012	6 Jul	4.6	7	30 Jun	12 Jul	30 Jul

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

Table 67. Frequency distribution of hatch dates for parakeet auklets at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date										
	91	92	93	94	95	96	97	98	99	00	01
164	-	-	-	-	-	-	-	-	*no data*	1	-
165	-	-	-	-	-	-	-	-		-	-
166	-	-	-	-	-	-	-	-	-	-	-
167	-	-	-	-	-	-	-	-	-	-	-
168	-	-	-	-	-	-	-	-	-	-	-
169	-	-	-	-	-	-	-	-	-	-	-
170	-	-	1	-	-	-	-	-	-	-	-
171	-	-	-	1	-	-	-	-	-	-	-
172	-	-	-	2	1	-	-	-	-	1	-
173	-	-	-	-	-	-	-	-	-	-	-
174	-	-	-	-	-	1	-	-	-	-	-
175	-	-	1	1	-	-	-	-	-	1	-
176	-	-	-	-	-	-	-	-	-	1	1
177	1	1	-	8	5	-	1	-	-	-	-
178	-	-	-	5	-	-	-	-	-	6	-
179	-	-	-	-	-	-	-	-	-	3	-
180	-	1	-	1	-	6	-	-	-	-	4
181	1	-	-	-	-	-	-	-	-	-	-
182	-	-	-	5	-	4	5	-	-	-	-
183	-	-	-	7	-	-	-	-	-	-	-
184	1	-	-	-	15	1	-	-	-	6	-
185	-	-	-	-	-	-	-	1	-	-	-
186	-	2	-	3	-	5	1	3	-	-	-
187	-	1	-	1	-	1	-	-	-	-	-
188	-	-	-	-	6	-	1	-	-	-	-
189	-	1	-	1	-	11	-	-	-	-	-
190	1	-	3	2	7	1	-	7	-	-	-
191	-	-	-	2	-	-	-	-	-	1	-
192	-	1	-	-	-	-	-	4	-	-	-
193	-	-	-	-	-	-	-	1	-	-	-
194	-	-	-	-	-	-	-	-	-	-	-
195	-	-	-	-	-	1	-	-	-	-	-
196	-	-	2	1	1	-	-	10	-	-	-
197	2	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	3	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	2	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	1	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	1	-	-	-	2	-	-	-
205	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	-	-	-	-	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	1	-	-	-
n	6	7	7	41	38	32	8	31	-	20	5

[a]Julian dates are adjusted by one day in leap years.

Table 67 (continued). Frequency distribution of hatch dates for parakeet auklets at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date										
	02	03	04	05	06	07	08	09	10	11	12
164	-	-	-	-	-	-	-	-	-	-	-
165	-	-	-	-	-	-	-	-	-	-	-
166	-	-	-	-	-	-	-	-	-	-	-
167	-	-	-	-	-	-	-	-	-	-	-
168	-	-	-	-	-	-	-	-	1	-	-
169	-	-	-	-	-	-	-	-	-	-	-
170	-	-	-	-	-	-	-	-	-	-	-
171	-	-	-	-	-	-	-	-	-	-	-
172	-	-	-	-	-	-	-	1	1	2	-
173	-	-	-	-	-	-	-	-	-	-	-
174	-	-	-	-	-	-	-	1	-	-	-
175	-	-	-	-	-	-	-	-	-	-	-
176	-	-	1	-	-	1	-	1	-	-	-
177	-	-	-	-	-	-	-	1	-	1	-
178	-	-	1	2	-	-	-	10	-	2	-
179	-	-	-	-	-	-	-	-	-	-	-
180	2	1	2	1	-	4	-	5	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-
182	3	-	-	-	1	1	1	-	-	3	1
183	-	-	-	-	-	-	-	-	-	-	1
184	2	2	-	2	3	3	9	7	4	-	1
185	-	1	-	-	-	-	-	-	-	-	-
186	5	-	4	-	-	-	-	1	3	-	-
187	1	-	-	-	-	-	4	-	-	-	-
188	1	-	1	-	-	-	1	-	1	1	1
189	2	1	-	-	3	-	-	2	-	-	1
190	3	1	2	2	-	-	2	-	1	2	-
191	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	3	-	-	-	2	-	-
193	-	-	-	-	2	-	1	-	-	-	-
194	-	-	-	-	1	-	-	-	-	-	2
195	-	-	-	-	-	-	2	-	-	-	-
196	-	-	-	-	-	-	-	-	1	-	-
197	-	-	-	1	2	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-
201	-	-	-	-	-	-	1	-	-	-	-
202	-	-	-	-	1	1	-	-	-	-	-
203	1	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	1	-	-
205	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	-	-	-	-	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	1	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	-	-	-
n	20	6	11	9	16	10	21	29	15	11	7

[a]Julian dates are adjusted by one day in leap years.

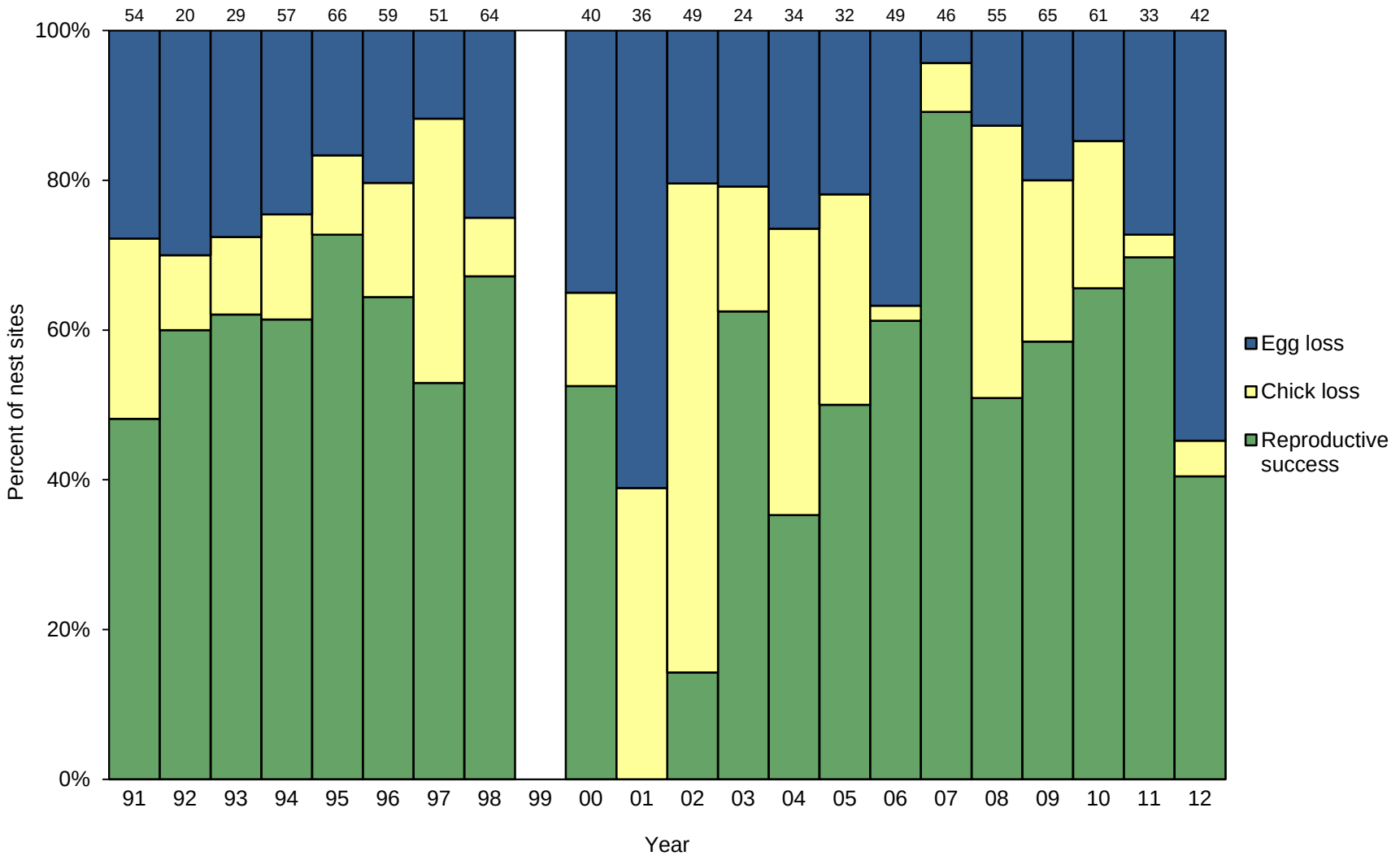

Figure 42. Reproductive performance of parakeet auklets at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 68. Reproductive performance of parakeet auklets at Buldir Island, Alaska.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Nesting success (D/B)[a]	Fledging success (F/D)[b]	Reproductive success (F/B)
1991	54	39	26	0.72	0.67	0.48
1992	20	14	12	0.70	0.86	0.60
1993	29	21	18	0.72	0.86	0.62
1994	57	43	35	0.75	0.81	0.61
1995	66	55	48	0.83	0.87	0.73
1996	59	47	38	0.80	0.81	0.64
1997	51	45	27	0.88	0.60	0.53
1998	64	48	43	0.75	0.90	0.67
1999	*no data*	-	-	-	-	-
2000	40	26	21	0.65	0.81	0.53
2001	36	14	0	0.39	0.00	0.00
2002	49	39	7	0.80	0.18	0.14
2003	24	19	15	0.79	0.79	0.63
2004	34	25	12	0.74	0.48	0.35
2005	32	25	16	0.78	0.64	0.50
2006	49	31	30	0.63	0.97	0.61
2007	46	44	41	0.96	0.93	0.89
2008	55	48	28	0.87	0.58	0.51
2009	65	52	38	0.80	0.73	0.58
2010	61	52	40	0.85	0.77	0.66
2011	33	24	23	0.73	0.96	0.70
2012	42	19	17	0.45	0.89	0.40

[a]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).

[b]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).

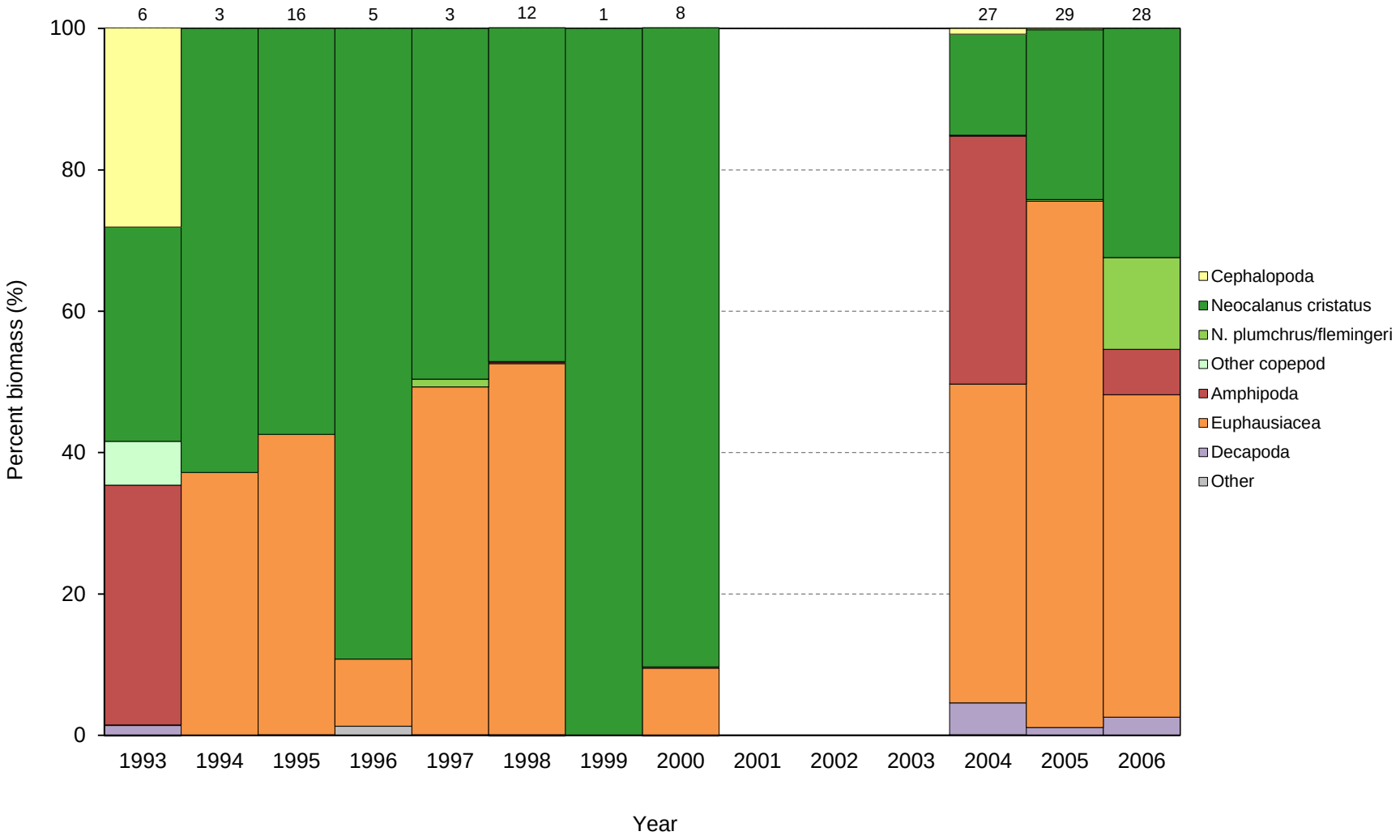

Figure 43. Relative biomass of prey in diets of parakeet auklet chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2007-2012 but have not yet been summarized.

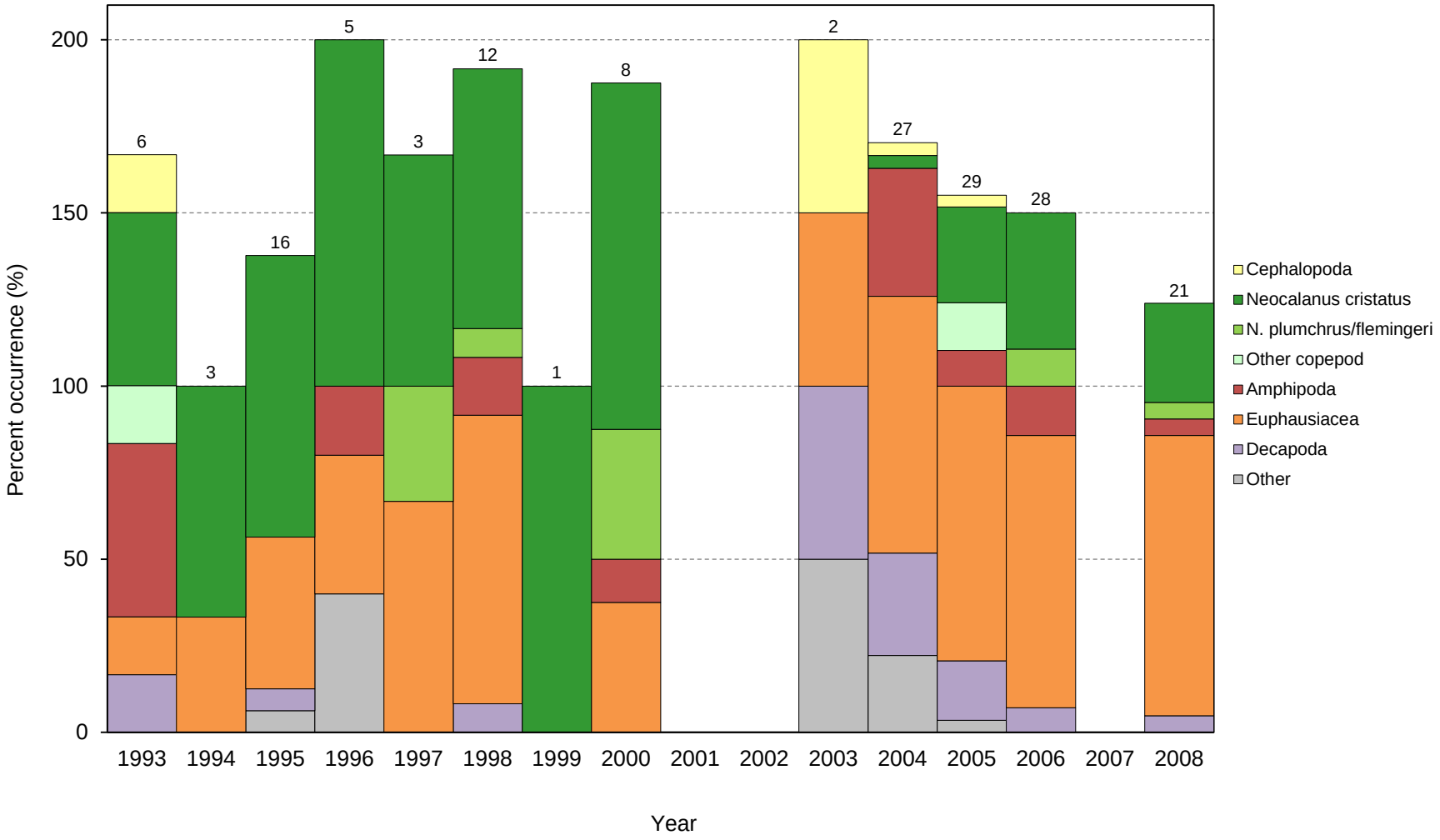

Figure 44. Frequency of occurrence of prey in diets of parakeet auklet chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2007 and 2009-2012 but have not yet been summarized.

Table 69. Relative biomass of prey in diets of parakeet auklet chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2007-2012 but have not yet been summarized.

Prey	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. samples[a]	6	3	16	5	3	12	1	8	*no samples*	*no samples*	*no mass data*	27	29	28
Total mass (g)	14.2	8.6	174.3	24.6	36.8	91.1	0.7	37.2				31.8	98.2	18.7
Cephalopoda	**28.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.8**	**0.2**	**-**
Decabrachia	28.2	-	-	-	-	-	-	-	-	-	-	0.8	0.2	-
Unid. squid	28.2	-	-	-	-	-	-	-	-	-	-	0.8	0.2	-
Gastropoda	**-**	**-**	**0.1**	**1.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.1**	**-**	**-**
Unid. pteropod	-	-	0.1	1.3	-	-	-	-	-	-	-	-	-	-
Unid. gastropod periostracum	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-
Copepoda	**36.5**	**62.8**	**57.4**	**89.2**	**50.7**	**47.3**	**100**	**90.4**	**-**	**-**	**-**	**14.4**	**24.2**	**45.4**
Neocalanus cristatus	30.3	62.8	57.4	89.2	49.6	47.2	100	90.4	-	-	-	14.3	24	32.4
N. plumchrus/flemingeri	-	-	-	-	1.1	0.1	-	-	-	-	-	-	0.2	13
Calanoid spp.	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-
Unid. copepod	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphipoda	**33.9**	**-**	**-**	**-**	**-**	**0.2**	**-**	**0.2**	**-**	**-**	**-**	**35.1**	**<0.1**	**6.4**
Hyperiidea	**33.9**	**-**	**-**	**-**	**-**	**0.1**	**-**	**0.2**	**-**	**-**	**-**	**35.1**	<0.1	**6.4**
Hyperoche medusarum	-	-	-	-	-	0.1	-	-	-	-	-	<0.1	-	-
Primno macropa	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-
Themisto pacifica	-	-	-	-	-	-	-	0.2	-	-	-	35.1	-	6.4
Themisto spp.	32.8	-	-	-	-	-	-	-	-	-	-	-	<0.1	-
Gammaridea	**-**	**-**	**-**	**-**	**-**	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Lysianassidae	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-
Unid. amphipod	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
Euphausiacea	**0.1**	**37.2**	**42.5**	**9.5**	**49.2**	**52.5**	**-**	**9.5**	**-**	**-**	**-**	**45.1[b]**	**74.5**	**45.6**
Thysanoessa raschii	-	-	-	-	-	-	-	-	-	-	-	-	2.8	-
Thysanoessa spp.	0.1	37.2	-	-	-	-	-	-	-	-	-	28.3	57.8	4.2
Unid. euphausiid	-	-	42.5	9.5	49.2	52.5	-	9.5	-	-	-	16.8	13.9	41.4
Decapoda	**1.4**	**-**	**0.1**	**-**	**-**	**0.1**	**-**	**-**	**-**	**-**	**-**	**4.5**	**1.1**	**2.6**
Unid. larval shrimp	-	-	-	-	-	-	-	-	-	-	-	<0.1	1.1	2.1
Unid. crab zoea	-	-	0.1	-	-	-	-	-	-	-	-	0.1	<0.1	-
Atelecyclidae megalopa	-	-	-	-	-	0.1	-	-	-	-	-	4.4	-	-
Unid. crab megalopa	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	0.5
Unid. Oregoninae	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 70) and some prey types may not appear in biomass data although they were present in diet samples.

[b]Biomass of euphausiids in 2004 is an underestimate because euphausiid data for most samples were recorded as presence or absence only.

Table 70. Frequency of occurrence of prey in diets of parakeet auklet chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2007 and 2009-2012 but have not yet been summarized.

Prey	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. samples	6	3	16	5	3	12	1	8	*no samples*	*no samples*	2	27	29	28	*pending analysis*	21
Cephalopoda	**16.7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**50.0**	**3.7**	**3.4**	**-**	**xx**[a]	**-**
Decabrachia	**16.7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**-**	**xx**	**-**
Unid. squid	16.7	-	-	-	-	-	-	-	-	-	-	3.7	3.4	-	xx	-
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**50.0**	**-**	**-**	**-**	**xx**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-	-	50.0	-	-	-	xx	-
Gastropoda	**-**	**-**	**6.3**	**40.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**14.8**	**-**	**-**	**xx**	**-**
Unid. pteropod	-	-	6.3	40.0	-	-	-	-	-	-	-	-	-	-	xx	-
Unid. gastropod periostracum	-	-	-	-	-	-	-	-	-	-	-	14.8	-	-	xx	-
Unid. mollusc	-	-	-	-	-	-	-	-	-	-	50.0	-	-	-	xx	-
Copepoda	**66.7**	**66.7**	**81.3**	**100.0**	**66.7**	**75.0**	**100.0**	**100.0**	**-**	**-**	**-**	**3.7**	**xx**	**xx**	**xx**	**xx**
Neocalanus cristatus	50.0	66.7	81.3	100.0	66.7	75.0	100.0	100.0	-	-	-	3.7	27.6	39.3	xx	28.6
N. plumchrus/flemingeri	-	-	-	-	33.3	8.3	-	37.5	-	-	-	-	-	10.7	xx	4.8
Calanoid spp.	-	-	-	-	-	-	-	-	-	-	-	-	13.8	-	xx	14.3
Unid. copepod	16.7	-	-	-	-	-	-	-	-	-	-	-	-	-	xx	-
Amphipoda	**50.0**	**-**	**-**	**20.0**	**-**	**16.7**	**-**	**12.5**	**-**	**-**	**-**	**37.0**	**10.3**	**14.3**	**xx**	**4.8**
Hyperiidea	**50.0**	**-**	**-**	**20.0**	**-**	**8.3**	**-**	**12.5**	**-**	**-**	**-**	**33.3**	**10.3**	**xx**	**xx**	**4.8**
Hyperoche medusarum	-	-	-	-	-	8.3	-	-	-	-	-	-	-	-	xx	-
Primno macropa	16.7	-	-	-	-	-	-	-	-	-	-	-	-	-	xx	-
Themisto pacifica	-	-	-	20.0	-	-	-	12.5	-	-	-	33.3	-	3.6	xx	4.8
Themisto spp.	50.0	-	-	-	-	-	-	-	-	-	-	-	10.3	3.6	xx	-
Unid. Hyperidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	xx	4.8
Gammaridea	**-**	**-**	**-**	**-**	**-**	**8.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**xx**	**-**
Unid. Lysianassidae	-	-	-	-	-	8.3	-	-	-	-	-	-	-	-	xx	-
Unid. amphipod	-	-	-	-	-	-	-	-	-	-	-	3.7	-	7.1	xx	-
Euphausiacea	**16.7**	**33.3**	**43.8**	**40.0**	**66.7**	**83.3**	**-**	**37.5**	**-**	**-**	**50.0**	**74.1**	**79.3**	**78.6**	**xx**	**80.9**
Euphausia pacifica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	xx	19.0
Thysanoessa raschii	-	-	-	-	-	-	-	-	-	-	-	-	6.9	-	xx	-
Thysanoessa spp.	16.7	33.3	-	-	-	-	-	-	-	-	50.0	18.5	31.0	3.6	xx	14.3
Unid. euphausiid	-	-	43.8	40.0	66.7	83.3	-	37.5	-	-	50.0	66.7	79.3	75.0	xx	76.2
Decapoda	**16.7**	**-**	**6.3**	**-**	**-**	**8.3**	**-**	**-**	**-**	**-**	**50.0**	**29.6**	**17.2**	**7.1**	**xx**	**4.8**
Pandalid shrimp	-	-	-	-	-	-	-	-	-	-	50.0	-	-	-	xx	-
Unid. larval shrimp	-	-	-	-	-	-	-	-	-	-	-	3.7	10.3	3.6	xx	-
Unid. crab zoea	-	-	6.3	-	-	-	-	-	-	-	-	3.7	3.4	-	xx	-
Atelecyclidae megalopa	-	-	-	-	-	8.3	-	-	-	-	-	29.6	3.4	-	xx	4.8
Unid. crab megalopa	-	-	-	-	-	-	-	-	-	-	-	-	-	3.6	xx	-
Unid. Oregoninae	16.7	-	-	-	-	-	-	-	-	-	-	-	-	-	xx	-
Insecta	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**7.4**	**-**	**-**	xx	**-**
Unid. insect	-	-	-	-	-	-	-	-	-	-	-	7.4	-	-	xx	-
Unid. worm	-	-	-	-	-	-	-	-	-	-	-	-	3.5	-	xx	-

[a]xx indicates data potentially exist but have not yet been summarized.

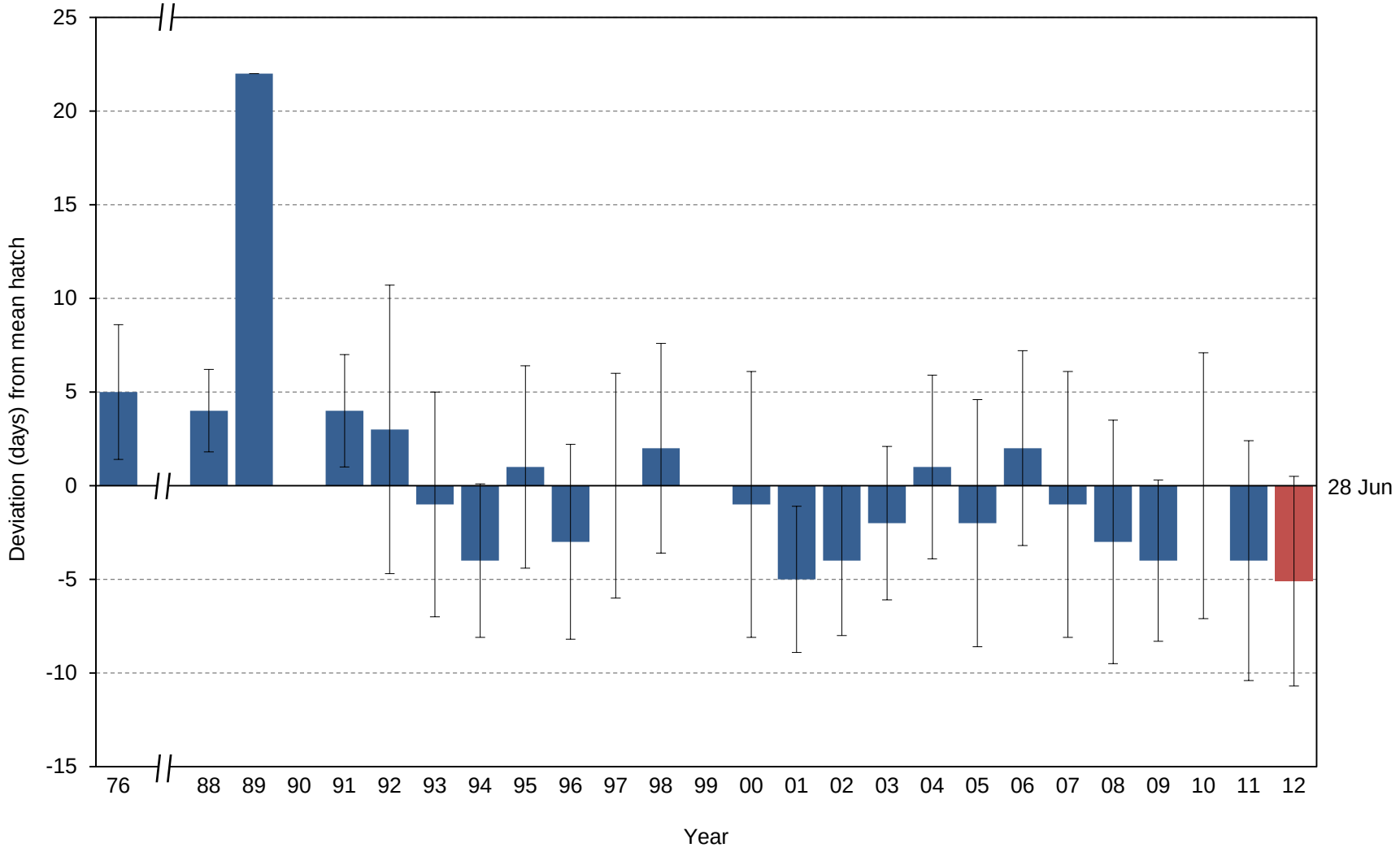

Figure 45. Yearly hatch date deviation (from the 1988-2011 average of 28 June) for least auklets at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 71. Breeding chronology of least auklets at Buldir Island, Alaska. No data were collected in 1977-1987.

Year	Mean hatch	SD	*n*[a]	First hatch	Last hatch	First fledge[b]
1976[c]	2 Jul	3.6	15	27 Jun	10 Jun	-
1988	1 Jul	2.2	4	30 Jun	5 Jul	>28 Jul
1989	20 Jul	0.0	1	20 Jul	-	>27 Jul
1990	-	-	-	-	-	>1 Aug
1991	2 Jul	3.0	7	27 Jun	5 Jul	25 Jul
1992	30 Jun	7.7	11	23 Jun	13 Jul	19 Jul
1993	27 Jun	6.0	5	24 Jun	9 Jul	19 Jul
1994	24 Jun	4.1	23	19 Jun	9 Jul	23 Jul
1995	29 Jun	5.4	49	21 Jun	18 Jul	21 Jul
1996	24 Jun	5.2	23	16 Jun	4 Jul	20 Jul
1997	28 Jun	6.0	21	21 Jun	15 Jul	19 Jul
1998	30 Jun	5.6	42	19 Jun	9 Jul	19 Jul
1999	*no data*	-	-	-	-	-
2000	26 Jun	7.1	27	18 Jun	22 Jul	17 Jul
2001	23 Jun	3.9	23	15 Jun	28 Jun	20 Jul
2002	24 Jun	4.0	12	17 Jun	1 Jul	14 Jul
2003	26 Jun	4.1	13	23 Jun	4 Jul	21 Jul
2004	28 Jun	4.9	23	20 Jun	12 Jul	21 Jul
2005	26 Jun	6.6	32	16 Jun	16 Jul	16 Jul
2006	30 Jun	5.2	33	19 Jun	11 Jul	16 Jul
2007	27 Jun	7.1	21	21 Jun	18 Jul	18 Jul
2008	24 Jun	6.5	30	20 Jun	17 Jul	17 Jul
2009	24 Jun	4.3	34	17 Jun	5 Jul	21 Jul
2010	28 Jun	7.1	17	21 Jun	18 Jul	13 Jul
2011	24 Jun	6.4	26	9 Jun	5 Jul	18 Jul
2012	22 Jun	5.6	28	9 Jun	7 Jul	12 Jul

[a]Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.
[b]In years when no chicks fledged before the last nest check, date of first fledge is listed as > the date of last nest check.
[c]Hatch dates in 1976 were assumed to be the midpoint of the interval reported in Knudtson and Byrd (1982).

Table 72. Frequency distribution of hatch dates for least auklets at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. Individual hatch date data are not available for 1976.

Julian date[a]	No. nests hatching on Julian date												
	88	89	90	91	92	93	94	95	96	97	98	99	00
160	-	-	-	-	-	-	-	-	-	-	-	*no data*	-
161	-	-	-	-	-	-	-	-	-	-	-		-
162	-	-	-	-	-	-	-	-	-	-	-	-	-
163	-	-	-	-	-	-	-	-	-	-	-	-	-
164	-	-	-	-	-	-	-	-	-	-	-	-	-
165	-	-	-	-	-	-	-	-	-	-	-	-	-
166	-	-	-	-	-	-	-	-	-	-	-	-	-
167	-	-	-	-	-	-	-	-	-	-	-	-	-
168	-	-	-	-	-	-	-	-	3	-	-	-	-
169	-	-	-	-	-	-	-	-	-	-	-	-	-
170	-	-	-	-	-	-	6	-	-	-	2	-	6
171	-	-	-	-	-	-	-	-	-	-	-	-	-
172	-	-	-	-	-	-	-	3	-	3	-	-	-
173	-	-	-	-	-	-	-	-	-	-	-	-	-
174	-	-	-	-	-	-	-	1	12	-	9	-	2
175	-	-	-	-	6	4	14	1	-	-	-	-	7
176	-	-	-	-	-	-	-	-	-	9	-	-	-
177	-	-	-	-	-	-	-	27	-	-	-	-	-
178	-	-	-	2	-	-	2	-	-	-	-	-	-
179	-	-	-	-	-	-	-	-	-	-	-	-	5
180	-	-	-	-	-	-	-	1	5	-	17	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-	-
182	3	-	-	-	-	-	-	-	-	6	1	-	-
183	-	-	-	-	-	-	-	-	-	-	-	-	-
184	-	-	-	4	-	-	-	11	-	-	1	-	6
185	-	-	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	1	-	-	-	-	3	1	6	-	-
187	1	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-	-
189	-	-	-	-	4	-	-	-	-	-	1	-	-
190	-	-	-	-	-	1	1	4	-	-	5	-	-
191	-	-	-	-	-	-	-	-	-	1	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	-	-	-	-	-
195	-	-	-	-	1	-	-	-	-	-	-	-	-
196	-	-	-	-	-	-	-	-	-	1	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	1	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-	-	-
201	-	1	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	-	-	-	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	-	-	-	-	1
n	4	1	-	7	11	5	23	49	23	21	42	-	27

[a]Julian dates are adjusted by one day in leap years.

Table 72 (continued). Frequency distribution of hatch dates for least auklets at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. Individual hatch date data are not available for 1976.

Julian date[a]	No. nests hatching on Julian date											
	01	02	03	04	05	06	07	08	09	10	11	12
160	-	-	-	-	-	-	-	-	-	-	1	-
161	-	-	-	-	-	-	-	-	-	-	-	1
162	-	-	-	-	-	-	-	-	-	-	-	-
163	-	-	-	-	-	-	-	-	-	-	-	-
164	-	-	-	-	-	-	-	-	-	-	1	-
165	-	-	-	-	-	-	-	-	-	-	-	-
166	2	-	-	-	-	-	-	-	-	-	-	1
167	-	-	-	-	2	-	-	-	-	-	-	2
168	-	2	-	-	-	-	-	-	4	-	2	-
169	-	-	-	-	1	-	-	-	-	-	-	-
170	1	-	-	-	-	1	-	-	-	-	-	3
171	-	-	-	-	5	-	-	-	-	-	-	-
172	1	-	-	1	-	-	8	15	-	6	6	9
173	11	-	-	2	2	-	-	-	-	-	-	-
174	-	4	7	-	-	4	1	-	19	-	3	-
175	-	-	-	-	-	-	-	1	-	-	-	1
176	-	-	1	-	14	-	6	10	-	-	5	-
177	1	-	-	-	-	-	-	-	3	-	-	1
178	-	5	-	12	-	13	-	-	-	5	-	7
179	7	-	-	-	1	-	-	-	-	-	-	1
180	-	-	3	-	2	-	-	-	6	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-
182	-	1	-	5	-	7	3	-	-	2	5	-
183	-	-	-	-	-	-	-	-	-	-	-	-
184	-	-	-	-	-	-	-	-	-	-	1	1
185	-	-	2	-	-	-	-	1	-	-	-	-
186	-	-	-	-	3	5	1	-	2	3	2	-
187	-	-	-	-	-	-	-	1	-	-	-	-
188	-	-	-	2	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	1
190	-	-	-	-	-	1	-	-	-	-	-	-
191	-	-	-	-	-	-	1	-	-	-	-	-
192	-	-	-	-	1	2	-	-	-	-	-	-
193	-	-	-	-	-	-	-	1	-	-	-	-
194	-	-	-	1	-	-	-	-	-	-	-	-
195	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	-	-	-	-	-	-	-	-
197	-	-	-	-	1	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	1	1	-	1	-	-
200	-	-	-	-	-	-	-	-	-	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	-	-	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	-	-	-	-
n	23	12	13	23	32	33	21	30	34	17	26	28

[a]Julian dates are adjusted by one day in leap years.

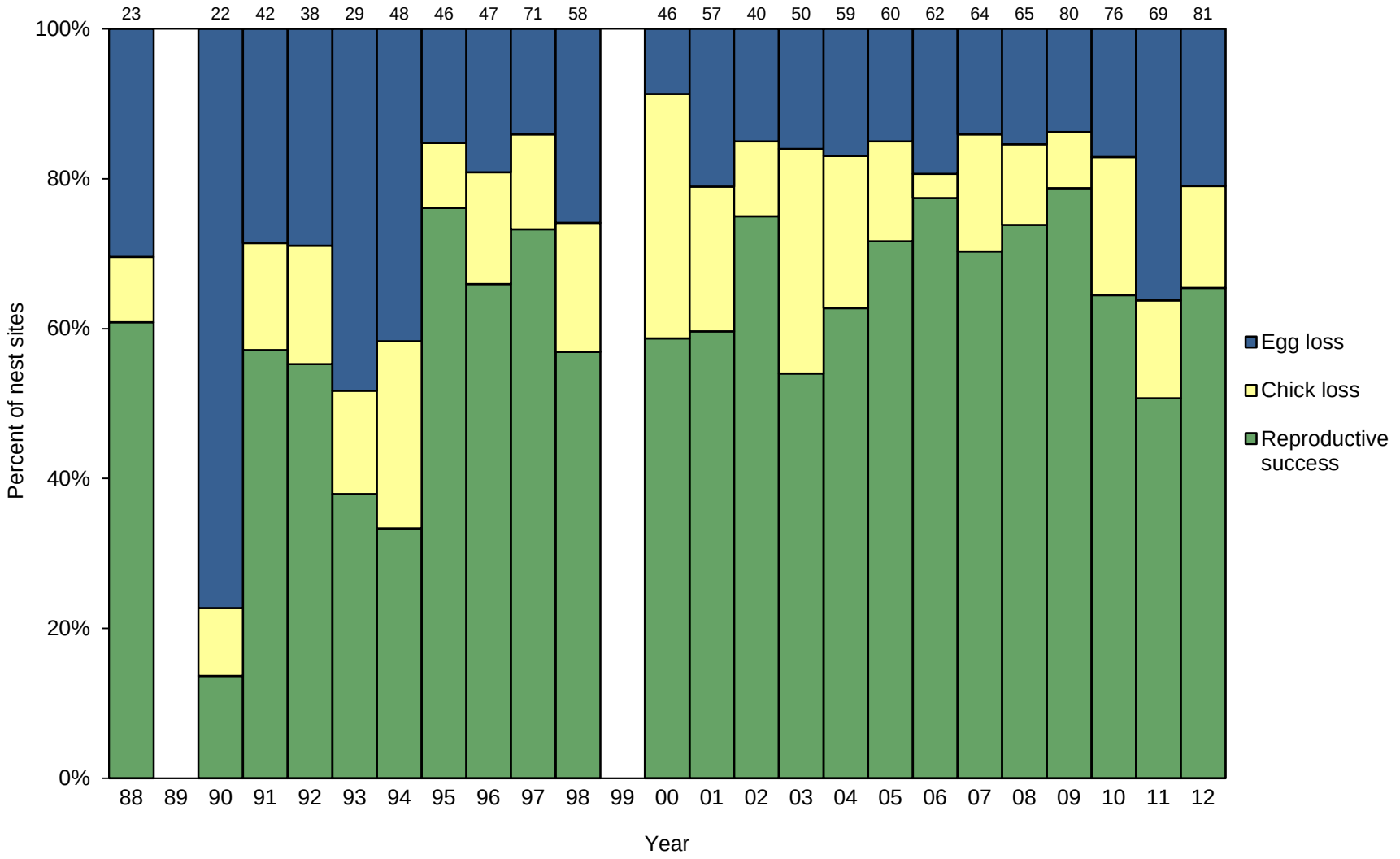

Figure 46. Reproductive performance of least auklets at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 73. Reproductive performance of least auklets at Buldir Island, Alaska. No data were collected in 1977-1987.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Nesting success (D/B)[a]	Fledging success (F/D)[b]	Reproductive success (F/B)
1976	28	19	-	0.68	-	-
1988	23	16	14	0.70	0.88	0.61
1989	29	6	4	0.21	0.67	0.14
1990	22	5	3	0.23	0.60	0.14
1991	42	30	24	0.71	0.80	0.57
1992	38	27	21	0.71	0.78	0.55
1993	29	15	11	0.52	0.73	0.38
1994	48	28	16	0.58	0.57	0.33
1995	46	39	35	0.85	0.90	0.76
1996	47	38	31	0.81	0.82	0.66
1997	71	61	52	0.86	0.85	0.73
1998	58	43	33	0.74	0.77	0.57
1999	*no data*	-	-	-	-	-
2000	46	42	27	0.91	0.64	0.59
2001	57	45	34	0.79	0.76	0.60
2002	40	34	30	0.85	0.88	0.75
2003	50	42	27	0.84	0.64	0.54
2004	59	49	37	0.83	0.76	0.63
2005	60	51	43	0.85	0.84	0.72
2006	62	50	48	0.81	0.96	0.77
2007	64	55	45	0.86	0.82	0.70
2008	65	55	48	0.85	0.87	0.74
2009	80	69	63	0.86	0.91	0.79
2010	76	63	49	0.83	0.78	0.64
2011	69	44	35	0.64	0.80	0.51
2012	81	64	53	0.79	0.83	0.65

[a]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).

[b]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).

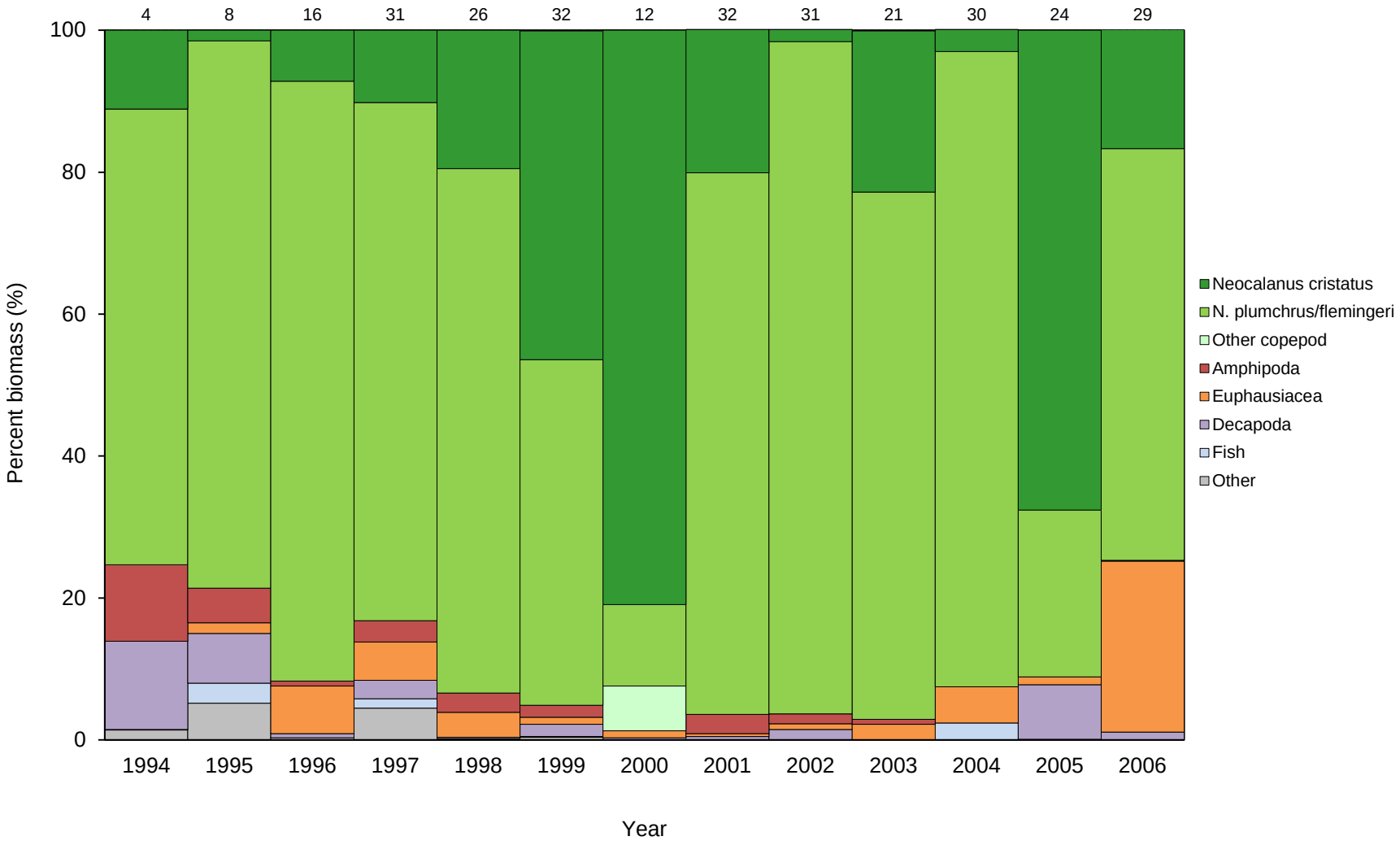

Figure 47. Relative biomass of prey in diets of least auklet chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2007-2012 but have not yet been summarized.

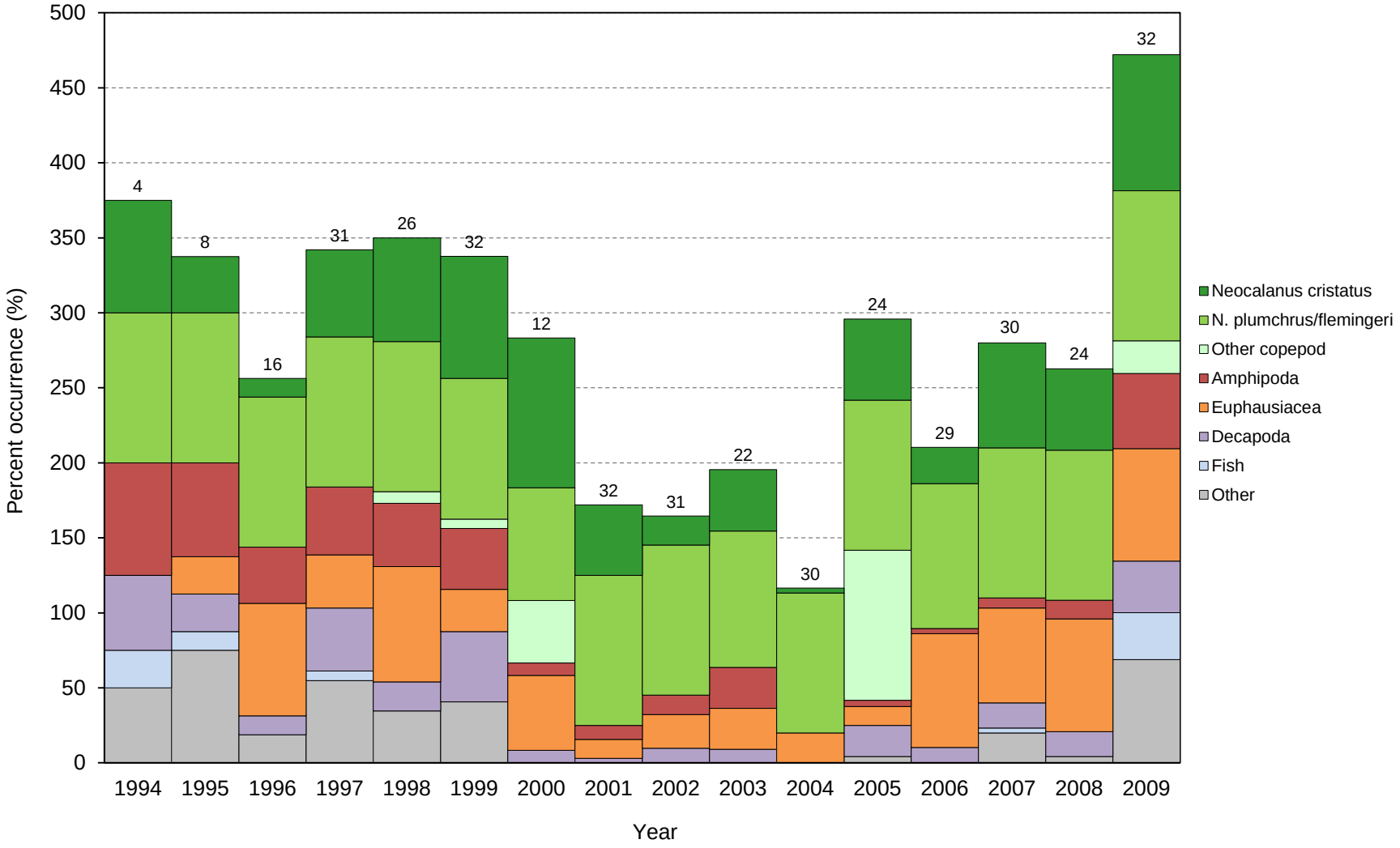

Figure 48. Frequency of occurrence of prey in diets of least auklet chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2010-2012 but have not yet been summarized.

Table 74. Relative biomass of prey in diets of least auklet chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2007-2012 but have not yet been summarized.

Prey	1994	1995	1996	1997	1998	1999	2000
No. samples[a]	4	8	16	31	26	32	12
Total mass (g)	12.1	18.2	46.3	97.6	87.1	146.1	40.7
Invertebrates	**99.1**	**97.3**	**100.0**	**98.6**	**100.0**	**99.8**	**100.0**
Cephalopoda	**-**	**-**	**-**	**-**	**-**	**0.1**	**-**
Decabrachia	**-**	**-**	**-**	**-**	**-**	**0.1**	**-**
Unid. squid	-	-	-	-	-	0.1	-
Gastropoda	**0.6**	**5.3**	**0.3**	**4.4**	**0.2**	**0.3**	**0.1**
Limacina helicina	-	-	-	-	0.2	-	-
Unid. pteropod	-	5.3	0.3	4.4	-	0.3	0.1
Unid. snail	0.6	-	-	-	-	-	-
Copepoda	**75.3**	**78.6**	**91.7**	**83.2**	**93.4**	**95.0**	**98.7**
Calanus marshallae	-	-	-	-	<0.1	-	0.4
Calanoid spp.	-	-	-	-	-	-	-
Neocalanus cristatus	11.1	1.5	7.2	10.2	19.5	46.3	80.9
N. plumchrus/flemingeri	64.2	77.1	84.5	73.0	73.9	48.6	11.5
Neocalanus spp.	-	-	-	-	-	-	5.9
Pachyptilus pacificus	-	-	-	-	-	<0.1	-
Pareuchaeta birostrata	-	-	-	-	-	<0.1	-
Amphipoda	**21.6**	**9.8**	**1.4**	**6.0**	**5.4**	**3.4**	**-**
Hyperiidea	**10.8**	**4.9**	**0.7**	**3.0**	**0.0**	**1.7**	**<0.1**
Hyperoche medusarum	-	3.6	0.1	-	-	-	-
Primno macropa	3.3	-	-	1.8	-	1.1	-
Themisto pacifica	7.5	1.3	0.6	1.2	0.1	0.6	<0.1
Themisto spp.	-	-	-	-	-	-	-
Gammaridea	**-**	**-**	**-**	**-**	**2.7**	**-**	**-**
Erichtonius spp.	-	-	-	-	2.7	-	-
Euphausiacea	**-**	**1.5**	**6.7**	**5.4**	**3.5**	**1.0**	**1.0**
Thysanoessa raschii	-	-	-	-	-	-	-
Thysanoessa spp.	-	-	-	-	-	-	-
Unid. euphausiid furcilla	-	-	-	-	1.0	0.3	-
Unid. euphausiid	-	1.5	6.7	5.4	2.5	0.7	1.0
Decapoda	**12.4**	**7.0**	**0.6**	**2.6**	**0.2**	**1.7**	**0.3**
Pandalid shrimp	-	-	-	-	-	-	-
Unid. larval shrimp	-	-	-	-	-	-	-
Unid. shrimp zoea	12.4	7.0	0.2	0.4	0.1	0.1	-
Unid. crab zoea	-	-	-	0.3	-	0.1	-
Hippolytidae juvenile	-	-	-	-	-	1.1	-
Atelecyclidae megalopa	-	-	-	-	0.1	0.1	-
Paguridae megalopa	-	-	-	-	-	0.3	-
Unid. crab megalopa	-	-	0.4	1.9	-	-	0.3
Fish	**0.8**	**2.8**	**-**	**1.3**	**-**	**0.1**	**-**
Unid. Teleostei	0.8	2.8	-	1.3	-	0.1	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 75) and some prey types may not appear in biomass data although they were present in diet samples.

Table 74 (continued). Relative biomass of prey in diets of least auklet chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2007-2012 but have not yet been summarized.

Prey	2001	2002	2003	2004	2005	2006
No. samples[a]	32	31	21	30	24	29
Total mass (g)	27.6	25.7	34.5	20.5	59.3	12.1
Invertebrates	**100.0**	**100.0**	**100.0**	**97.7**	**100.0**	**100.0**
Cephalopoda	**-**	**-**	**-**	**-**	**-**	**-**
Decabrachia	**-**	**-**	**-**	**-**	**-**	**-**
Unid. squid	-	-	-	-	-	-
Gastropoda	**-**	**-**	**-**	**-**	**0.1**	**-**
Limacina helicina	-	-	-	-	-	-
Unid. pteropod	-	-	-	-	0.1	-
Unid. snail	-	-	-	-	-	-
Copepoda	**96.5**	**96.4**	**97.0**	**92.6**	**91.1**	**75.9**
Calanus marshallae	-	-	-	-	-	-
Calanoid spp.	-	-	-	-	-	-
Neocalanus cristatus	20.2	1.7	22.7	3.1	67.6	17.9
N. plumchrus/flemingeri	76.3	94.7	74.3	89.5	23.5	58.0
Neocalanus spp.	-	-	-	-	-	-
Pachyptilus pacificus	-	-	-	-	-	-
Pareuchaeta birostrata	-	-	-	-	-	-
Amphipoda	**5.4**	**2.8**	**1.4**	**-**	**-**	**0.2**
Hyperiidea	**2.7**	**1.4**	**0.7**	**-**	**-**	**0.1**
Hyperoche medusarum	-	<0.1	-	-	-	-
Primno macropa	-	<0.1	<0.1	-	-	-
Themisto pacifica	2.7	1.4	-	-	-	0.1
Themisto spp.	-	-	0.7	-	-	-
Gammaridea	**-**	**-**	**-**	**-**	**-**	**-**
Erichtonius spp.	-	-	-	-	-	-
Euphausiacea	**0.4**	**0.8**	**2.2**	**5.0**[b]	**1.1**	**24.1**
Thysanoessa raschii	-	-	-	-	1.0	-
Thysanoessa spp.	-	-	0.2	-	-	0.7
Unid. euphausiid furcilla	-	-	-	-	-	-
Unid. euphausiid	0.4	0.8	2.0	5.0	0.1	22.4
Decapoda	**0.5**	**1.5**	**-**	**-**	**7.7**	**1.1**
Pandalid shrimp	0.5	1.5	-	-	0.3	-
Unid. larval shrimp	-	-	-	-	7.3	-
Unid. shrimp zoea	-	-	-	-	-	-
Unid. crab zoea	-	-	<0.1	-	-	-
Hippolytidae juvenile	-	-	-	-	-	-
Atelecyclidae megalopa	-	-	-	-	-	1.1
Paguridae megalopa	-	-		-	-	-
Unid. crab megalopa	-	-	<0.1	-	0.1	-
Fish	**-**	**-**	**-**	**2.4**	**-**	**-**
Unid. Teleostei	-	-	-	2.4	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 75) and some prey types may not appear in biomass data although they were present in diet samples.

[b]Biomass of euphausiids in 2004 is an underestimate because euphausiid data for most samples were recorded as presence or absence only.

Table 75. Frequency of occurrence of prey in diets of least auklet chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2010-2012 but have not yet been summarized.

Prey	1994	1995	1996	1997	1998	1999	2000	2001
No. samples	4	8	16	31	26	32	12	32
Invertebrates	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Cephalopoda	**-**	**-**	**-**	**-**	**-**	**3.1**	**-**	**-**
Decabrachia	**-**	**-**	**-**	**-**	**-**	**3.1**	**-**	**-**
Unid. squid	-	-	-	-	-	3.1	-	-
Gastropoda	**50.0**	**75.0**	**18.8**	**54.8**	**34.6**	**40.6**	**8.3**	**-**
Limacina helicina	-	-	-	-	34.6	-	-	-
Unid. pteropod	-	75.0	18.8	54.8	-	40.6	8.3	-
Unid. snail	50.0	-	-	-	-	-	-	-
Copepoda	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Calanus marshallae	-	-	-	-	7.7	-	41.7	-
Calanoid spp.	-	-	-	-	-	-	-	-
Eucalanus bungii	-	-	-	-	-	-	-	-
E. elongata	-	-	-	-	-	-	-	-
Neocalanus cristatus	75.0	37.5	12.5	58.1	69.2	81.3	100.0	46.9
N. plumchrus/flemingeri	100.0	100.0	100.0	100.0	100.0	93.8	75.0	100.0
Neocalanus spp.	-	-	-	-	-	-	58.3	-
Pachyptilus pacificus	-	-	-	-	-	3.1	-	-
Pareuchaeta birostrata	-	-	-	-	-	3.1	-	-
Amphipoda	**75.0**	**62.5**	**37.5**	**45.2**	**42.3**	**40.6**	**8.3**	**9.4**
Hyperiidea	**75.0**	**62.5**	**37.5**	**45.2**	**11.5**	**40.6**	**8.3**	**9.4**
Hyperoche medusarum	-	50.0	12.5	-	-	-	-	-
Primno macropa	25.0	-	-	25.8	-	18.6	-	-
Themisto pacifica	75.0	50.0	31.3	19.4	11.5	31.3	8.3	9.4
Themisto spp.	-	-	-	-	-	-	-	-
Gammaridea	**-**	**-**	**-**	**-**	**34.6**	**-**	**-**	**-**
Erichtonius spp.	-	-	-	-	34.6	-	-	-
Euphausiacea	**-**	**25.0**	**75.0**	**35.5**	**76.9**	**28.1**	**50.0**	**12.5**
Euphausia pacifica	-	-	-	-	-	-	-	-
Thysanoessa inermis	-	-	-	-	-	-	-	-
T. inspinata	-	-	-	-	-	-	-	-
T. longipes	-	-	-	-	-	-	-	-
T. raschii	-	-	-	-	-	-	-	-
Thysanoessa spp.	-	-	-	-	-	-	-	-
Unid. euphausiid furcilla	-	-	-	-	61.5	6.3	-	-
Unid. euphausiid	-	25.0	75.0	35.5	26.9	21.9	50.0	12.5
Decapoda	**50.0**	**25.0**	**12.5**	**41.9**	**19.3**	**46.9**	**8.3**	**3.1**
Pandalid shrimp	-	-	-	-	-	-	-	-
Unid. larval shrimp	-	-	-	-	-	-	-	3.1
Unid. shrimp zoea	50.0	25.0	6.3	19.4	19.2	15.6	-	-
Lithodidae zoea	-	-	-	-	-	-	-	-
Oregoninae zoea	-	-	-	-	-	-	-	-
Paguridae zoea	-	-	-	-	-	-	-	-
Unid. crab zoea	-	-	-	3.2	-	3.1	-	-
Hippolytidae juvenile	-	-	-	-	-	37.5	-	-
Atelecyclidae megalopa	-	-	-	-	3.8	6.3	-	-
Chionecetes megalopa	-	-	-	-	-	-	-	-
Paguridae megalopa	-	-	-	-	-	6.3	-	-
Unid. crab megalopa	-	-	6.3	22.6	-	-	8.3	-
Fish	**25.0**	**12.5**	**-**	**6.5**	**-**	**-**	**-**	**-**
Unid. Teleostei	25.0	12.5	-	6.5	-	-	-	-

[a]xx indicates data potentially exist but have not yet been summarized.

Table 75 (continued). Frequency of occurrence of prey in diets of least auklet chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2010-2012 but have not yet been summarized.

Prey	2002	2003	2004	2005	2006	2007	2008	2009
No. samples	31	21	30	24	29	30	24	32
Invertebrates	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Cephalopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Decabrachia	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. squid	-	-	-	-	-	-	-	-
Gastropoda	**-**	**-**	**-**	**4.2**	**-**	**20.0**	**4.2**	**68.8**
Limacina helicina	-	-	-	-	-	20.0	4.2	68.8
Unid. pteropod	-	-	-	4.2	-	-	-	-
Unid. snail	-	-	-	-	-	-	-	-
Copepoda	**100.0**	**100.0**	**93.3**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Calanus marshallae	-	-	-	-	-	-	-	-
Calanoid spp.	-	-	-	-	-	96.7	100.0	-
Eucalanus bungii	-	-	-	-	-	-	-	3.1
E. elongata	-	-	-	-	-	-	-	18.8
Neocalanus cristatus	19.4	40.9	3.3	54.2	24.1	70.0	54.2	90.6
N. plumchrus/flemingeri	100.0	90.9	93.3	100.0	96.6	100.0	100.0	100.0
Neocalanus spp.	-	-	-		-	-	-	-
Pachyptilus pacificus	-	-	-	-	-	-	-	-
Pareuchaeta birostrata	-	-	-	-	-	-	-	-
Amphipoda	**12.9**	**27.3**	**-**	**4.2**	**3.4**	**6.7**	**12.5**	**50.0**
Hyperiidea	**12.9**	**27.3**	**-**	**4.2**	**3.4**	**6.7**	**12.5**	**50.0**
Hyperoche medusarum	3.2	-	-	-	-	3.3	-	3.1
Primno macropa	3.2	4.5	-	-	-	-	-	28.1
Themisto pacifica	9.7	-	-	4.2	3.4	6.7	12.5	28.1
Themisto spp.	-	27.3	-	-	-	-	-	-
Gammaridea	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Erichtonius spp.	-	-	-	-	-	-	-	-
Euphausiacea	**22.6**	**27.3**	**20.0**	**12.5**	**75.9**	**63.3**	**75.0**	**75.0**
Euphausia pacifica	-	-	-	-	-	-	-	56.3
Thysanoessa inermis	-	-	-	-	-	-	-	6.3
T. inspinata	-	-	-	-	-	-	-	12.5
T. longipes	-	-	-	-	-	-	-	25.0
T. raschii	-	-	-	4.2	-	-	-	6.3
Thysanoessa spp.	-	4.5	-	-	3.4	23.3	8.3	-
Unid. euphausiid furcilla	-	-	-	-	-	-	-	-
Unid. euphausiid	22.6	22.7	20.0	8.3	75.9	46.7	70.8	-
Decapoda	**9.7**	**9.1**	**-**	**20.8**	**10.3**	**16.7**	**16.7**	**34.4**
Pandalid shrimp	-	-	-	4.2	-	3.3	-	18.8
Unid. larval shrimp	9.7	-	-	12.5	-	-	12.5	-
Unid. shrimp zoea	-	-	-	-	-	-	-	-
Lithodidae zoea	-	-	-	-	-	-	-	3.1
Oregoninae zoea	-	-	-	-	-	-	-	3.1
Paguridae zoea	-	-	-	-	-	3.3		
Unid. crab zoea	-	4.5	-	-	-	-	-	-
Hippolytidae juvenile	-	-	-	-	-	3.3	4.2	21.9
Atelecyclidae megalopa	-	-	-	-	10.3	16.7	-	3.1
Chionecetes megalopa	-	-	-	-	-	-	-	3.1
Paguridae megalopa	-	-	-	-	-	-	-	-
Unid. crab megalopa	-	4.5	-	8.3	-	-	-	-
Fish	**-**	**-**	**-**	**-**	**-**	**3.3**	**-**	**31.3**
Unid. Teleostei	-	-	-	-	-	3.3	-	31.3

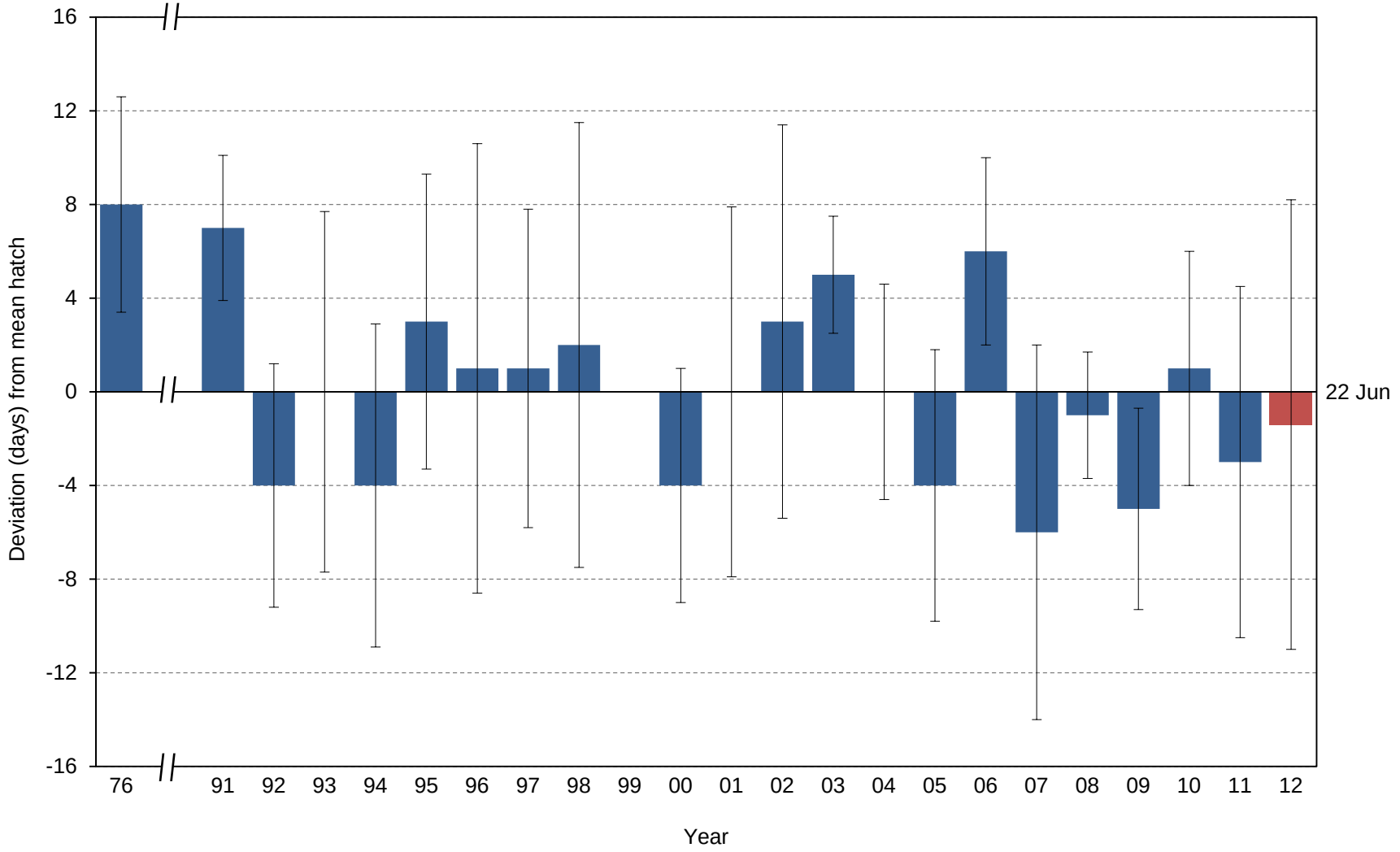

Figure 49. Yearly hatch date deviation (from the 1976-2011 average of 22 June) for whiskered auklets at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 76. Breeding chronology of whiskered auklets at Buldir Island, Alaska. No data were collected in 1977-1987.

Year	Mean hatch	SD	*n*[a]	First hatch	Last hatch	First fledge[b]
1976[c]	30 Jun	4.6	6	27 Jun	6 Jul	-
1988	*no data*	-	-	-	-	-
1989	-	-	-	-	-	>27 Jul
1990	-	-	-	-	-	>1 Aug
1991	29 Jun	3.1	8	26 Jun	3 Jul	26 Jul
1992	17 Jun	5.2	11	10 Jun	28 Jun	19 Jul
1993	22 Jun	7.7	14	13 Jun	9 Jul	15 Jul
1994	18 Jun	6.9	37	9 Jun	8 Jul	19 Jul
1995	25 Jun	6.3	51	18 Jun	15 Jul	21 Jul
1996	22 Jun	9.6	27	10 Jun	20 Jul	20 Jul
1997	23 Jun	6.8	22	11 Jun	7 Jul	19 Jul
1998	24 Jun	9.5	55	9 Jun	15 Jul	19 Jul
1999	*no data*	-	-	-	-	-
2000	17 Jun	5.0	26	6 Jun	27 Jun	17 Jul
2001	22 Jun	7.9	17	9 Jun	15 Jul	15 Jul
2002	25 Jun	8.4	35	15 Jun	15 Jul	20 Jul
2003	27 Jun	2.5	4	23 Jun	29 Jun	15 Jul
2004	21 Jun	4.6	27	16 Jun	4 Jul	21 Jul
2005	18 Jun	5.8	28	11 Jun	5 Jul	16 Jul
2006	28 Jun	4.0	17	23 Jun	5 Jul	31 Jul
2007	16 Jun	8.0	23	11 Jun	10 Jul	14 Jul
2008	20 Jun	2.7	36	14 Jun	24 Jun	23 Jul
2009	17 Jun	4.3	49	5 Jun	29 Jun	15 Jul
2010	23 Jun	5.0	24	17 Jun	5 Jul	18 Jul
2011	19 Jun	7.5	28	7 Jun	5 Jul	23 Jul
2012	20 Jun	9.6	18	9 Jun	12 Jul	17 Jul

[a]Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.
[b]In years when no chicks fledged before the last nest check, date of first fledge is listed as > the date of last nest check.
[c]Hatch dates in 1976 were assumed to be the midpoint of the interval reported in Knudtson and Byrd (1982).

Table 77. Frequency distribution of hatch dates for whiskered auklets at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date										
	91	92	93	94	95	96	97	98	99	00	01
156	-	-	-	-	-	-	-	-	*no data*	-	-
157	-	-	-	-	-	-	-	-		-	-
158	-	-	-	-	-	-	-	-	-	1	-
159	-	-	-	-	-	-	-	-	-	-	-
160	-	-	-	2	-	-	-	2	-	-	1
161	-	-	-	1	-	-	-	1	-	-	-
162	-	1	-	3	-	1	1	-	-	-	-
163	-	1	-	-	-	-	-	-	-	-	-
164	-	-	2	2	-	-	-	1	-	8	-
165	-	1	-	6	-	-	-	-	-	2	-
166	-	1	-	4	-	-	-	9	-	-	2
167	-	1	-	1	-	-	-	-	-	-	-
168	-	3	1	1	-	12	6	1	-	-	-
169	-	-	-	-	1	-	-	2	-	-	2
170	-	-	6	4	-	-	-	11	-	10	1
171	-	-	-	3	-	-	-	-	-	-	4
172	-	-	-	1	30	-	6	2	-	-	-
173	-	-	-	-	-	-	-	-	-	-	3
174	-	1	-	-	1	8	-	6	-	-	-
175	-	1	3	3	-	-	-	-	-	3	-
176	-	-	-	-	-	-	3	-	-	-	1
177	2	-	-	3	9	-	1	1	-	-	-
178	3	-	-	-	-	-	-	-	-	1	-
179	-	-	-	-	-	-	-	-	-	1	1
180	-	1	-	-	-	2	-	5	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-
182	-	-	-	-	-	-	2	-	-	-	-
183	-	-	-	1	-	-	-	-	-	-	-
184	3	-	-	-	4	-	-	-	-	-	-
185	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	1	-	2	2	7	-	-	1
187	-	-	-	-	2	-	-	-	-	-	-
188	-	-	-	-	-	-	1	-	-	-	-
189	-	-	-	1	-	-	-	-	-	-	-
190	-	-	2	-	3	-	-	4	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	-	-	1	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	-	-	-
195	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	1	-	-	2	-	-	1
197	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	2	-	-	-	-	-
n	8	11	14	37	51	27	22	55	-	26	17

[a]Julian dates are adjusted by one day in leap years.

Table 77 (continued). Frequency distribution of hatch dates for whiskered auklets at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date										
	02	03	04	05	06	07	08	09	10	11	12
156	-	-	-	-	-	-	-	1	-	-	-
157	-	-	-	-	-	-	-	-	-	-	-
158	-	-	-	-	-	-	-	-	-	2	-
159	-	-	-	-	-	-	-	-	-	-	-
160	-	-	-	-	-	-	-	-	-	-	-
161	-	-	-	-	-	-	-	-	-	-	3
162	-	-	-	5	-	9	-	8	-	3	-
163	-	-	-	-	-	-	-	-	-	-	-
164	-	-	-	1	-	2	-	-	-	5	1
165	-	-	-	1	-	-	-	4	-	-	1
166	3	-	-	4	-	7	3	1	-	-	2
167	1	-	-	7	-	-	-	-	-	-	2
168	4	-	8	-	-	-	-	27	5	3	-
169	1	-	-	-	-	-	-	-	-	-	-
170	-	-	-	1	-	-	2	-	-	-	-
171	-	-	-	1	-	-	-	2	-	-	-
172	10	-	4	1	-	2	21	1	10	8	4
173	-	-	8	-	-	-	-	-	-	1	-
174	2	1	-	-	4	-	1	3	-	-	-
175	-	-	-	-	-	-	-	-	-	-	-
176	3	-	-	6	-	-	9	-	-	2	-
177	-	1	-	-	-	-	-	-	-	-	-
178	2	-	5	-	8	-	-	-	5	-	3
179	1	-	-	-	-	-	-	-	-	-	-
180	-	2	-	-	-	-	-	2	1	-	-
181	-	-	1	-	1	-	-	-	1	-	-
182	2	-	-	-	1	1	-	-	1	2	-
183	-	-	-	-	-	-	-	-	-	-	-
184	-	-	-	-	-	-	-	-	-	-	-
185	-	-	-	-	-	-	-	-	-	-	-
186	1	-	1	1	3	1	-	-	1	2	-
187	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-
189	1	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-
191	-	-	-	-	-	1	-	-	-	-	-
192	2	-	-	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	-	-	2
195	1	-	-	-	-	-	-	-	-	-	-
196	1	-	-	-	-	-	-	-	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	-	-	-	-	-	-
n	35	4	27	28	17	23	36	49	24	28	18

[a]Julian dates are adjusted by one day in leap years.

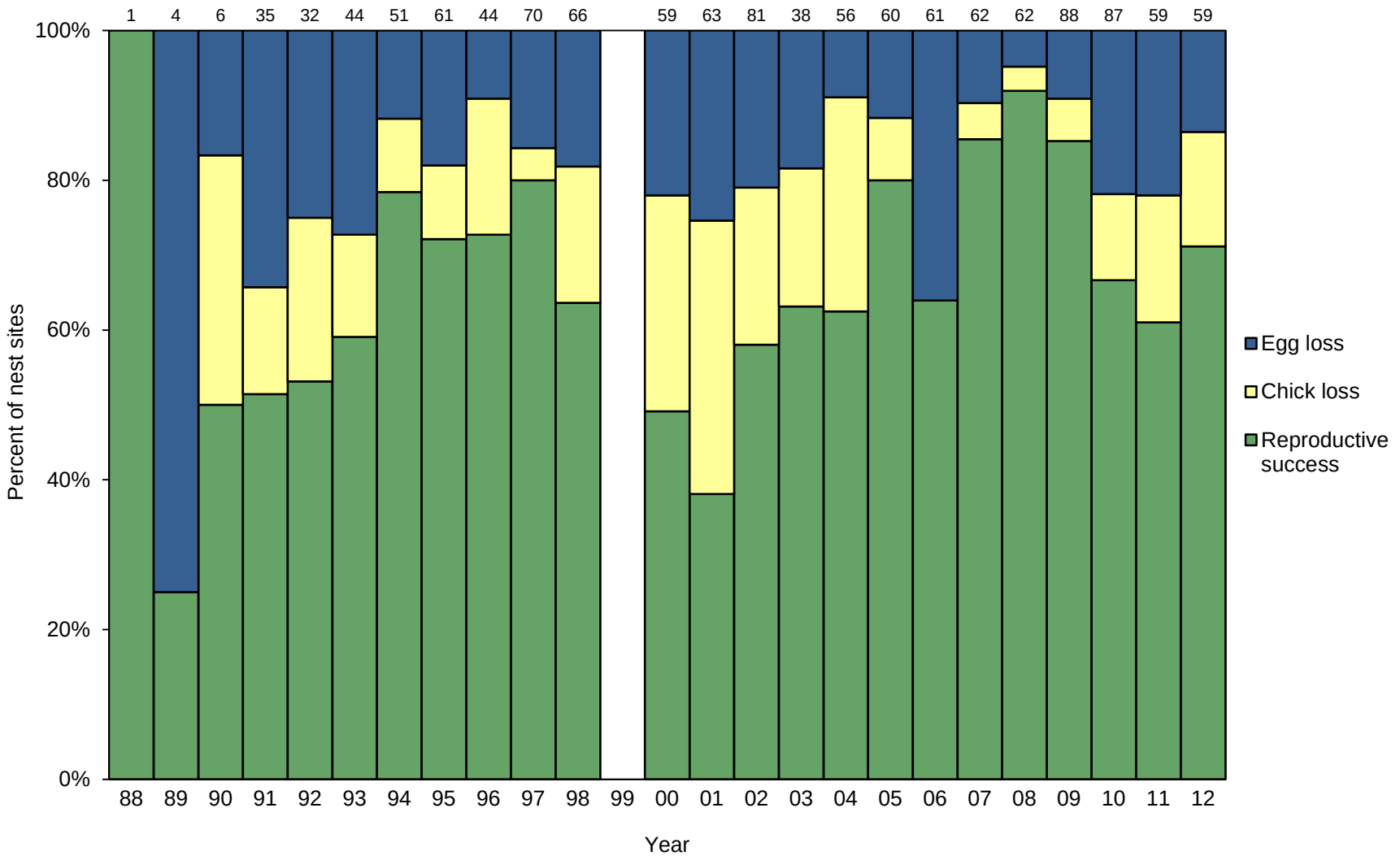

Figure 50. Reproductive performance of whiskered auklets at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 78. Reproductive performance of whiskered auklets at Buldir Island, Alaska. No data were collected in 1977-1987.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Nesting success (D/B)[a]	Fledging success (F/D)[b]	Reproductive success (F/B)
1976	7	6	-	0.86	-	-
1988	1	1	1	1.00	1.00	1.00
1989	4	1	1	0.25	1.00	0.25
1990	6	5	3	0.83	0.60	0.50
1991	35	23	18	0.66	0.78	0.51
1992	32	24	17	0.75	0.71	0.53
1993	44	32	26	0.73	0.81	0.59
1994	51	45	40	0.88	0.89	0.78
1995	61	50	44	0.82	0.88	0.72
1996	44	40	32	0.91	0.80	0.73
1997	70	59	56	0.84	0.95	0.80
1998	66	54	42	0.82	0.78	0.64
1999	*no data*	-	-	-	-	-
2000	59	46	29	0.78	0.63	0.49
2001	63	47	24	0.75	0.51	0.38
2002	81	64	47	0.79	0.73	0.58
2003	38	31	24	0.82	0.77	0.63
2004	56	51	35	0.91	0.69	0.63
2005	60	53	48	0.88	0.91	0.80
2006	61	39	39	0.64	1.00	0.64
2007	62	56	53	0.90	0.95	0.85
2008	62	59	57	0.95	0.97	0.92
2009	88	80	75	0.91	0.94	0.85
2010	87	68	58	0.78	0.85	0.67
2011	59	46	36	0.78	0.78	0.61
2012	59	51	42	0.86	0.82	0.71

[a]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).

[b]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).

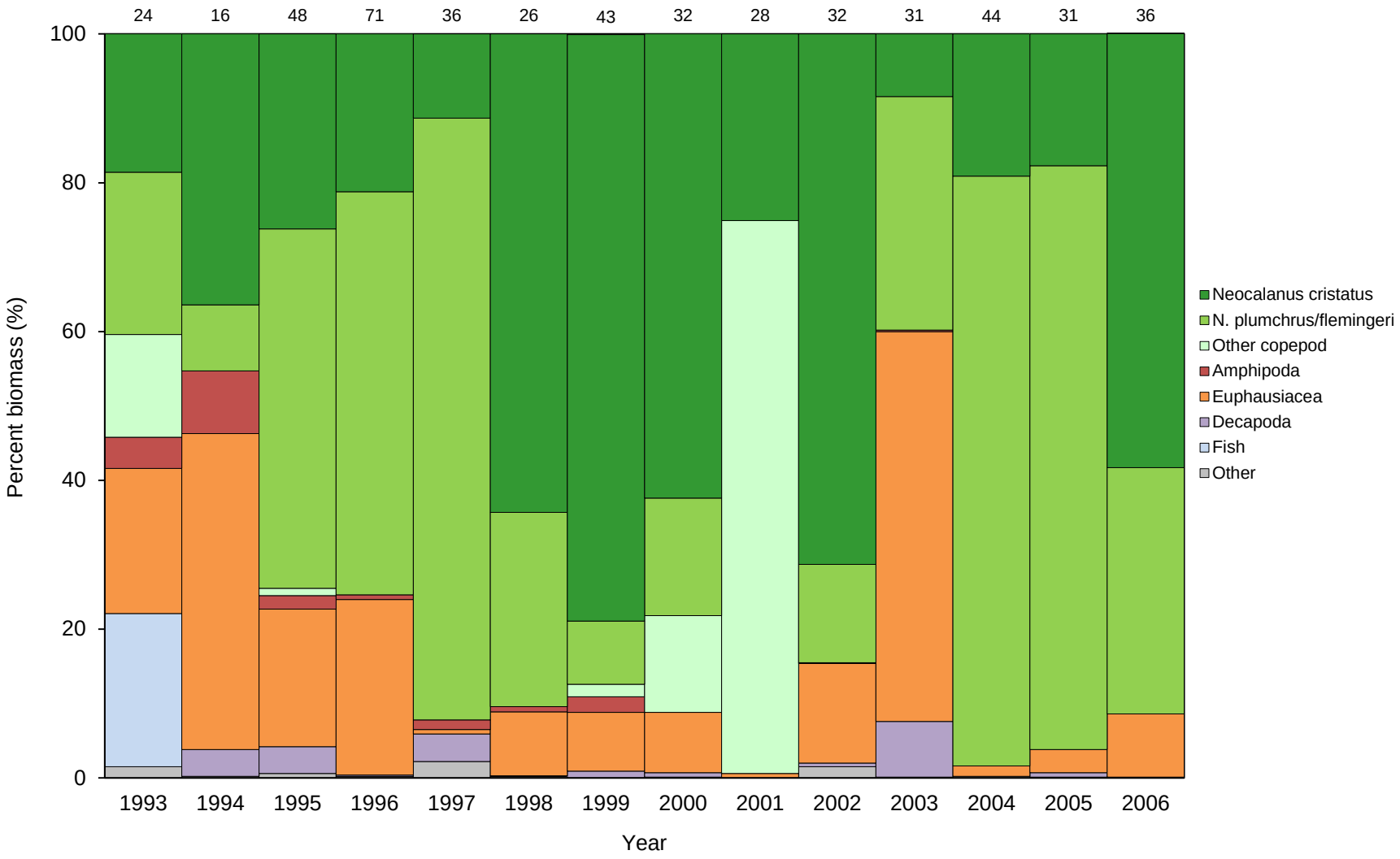

Figure 51. Relative biomass of prey in diets of whiskered auklet chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2007-2012 but have not yet been summarized.

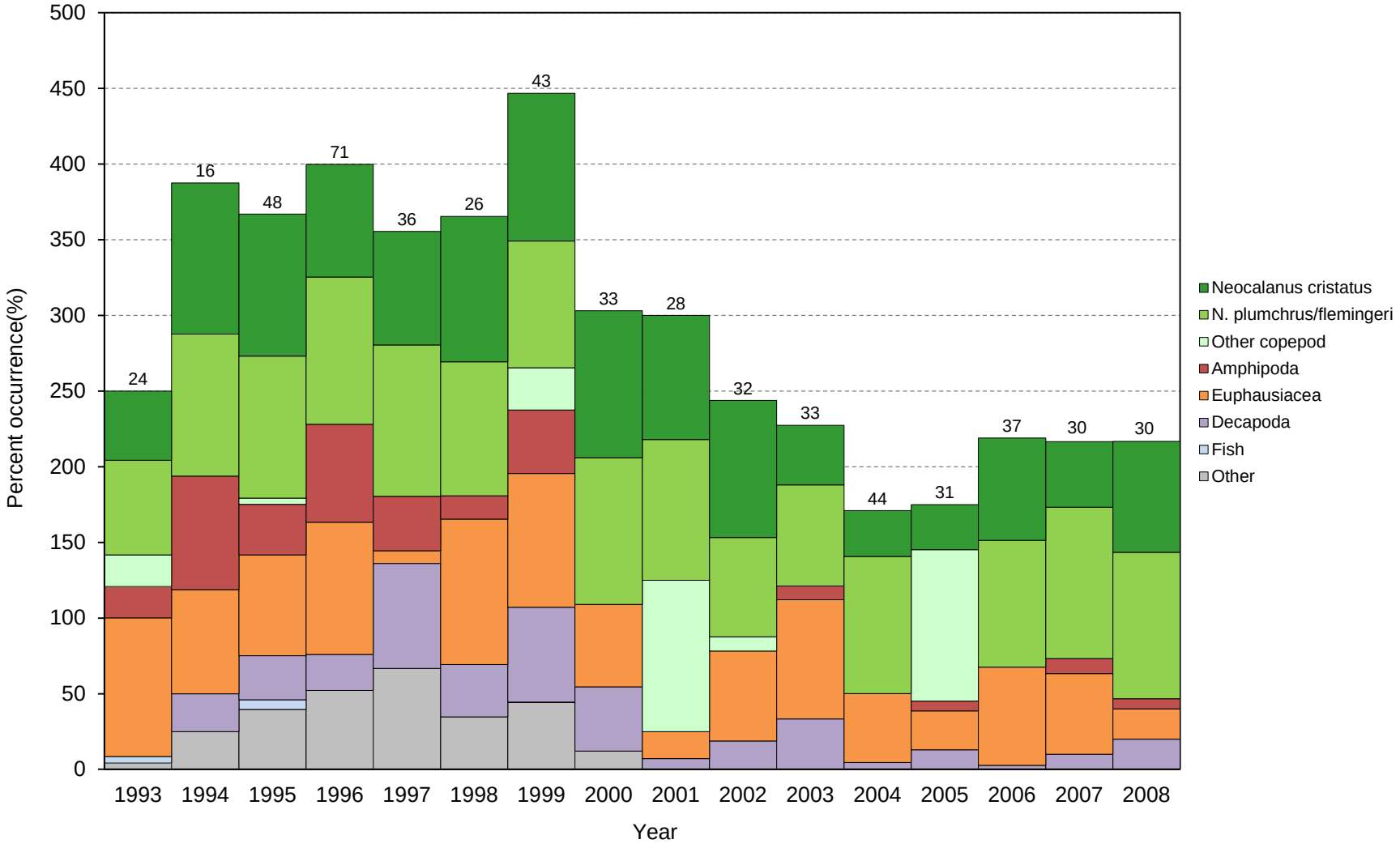

Figure 52. Frequency of occurrence of prey in diets of whiskered auklet chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2009-2012 but have not yet been summarized.

Table 79. Relative biomass of prey in diets of whiskered auklet chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals from those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2007-2012 but have not yet been summarized.

Prey	1993	1994	1995	1996	1997	1998	1999
No. samples[a]	24	16	48	71	36	26	43
Total mass (g)	53.4	93.9	387.5	481.3	300.2	214.1	434.1
Invertebrates	**79.4**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**99.9**
Gastropoda	**1.5**	**0.2**	**0.7**	**0.3**	**2.1**	**0.2**	**0.2**
Limacina helicina	1.5	-	-	-	-	0.2	-
Unid. pteropod	-	-	0.7	0.3	2.1	-	0.2
Unid. snail	-	0.2	-	-	-	-	-
Copepoda	**54.2**	**45.3**	**75.5**	**75.4**	**92.2**	**90.4**	**89.0**
Calanus pacifica	-	-	0.1	-	-	-	-
Calanoid spp.	-	-	-	-	-	-	-
Lophotrix frontalis	-	-	-	-	-	-	<0.1
Neocalanus cristatus	18.6	36.4	26.2	21.2	11.3	64.3	78.8
N. plumchrus/flemingeri	21.8	8.9	48.3	54.2	80.9	26.1	8.5
Neocalanus spp.	-	-	-	-	-	-	-
Pachyptilus pacificus	-	-	-	-	-	-	1.0
Pareuchta birostrata	-	-	-	-	-	-	0.7
Pareuchaeta elongata	-	-	-	-	-	-	-
Unid. copepod	13.8	-	0.9	-	-	-	-
Amphipoda	**4.2**	**8.4**	**1.8**	**0.6**	**1.3**	**0.7**	**2.1**
Hyperiidea	**4.2**	**8.4**	**1.8**	**0.5**	**1.3**	**0.7**	**2.1**
Hyperoche medusarum	-	-	1.7	0.5	-	-	-
Primno macropa	0.3	7.9	-	-	1.3	0.7	2.1
Themisto pacifica	3.9	0.5	0.1	<0.1	<0.1	-	-
Themisto spp.	-	-	-	-	-	-	-
Gammaridea	**-**	**-**	**-**	**0.1**	**-**	**-**	**-**
Unid. Talitridae	-	-	-	0.1	-	-	-
Unid. amphipod	-	-	-	-	-	-	-
Euphausiacea	**19.5**	**42.5**	**18.5**	**23.6**	**0.6**	**8.6**	**7.9**
Thysanoessa raschii	-	-	-	-	-	-	-
Thysanoessa spp.	19.5	42.5	-	-	-	-	-
Unid. euphausiid furcilla	-	-	-	-	-	0.2	-
Unid. euphausiid	-	-	18.5	23.6	0.6	8.4	7.9
Decapoda	**-**	**3.6**	**3.6**	**0.2**	**3.7**	**0.1**	**0.9**
Pandalid shrimp	-	-	-	-	-	-	-
Unid. larval shrimp	-	-	-	-	-	-	-
Unid. shrimp	-	-	-	-	-	-	-
Unid. shrimp zoea	-	3.6	3.6	0.1	1.5	0.1	0.6
Unid. crab zoea	-	-	-	<0.1	0.6	-	-
Atelecyclidae megalopa	-	-	-	-	-	-	-
Unid. crab megalopa	-	-	-	0.1	1.6	-	-
Hippolytidae juvenile	-	-	-	-	-	-	0.3
Fish	**20.6**	**-**	**-**	**-**	**-**	**-**	**<0.1**
Hexagrammidae	**20.6**	**-**	**-**	**-**	**-**	**-**	**-**
Hexagrammos spp.	20.6	-	-	-	-	-	-
Unid. Teleostei	-	-	-	-	-	-	<0.1

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 80) and some prey types may not appear in biomass data although they were present in diet samples.

Table 79 (continued). Relative biomass of prey in diets of whiskered auklet chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals from those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2007-2012 but have not yet been summarized.

Prey	2000	2001	2002	2003	2004	2005	2006
No. samples[a]	32	28	32	31	44	31	36
Total mass (g)	288.9	182.2	151.6	94.8	37.0	75.0	57.9
Invertebrates	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Gastropoda	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**
Limacina helicina	-	-	-	-	-	-	-
Unid. pteropod	0.1	-	-	-	-	-	-
Unid. snail	-	-	-	-	-	-	-
Copepoda	**91.2**	**99.4**	**84.6**	**39.8**	**98.4**	**96.2**	**91.5**
Calanus pacifica	-	-	-	-	-	-	-
Calanoid spp.	0.4	1.5	-	-	-	-	-
Lophotrix frontalis	-	-	-	-	-	-	-
Neocalanus cristatus	62.4	25.1	71.3	8.4	19.1	17.7	58.4
N. plumchrus/flemingeri	15.8	-	13.2	31.4	79.3	78.5	33.1
Neocalanus spp.	12.6	72.7			-		
Pachyptilus pacificus	-	-	-	-	-	-	-
Pareuchta birostrata	-	-	-	-	-	-	-
Pareuchaeta elongata	-	0.1	0.1	-	-	-	-
Unid. copepod	-	-	-	-	-	-	-
Amphipoda	**-**	**-**	**-**	**0.2**	**-**	**<0.1**	**-**
Hyperiidea	**-**	**-**	**-**	**-**	**-**	**<0.1**	**-**
Hyperoche medusarum	-	-	-	-	-	-	-
Primno macropa	-	-	-	-	-	-	-
Themisto pacifica	-	-	-	-	-	-	-
Themisto spp.	-	-	-	-	-	<0.1	-
Gammaridea	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Talitridae	-	-	-	-	-	-	-
Unid. amphipod	-	-	-	0.2	-	-	-
Euphausiacea	**8.1**	**0.6**	**13.4**	**52.4**	**1.4[b]**	**3.1**	**8.5**
Thysanoessa raschii	-	-	-	-	-	0.1	-
Thysanoessa spp.	-	-	1.8	48.1	1.1	-	-
Unid. euphausiid furcilla	-	-	-	-	-	-	-
Unid. euphausiid	8.1	0.6	11.6	4.3	0.3	3.0	8.5
Decapoda	**0.6**	**<0.1**	**0.5**	**7.5**	**-**	**0.6**	**0.1**
Pandalid shrimp	-	<0.1	0.1	7.5	-	-	-
Unid. larval shrimp	-	-	-	0.0	-	0.6	0.1
Unid. shrimp	-	-	0.4	-	-	-	-
Unid. shrimp zoea	0.6	-	-	-	-	-	-
Unid. crab zoea	-	-	-	-	<0.1	<0.1	-
Atelecyclidae megalopa	-	-	-	-	<0.1	-	-
Unid. crab megalopa	-	-	-	-	-	<0.1	-
Hippolytidae juvenile	-	-	-	-	-	-	-
Fish	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hexagrammidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hexagrammos spp.	-	-	-	-	-	-	-
Unid. Teleostei	-	-	-	-	-	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 80) and some prey types may not appear in biomass data although they were present in diet samples.

[b]Biomass of euphausiids in 2004 is an underestimate because euphausiid data for most samples were recorded as presence or absence only.

Table 80. Frequency of occurrence of prey in diets of whiskered auklet chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals from those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2009-2012 but have not yet been summarized.

Prey	1993	1994	1995	1996	1997	1998	1999	2000
No. samples	24	16	48	71	36	26	43	33
Invertebrates	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Scyphozoa	**-**	**-**	**-**	**1.4**	**-**	**-**	**-**	**-**
Unid. Scyphozoa	-	-	-	1.4	-	-	-	-
Gastropoda	**4.2**	**25.0**	**39.6**	**50.7**	**66.7**	**34.6**	**44.2**	**12.1**
Limacina helicina	4.2	-	-	-	-	34.6	-	-
Unid. pteropod	-	-	39.6	50.7	66.7	-	44.2	12.1
Unid. snail	-	25.0	-	-	-	-	-	-
Copepoda	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Calanus pacifica	-	-	4.2	-	-	-	-	-
Calanoid spp.	-	-	-	-	-	-	-	-
Lophotrix frontinalis	-	-	-	-	-	-	2.3	-
Neocalanus cristatus	45.8	100.0	93.8	74.6	75.0	96.2	97.7	97.0
N. plumchrus/flemingeri	62.5	93.8	93.8	97.2	100.0	88.5	83.7	97.0
Pachyptilus pacifica	-	-	-	-	-	-	14.0	-
Pareuchta birostrata	-	-	-	-	-	-	18.6	-
Pareuchaeta elongata	-	-	-	-	-	-	-	-
Unid. copepod	20.8	-	2.1	-	-	-	-	-
Amphipoda	**20.8**	**75.0**	**33.3**	**64.8**	**36.1**	**15.4**	**41.9**	**-**
Hyperiidea	**20.8**	**75.0**	**33.3**	**xx**	**36.1**	**15.4**	**41.9**	**-**
Hyperoche medusarum	-	-	31.3	62.0	-	-	-	-
Primno macropa	4.2	68.8	-	-	36.1	15.4	41.9	-
Themisto pacifica	16.7	12.5	6.3	2.8	2.8	-	-	-
Themisto spp.	-	-	-	-	-	-	-	-
Gammaridea	**-**	**-**	**-**	**4.2**	**-**	**-**	**-**	**-**
Unid. Lysianassidae	-	-	-	-	-	-	-	-
Unid. Talitridae	-	-	-	4.2	-	-	-	-
Unid. amphipod	-	-	-	-	-	-	-	-
Euphausiacea	**91.7**	**68.8**	**66.7**	**87.3**	**8.3**	**96.2**	**88.4**	**54.5**
Thysanoessa raschii	-	-	-	-	-	-	-	-
Thysanoessa spp.	91.7	68.8	-	-	-	-	-	-
Unid. euphausiid furcilla	-	-	-	-	-	19.2	-	-
Unid. euphausiid	-	-	66.7	87.3	8.3	92.3	88.4	54.5
Decapoda	**-**	**25.0**	**29.2**	**23.9**	**69.4**	**34.6**	**62.8**	**42.4**
Pandalid shrimp	-	-	-	-	-	-	-	42.4
Unid. larval shrimp	-	-	-	-	-	-	-	-
Unid. shrimp	-	-	-	-	-	-	-	-
Unid. shrimp zoea	-	25.0	29.2	12.7	58.3	34.6	60.5	-
Unid. crab zoea	-	-	-	9.9	16.7	-	-	-
Atelecyclidae megalopa	-	-	-	-	-	-	-	-
Unid. crab megalopa	-	-	-	5.6	22.2	-	-	-
Hippolytidae juvenile	-	-	-	-	-	-	16.3	-
Fish	**4.2**	**-**	**6.3**	**-**	**-**	**-**	**0.2**	**-**
Hexagrammidae	**4.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hexagrammos spp.	4.2	-	-	-	-	-	-	-
Unid. Teleostei	-	-	6.3	-	-	-	0.2	-
Other	**4.2**	-	-	-	-	-	-	-
Plastic	4.2	-	-	-	-	-	-	-

Table 80 (continued). Frequency of occurrence of prey in diets of whiskered auklet chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals from those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2009-2012 but have not yet been summarized.

Prey	2001	2002	2003	2004	2005	2006	2007	2008
No. samples	28	32	33	44	31	37	30	30
Invertebrates	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Scyphozoa	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scyphozoa	-	-	-	-	-	-	-	-
Gastropoda	**-**	**-**	**-**	**-**	**-**	**-**	**60.0**	**30.0**
Limacina helicina	-	-	-	-	-	-	60.0	30.0
Unid. pteropod	-	-	-	-	-	-	-	-
Unid. snail	-	-	-	-	-	-	-	-
Copepoda	**100.0**	**96.9**	**84.8**	**95.5**	**100.0**	**97.3**	**100.0**	**100.0**
Calanus pacifica	-	-	-	-	-	-	-	-
Calanoid spp.	100.0	-	-	-	-	-	100.0	100.0
Lophotrix frontinalis	-	-	-	-	-	-	-	-
Neocalanus cristatus	82.1	90.6	39.4	30.2	29.7	67.6	43.3	73.3
N. plumchrus/flemingeri	92.9	65.6	66.7	90.7	-	83.8	100.0	96.7
Pachyptilus pacifica	-	-	-	-	-	-	-	-
Pareuchta birostrata	-	-	-	-	-	-	-	-
Pareuchaeta elongata	7.1	9.4	-	-	-	-	-	-
Unid. copepod	-	-	-	-	100.0	-	-	-
Amphipoda	**-**	**-**	**9.1**	**-**	**6.5**	**-**	**10.0**	**6.7**
Hyperiidea	**-**	**-**	**9.1**	**-**	**6.5**	**-**	**10.0**	**6.7**
Hyperoche medusarum	-	-	-	-	-	-	-	-
Primno macropa	-	-	-	-	-	-	6.7	-
Themisto pacifica	-	-	-	-	-	-	3.3	6.7
Themisto spp.	-	-	-	-	6.5	-	-	-
Gammaridea	**-**	**-**	**9.1**	**-**	**-**	**-**	**-**	**-**
Unid. Lysianassidae	-	-	3.0	-	-	-	-	-
Unid. Talitridae	-	-	-	-	-	-	-	-
Unid. amphipod	-	-	6.1	-	-	-	-	-
Euphausiacea	**17.9**	**59.4**	**78.8**	**45.5**	**25.8**	**64.9**	**53.3**	**20.0**
Thysanoessa raschii	-	-	-	-	3.2	-	-	-
Thysanoessa spp.	-	12.5	24.2	7.0	-	-	6.7	3.3
Unid. euphausiid furcilla	-	-	-	-	-	-	-	-
Unid. euphausiid	17.9	56.3	57.6	41.9	25.8	64.9	46.7	20.0
Decapoda	**7.1**	**18.8**	**33.3**	**4.6**	**12.9**	**2.7**	**10.0**	**20.0**
Pandalid shrimp	-	6.3	33.3	-	-	-	-	6.7
Unid. larval shrimp	7.1	9.4	3.0	-	6.5	2.7	-	-
Unid. shrimp	-	3.1	-	-	-	-	-	3.3
Unid. shrimp zoea	-	-	-	-	-	-	-	-
Unid. crab zoea	-	-	-	2.3	6.5	-	-	6.7
Atelecyclidae megalopa	-	-	-	2.3	-	-	10.0	-
Unid. crab megalopa	-	-	-	-	6.5	-	-	-
Hippolytidae juvenile	-	-	-	-	-	-	3.3	3.3
Fish	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hexagrammidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hexagrammos spp.	-	-	-	-	-	-	-	-
Unid. Teleostei	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-
Plastic	-	-	-	-	-	-	-	-

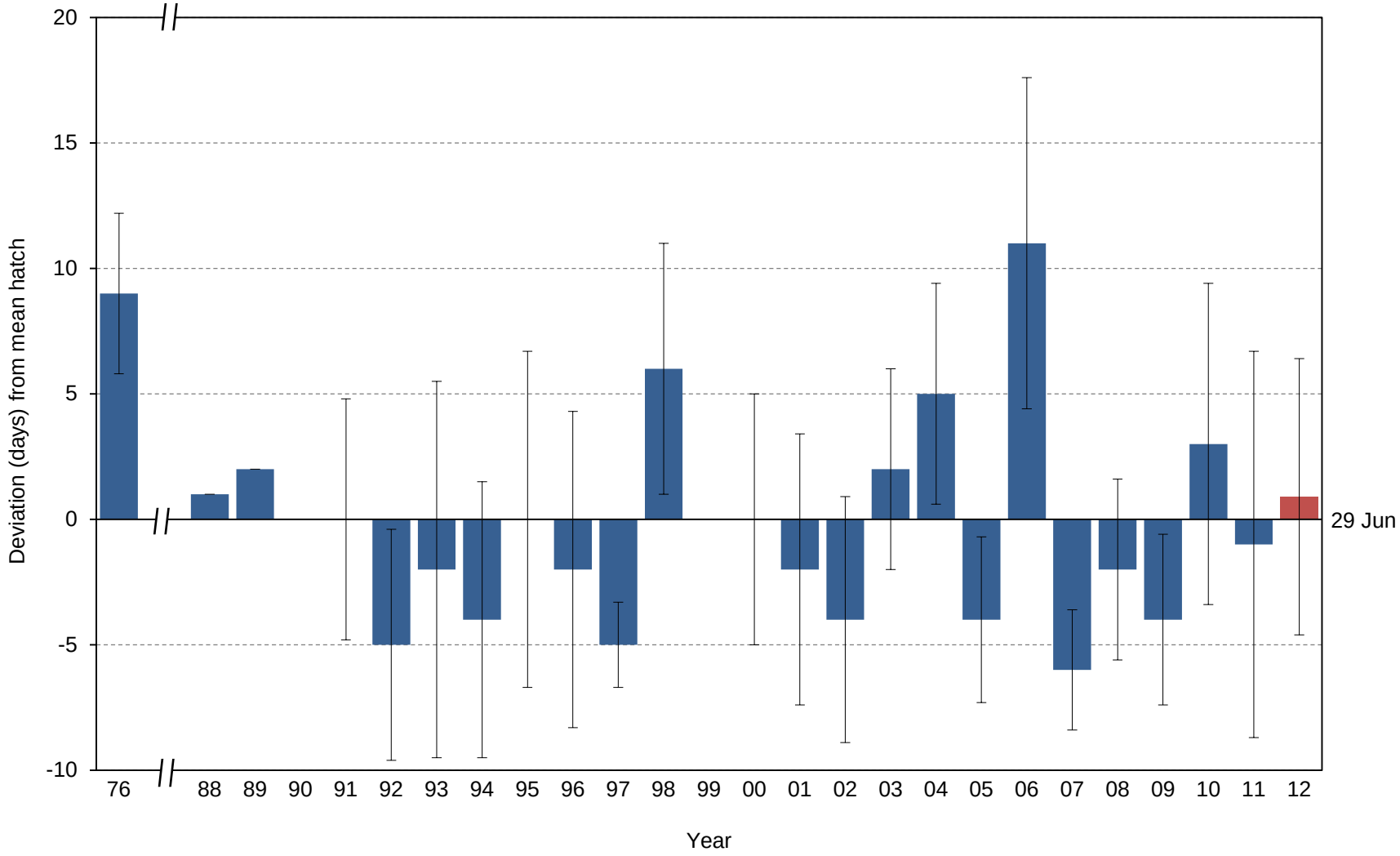

Figure 53. Yearly hatch date deviation (from the 1988-2011 average of 29 June) for crested auklets at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 81. Breeding chronology of crested auklets at Buldir Island, Alaska. No data were collected in 1977-1989.

Year	Mean hatch	SD	*n*[a]	First hatch	Last hatch	First fledge[b]
1976[c]	7 Jul	3.2	36	2 Jul	14 Jul	-
1988	30 Jun	0.0	3	30 Jun	-	>28 Jul
1989	1 Jul	0.0	1	1 Jul	-	24 Jul
1990	*no data*	-	-	-	-	-
1991	29 Jun	4.8	6	21 Jun	5 Jul	25 Jul
1992	23 Jun	4.6	7	16 Jun	3 Jul	19 Jul
1993	27 Jun	7.5	10	22 Jun	16 Jul	19 Jul
1994	25 Jun	5.5	36	19 Jun	9 Jul	23 Jul
1995	29 Jun	6.7	48	21 Jun	21 Jul	26 Jul
1996	26 Jun	6.3	14	16 Jun	12 Jul	19 Jul
1997	24 Jun	1.7	5	21 Jun	26 Jun	16 Jul
1998	5 Jul	5.0	10	25 Jun	9 Jul	27 Jul
1999	*no data*	-	-	-	-	-
2000	28 Jun	5.0	20	12 Jun	8 Jul	22 Jul
2001	27 Jun	5.4	14	15 Jun	7 Jul	20 Jul
2002	25 Jun	4.9	23	17 Jun	5 Jul	14 Jul
2003	1 Jul	4.0	6	23 Jun	4 Jul	21 Jul
2004	3 Jul	4.4	18	26 Jun	12 Jul	30 Jul
2005	25 Jun	3.3	29	20 Jun	5 Jul	21 Jul
2006	10 Jul	6.6	26	27 Jun	27 Jul	26 Jul
2007	23 Jun	2.4	31	21 Jun	1 Jul	18 Jul
2008	26 Jun	3.6	34	20 Jun	5 Jul	23 Jul
2009	25 Jun	3.4	45	17 Jun	5 Jul	21 Jul
2010	2 Jul	6.4	24	17 Jun	23 Jul	18 Jul
2011	28 Jun	7.7	29	13 Jun	19 Jul	19 Jul
2012	29 Jun	5.5	27	18 Jun	12 Jul	23 Jul

[a]Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.
[b]In years when no chicks fledged before the last nest check, date of first fledge is listed as > the date of last nest check.
[c]Hatch dates in 1976 were assumed to be the midpoint of the interval reported in Knudtson and Byrd (1982).

Table 82. Frequency distribution of hatch dates for crested auklets at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. Individual hatch date data are not available for 1976.

Julian date[a]	No. nests hatching on Julian date												
	88	89	90	91	92	93	94	95	96	97	98	99	00
164	-	-	*no data*	-	-	-	-	-	-	-	-	*no data*	1
165	-	-		-	-	-	-	-	-	-	-		-
166	-	-	-	-	-	-	-	-	-	-	-	-	-
167	-	-	-	-	-	-	-	-	-	-	-	-	-
168	-	-	-	-	1	-	-	-	1	-	-	-	-
169	-	-	-	-	-	-	-	-	1	-	-	-	-
170	-	-	-	-	-	-	8	-	-	-	-	-	-
171	-	-	-	-	-	-	-	-	-	-	-	-	-
172	-	-	-	1	-	-	-	2	-	1	-	-	-
173	-	-	-	-	-	1	-	-	-	-	-	-	-
174	-	-	-	-	-	-	-	-	2	-	-	-	-
175	-	-	-	-	5	7	23	-	2	1	-	-	1
176	-	-	-	-	-	-	-	-	-	2	1	-	-
177	-	-	-	-	-	-	-	32	-	1	-	-	-
178	-	-	-	2	-	-	1	-	-	-	-	-	1
179	-	-	-	-	-	-	-	-	-	-	1	-	10
180	-	-	-	-	-	-	-	-	-	-	-	-	-
181	-	-	-	-	-	-	-	1	5	-	-	-	-
182	3	1	-	-	-	-	-	-	2	-	1	-	-
183	-	-	-	-	-	-	-	-	-	-	-	-	-
184	-	-	-	2	-	-	-	8	-	-	-	-	6
185	-	-	-	-	1	-	-	-	-	-	1	-	-
186	-	-	-	1	-	-	-	-	-	-	1	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	1	4	1	-	-	5	-	1
191	-	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	1	-	-	-	-
195	-	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	-	1	-	2	-	-	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-	-	-
201	-	-	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	-	-	2	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	-	-	-	-	-	-	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-	-	-	-	-
n	3	1	-	6	7	10	36	48	14	5	10	-	20

[a]Julian dates are adjusted by one day in leap years.

Table 82 (continued). Frequency distribution of hatch dates for crested auklets at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days. Individual hatch date data are not available for 1976.

Julian date[a]	No. nests hatching on Julian date											
	01	02	03	04	05	06	07	08	09	10	11	12
164	-	-	-	-	-	-	-	-	-	-	1	-
165	-	-	-	-	-	-	-	-	-	-	-	-
166	1	-	-	-	-	-	-	-	-	-	-	-
167	-	-	-	-	-	-	-	-	-	-	-	-
168	-	3	-	-	-	-	-	-	1	1	1	-
169	-	-	-	-	-	-	-	-	-	-	-	-
170	-	-	-	-	-	-	-	-	-	-	1	1
171	-	-	-	-	4	-	-	-	-	-	-	-
172	-	1	-	-	-	-	16	2	-	-	1	-
173	3	-	-	-	1	-	-	-	-	-	2	-
174	-	7	1	-	2	-	-	-	28	-	1	-
175	-	-	-	-	-	-	1	-	-	-	-	2
176	-	-	-	-	14	-	13	18	-	-	3	1
177	-	-	-	-	-	-	-	-	3	-	4	2
178	-	6	-	1	1	1	-	-	4	7	2	4
179	6	-	-	-	1	-	-	1	-	-	1	6
180	1	2	2	-	5	-	-	-	7	-	3	-
181	-	1	-	1	-	-	-	-	-	-	-	1
182	-	1	-	8	-	3	1	11	-	9	3	-
183	-	-	-	-	-	-	-	-	-	-	-	4
184	2	-	-	-	-	-	-	-	-	-	1	1
185	-	-	3	-	-	-	-	1	-	-	-	-
186	-	2	-	-	1	6	-	-	2	4	-	-
187	-	-	-	-	-	-	-	1	-	-	-	1
188	1	-	-	6	-	-	-	-	-	-	2	1
189	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	2	-	-
191	-	-	-	-	-	-	-	-	-	-	-	1
192	-	-	-	-	-	10	-	-	-	-	-	1
193	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	2	-	-	-	-	-	-	2	1
195	-	-	-	-	-	-	-	-	-	-	-	-
196	-	-	-	-	-	-	-	-	-	-	-	-
197	-	-	-	-	-	4	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	1	-
201	-	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	-	1	-	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-	-	1	-	-
205	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	-	-	-	-	-	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	1	-	-	-	-	-	-
n	14	23	6	18	29	26	31	34	45	24	29	27

[a]Julian dates are adjusted by one day in leap years.

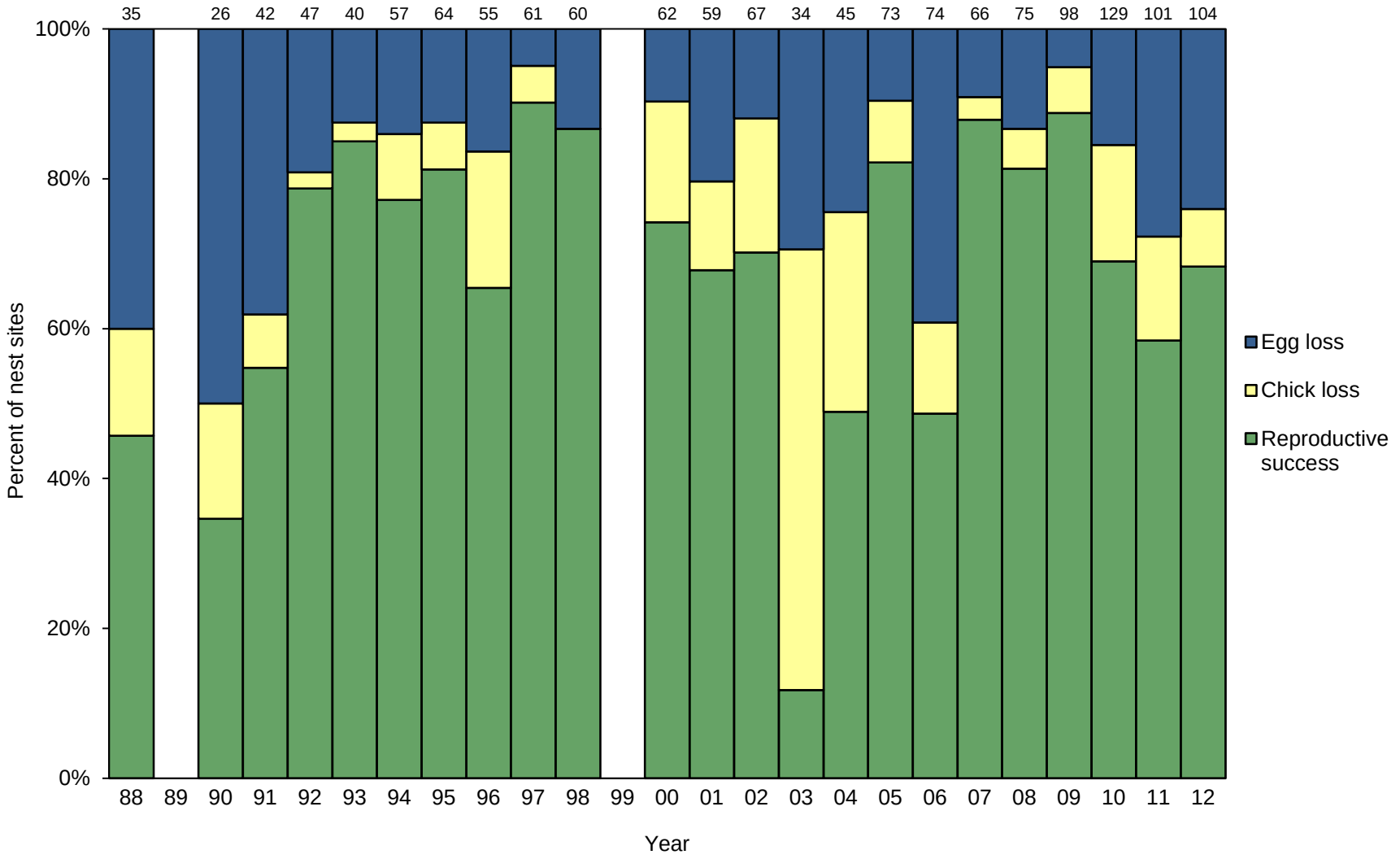

Figure 54. Reproductive performance of crested auklets at Buldir Island, Alaska. Egg loss=(B-D)/B; Chick loss=(D-F)/B; Reproductive success=F/B, where B=nest sites with eggs; D=nest sites with chicks; F=nest sites with chicks fledged. Numbers above columns indicate sample sizes (B).

Table 83. Reproductive performance of crested auklets at Buldir Island, Alaska. No data were collected in 1977-1987.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Nesting success (D/B)[a]	Fledging success (F/D)[b]	Reproductive success (F/B)
1976	59	45	-	0.76	-	-
1988	35	21	16	0.60	0.76	0.46
1989	40	13	13	0.33	1.00	0.33
1990	26	13	9	0.50	0.69	0.35
1991	42	26	23	0.62	0.88	0.55
1992	47	38	37	0.81	0.97	0.79
1993	40	35	34	0.88	0.97	0.85
1994	57	49	44	0.86	0.90	0.77
1995	64	56	52	0.88	0.93	0.81
1996	55	46	36	0.84	0.78	0.65
1997	61	58	55	0.95	0.95	0.90
1998	60	52	52	0.87	1.00	0.87
1999	*no data*	-	-	-	-	-
2000	62	56	46	0.90	0.82	0.74
2001	59	47	40	0.80	0.85	0.68
2002	67	59	47	0.88	0.80	0.70
2003	34	24	4	0.71	0.17	0.12
2004	45	34	22	0.76	0.65	0.49
2005	73	66	60	0.90	0.91	0.82
2006	74	45	36	0.61	0.80	0.49
2007	66	60	58	0.91	0.97	0.88
2008	75	65	61	0.87	0.94	0.81
2009	98	93	87	0.95	0.94	0.89
2010	129	109	89	0.84	0.82	0.69
2011	101	73	59	0.72	0.81	0.58
2012	104	79	71	0.76	0.90	0.68

[a]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).

[b]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).

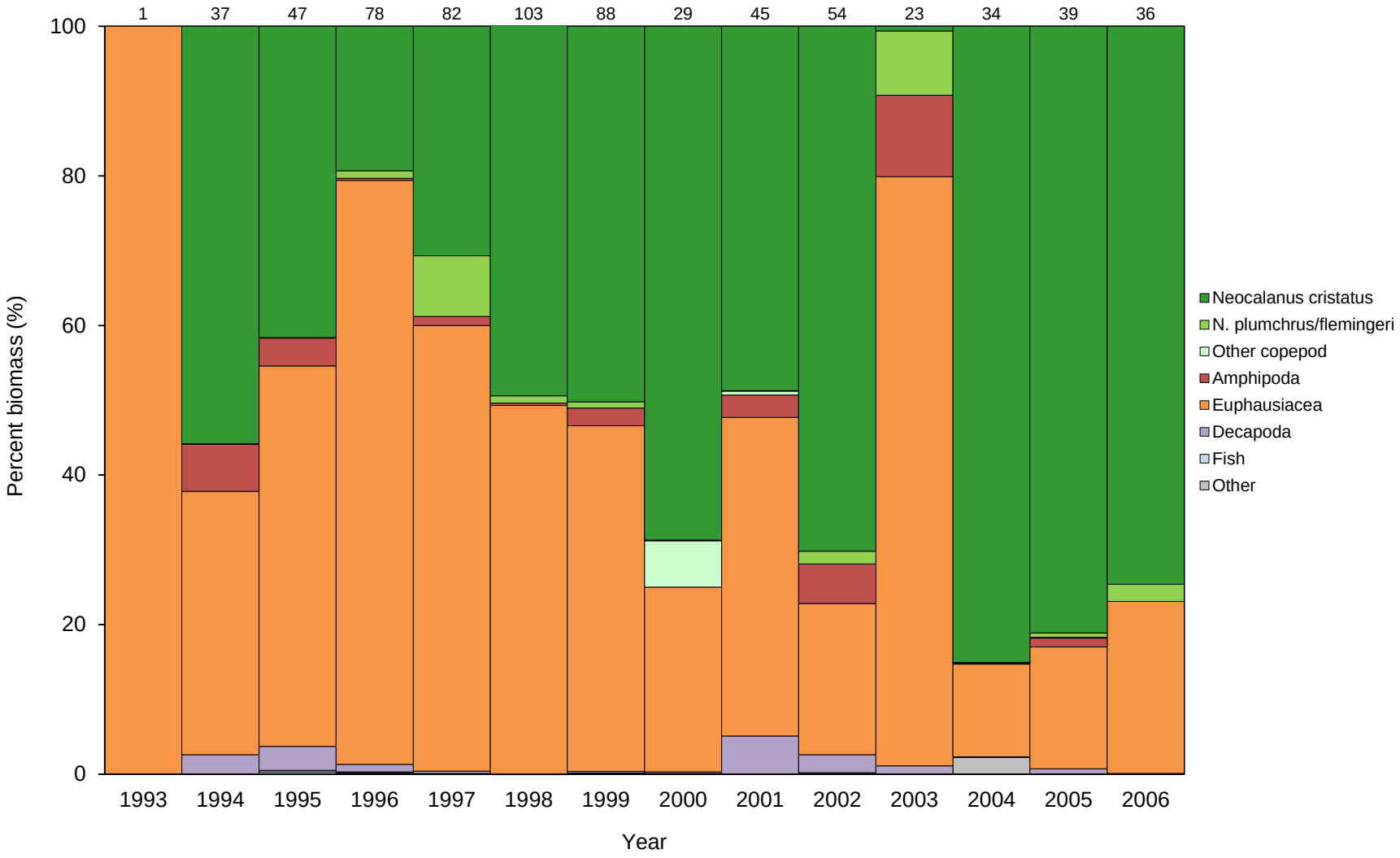

Figure 55. Relative biomass of prey in diets of crested auklet chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2007-2012 but have not yet been summarized.

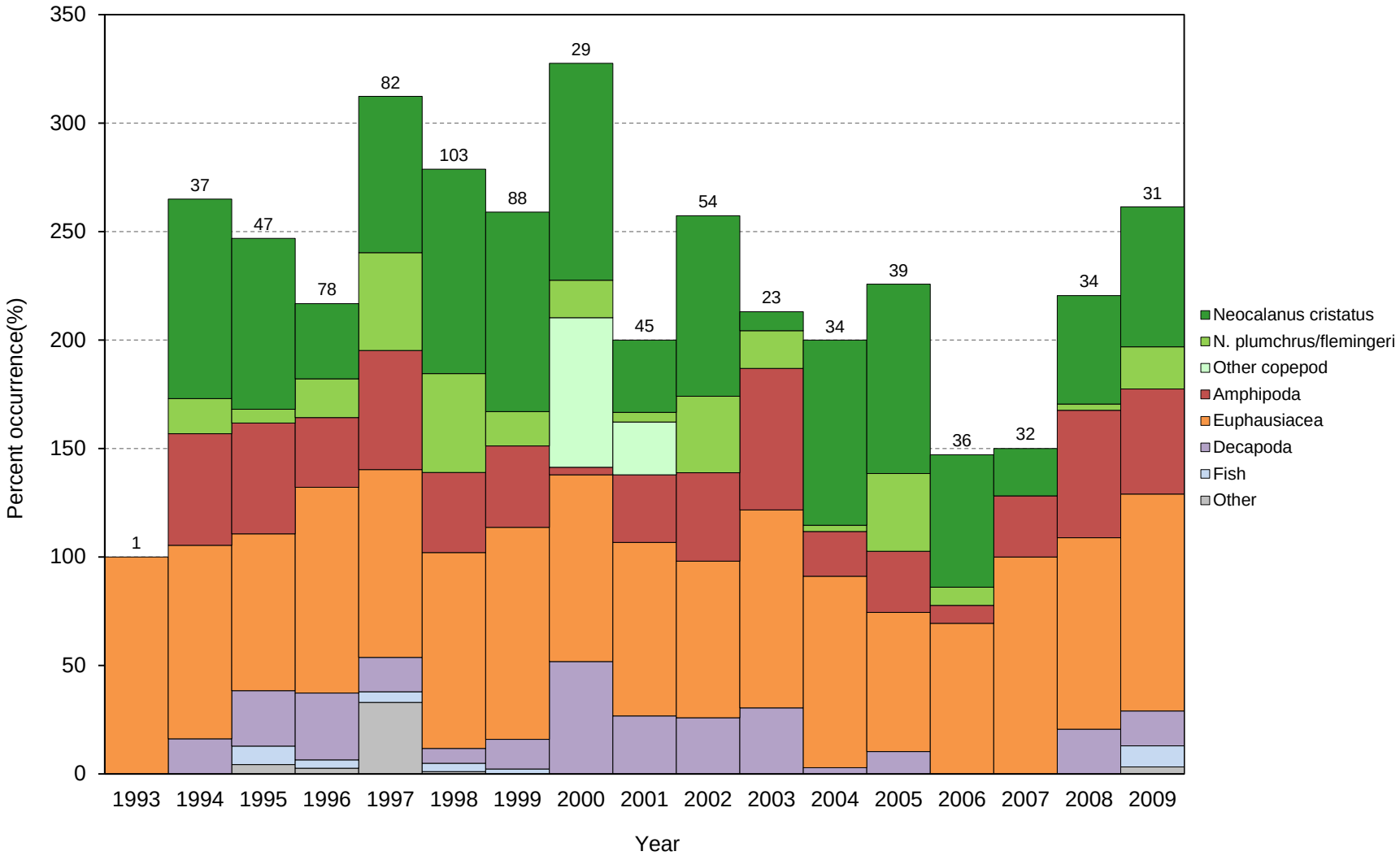

Figure 56. Frequency of prey occurrence in diets of crested auklet chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes. Diet samples were collected in 2010-2012 but have not yet been summarized.

Table 84. Relative biomass of prey in diets of crested auklet chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2007-2012 but have not yet been summarized.

Prey	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. samples[a]	1	37	47	78	82	103	88	29	45	54	23	34	39	36
Total mass (g)	1.2	335.4	487.6	745.0	904.7	1102.9	908.6	380.6	183.2	265.2	128.8	87.5	245.2	47.4
Invertebrates	**100.0**	**100.0**	**99.8**	**99.9**	**100.0**	**100.0**	**99.9**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Cephalopoda	**-**	**-**	**0.2**	**0.1**	**<0.1**	**<0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Decabrachia	**-**	**-**	**0.2**	**0.1**	**<0.1**	**<0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. squid	-	-	0.2	0.1	<0.1	<0.1	-	-	-	-	-	-	-	-
Gastropoda	**-**	**-**	**-**	**<0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. pteropod	-	-	-	<0.1	-	-	-	-	-	-	-	-	-	-
Copepoda	**-**	**55.9**	**41.7**	**20.3**	**38.8**	**50.5**	**51.0**	**75.0**	**49.3**	**71.9**	**9.2**	**85.1**	**81.8**	**76.9**
Calanus marshallae	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-
Calanoid spp.	-	-	-	-	-	-	-	-	0.5	-	-	-	-	-
Neocalanus cristatus	-	55.8	41.6	19.3	30.7	49.5	50.2	68.7	48.7	70.2	0.6	85.0	81.1	74.6
N. plumchrus/flemingeri	-	0.1	0.1	1.0	8.1	1.0	0.8	0.1	0.1	1.7	8.6	0.1	0.6	2.3
Neocalanus spp.	-	-	-	-	-	-	-	6.2	-	-	-	-	-	-
Amphipoda	**-**	**6.3**	**3.7**	**0.3**	**1.2**	**0.3**	**2.4**	**<0.1**	**3.0**	**5.3**	**10.9**	**0.2**	**1.2**	**<0.1**
Hyperiidea	**-**	**6.3**	**3.7**	**0.3**	**1.2**	**0.3**	**2.4**	**<0.1**	**3.0**	**5.3**	**10.9**	**0.2**	**1.2**	**<0.1**
Hyperoche medusarum	-	-	-	<0.1	-	-	-	-	-	<0.1	-	-	-	-
Primno macropa	-	0.7	-	-	-	-	0.1	-	-	<0.1	-	-	-	-
Themisto pacifica	-	5.6	3.7	0.3	1.2	0.3	2.3	<0.1	2.8	4.9	-	0.2	<0.1	<0.1
Themisto spp.	-	-	-	-	-	-	-	-	0.2	0.4	10.9	-	1.2	<0.1
Euphausiacea	**100.0**	**35.2**	**50.9**	**78.1**	**59.6**	**49.3**	**46.2**	**24.7**	**42.6**	**20.2**	**78.8**	**12.4[b]**	**16.3**	**23.0**
Thysanoessa inermis	-	-	-	-	-	-	-	4.1	-	-	-	-	-	-
T. raschii	-	-	-	-	-	-	-	-	-	-	-	8.5	-	-
Thysanoessa spp.	100.0	35.2	-	-	-	-	-	-	36.5	11.3	66.7	3.9	13.0	-
Unid. euphausiid furcilla	-	-	-	-	-	-	<0.1	-	-	-	-	-	-	-
Unid. euphausiid	-	-	50.9	78.1	59.6	49.3	46.2	20.6	6.1	8.9	12.1	<0.1	3.3	23.0
Decapoda	**-**	**2.6**	**3.2**	**1.0**	**0.3**	**<0.1**	**0.2**	**0.2**	**5.1**	**2.4**	**1.1**	**0.1**	**0.7**	**-**
Pandalid shrimp	-	-	-	-	-	-	-	-	0.1	2.4	1.1	0.1	0.7	-
Unid. larval shrimp	-	-	-	-	-	-	-	-	5.0	-	-	-	-	-
Unid. shrimp zoea	-	2.6	2.5	0.9	0.1	<0.1	-	0.2	-	-	-	-	-	-
Unid. crab zoea	-	<0.1	0.7	-	<0.1	<0.1	0.1	-	-	<0.1	-	-	-	-
Atelecyclidae megalopa	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
Paguridae megalopa	-	-	-	-	-	-	<0.1	-	-	-	-	-	-	-
Unid. crab megalopa	-	-	-	0.1	0.2	-	-	-	-	-	-	-	-	-
Hippolytidae juvenile	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-
Fish	**-**	**-**	**0.2**	**0.1**	**<0.1**	**<0.1**	**<0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Teleostei	-	-	0.2	0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 85) and some prey types may not appear in biomass data although they were present in diet samples.

[b]Biomass of euphausiids in 2004 is an underestimate because euphausiid data for most samples were recorded as presence or absence only.

Table 85. Frequency of occurrence of prey in diets of crested auklet chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2010-2012 but have not yet been summarized.

Prey	1993	1994	1995	1996	1997	1998	1999	2000	2001
No. samples	1	37	47	78	82	103	88	29	45
Invertebrates	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Cephalopoda	**-**	**-**	**4.3**	**1.3**	**2.2**	**1.0**	**-**	**-**	**-**
Decabrachia	**-**	**-**	**4.3**	**1.3**	**2.2**	**1.0**	**-**	**-**	**-**
Unid. squid	-	-	4.3	1.3	2.2	1.0	-	-	-
Gastropoda	**-**	**-**	**-**	**1.3**	**-**	**-**	**-**	**-**	**-**
Limacina helicina	-	-	-	-	-	-	-	-	-
Unid. pteropod	-	-	-	1.3	-	-	-	-	-
Copepoda	**-**	**91.9**	**78.7**	**43.6**	**75.6**	**95.1**	**92.0**	**100.0**	**37.8**
Calanus marshallae	-	-	-	-	-	-	-	-	-
Calanoid spp.	-	-	-	-	-	-	-	-	24.4
Neocalanus cristatus	-	91.9	78.7	34.6	72.0	94.2	92.0	100.0	33.3
N. plumchrus/flemingeri	-	16.2	6.4	17.9	45.1	45.6	15.9	17.2	4.4
Neocalanus spp.	-	-	-	-	-	-	-	69.0	-
Amphipoda	**-**	**51.4**	**51.1**	**32.1**	**54.9**	**36.9**	**37.5**	**3.4**	**31.1**
Hyperiidea	-	51.4	51.1	32.1	54.9	36.9	37.5	3.4	31.1
Hyperoche medusarum	-	-	-	2.6	-	-	-	-	-
Primno macropa	-	21.6	-	-	-	-	1.1	-	-
Themisto libellula	-	-	-	-	-	-	-	-	-
T. pacifica	-	43.2	51.1	32.1	54.9	36.9	37.5	3.4	15.6
Themisto spp.	-	-	-	-	-	-	-	-	15.6
Euphausiacea	**100.0**	**89.2**	**72.3**	**94.9**	**86.6**	**90.3**	**97.7**	**86.2**	**80.0**
Euphausia pacifica	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thysanoessa inermis	-	-	-	-	-	-	-	17.2	-
T. inspinata	-	-	-	-	-	-	-	-	-
T. longipes	-	-	-	-	-	-	-	-	-
T. raschii	-	-	-	-	-	-	-	-	-
T. spinifera	-	-	-	-	-	-	-	-	-
Thysanoessa spp.	100.0	89.2	-	-	-	-	-	-	28.9
Unid. euphausiid furcilla	-	-	72.3	94.9	86.6	-	1.1	-	-
Unid. euphausiid	-	-	-	-	-	90.3	97.7	69.0	55.6
Decapoda	**-**	**16.2**	**25.5**	**30.8**	**15.9**	**6.8**	**13.6**	**51.7**	**26.7**
Pandalid shrimp	-	-	-	-	-	-	-	-	-
Unid. larval shrimp	-	-	-	-	-	-	-	-	24.4
Unid. shrimp zoea	-	13.5	25.5	25.6	6.1	5.8	-	51.7	2.2
Unid. crab zoea	-	2.7	4.3	-	3.7	1.0	5.7	-	-
Atelecyclidae megalopa	-	-	-	-	-	-	-	-	-
Lithodidae megalopa	-	-	-	-	-	-	-	-	-
Paguridae megalopa	-	-	-	-	-	-	1.1	-	-
Unid. crab megalopa	-	-	-	9.0	9.8	-	-	-	-
Hippolytidae juvenile	-	-	-	-	-	-	8.0	-	-
Fish		**-**	**8.5**	**3.8**	**4.9**	**3.9**	**2.3**	**-**	**-**
Unid. Teleostei		-	8.5	3.8	4.9	3.9	2.3	-	-
Other	**-**	**-**	**-**	**-**	**30.5**	**-**	**-**	**-**	**-**
Unid. Nematoda	-	-	-	-	30.5	-	-	-	-

Table 85 (continued). Frequency of occurrence of prey in diets of crested auklet chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of regurgitations collected from adults returning to the colony to feed chicks; all prey was identified and measured in the laboratory. Diet samples were collected in 2010-2012 but have not yet been summarized.

Prey	2002	2003	2004	2005	2006	2007	2008	2009
No. samples	54	23	34	39	36	32	34	31
Invertebrates	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Cephalopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Decabrachia	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. squid	-	-	-	-	-	-	-	-
Gastropoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.2**
Limacina helicina	-	-	-	-	-	-	-	3.2
Unid. pteropod	-	-	-	-	-	-	-	-
Copepoda	**83.3**	**21.7**	**85.3**	**89.7**	**63.9**	**21.9**	**58.8**	**64.5**
Calanus marshallae	-	-	-	5.1	-	-	-	-
Calanoid spp.	-	-	-	-	-	-	20.6	-
Neocalanus cristatus	83.3	8.7	85.3	87.2	61.1	21.9	50.0	64.5
N. plumchrus/flemingeri	35.2	17.4	2.9	35.9	8.3	-	2.9	19.4
Neocalanus spp.	-	-	-	-	-	-	-	-
Amphipoda	**40.7**	**65.2**	**20.6**	**28.2**	**8.3**	**28.1**	**58.8**	**48.4**
Hyperiidea	40.7	65.2	20.6	28.2	8.3	28.1	58.8	**48.4**
Hyperoche medusarum	3.7	-	-	-	-	-	17.6	6.5
Primno macropa	1.9	-	-	-	-	-	-	-
Themisto libellula	-	-	-	-	-	-	-	6.5
T. pacifica	25.9	-	20.6	2.6	5.6	6.3	32.4	41.9
Themisto spp.	22.2	65.2	-	23.1	2.8	21.9	14.7	-
Euphausiacea	**72.2**	**91.3**	**88.2**	**64.1**	**69.4**	**100.0**	**88.2**	**100.0**
Euphausia pacifica	**-**	**-**	**-**	**-**	**-**	3.1	2.9	51.6
Thysanoessa inermis	-	-	-	-	-	-	-	3.2
T. inspinata	-	-	-	-	-	-	-	61.3
T. longipes	-	-	-	-	-	-	-	83.9
T. raschii	-	-	5.9	-	-	-	-	16.1
T. spinifera	-	-	-	-	-	-	-	35.5
Thysanoessa spp.	24.1	65.2	8.8	10.3	-	3.1	17.6	-
Unid. euphausiid furcilla	-	-	-	-	-	-	2.9	-
Unid. euphausiid	63.0	26.1	73.5	56.4	69.4	100.0	82.4	-
Decapoda	**25.9**	**30.4**	**2.9**	**10.3**	**-**	**-**	**20.6**	**16.1**
Pandalid shrimp	22.2	-	-	10.3	-	-	8.8	6.5
Unid. larval shrimp	-	-	-	-	-	-	5.8	-
Unid. shrimp zoea	-	30.4	2.9	-	-	-	-	-
Unid. crab zoea	1.9	-	-	-	-	-	-	-
Atelecyclidae megalopa	1.9	-	-	-	-	-	-	-
Lithodidae megalopa	-	-	-	-	-	-	-	3.2
Paguridae megalopa	-	-	-	-	-	-	-	3.2
Unid. crab megalopa	-	-	-	-	-	-	2.9	3.2
Hippolytidae juvenile	-	-	-	-	-	-	11.8	9.7
Fish	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**9.7**
Unid. Teleostei	-	-	-	-	-	-	-	9.7
Other	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Nematoda	-	-	-	-	-	-	-	-

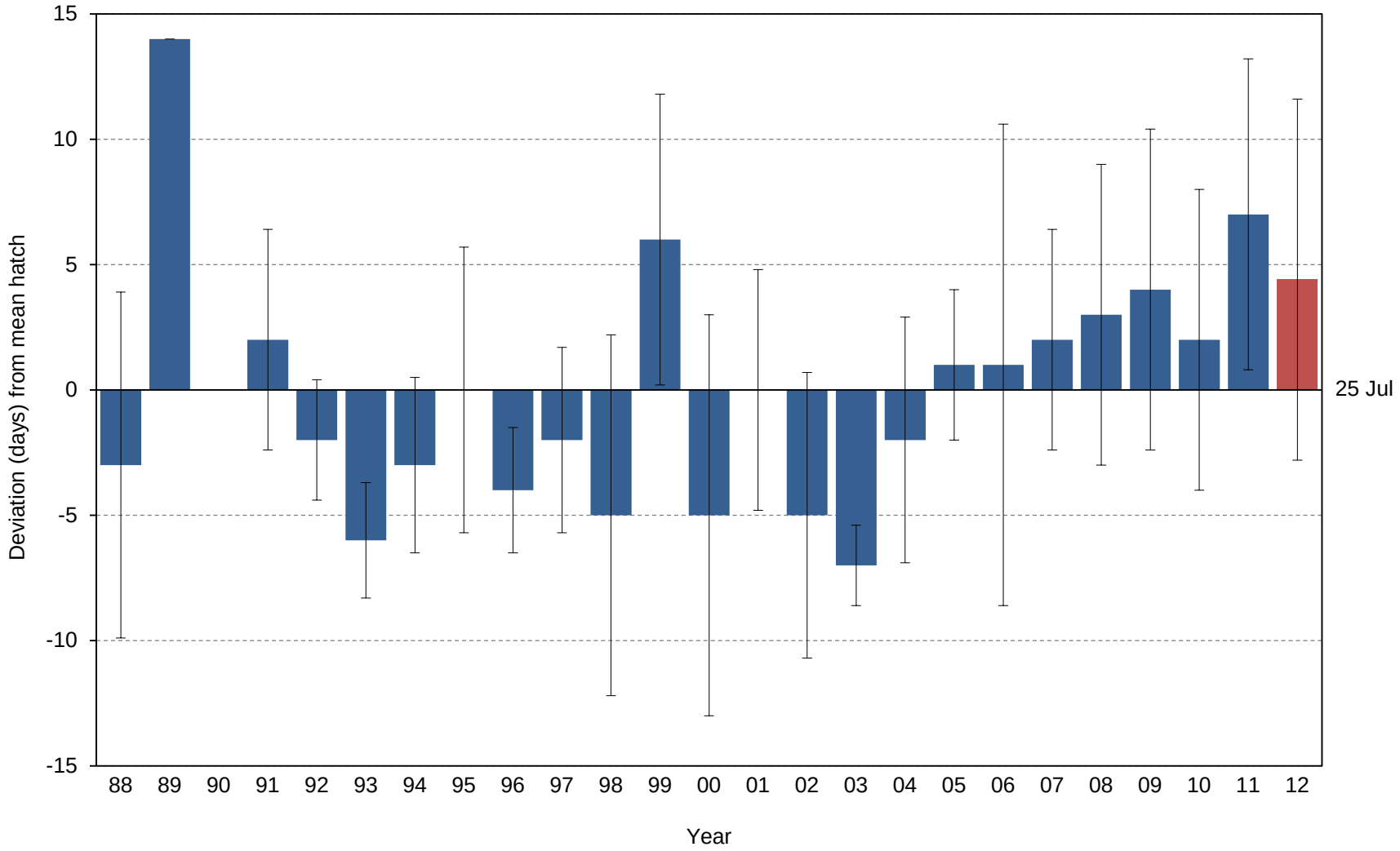

Figure 57. Yearly hatch date deviation (from the 1988-2011 average of 25 July) for horned puffins at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 86. Breeding chronology of horned puffins at Buldir Island, Alaska.

Year	Mean hatch	SD	*n*[a]	First hatch	Last hatch	First fledge[b]
1988	21 Jul	6.9	13	30 Jun	30 Jul	3 Sep
1989	8 Aug	0.0	1	8 Aug	-	>22 Aug
1990	-	-	-	-	-	>13 Aug
1991	27 Jul	4.4	11	19 Jul	4 Aug	>5 Aug
1992	22 Jul	2.4	6	20 Jul	26 Jul	>10 Aug
1993	19 Jul	2.3	6	15 Jul	23 Jul	28 Aug
1994	22 Jul	3.5	15	15 Jul	1 Aug	28 Aug
1995	25 Jul	5.7	10	15 Jul	4 Aug	>13 Aug
1996	20 Jul	2.5	14	13 Jul	26 Jul	>29 Jul
1997	23 Jul	3.7	5	19 Jul	29 Jul	>13 Aug
1998	20 Jul	7.2	16	5 Jul	2 Aug	>26 Aug
1999	31 Jul	5.8	7	23 Jul	8 Aug	>21 Aug
2000	19 Jul	8.0	21	2 Jul	1 Aug	>22 Aug
2001	25 Jul	4.8	8	19 Jul	6 Aug	>5 Aug
2002	20 Jul	5.7	28	10 Jul	2 Aug	>24 Aug
2003	18 Jul	1.6	5	15 Jul	19 Jul	23 Aug
2004	22 Jul	4.9	14	16 Jul	1 Aug	>18 Aug
2005	26 Jul	3.0	7	21 Jul	31 Jul	>24 Aug
2006	26 Jul	9.6	22	1 Jul	16 Aug	17 Aug
2007	27 Jul	4.4	18	17 Jul	4 Aug	>24 Aug
2008	27 Jul	6.0	21	19 Jul	13 Aug	>24 Aug
2009	29 Jul	6.4	25	19 Jul	11 Aug	>20 Aug
2010	27 Jul	6.0	14	18 Jul	5 Aug	21 Aug
2011	1 Aug	6.2	19	23 Jul	12 Aug	>18 Aug
2012	28 Jul	7.2	25	12 Jul	15 Aug	>24 Aug

[a]Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.
[b]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 87. Frequency distribution of hatch dates for horned puffins at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date												
	88	89	90	91	92	93	94	95	96	97	98	99	00
182	1	-	*no data*	-	-	-	-	-	-	-	-	-	-
183	-	-		-	-	-	-	-	-	-	-	-	-
184	-	-	-	-	-	-	-	-	-	-	-	-	2
185	-	-	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	-	-	-	-	-	-	-	1	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	1	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	-	-	-	-	-
195	-	-	-	-	-	-	-	-	1	-	-	-	3
196	-	-	-	-	-	1	1	1	-	-	2	-	1
197	-	-	-	-	-	-	-	-	-	-	1	-	-
198	-	-	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-	-	2
200	1	-	-	1	-	4	-	-	-	2	3	-	3
201	1	-	-	-	-	-	4	-	-	-	-	-	-
202	2	-	-	1	3	-	-	4	12	-	-	-	-
203	-	-	-	-	-	-	-	-	-	1	-	-	-
204	1	-	-	-	-	1	8	-	-	-	3	2	1
205	1	-	-	-	-	-	-	-	-	1	-	-	3
206	3	-	-	3	2	-	1	-	-	-	2	-	-
207	-	-	-	-	-	-	-	3	-	-	-	-	1
208	2	-	-	2	1	-	-	-	1	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-	-	2
210	-	-	-	-	-	-	-	-	-	1	2	1	1
211	-	-	-	1	-	-	-	-	-	-	-	-	-
212	1	-	-	2	-	-	-	-	-	-	-	-	-
213	-	-	-	-	-	-	1	-	-	-	-	-	-
214	-	-	-	-	-	-	-	1	-	-	1	1	2
215	-	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	1	-	-	-	1	-	-	-	2	-
217	-	-	-	-	-	-	-	-	-	-	-	-	-
218	-	-	-	-	-	-	-	-	-	-	-	-	-
219	-	-	-	-	-	-	-	-	-	-	-	-	-
220	-	1	-	-	-	-	-	-	-	-	-	1	-
221	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	-	-	-	-	-	-
223	-	-	-	-	-	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	-	-	-	-	-	-	-
225	-	-	-	-	-	-	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	-	-	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	-	-	-	-	-	-	-	-	-
n	13	1	-	11	6	6	15	10	14	5	16	7	21

[a]Julian dates are adjusted by one day in leap years.

Table 87 (continued). Frequency distribution of hatch dates for horned puffins at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date											
	01	02	03	04	05	06	07	08	09	10	11	12
182	-	-	-	-	-	1	-	-	-	-	-	-
183	-	-	-	-	-	-	-	-	-	-	-	-
184	-	-	-	-	-	-	-	-	-	-	-	-
185	-	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	-	-	-	-	-	-	-	-	-
187	-	-	-	-	-	-	-	-	-	-	-	-
188	-	-	-	-	-	-	-	-	-	-	-	-
189	-	-	-	-	-	1	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-
191	-	1	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-
194	-	4	-	-	-	-	-	-	-	-	-	1
195	-	1	-	-	-	-	-	-	-	-	-	-
196	-	-	1	-	-	-	-	-	-	-	-	-
197	-	-	-	-	-	-	-	-	-	-	-	-
198	-	-	-	2	-	-	1	-	-	-	-	-
199	-	2	-	-	-	-	-	-	-	3	-	-
200	1	9	4	1	-	-	-	-	1	-	-	-
201	-	-	-	1	-	-	-	4	-	-	-	1
202	-	-	-	2	1	4	1	-	3	1	-	-
203	-	4	-	-	-	-	-	-	-	-	-	1
204	2	1	-	4	-	-	1	-	-	1	3	3
205	-	-	-	-	-	1	3	1	-	-	-	-
206	4	1	-	-	3	6	1	-	4	1	-	-
207	-	-	-	-	-	-	3	7	-	-	1	-
208	-	2	-	1	1	2	2	-	6	1	1	5
209	-	-	-	-	-	-	1	-	1	-	1	-
210	-	-	-	1	1	-	-	-	1	3	-	4
211	-	-	-	-	-	-	1	4	-	-	1	-
212	-	2	-	-	1	3	2	-	-	-	4	5
213	-	-	-	1	-	-	-	2	1	-	-	-
214	-	1	-	1	-	-	-	-	3	3	-	-
215	-	-	-	-	-	-	-	-	-	-	2	-
216	-	-	-	-	-	1	2	-	1	-	1	-
217	-	-	-	-	-	-	-	2	1	1	-	-
218	1	-	-	-	-	1	-	-	-	-	2	1
219	-	-	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-	-	-	-	1
221	-	-	-	-	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	-	-	-	1	2
223	-	-	-	-	-	1	-	-	3	-	-	-
224	-	-	-	-	-	-	-	-	-	-	2	-
225	-	-	-	-	-	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	1	-	-	-	-
227	-	-	-	-	-	-	-	-	-	-	-	-
228	-	-	-	-	-	1	-	-	-	-	-	1
n	8	28	5	14	7	22	18	21	25	14	19	25

[a]Julian dates are adjusted by one day in leap years.

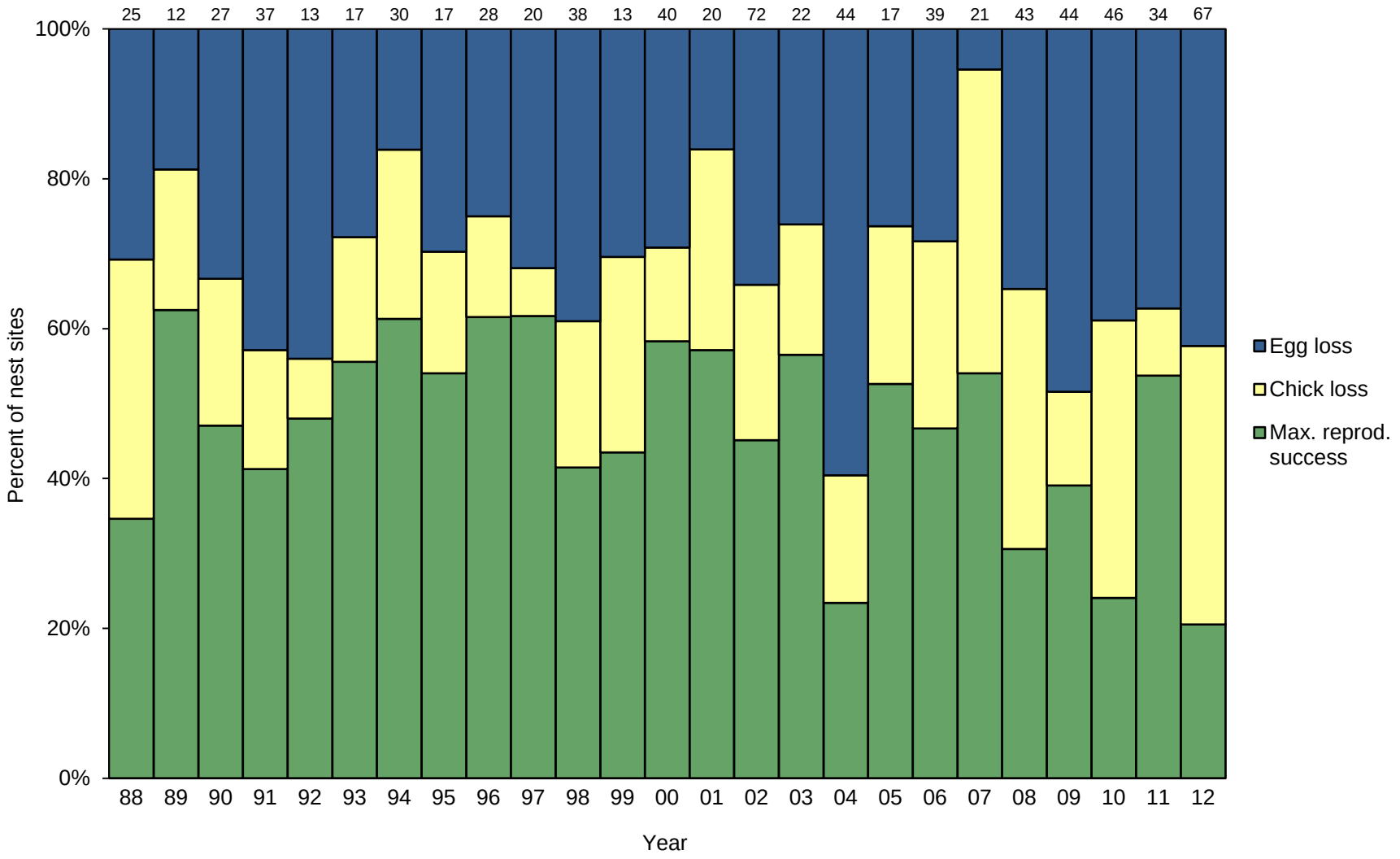

Figure 58. Reproductive performance of horned puffins at Buldir Island, Alaska. Values represent maximum potential success, including nest sites with chicks too young to consider fledged at the last check. Egg loss=[(B+H)-D+H]/(D+H); Chick loss=[(D+H)-F+H]/(B+H); Maximum potential reproductive success=[(F+H)/(B+H)], 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).

Table 88. Reproductive performance of horned puffins at Buldir Island, Alaska.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Nest sites w/ young chicks still present[a] (H)	Nesting success (D/B)[b]	Fledging success (F/D)[c]	Reproductive success (F/B)	Max. potential nesting success[d] [(D+H)/(B+H)]	Max. potential fledging success[d] [(F+H)/(D+H)]	Max. potential reproductive success[d] [(F+H)/(B+H)]
1988	25	17	8	1	0.68	0.47	0.32	0.69	0.50	0.35
1989	12	6	0	20	0.50	0.00	0.00	0.81	0.77	0.63
1990	27	10	0	24	0.37	0.00	0.00	0.67	0.71	0.47
1991	37	10	0	26	0.27	0.00	0.00	0.57	0.72	0.41
1992	13	2	0	12	0.15	0.00	0.00	0.56	0.86	0.48
1993	17	12	9	1	0.71	0.75	0.53	0.72	0.77	0.56
1994	30	25	18	1	0.83	0.72	0.60	0.84	0.73	0.61
1995	17	6	0	20	0.35	0.00	0.00	0.70	0.77	0.54
1996	28	15	8	24	0.54	0.53	0.29	0.75	0.82	0.62
1997	20	5	2	27	0.25	0.40	0.10	0.68	0.91	0.62
1998	38	22	14	3	0.58	0.64	0.37	0.61	0.68	0.41
1999	13	6	0	10	0.46	0.00	0.00	0.70	0.63	0.43
2000	40	26	20	8	0.65	0.77	0.50	0.71	0.82	0.58
2001	20	3	0	42	0.15	0.00	0.00	0.73	0.93	0.68
2002	72	44	27	10	0.61	0.61	0.38	0.66	0.69	0.45
2003	22	16	12	1	0.73	0.75	0.55	0.74	0.76	0.57
2004	44	16	8	3	0.36	0.50	0.18	0.40	0.58	0.23
2005	17	12	8	2	0.71	0.67	0.47	0.74	0.71	0.53
2006	39	22	7	21	0.56	0.32	0.18	0.72	0.65	0.47
2007	21	19	4	16	0.90	0.21	0.19	0.95	0.57	0.54
2008	43	26	9	6	0.60	0.35	0.21	0.65	0.47	0.31
2009	44	13	5	20	0.30	0.38	0.11	0.52	0.76	0.39
2010	46	25	5	8	0.54	0.20	0.11	0.61	0.39	0.24
2011	34	9	3	33	0.26	0.33	0.09	0.63	0.86	0.54
2012	67	34	5	11	0.51	0.15	0.07	0.58	0.36	0.21

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

[b]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).

[c]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).

[d]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.

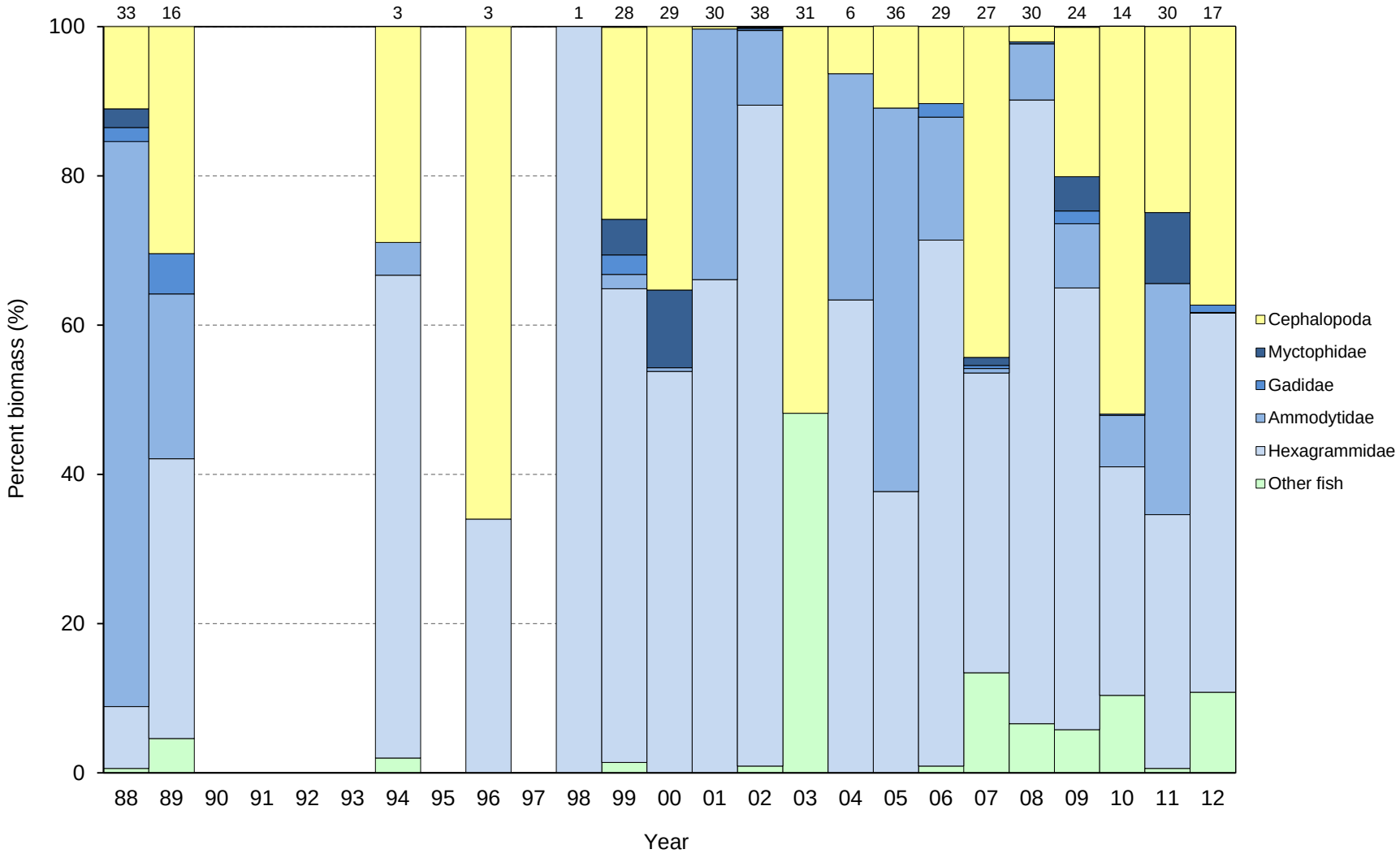

Figure 59. Relative biomass of prey in diets of horned puffin chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

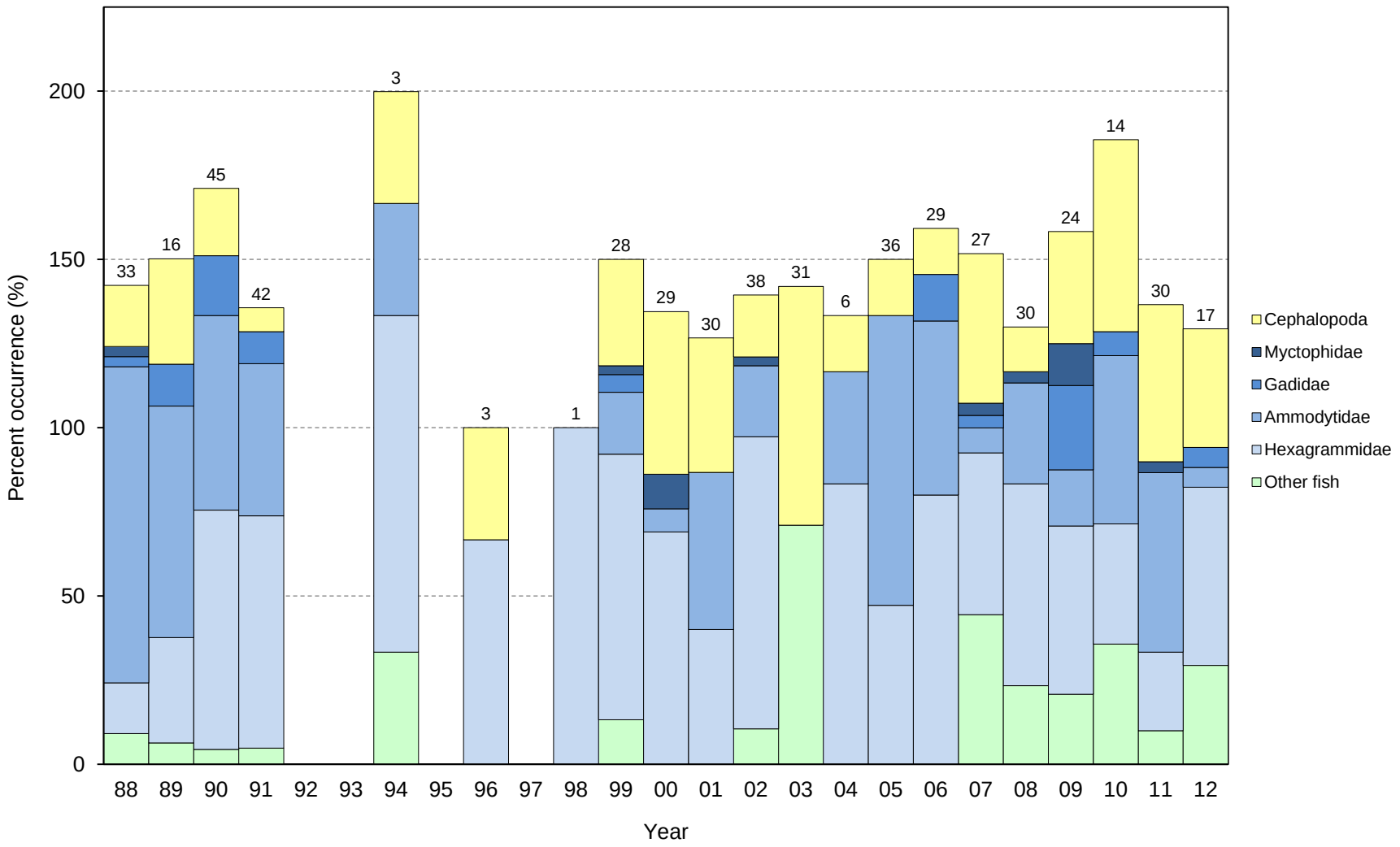

Figure 60. Frequency of occurrence of prey in diets of horned puffin chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

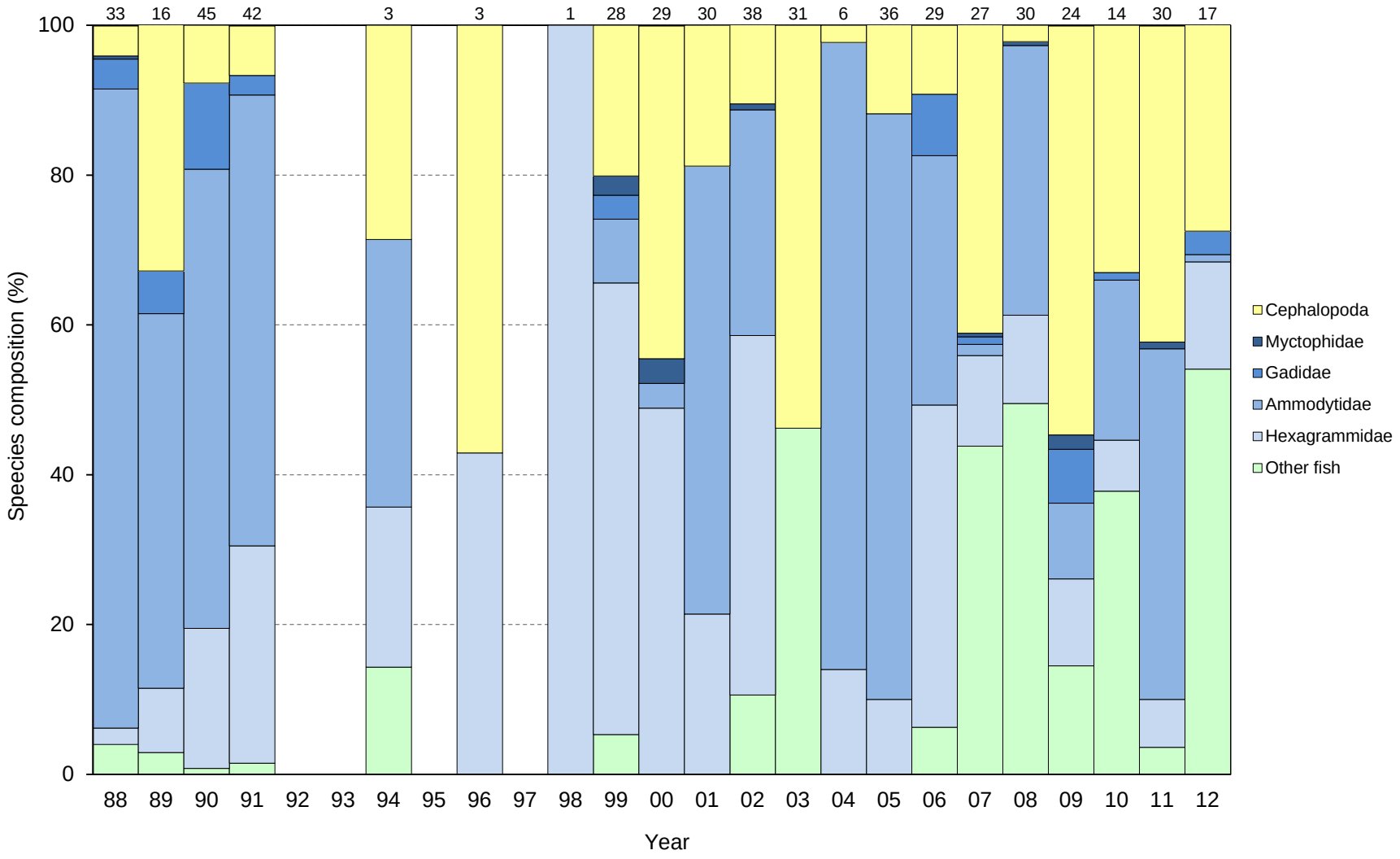

Figure 61. Species composition of prey in diets of horned puffin chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 89. Relative biomass of prey in diets of horned puffin chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	1988	1989	1990	1991	1992	1993	1994	1995	1996
No. samples[a]	33	16	*no mass data*	*no mass data*	*no samples*	*no samples*	3	*no samples*	3
Total mass (g)	399.2	92.1					20.4		36.5
Invertebrates	**11.0**	**30.4**	**-**	**-**	**-**	**-**	**28.9**	**-**	**66.0**
Cephalopoda	**11.0**	**30.4**	**-**	**-**	**-**	**-**	**28.9**	**-**	**66.0**
Dechabrachia	**11.0**	**30.4**	**-**	**-**	**-**	**-**	**28.9**	**-**	**66.0**
Gonatus middendorffi	-	-	-	-	-	-	-	-	66.0
Unid. squid	11.0	30.4	-	-	-	-	28.9	-	-
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Fish	**89.0**	**69.6**	**-**	**-**	**-**	**-**	**71.1**	**100.0**	**34.0**
Myctophidae	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Stenobrachius leucopsarus	2.5	-	-	-	-	-	-	-	-
S. nannochir	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	-	-	-	-	-	-	-
Gadidae	**1.9**	**5.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Theragra chalcogramma	1.9	5.4	-	-	-	-	-	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Gasterosteidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	-
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	-
Hexagrammidae	**8.3**	**37.5**	**-**	**-**	**-**	**-**	**64.7**	**-**	**34.0**
Hexagrammos decagrammus	-	-	-	-	-	-	64.7	-	34.0
H. lagocephalus	-	-	-	-	-	-	-	-	-
H. octogrammus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	7.2	37.5	-	-	-	-	-	-	-
Pleurogrammus monopterygius	1.1	-	-	-	-	-	-	-	-
Unid. Hexagrammidae	-	-	-	-	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Agonidae	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	0.1	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ammodytidae	**75.7**	**22.1**	**-**	**-**	**-**	**-**	**4.4**	**-**	**-**
Ammodytes hexapterus	75.7	22.1	-	-	-	-	4.4	-	-
Pleuronectidae	**-**	**-**	**-**	**-**	**-**	**-**	**2.0**	**-**	**-**
Hippoglossoides elassodon	-	-	-	-	-	-	-	-	-
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	-	-	-	-	2.0	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	-	-	-	-	-	-
Unid. Teleostei	0.5	4.6	-	-	-	-	-	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 90) and species composition (Table 91) and some prey types may not appear in biomass data although they were present in diet samples.

Table 89 (continued). Relative biomass of prey in diets of horned puffin chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples[a]	*no samples*	1	28	29	30	38	31	6	36
Total mass (g)		5.8	348.9	205.8	416.3	732.2	260.3	39.7	218.9
Invertebrates	**-**	**-**	**25.7**	**35.3**	**0.3**	**0.1**	**51.8**	**6.3**	**11.0**
Cephalopoda	**-**	**-**	**25.7**	**35.3**	**0.3**	**0.1**	**51.8**	**6.3**	**11.0**
Dechabrachia	**-**	**-**	**25.7**	**35.3**	**0.3**	**0.1**	**51.8**	**6.3**	**11.0**
Gonatus middendorffi	-	-	-	-	-	-	-	-	-
Unid. squid	-	-	25.7	35.3	0.3	0.1	51.8	6.3	11.0
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Fish	**-**	**100.0**	**74.3**	**64.7**	**99.7**	**99.9**	**48.2**	**93.7**	**89.0**
Myctophidae	**-**	**-**	**4.8**	**10.4**	**-**	**0.3**	**-**	**-**	**-**
Stenobrachius leucopsarus	-	-	4.8	-	-	-	-	-	-
S. nannochir	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	-	10.4	-	0.3	-	-	-
Gadidae	**-**	**-**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**
Theragra chalcogramma	-	-	2.6	-	-	-	-	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Gasterosteidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	-
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	-
Hexagrammidae	**-**	**100.0**	**63.5**	**53.8**	**66.1**	**88.6**	**-**	**63.4**	**37.7**
Hexagrammos decagrammus	-	-	47.7	32.8	66.1	88.6	-	63.4	37.7
H. lagocephalus	-	-	-	-	-	-	-	-	-
H. octogrammus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	-	-	-	2.9	-	-	-	-	-
Pleurogrammus monopterygius	-	100.0	15.8	18.1	-	-	-	-	-
Unid. Hexagrammidae	-	-	-	-	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ammodytidae	**-**	**-**	**1.9**	**0.5**	**33.6**	**10.0**	**-**	**30.3**	**51.4**
Ammodytes hexapterus	-	-	1.9	0.5	33.6	10.0	-	30.3	51.4
Pleuronectidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hippoglossoides elassodon	-	-	-	-	-	-	-	-	-
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	-	-	-	-	-	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	-	-	-	-	-	-
Unid. Teleostei	-	-	1.2	-	-	0.9	48.2	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 90) and species composition (Table 91) and some prey types may not appear in biomass data although they were present in diet samples.

Table 89 (continued). Relative biomass of prey in diets of horned puffin chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	2006	2007	2008	2009	2010	2011	2012
No. samples[a]	29	26	30	24	14	30	17
Total mass (g)	301.0	149.5	243.8	145.8	121.0	146.4	101.2
Invertebrates	**10.3**	**44.3**	**2.1**	**20.0**	**52.0**	**24.9**	**37.4**
Cephalopoda	**10.3**	**44.3**	**2.1**	**20.0**	**52.0**	**24.9**	**37.4**
Dechabrachia	**10.2**	**44.3**	**2.1**	**20.0**	**52.0**	**24.9**	**37.4**
Gonatus middendorffi	-	-	-	-	-	-	-
Unid. squid	10.2	44.3	2.1	20.0	52.0	24.9	37.4
Octopoda	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	0.1	-	-	-	-	-	-
Fish	**89.7**	**55.7**	**97.9**	**80.0**	**48.0**	**75.1**	**62.6**
Myctophidae	**-**	**1.1**	**0.3**	**4.6**	**-**	**9.5**	**-**
Stenobrachius leucopsarus	-	1.1	0.3	0.6	-	9.5	-
S. nannochir	-	-	-	3.3	-	-	-
Unid. Myctophidae	-	-	-	0.7	-	-	-
Gadidae	**1.8**	**0.4**	**-**	**1.7**	**0.2**	**-**	**1.0**
Theragra chalcogramma	1.7	0.4	-	1.5	-	-	1.0
Unid. Gadidae	0.1	-	-	0.3	0.2	-	-
Gasterosteidae	**-**	**-**	**-**	**2.2**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	2.2	-	-	-
Scorpaenidae	**-**	**2.2**	**3.0**	**0.5**	**0.4**	**-**	**1.1**
Unid. Scorpaenidae	-	2.2	3.0	0.5	0.4	-	1.1
Anoplopomatidae	**-**	**6.9**	**2.4**	**1.0**	**0.1**	**0.2**	**1.8**
Anoplopoma fimbria	-	6.9	2.4	1.0	0.1	0.2	1.8
Hexagrammidae	**70.5**	**40.2**	**83.6**	**59.2**	**30.6**	**34.0**	**50.8**
Hexagrammos decagrammus	67.0	-	-	-	-	-	3.7
H. lagocephalus	-	-	-	-	-	-	25.7
H. octogrammus	-	1.7	-	-	-	-	-
Hexagrammos spp.	3.5	-	-	-	-	-	-
Pleurogrammus monopterygius	-	38.2	83.6	56.8	30.2	34.0	19.2
Unid. Hexagrammidae	-	0.2	-	2.4	0.4	-	2.0
Cottidae	**-**	**3.8**	**1.0**	**2.0**	**2.8**	**0.2**	**6.4**
Hemilepidotus hemilepidotus	-	3.6	0.5	0.4	0.7	-	5.5
H. jordani	-	0.2	0.5	1.6	2.1	0.2	0.8
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	-	-	-	-	-	-	-
Zaproridae	**-**	**0.2**	**-**	**-**	**5.9**	**-**	**0.2**
Zaprora silenus	-	0.2	-	-	5.9	-	0.2
Ammodytidae	**16.5**	**0.6**	**7.5**	**8.6**	**6.9**	**31.0**	**0.1**
Ammodytes hexapterus	16.5	0.6	7.5	8.6	6.9	31.0	0.1
Pleuronectidae	**-**	**0.1**	**0.2**	**-**	**1.2**	**0.2**	**1.2**
Hippoglossoides elassodon	-	-	-	0.1	-	-	-
Reinhardtius stomias	-	0.1	0.2	0.1	1.2	0.2	1.2
Unid. Pleuronectidae	-	-	-	-	-	-	-
Stichaeidae	**-**	**-**	**-**	**0.1**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	0.1	-	-	-
Unid. Teleostei	0.9	0.2	-	-	-	-	0.1

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 90) and species composition (Table 91) and some prey types may not appear in biomass data although they were present in diet samples..

Table 90. Frequency of occurrence of prey in diets of horned puffin chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	1988	1989	1990	1991	1992	1993	1994	1995	1996
No. samples	33	16	45	42	*no samples*	*no samples*	3	*no samples*	3
Invertebrates	**18.2**	**31.3**	**20.0**	**7.1**	**-**	**-**	**33.3**	**-**	**33.3**
Cephalopoda	**18.2**	**31.3**	**20.0**	**7.1**	**-**	**-**	**33.3**	**-**	**33.3**
Dechabrachia	**18.2**	**31.3**	**20.0**	**7.1**	**-**	**-**	**33.3**	**-**	**33.3**
Gonatus middendorffi	-	-	-	-	-	-	-	-	33.3
Unid. squid	18.2	31.3	20.0	7.1	-	-	33.3	-	-
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Fish	**93.9**	**87.5**	**93.3**	**97.6**	**-**	**-**	**100.0**	**-**	**66.7**
Myctophidae	**3.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Stenobrachius leucopsarus	3.0	-	-	-	-	-	-	-	-
S. nannochir	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	-	-	-	-	-	-	-
Gadidae	**3.0**	**12.5**	**17.8**	**9.5**	**-**	**-**	**-**	**-**	**-**
Gadus macrocephalus	-	-	2.2	-	-	-	-	-	-
Theragra chalcogramma	3.0	12.5	17.8	9.5	-	-	-	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Gasterosteidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	-
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	-
Hexagrammidae	**15.1**	**31.3**	**71.1**	**69.0**	**-**	**-**	**100.0**	**-**	**66.7**
Hexagrammos decagrammus	-	-	-	-	-	-	100.0	-	66.7
H. lagocephalus	-	-	-	-	-	-	-	-	-
H. octogrammus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	12.1	31.3	4.4	4.8	-	-	-	-	-
Pleurogrammus monopterygius	3.0	-	66.7	64.3	-	-	-	-	-
Unid. Hexagrammidae	-	-	-	-	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Agonidae	**3.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	3.0	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ammodytidae	**93.9**	**68.8**	**57.8**	**45.2**	**-**	**-**	**33.3**	**-**	**-**
Ammodytes hexapterus	93.9	68.8	57.8	45.2	-	-	33.3	-	-
Pleuronectidae	**-**	**-**	**2.2**	**2.4**	**-**	**-**	**33.3**	**-**	**-**
Hippoglossoides elassodon	-	-	-	-	-	-	-	-	-
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	2.2	2.4	-	-	33.3	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	-	-	-	-	-	-
Unid. Teleostei	9.1	6.3	2.2	2.4	-	-	-	-	-

Table 90 (continued). Frequency of occurrence of prey in diets of horned puffin chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	*no samples*	1	38	29	30	38	31	6	36
Invertebrates	**-**	**-**	**31.6**	**48.3**	**40.0**	**18.4**	**71.0**	**16.7**	**16.7**
Cephalopoda	**-**	**-**	**31.6**	**48.3**	**40.0**	**18.4**	**71.0**	**16.7**	**16.7**
Dechabrachia	**-**	**-**	**31.6**	**48.3**	**40.0**	**18.4**	**71.0**	**16.7**	**16.7**
Gonatus middendorffi	-	-	-	-	-	-	-	-	-
Unid. squid	-	-	31.6	48.3	40.0	18.4	71.0	16.7	16.7
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Fish	**-**	**100.0**	**86.8**	**72.4**	**76.7**	**92.1**	**71.0**	**100.0**	**100.0**
Myctophidae	**-**	**-**	**2.6**	**10.3**	**-**	**2.6**	**-**	**-**	**-**
Stenobrachius leucopsarus	-	-	-	-	-	-	-	-	-
S. nannochir	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	2.6	10.3	-	2.6	-	-	-
Gadidae	**-**	**-**	**5.3**	**-**	**-**	**-**	**-**	**-**	**-**
Gadus macrocephalus	-	-	-	-	-	-	-	-	-
Theragra chalcogramma	-	-	5.3	-	-	-	-	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Gasterosteidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	-
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	-	-	-	-		-	-	-
Hexagrammidae	**-**	**100.0**	**78.9**	**69.0**	**40.0**	**86.8**	**-**	**83.3**	**47.2**
Hexagrammos decagrammus	-	-	71.1	51.7	40.0	86.8	-	83.3	47.2
H. lagocephalus	-	-	-	-	-	-	-	-	-
H. octogrammus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	-	-	-	17.2	-	-	-	-	-
Pleurogrammus monopterygius	-	100.0	7.9	17.2	-	-	-	-	-
Unid. Hexagrammidae	-	-	-	-	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ammodytidae	**-**	**-**	**18.4**	**6.9**	**46.7**	**21.1**	**-**	**33.3**	**86.1**
Ammodytes hexapterus	-	-	18.4	6.9	46.7	21.1	-	33.3	86.1
Pleuronectidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hippoglossoides elassodon	-	-	-	-	-	-	-	-	-
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	-	-	-	-	-	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	-	-	-	-	-	-
Unid. Teleostei	-	-	13.2	-	-	10.5	71.0	-	-

Table 90 (continued). Frequency of occurrence of prey in diets of horned puffin chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	2006	2007	2008	2009	2010	2011	2012
No. samples	29	27	30	24	14	30	17
Invertebrates	**13.7**	**44.4**	**13.3**	**33.3**	**57.1**	**46.7**	**35.3**
Cephalopoda	**13.7**	**44.4**	**13.3**	**33.3**	**57.1**	**46.7**	**35.3**
Dechabrachia	**10.3**	**44.4**	**13.3**	**33.3**	**57.1**	**46.7**	**35.3**
Gonatus middendorffi	-	-	-	-	-	-	-
Unid. squid	10.3	44.4	13.3	33.3	57.1	46.7	35.3
Octopoda	**3.4**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	3.4	-	-	-	-	-	-
Fish	**96.6**	**77.8**	**93.3**	**83.3**	**78.6**	**66.7**	**76.5**
Myctophidae	**-**	**3.7**	**3.3**	**12.5**	**-**	**3.3**	**-**
Stenobrachius leucopsarus	-	3.7	3.3	4.2	-	3.3	-
S. nannochir	-	-	-	8.3	-	-	-
Unid. Myctophidae	-	-	-	4.2	-	-	-
Gadidae	**13.8**	**3.7**	**-**	**25.0**	**7.1**	**-**	**5.9**
Gadus macrocephalus	-	-	-	-	-	-	-
Theragra chalcogramma	6.9	3.7	-	16.7	-	-	5.9
Unid. Gadidae	6.9	-	-	8.3	7.1	-	5.9
Gasterosteidae	**-**	**-**	**-**	**4.2**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	4.2	-	-	-
Scorpaenidae	**-**	**25.9**	**26.7**	**4.2**	**7.1**	**-**	**17.6**
Unid. Scorpaenidae	-	25.9	26.7	4.2	7.1	-	17.6
Anoplopomatidae	**-**	**33.3**	**-**	**8.3**	**7.1**	**3.3**	**11.8**
Anoplopoma fimbria	-	33.3	13.3	8.3	7.1	3.3	11.8
Hexagrammidae	**80.0**	**48.1**	**60.0**	**50.0**	**35.7**	**23.3**	**52.9**
Hexagrammos decagrammus	69.0	-	-	-	-	-	5.9
H. lagocephalus	-	-	-	-	-	-	29.4
H. octogrammus	-	7.4	-	-	-	-	-
Hexagrammos spp.	17.2	-	-	-	-	-	-
Pleurogrammus monopterygius	-	40.7	60.0	50.0	28.6	23.3	5.9
Unid. Hexagrammidae	-	3.7	-	12.5	7.1	-	17.6
Cottidae	**-**	**22.2**	**13.3**	**16.7**	**35.7**	**3.3**	**35.3**
Hemilepidotus hemilepidotus	-	18.5	10.0	12.5	14.3	-	39.4
H. jordani	-	3.7	10.0	8.3	35.7	3.3	11.8
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	-	-	-	-	-	-	-
Zaproridae	**-**	**3.7**	**-**	**-**	**-**	**-**	**5.9**
Zaprora silenus	-	3.7	-	-	-	-	5.9
Ammodytidae	**51.7**	**7.4**	**30.0**	**16.7**	**50.0**	**53.3**	**5.9**
Ammodytes hexapterus	51.7	7.4	30.0	16.7	50.0	53.3	5.9
Pleuronectidae	**-**	**3.7**	**10.0**	**8.3**	**21.4**	**6.7**	**17.6**
Hippoglossoides elassodon	-	-	-	4.2	-	-	-
Reinhardtius stomias	-	3.7	10.0	4.2	21.4	6.7	17.6
Unid. Pleuronectidae	-	-	-	-	-	-	-
Stichaeidae	**-**	**-**	**-**	**4.2**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	4.2	-	-	-
Unid. Teleostei	6.9	3.7	-	-	7.1	-	5.9

Table 91. Species composition of prey in diets of horned puffin chicks at Buldir Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	1988	1989	1990	1991	1992	1993	1994	1995	1996
No. samples	33	16	45	42	*no samples*	*no samples*	3	*no samples*	3
No. individuals	273	70	261	196			14		7
Invertebrates	**4.0**	**32.9**	**7.7**	**6.6**	**-**	**-**	**28.6**	**-**	**57.1**
Cephalopoda	**4.0**	**32.9**	**7.7**	**6.6**	**-**	**-**	**28.6**	**-**	**57.1**
Dechabrachia	**4.0**	**32.9**	**7.7**	**6.6**	**-**	**-**	**28.6**	**-**	**57.1**
Gonatus middendorffi	-	-	-	-	-	-	-	-	57.1
Unid. squid	4.0	32.9	7.7	6.6	-	-	28.6	-	-
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Fish	**96.0**	**67.1**	**92.3**	**93.4**	**-**	**-**	**71.4**	**-**	**42.9**
Myctophidae	**0.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Stenobrachius leucopsarus	0.4	-	-	-	-	-	-	-	-
S. nannochir	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	-	-	-	-	-	-	-
Gadidae	**4.0**	**5.7**	**11.5**	**2.6**	**-**	**-**	**-**	**-**	**-**
Gadus macrocephalus	-	-	0.4	-	-	-	-	-	-
Theragra chalcogramma	4.0	5.7	11.1	2.6	-	-	-	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Gasterosteidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	-
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	-
Hexagrammidae	**2.2**	**8.6**	**18.8**	**29.1**	**-**	**-**	**21.4**	**-**	**42.9**
Hexagrammos decagrammus	-	-	-	-	-	-	21.4	-	42.9
H. lagocephalus	-	-	-	-	-	-	-	-	-
H. octogrammus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	1.8	8.6	1.1	7.1	-	-	-	-	-
Pleurogrammus monopterygius	0.4	-	17.6	21.9	-	-	-	-	-
Unid. Hexagrammidae	-	-	-	-	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Agonidae	**0.7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	0.7	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ammodytidae	**85.3**	**50.0**	**61.3**	**60.2**	**-**	**-**	**35.7**	**-**	**-**
Ammodytes hexapterus	85.3	50.0	61.3	60.2	-	-	35.7	-	-
Pleuronectidae	**-**	**-**	**0.4**	**0.5**	**-**	**-**	**14.3**	**-**	**-**
Hippoglossoides elassodon	-	-	-	-	-	-	-	-	-
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	0.4	0.5	-	-	14.3	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	-	-	-	-	-	-
Unid. Teleostei	3.3	2.9	0.4	1.0	-	-	-	-	-

Table 91 (continued). Species composition of prey in diets of horned puffin chicks at Buldir Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa.. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	*no samples*	1	28	29	30	38	31	6	36
No. individuals		1	189	90	117	123	208	43	261
Invertebrates	**-**	**-**	**20.1**	**44.4**	**18.8**	**10.6**	**53.8**	**2.3**	**11.9**
Cephalopoda	**-**	**-**	**20.1**	**44.4**	**18.8**	**10.6**	**53.8**	**2.3**	**11.9**
Dechabrachia	**-**	**-**	**20.1**	**44.4**	**18.8**	**10.6**	**53.8**	**2.3**	**11.9**
Gonatus middendorffi	-	-	-	-	-	-	-	-	-
Unid. squid	-	-	20.1	44.4	18.8	10.6	53.8	2.3	11.9
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Fish	**-**	**100.0**	**79.9**	**55.6**	**81.2**	**89.4**	**46.2**	**97.7**	**88.1**
Myctophidae	**-**	**-**	**2.6**	**3.3**	**-**	**0.8**	**-**	**-**	**-**
Stenobrachius leucopsarus	-	-	2.6	-	-	-	-	-	-
S. nannochir	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	-	3.3	-	0.8	-	-	-
Gadidae	**-**	**-**	**3.2**	**-**	**-**	**-**	**-**	**-**	**-**
Gadus macrocephalus	-	-	-	-	-	-	-	-	-
Theragra chalcogramma	-	-	3.2	-	-	-	-	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Gasterosteidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	-
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	-
Hexagrammidae	**-**	**100.0**	**60.3**	**48.9**	**21.4**	**48.0**	**-**	**14.0**	**10.0**
Hexagrammos decagrammus	-	-	56.1	17.8	21.4	48.0	-	14.0	10.0
H. lagocephalus	-	-	-	-	-	-	-	-	-
H. octogrammus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	-	-	-	24.4	-	-	-	-	-
Pleurogrammus monopterygius	-	100.0	4.2	6.7	-	-	-	-	-
Unid. Hexagrammidae	-	-	-	-	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ammodytidae	**-**	**-**	**8.5**	**3.3**	**59.8**	**30.1**	**-**	**83.7**	**78.2**
Ammodytes hexapterus	-	-	8.5	3.3	59.8	30.1	-	83.7	78.2
Pleuronectidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hippoglossoides elassodon	-	-	-	-	-	-	-	-	-
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	-	-	-	-	-	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	-	-	-	-	-	-
Unid. Teleostei	-	-	5.3	-	-	10.6	46.2	97.7	-

Table 91 (continued). Species composition of prey in diets of horned puffin chicks at Buldir Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990-1991) and collected from (1988-1989 and 1992-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990-1991 and 2003) and the laboratory (1988-1989, 1992-2002, and 2004-2012).

Prey	2006	2007	2008	2009	2010	2011	2012
No. samples	29	27	30	24	14	30	17
No. individuals	207	199	186	207	103	109	98
Invertebrates	**9.2**	**41.2**	**2.2**	**54.6**	**33.0**	**42.2**	**27.6**
Cephalopoda	**9.2**	**41.2**	**2.2**	**54.6**	**33.0**	**42.2**	**27.6**
Dechabrachia	**8.7**	**41.2**	**2.2**	**54.6**	**33.0**	**42.2**	**27.6**
Gonatus middendorffi	-	-	-	-	-	-	-
Unid. squid	8.7	41.2	2.2	54.6	33.0	42.2	27.6
Octopoda	**0.5**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	0.5	-	-	-	-	-	-
Fish	**90.8**	**58.8**	**97.8**	**45.4**	**67.0**	**57.8**	**72.4**
Myctophidae	**-**	**0.5**	**0.5**	**1.9**	**-**	**0.9**	**-**
Stenobrachius leucopsarus	-	0.5	0.5	0.5	-	0.9	-
S. nannochir	-	-	-	1.0	-	-	-
Unid. Myctophidae	-	-	-	0.5	-	-	-
Gadidae	**8.2**	**1.0**	**-**	**7.2**	**1.0**	**-**	**3.1**
Gadus macrocephalus	-	-	-	-	-	-	-
Theragra chalcogramma	2.4	1.0	-	6.3	-	-	2.0
Unid. Gadidae	5.8	-	-	1.0	1.0	-	1.0
Gasterosteidae	**-**	**-**	**-**	**0.5**	**-**	**-**	**-**
Gasterosteus aculeatus	-	-	-	0.5	-	-	-
Scorpanidae	**-**	**21.6**	**31.2**	**4.3**	**5.8**	**-**	**13.3**
Unid. Scorpanaeidae	-	21.6	31.2	4.3	5.8	-	13.3
Anoplopomatidae	**-**	**10.1**	**9.7**	**2.4**	**1.0**	**0.9**	**3.1**
Anoplopoma fimbria	-	10.1	9.7	2.4	1.0	0.9	3.1
Hexagrammidae	**40.0**	**12.1**	**11.8**	**11.6**	**6.8**	**6.4**	**14.3**
Hexagrammos decagrammus	22.7	-	-	-	-	-	1.0
H. lagocephalus	-	-	-	-	-	-	7.1
H. octogrammus	-	2.5	-	-	-	-	-
Hexagrammos spp.	20.3	-	-	-	-	-	-
Pleurogrammus monopterygius	-	8.5	11.8	8.7	4.9	6.4	1.0
Unid. Hexagrammidae	-	1.0	-	2.9	1.9	-	5.1
Cottidae	**-**	**10.1**	**5.9**	**5.3**	**17.5**	**0.9**	**29.6**
Hemilepidotus hemilepidotus	-	9.5	3.2	1.4	4.9		25.5
H. jordani	-	0.5	2.7	3.9	12.6	0.9	4.1
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Agonidae	-	-	-	-	-	-	-
Zaproridae	**-**	**0.5**	**-**	**-**	**1.0**	**-**	**1.0**
Zaprora silenus	-	0.5	-	-	1.0	-	1.0
Ammodytidae	**33.3**	**1.5**	**36.0**	**10.1**	**21.4**	**46.8**	**1.0**
Ammodytes hexapterus	33.3	1.5	36.0	10.1	21.4	46.8	1.0
Pleuronectidae	**-**	**0.5**	**2.7**	**1.5**	**11.7**	**1.8**	**5.1**
Hippoglossoides elassodon	-	-	-	1.0	-	-	-
Reinhardtius stomias	-	0.5	2.7	0.5	11.7	1.8	5.1
Unid. Pleuronectidae	-	-	-	-	-	-	-
Stichaeidae	**-**	**-**	**-**	**0.5**	**-**	**-**	**-**
Unid. Stichaeidae	-	-	-	0.5	-	-	-
Unid. Teleostei	6.3	1.0	-	-	1.0	-	2.0

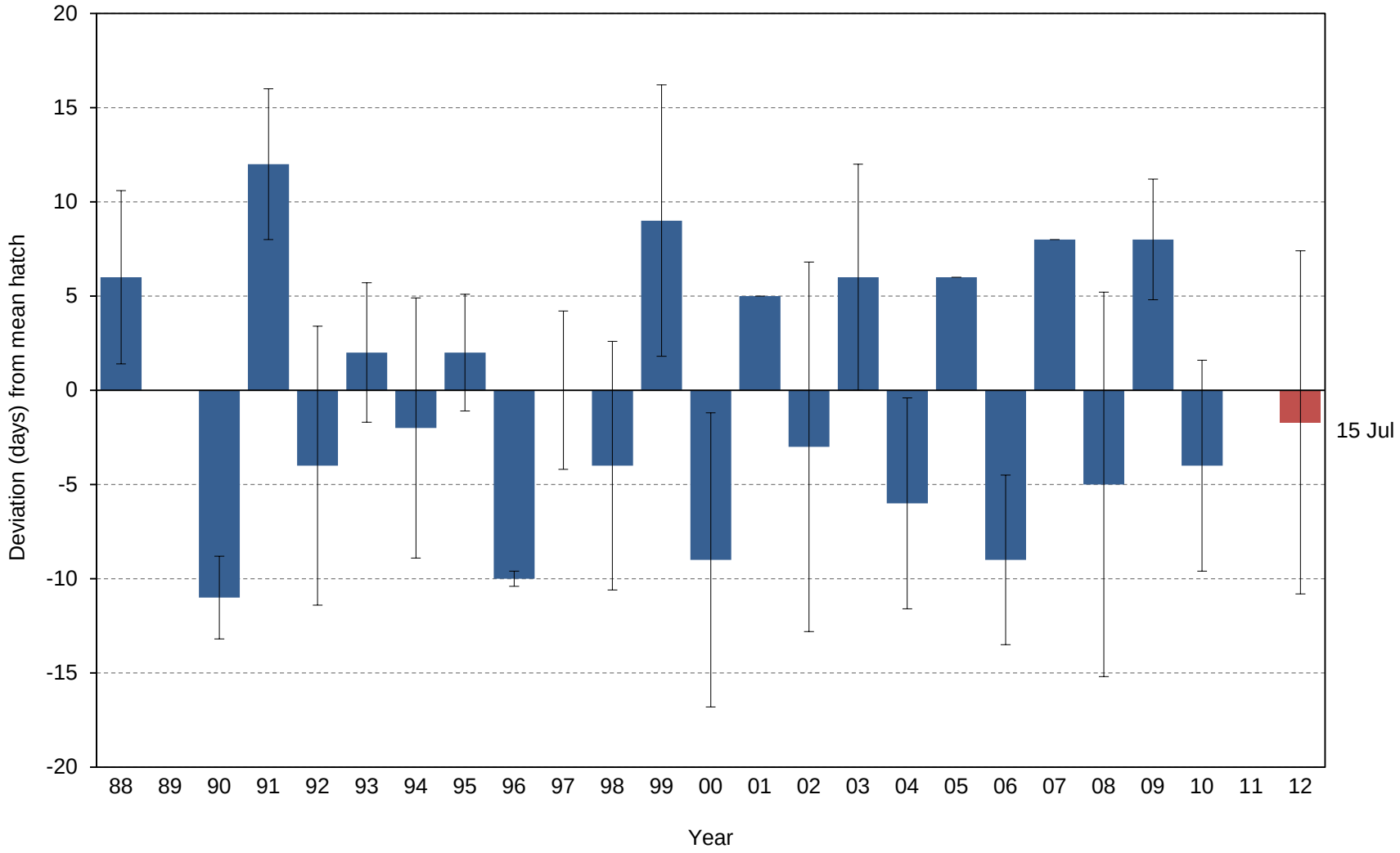

Figure 62. Yearly hatch date deviation (from the 1988-2011 average of 15 July) for tufted puffins at Buldir Island, Alaska. Negative values indicate earlier than mean hatch date, positive values indicate later than mean hatch date. Error bars represent standard deviation around each year's mean hatch date; red highlights the current year.

Table 92. Breeding chronology of tufted puffins at Buldir Island, Alaska.

Year	Mean hatch	SD	*n*[a]	First hatch	Last hatch	First fledge[b]
1988	20 Jul	4.6	4	14 Jul	24 Jul	30 Aug
1989	-	-	-	-	-	> 10 Aug
1990	4 Jul	2.2	3	2 Jul	7 Jul	11 Aug
1991	27 Jul	4.0	2	23 Jul	31 Jul	>2 Aug
1992	10 Jul	7.4	11	2 Jul	26 Jul	>30 Jul
1993	17 Jul	3.7	15	9 Jul	23 Jul	23 Aug
1994	13 Jul	6.9	4	9 Jul	25 Jul	28 Aug
1995	17 Jul	3.1	14	15 Jul	25 Jul	>13 Aug
1996	4 Jul	0.4	4	4 Jul	5 Jul	>14 Aug
1997	15 Jul	4.2	11	10 Jul	24 Jul	>13 Aug
1998	11 Jul	6.6	15	2 Jul	23 Jul	>18 Aug
1999	24 Jul	7.2	7	13 Jul	4 Aug	>26 Aug
2000	5 Jul	7.8	11	26 Jun	27 Jul	18 Aug
2001	20 Jul	0.0	1	20 Jul	-	>5 Aug
2002	12 Jul	9.8	13	1 Jul	4 Aug	>18 Jul
2003	21 Jul	6.0	2	15 Jul	27 Jul	>4 Sep
2004	8 Jul	5.6	10	30 Jun	16 Jul	19 Aug
2005	21 Jul	0.0	2	21 Jul	-	>24 Aug
2006	6 Jul	4.5	5	1 Jul	11 Jul	26 Aug
2007	23 Jul	0.0	1	23 Jul	-	>25 Aug
2008	9 Jul	10.2	11	30 Jun	4 Aug	>23 Aug
2009	23 Jul	3.2	5	21 Jul	29 Jul	>22 Aug
2010	11 Jul	5.6	10	1 Jul	18 Jul	>21 Aug
2011	-	-	-	-	-	>20 Aug
2012	12 Jul	9.1	4	7 Jul	28 Jul	>24 Aug

[a]Sample sizes for mean hatch dates are a sub-sample of total nests for which egg to chick interval is ≤ 7 days.
[b]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 93. Frequency distribution of hatch dates for tufted puffins at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date												
	88	89	90	91	92	93	94	95	96	97	98	99	00
178	-	*no data*	-	-	-	-	-	-	-	*no data*	-	-	1
179	-		-	-	-	-	-	-	-		-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-	-
182	-	-	-	-	-	-	-	-	-	-	-	-	1
183	-	-	1	-	-	-	-	-	-	-	1	-	-
184	-	-	1	-	3	-	-	-	-	-	1	-	6
185	-	-	-	-	-	-	-	-	-	-	-	-	-
186	-	-	-	-	-	-	-	-	3	-	3	-	-
187	-	-	-	-	-	-	-	-	1	-	-	-	-
188	-	-	1	-	1	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	3	2	3	-	-	-	3	-	2
191	-	-	-	-	-	-	-	-	-	-	-	-	-
192	-	-	-	-	-	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	-	-	-	1	-
195	-	-	-	-	2	-	-	-	-	-	-	-	-
196	1	-	-	-	-	5	-	11	-	-	3	-	-
197	-	-	-	-	-	-	-	-	-	-	-	1	-
198	1	-	-	-	-	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	7	-	-	-	-	3	-	-
201	-	-	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	1	-	-	2	-	-	-	-	-
203	-	-	-	-	-	-	-	-	-	-	-	-	-
204	-	-	-	1	-	1	-	-	-	-	1	2	-
205	-	-	-	-	-	-	-	-	-	-	-	-	-
206	2	-	-	-	-	-	1	1	-	-	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	1	-	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-	-	1
210	-	-	-	-	-	-	-	-	-	-	-	2	-
211	-	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	1	-	-	-	-	-	-	-	-	-
213	-	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	-	-	-	-	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-	-	-	-	1	-
217	-	-	-	-	-	-	-	-	-	-	-	-	-
n	4	-	3	2	11	15	4	14	4	-	15	7	11

[a]Julian dates are adjusted by one day in leap years.

Table 93 (continued). Frequency distribution of hatch dates for tufted puffins at Buldir Island, Alaska. Data include only nests in which observations of egg to chick ≤ 7 days.

Julian date[a]	No. nests hatching on Julian date											
	01	02	03	04	05	06	07	08	09	10	11	12
178	-	-	-	-	-	-	-	-	-	-	*no data*	-
179	-	-	-	-	-	-	-	-	-	-		-
180	-	-	-	-	-	-	-	-	-	-	-	-
181	-	-	-	-	-	-	-	-	-	-	-	-
182	-	2	-	2	-	2	-	2	-	1	-	-
183	-	-	-	-	-	-	-	-	-	-	-	-
184	-	1	-	-	-	-	-	-	-	-	-	-
185	-	-	-	-	-	1	-	1	-	-	-	-
186	-	2	-	1	-	-	-	-	-	1	-	-
187	-	-	-	-	-	-	-	5	-	-	-	-
188	-	-	-	2	-	-	-	-	-	-	-	-
189	-	-	-	-	-	-	-	-	-	-	-	3
190	-	1	-	-	-	-	-	-	-	4	-	-
191	-	2	-	-	-	-	-	-	-	-	-	-
192	-	-	-	1	-	2	-	-	-	-	-	-
193	-	-	-	-	-	-	-	1	-	-	-	-
194	-	-	-	1	-	-	-	-	-	-	-	-
195	-	2	-	-	-	-	-	-	-	-	-	-
196	-	-	1	2	-	-	-	-	-	-	-	-
197	-	-	-	-	-	-	-	-	-	1	-	-
198	-	-	-	1	-	-	-	-	-	1	-	-
199	-	-	-	-	-	-	-	-	-	2	-	-
200	-	-	-	-	-	-	-	-	-	-	-	-
201	1	-	-	-	-	-	-	-	-	-	-	-
202	-	-	-	-	2	-	-	-	3	-	-	-
203	-	1	-	-	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	1	-	-	-	-	-
205	-	-	-	-	-	-	-	1	-	-	-	-
206	-	1	-	-	-	-	-	-	1	-	-	-
207	-	-	-	-	-	-	-	-	-	-	-	-
208	-	-	1	-	-	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	1	-	-	1
211	-	-	-	-	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	-	-	-	-	-	-
213	-	-	-	-	-	-	-	-	-	-	-	-
214	-	-	-	-	-	-	-	-	-	-	-	-
215	-	-	-	-	-	-	-	-	-	-	-	-
216	-	1	-	-	-	-	-	-	-	-	-	-
217	-	-	-	-	-	-	-	1	-	-	-	-
n	1	13	2	10	2	5	1	11	5	10	-	4

[a]Julian dates are adjusted by one day in leap years.

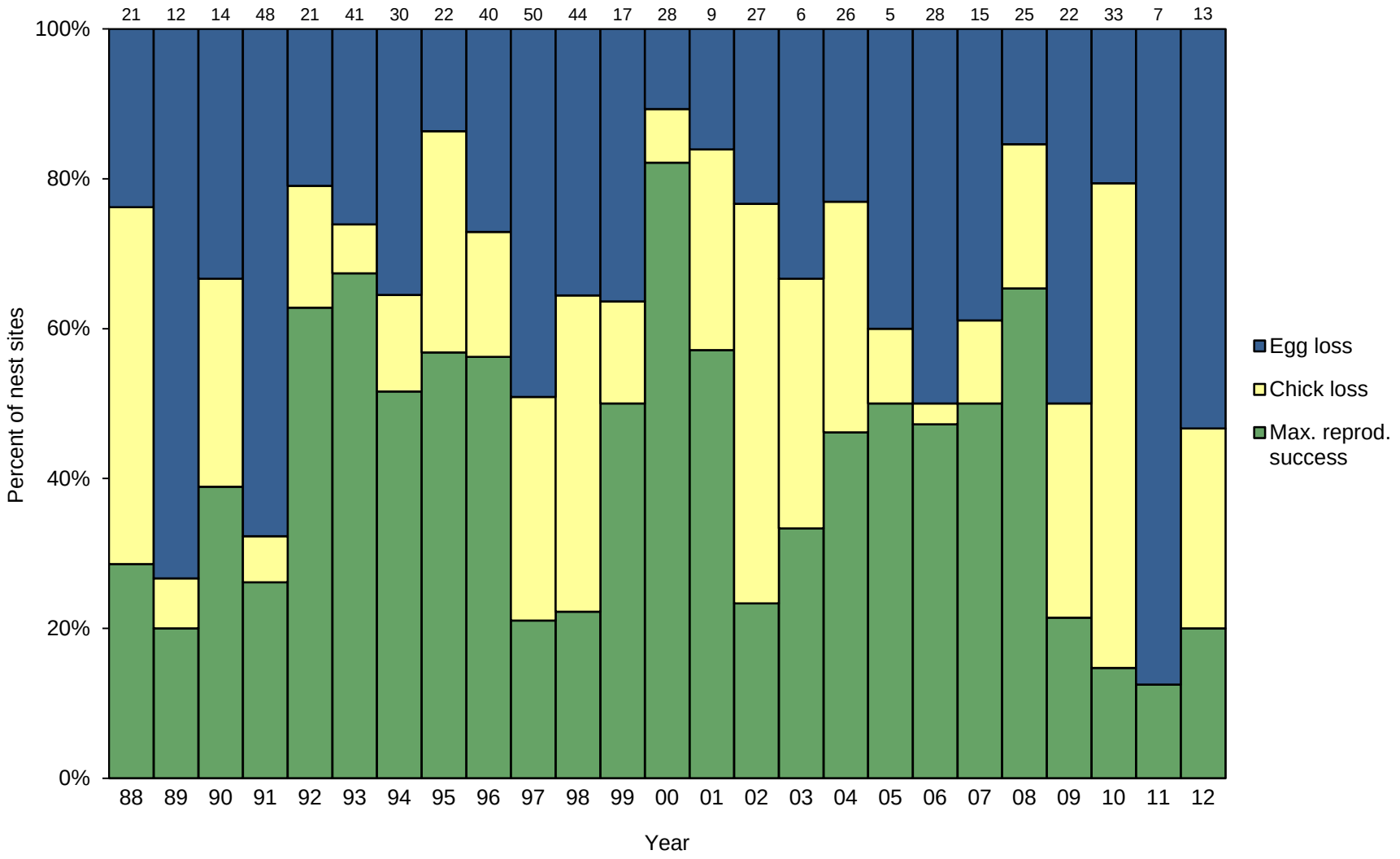

Figure 63. Reproductive performance of tufted puffins at Buldir Island, Alaska. Values represent maximum potential success, including nest sites with chicks too young to consider fledged at the last check. Egg loss=[(B+H)-D+H]/(D+H); Chick loss=[(D+H)-F+H]/(B+H); Maximum potential reproductive success=[(F+H)/(B+H)], 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).

Table 94. Reproductive performance of tufted puffins at Buldir Island, Alaska.

Year	Nest sites w/ eggs (B)	Nest sites w/ chicks (D)	Nest sites w/ chicks fledged (F)	Nest sites w/ young chicks still present[a] (H)	Nesting success (D/B)[b]	Fledging success (F/D)[c]	Reproductive success (F/B)	Max. potential nesting success[d] [(D+H)/(B+H)]	Max. potential fledging success[d] [(F+H)/(D+H)]	Max. potential reproductive success[d] [(F+H)/(B+H)]
1988	21	16	6	0	0.76	0.38	0.29	0.76	0.38	0.29
1989	12	1	0	3	0.08	0.00	0.00	0.27	0.75	0.20
1990	14	8	3	4	0.57	0.38	0.21	0.67	0.58	0.39
1991	48	4	0	17	0.08	0.00	0.00	0.32	0.81	0.26
1992	21	12	5	22	0.57	0.42	0.24	0.79	0.79	0.63
1993	41	29	26	5	0.71	0.90	0.63	0.74	0.91	0.67
1994	30	19	15	1	0.63	0.79	0.50	0.65	0.80	0.52
1995	22	16	3	22	0.73	0.19	0.14	0.86	0.66	0.57
1996	40	27	19	8	0.68	0.70	0.48	0.73	0.77	0.56
1997	50	22	5	7	0.44	0.23	0.10	0.51	0.41	0.21
1998	44	28	9	1	0.64	0.32	0.20	0.64	0.34	0.22
1999	17	9	6	5	0.53	0.67	0.35	0.64	0.79	0.50
2000	28	25	23	0	0.89	0.92	0.82	0.89	0.92	0.82
2001	9	2	1	21	0.22	0.50	0.11	0.77	0.96	0.73
2002	27	20	4	3	0.74	0.20	0.15	0.77	0.30	0.23
2003	6	4	2	0	0.67	0.50	0.33	0.67	0.50	0.33
2004	26	20	12	0	0.77	0.60	0.46	0.77	0.60	0.46
2005	5	1	0	5	0.20	0.00	0.00	0.60	0.83	0.50
2006	28	10	9	8	0.36	0.90	0.32	0.50	0.94	0.47
2007	15	8	6	3	0.53	0.75	0.40	0.61	0.82	0.50
2008	25	21	16	1	0.84	0.76	0.64	0.85	0.77	0.65
2009	22	8	0	6	0.36	0.00	0.00	0.50	0.43	0.21
2010	33	26	4	1	0.79	0.15	0.12	0.79	0.19	0.15
2011	7	0	0	1	0.00	0.00	0.00	0.13	1.00	0.13
2012	13	5	1	2	0.38	0.20	0.08	0.47	0.43	0.20

[a]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.

[b]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).

[c]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).

[d]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.

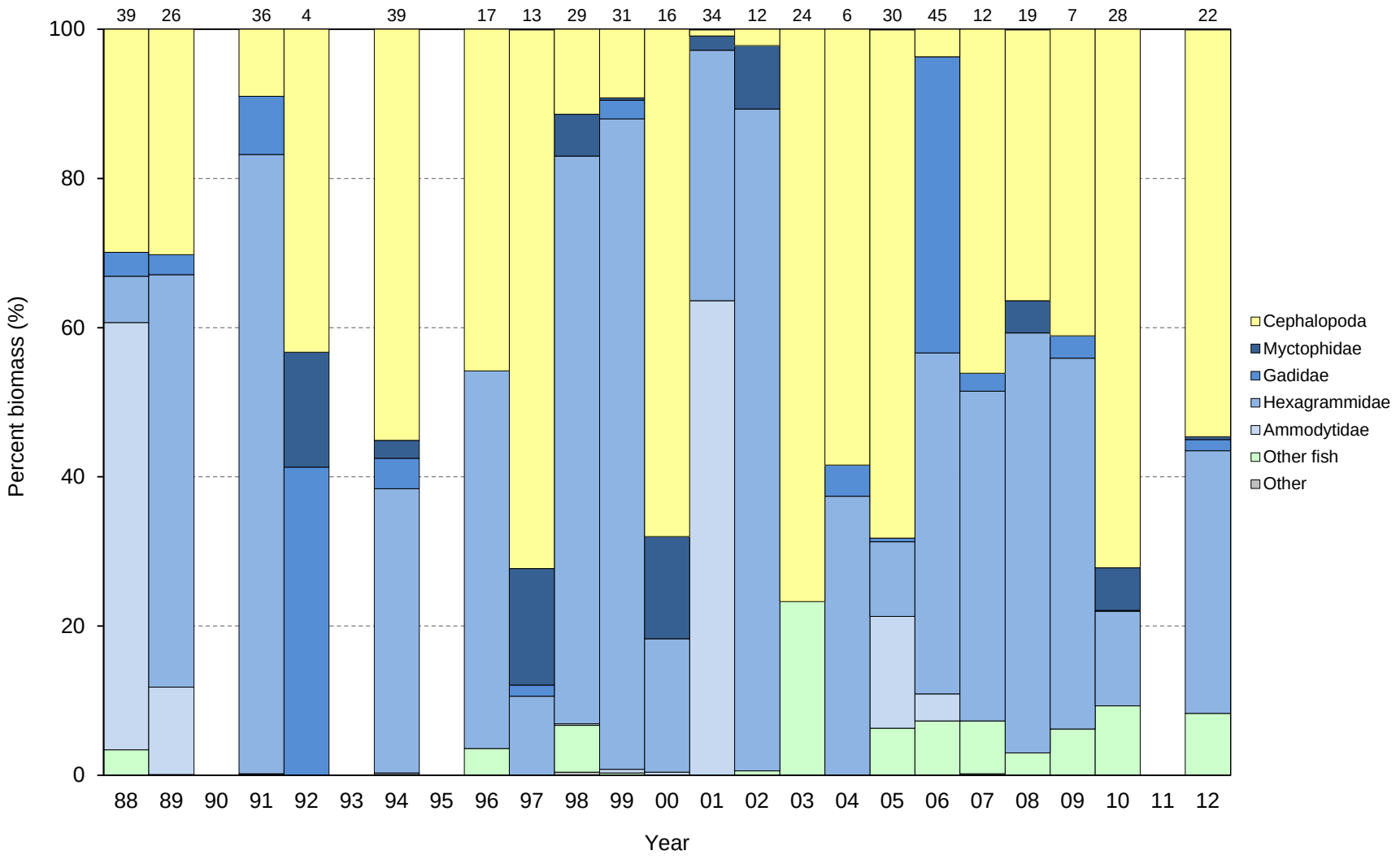

Figure 64. Relative biomass of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

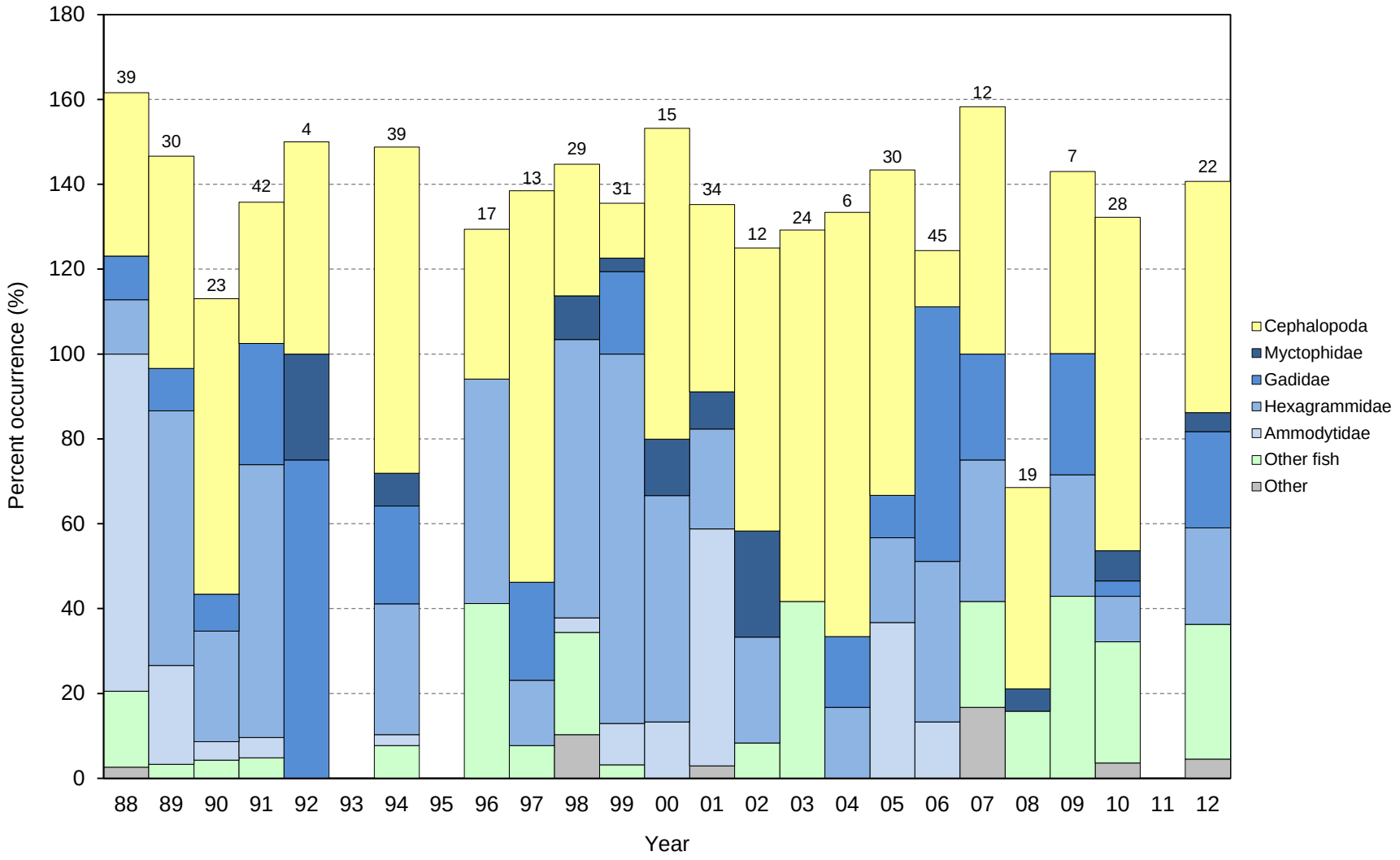

Figure 65. Frequency of occurrence of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

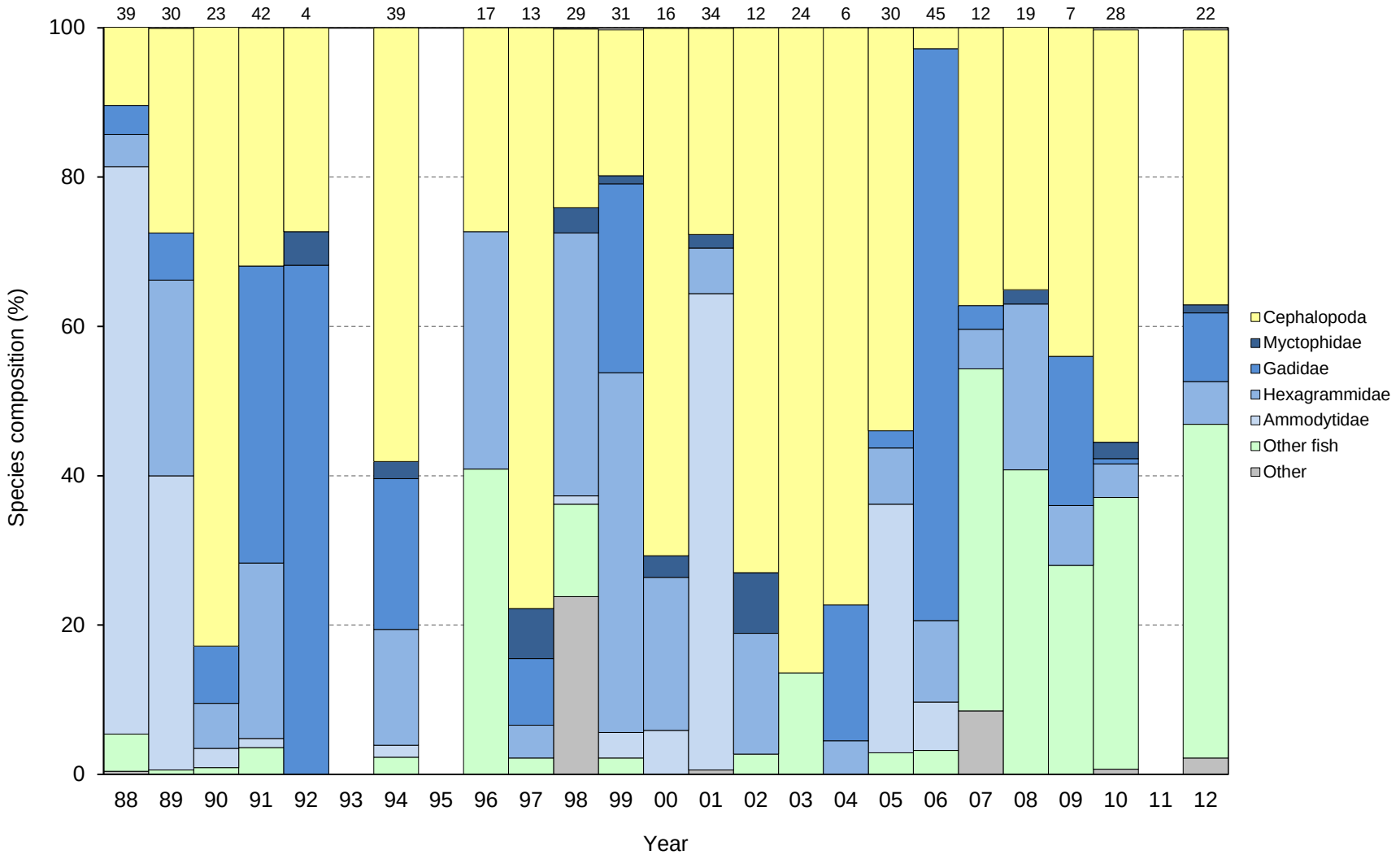

Figure 66. Species composition of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 95. Relative biomass of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	1988	1989	1990	1991	1992	1993	1994	1995	1996
No. samples[a]	39	26	*no mass*	36	4	*no*	39	*no*	17
Total mass (g)	279.2	376.5	*data*	608.2	48.7	*samples*	649.7	*samples*	196.2
Invertebrates	**29.9**	**30.2**	**-**	**9.0**	**43.3**	**-**	**55.1**	**-**	**45.8**
Cephalopoda	**29.9**	**30.2**	**-**	**9.0**	**43.3**	**-**	**55.1**	**-**	**45.8**
Dechabrachia	**29.9**	**30.2**	**-**	**9.0**	**43.3**	**-**	**55.1**	**-**	**45.8**
Gonatus middendorffi	-	-	-	-	-	-	-	-	32.5
Berryteuthis magister	-	-	-	-	-	-	-	-	6.7
Gonatopsis makko	-	-	-	-	-	-	-	-	-
Unid. squid	29.9	30.2	-	9.0	43.3	-	55.1	-	6.6
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Unid. Cephalopoda	-	-	-	-	-	-	-		
Euphausiaceae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thysanoessa longipes	-	-	-	-	-	-	-	-	-
T. spinifera	-	-	-	-	-	-	-	-	-
Thysanoessa spp.	-	-	-	-	-	-	-	-	-
Decapoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. shrimp	-	-	-	-	-	-	-	-	-
Fish	**70.1**	**69.8**	**-**	**91.0**	**56.7**	**-**	**44.9**	**-**	**54.2**
Salmonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Oncorhynchus spp.	-	-	-	-	-	-	-	-	-
Myctophidae	**-**	**-**	**-**	**-**	**15.4**	**-**	**2.4**	**-**	**-**
Stenobrachius leucopsarus	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	-	-	15.4	-	2.4	-	-
Gadidae	**3.2**	**2.7**	**-**	**7.8**	**41.3**	**-**	**4.1**	**-**	**-**
Theragra chalcogramma	3.2	2.7	-	7.8	41.3	-	4.1	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.4**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	1.4
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.4**
Anoplopoma fimbria	-	-		-	-		-		0.4
Hexagrammidae	**6.2**	**55.3**	**-**	**83.0**	**-**	**-**	**38.1**	**-**	**50.6**
Hexagrammos decagrammus	-	-	-	-	-	-	38.1	-	49.8
H. lagocephalus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	6.2	55.3	-	0.2	-	-	-	-	0.8
Pleurogrammus monopterygius	-	-	-	82.8	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.6**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Hemilepidotus spp.	-	-	-	-	-	-	-	-	0.6
Hemitripteridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Blepsias bilobus	-	-	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Aspidophoroides monopterygius	-	-	-	-	-	-	-	-	-
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ptilichthyidae	**-**	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ptilichthys goodei	-	0.1	-	-	-	-	-	-	-
Ammodytidae	**57.3**	**11.7**	**-**	**0.1**	**-**	**-**	**0.2**	**-**	**-**
Ammodytes hexapterus	57.3	11.7	-	0.1	-	-	0.2	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Chirolophis spp.	-	-	-	-	-	-	-	-	-
Pleuronectidae	**-**	**-**	**-**	**-**	**-**	**-**	**0.1**	**-**	**0.4**
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	-	-	-	-	0.1	-	0.4
Unid. Teleostei	3.5	-	-	0.1	-	-	-	-	0.8
Unid. prey	-	-	-	-	-	-	-	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 96) and species composition (Table 97) and some prey types may not appear in biomass data although they were present in diet samples.

Table 95 (continued). Relative biomass of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples[a]	13	29	31	16	34	12	24	6	30
Total mass (g)	227.1	371	464.2	129.8	327.1	74.4	454.5	64.9	18.4
Invertebrates	**72.2**	**12.0**	**9.2**	**68.0**	**0.8**	**2.2**	**76.7**	**58.4**	**68.1**
Cephalopoda	**72.2**	**11.4**	**9.2**	**68.0**	**0.8**	**2.2**	**76.7**	**58.4**	**68.1**
Dechabrachia	**72.2**	**11.4**	**9.2**	**68.0**	**0.8**	**2.2**	**76.7**	**58.4**	**68.1**
Gonatus middendorffi	71.8	-	-	-	-	-	76.7	-	-
Berryteuthis magister	-	-	-	-	-	-	-	-	-
Gonatopsis makko	0.4	-	-	-	-	-	-	-	-
Unid. squid	-	11.4	9.2	68.0	0.8	2.2	-	58.4	68.1
Octopoda	-	-	-	-	-	-	-	-	-
Unid. octopus	-	-	-	-	-	-	-	-	-
Unid. Cephalopoda	-	-	-	-	-	-	-		
Euphausiaceae	**-**	**0.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thysanoessa longipes	-	0.4	-	-	-	-	-	-	-
T. spinifera	-	-	-	-	-	-	-	-	-
Thysanoessa spp.	-	0.2	-	-	-	-	-	-	-
Decapoda	**-**	**-**	**-**	**-**	**<0.1**	**-**	**-**	**-**	**-**
Unid. shrimp	-	-	-	-	<0.1	-	-	-	-
Fish	**27.8**	**88.0**	**90.8**	**32.0**	**99.2**	**97.8**	**23.3**	**41.6**	**31.9**
Salmonidae	-	-	-	-	-	-	-	-	-
Oncorhynchus spp.	-	-	-	-	-	-	-	-	-
Myctophidae	**15.6**	**5.6**	**0.3**	**13.7**	**1.9**	**8.5**	**-**	**-**	**-**
Stenobrachius leucopsarus	15.6	1.8	-	-	-	-	-	-	-
Unid. Myctophidae	-	3.8	0.3	13.7	1.9	8.5	-	-	-
Gadidae	**1.5**	**-**	**2.5**	**-**	**-**	**-**	**-**	**4.2**	**0.5**
Theragra chalcogramma	1.5	-	2.5	-	-	-	-	4.2	0.5
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	0.1	-	-	-	-	-	-	-
Anoplopomatidae	-	-	-	-	-	-	-	-	-
Anoplopoma fimbria	-	-	-	-	-	-	-	-	-
Hexagrammidae	**10.6**	**76.1**	**87.2**	**17.9**	**33.6**	**88.7**	**-**	**37.4**	**10.0**
Hexagrammos decagrammus	10.6	29.7	5.1	9.2	33.6	88.7	-	37.4	10.0
H. lagocephalus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	-	-	-	2.5	-	-	-	-	-
Pleurogrammus monopterygius	-	46.4	82.1	6.2	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Hemilepidotus spp.	-	-	-	-	-	-	-	-	-
Hemitripteridae	**-**	**0.4**	**0.3**	**-**	**-**	**-**	**-**	**-**	**-**
Blepsias bilobus	-	0.4	0.3	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Aspidophoroides monopterygius	-	-	-	-	-	-	-	-	-
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**0.1**	**-**	**-**	**-**	**-**	**-**	**6.3**
Zaprora silenus	-	-	0.1	-	-	-	-	-	6.3
Ptilichthyidae	-	**0.1**	-	-	-	-	-	-	-
Ptilichthys goodei	-	0.1	-	-	-	-	-	-	-
Ammodytidae	**-**	**0.2**	**0.5**	**0.4**	**63.6**	**-**	**-**	**-**	**15.0**
Ammodytes hexapterus	-	0.2	0.5	0.4	63.6	-	-	-	15.0
Stichaeidae	-	-	-	-	-	-	-	-	-
Chirolophis spp.	-	-	-	-	-	-	-	-	-
Pleuronectidae	-	**0.2**	-	-	-	-	-	-	-
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	0.2	-	-	-	-	-	-	-
Unid. Teleostei	-	5.5	-	-	-	0.7	23.3	-	-
Unid. prey	-	-	-	-	-	-	-	-	-

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 96) and species composition (Table 97) and some prey types may not appear in biomass data although they were present in diet samples.

Table 95 (continued). Relative biomass of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	2006	2007	2008	2009	2010	2011	2012
No. samples[a]	45	12	19	7	28	*no samples*	22
Total mass (g)	475.2	140.0	153.3	51.3	232.6		159.9
Invertebrates	**3.7**	**46.3**	**36.3**	**41.1**	**72.2**	**-**	**54.5**
Cephalopoda	**3.7**	**46.1**	**36.3**	**41.1**	**72.2**	**-**	**54.5**
Dechabrachia	**3.7**	**45.8**	**36.3**	**41.1**	**72.0**	**-**	**54.5**
Gonatus middendorffi	-	-	-	-	-	-	-
Berryteuthis magister	-	-	-	-	-	-	-
Gonatopsis makko	-	-	-	-	-	-	-
Unid. squid	3.7	45.8	36.3	41.1	72.0	-	54.5
Octopoda	**-**	**0.2**	**-**	**-**	**0.2**	**-**	**-**
Unid. octopus	-	0.2	-	-	0.2	-	-
Unid. Cephalopoda	-	<0.1	-	-	-	-	-
Euphausiaceae	**-**	**0.2**	**-**	**-**	**<0.1**	**-**	**<0.1**
Thysanoessa longipes	-	-	-	-	-	-	-
T. spinifera	-	0.2	-	-	<0.1	-	<0.1
Thysanoessa spp.	-	<0.1	-	-	-	-	-
Decapoda	-	-	-	-	-	-	-
Unid. shrimp	-	-	-	-	-	-	-
Fish	**96.3**	**53.7**	**63.7**	**58.9**	**27.8**	**-**	**45.5**
Salmonidae	**-**	**-**	**-**	**-**	**4.8**	**-**	**-**
Oncorhynchus spp.	-	-	-	-	4.8	-	-
Myctophidae	**-**	**-**	**4.3**	**-**	**5.7**	**-**	**0.4**
Stenobrachius leucopsarus	-	-	-	-	5.7	-	-
Unid. Myctophidae	-	-	4.3	-	-	-	0.4
Gadidae	**39.7**	**2.4**	**-**	**3.0**	**0.1**	**-**	**1.5**
Theragra chalcogramma	39.7	2.2	-	-	0.1	-	1.5
Unid. Gadidae	-	0.2	-	3.0	-	-	-
Scorpaenidae	**-**	**0.6**	**-**	**1.1**	**0.1**	**-**	**-**
Unid. Scorpaenidae	-	0.6	-	1.1	0.1	-	-
Anoplopomatidae	**-**	**0.2**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	0.2	-	-	-	-	-
Hexagrammidae	**45.7**	**44.2**	**56.3**	**49.7**	**12.7**	**-**	**35.2**
Hexagrammos decagrammus	45.7	-	-	-	-	-	-
H. lagocephalus	-	-	-	-	-	-	2.2
Hexagrammos spp.	-	-	-	-	-	-	-
Pleurogrammus monopterygius	-	44.2	56.3	49.7	12.7	-	33.0
Cottidae	**-**	**5.3**	**2.7**	**-**	**3.6**	**-**	**0.7**
Hemilepidotus hemilepidotus	-	1.3	0.3	-	0.3	-	0.1
H. jordani	-	4.0	2.3	-	2.1	-	0.5
Hemilepidotus spp.	-	-	-	-	1.3	-	-
Hemitripteridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Blepsias bilobus	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**0.2**	**-**	**-**	**0.1**
Aspidophoroides monopterygius	-	-	-	0.2	-	-	-
Unid. Agonidae	-	-	-	-	-	-	0.1
Zaproridae	**7.2**	**0.9**	**-**	**4.2**	**0.3**	**-**	**0.9**
Zaprora silenus	7.2	0.9	-	4.2	0.3	-	0.9
Ptilichthyidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ptilichthys goodei	-	-	-	-	-	-	-
Ammodytidae	**3.6**	**-**	**-**	**-**	**-**	**-**	**-**
Ammodytes hexapterus	3.6	-	-	-	-	-	-
Stichaeidae	**-**	**0.1**	**-**	**-**	**0.1**	**-**	**-**
Chirolophis spp.	-	0.1	-	-	0.1	-	-
Pleuronectidae	**-**	**-**	**0.4**	**0.7**	**0.3**	**-**	**3.5**
Reinhardtius stomias	-	-	0.4	0.7	0.3	-	3.5
Unid. Pleuronectidae	-	-	-	-	-	-	-
Unid. Teleostei	0.1	-	-	-	-	-	2.6
Unid. prey	-	-	<0.1	-	-	-	0.7

[a]Mass data are not always available for all samples; therefore, sample sizes for biomass may not equal those for frequency of occurrence (Table 95) and species composition (Table 96) and some prey types may not appear in biomass data although they were present in diet samples.

Table 96. Frequency of occurrence of prey in diet of tufted puffin chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	1988	1989	1990	1991	1992	1993	1994	1995	1996
No. samples	39	30	23	42	4	*no samples*	39	*no samples*	17
Invertebrates	**41.0**	**50.0**	**69.6**	**33.3**	**50.0**	**-**	**76.9**	**-**	**35.3**
Cephalopoda	**38.5**	**50.0**	**69.6**	**33.3**	**50.0**	**-**	**76.9**	**-**	**35.3**
Dechabrachia	**38.5**	**50.0**	**69.6**	**33.3**	**50.0**	**-**	**76.9**	**-**	**35.3**
Gonatus middendorffi	-	-	-	-	-	-	-	-	29.4
Berryteuthis magister	-	-	-	-	-	-	-	-	5.9
Gonatopsis makko	-	-	-	-	-	-	-	-	-
Unid. squid	38.5	50.0	69.6	33.3	50.0	-	76.9	-	5.9
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Unid. Cephalopoda	-	-	-	-	-	-	-		
Euphausiaceae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thysanoessa longipes	-	-	-	-	-	-	-	-	-
T. spinifera	-	-	-	-	-	-	-	-	-
Thysanoessa spp.	-	-	-	-	-	-	-	-	-
Decapoda	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. shrimp	2.6	-	-	-	-	-	-	-	-
Fish	**89.7**	**86.7**	**39.1**	**83.3**	**100.0**	**-**	**66.7**	**-**	**70.6**
Salmonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Oncorhynchus spp.	-	-	-	-	-	-	-	-	-
Myctophidae	**-**	**-**	**-**	**-**	**25.0**	**-**	**7.7**	**-**	**-**
Stenobrachius leucopsarus	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	-	-	25.0	-	7.7	-	-
Gadidae	**10.3**	**10.0**	**8.7**	**28.6**	**75.0**	**-**	**23.1**	**-**	**-**
Theragra chalcogramma	10.3	10.0	8.7	28.6	75.0	-	23.1	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**17.6**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	17.6
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5.9**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	5.9
Hexagrammidae	**12.8**	**60.0**	**26.1**	**64.3**	**-**	**-**	**30.8**	**-**	**52.9**
Hexagrammos decagrammus	-	6.7	-	-	-	-	30.8	-	47.1
H. lagocephalus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	12.8	53.3	-	4.8	-	-	-	-	11.8
Pleurogrammus monopterygius	-	-	26.1	59.5	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**11.8**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Hemilepidotus spp.	-	-	-	-	-	-	-	-	11.8
Hemitripteridae	-	-	-	-	-	-	-	-	-
Blepsias bilobus	-	-	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Aspidophoroides monopterygius	-	-	-	-	-	-	-	-	-
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ptilichthyidae	-	-	-	-	-	-	-	-	-
Ptilichthys goodei	-	3.3	-	-	-	-	-	-	-
Ammodytidae	**79.5**	**23.3**	**4.3**	**4.8**	**-**	**-**	**2.6**	**-**	**-**
Ammodytes hexapterus	79.5	23.3	4.3	4.8	-	-	2.6	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Chirolophis spp.	-	-	-	-	-	-	-	-	-
Pleuronectidae	**-**	**-**	**-**	**-**	**-**	**-**	**7.7**	**-**	**5.9**
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	-	-	-	-	7.7	-	5.9
Unid. Teleostei	17.9	-	4.3	4.8	-	-	-	-	23.5
Unid. prey	-	-	-	-	-	-	-	-	-

Table 96 (continued). Frequency of occurrence of prey in diet of tufted puffin chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals from those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	13	29	31	15	34	12	24	6	30
Invertebrates	**92.3**	**34.5**	**12.9**	**73.3**	**47.1**	**66.7**	**87.5**	**100.0**	**76.7**
Cephalopoda	**92.3**	**31.0**	**12.9**	**73.3**	**44.1**	**66.7**	**87.5**	**100.0**	**76.7**
Dechabrachia	**92.3**	**31.0**	**12.9**	**73.3**	**44.1**	**66.7**	**87.5**	**100.0**	**76.7**
Gonatus middendorffi	84.6	-	-	-	-	-	-	-	-
Berryteuthis magister	-	-	-	-	-	-	-	-	-
Gonatopsis makko	7.7	-	-	-	-	-	-	-	-
Unid. squid	-	31.0	12.9	73.3	44.1	66.7	87.5	100.0	76.7
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Unid. Cephalopoda	-	-	-	-	-	-	-		
Euphausiaceae	**-**	**10.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thysanoessa longipes	-	3.4	-	-	-	-	-	-	-
T. spinifera	-	-	-	-	-	-	-	-	-
Thysanoessa spp.	-	6.9	-	-	-	-	-	-	-
Decapoda	**-**	**-**	**-**	**-**	**2.9**	**-**	**-**	**-**	**-**
Unid. shrimp	-	-	-	-	2.9	-	-	-	-
Fish	**53.8**	**89.7**	**100.0**	**73.3**	**67.6**	**58.3**	**41.7**	**33.3**	**63.3**
Salmonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Oncorhynchus spp.	-	-	-	-	-	-	-	-	-
Myctophidae	**-**	**10.3**	**3.2**	**13.3**	**8.8**	**25.0**	**-**	**-**	**-**
Stenobrachius leucopsarus	15.4	3.4	-	-	-	-	-	-	-
Unid. Myctophidae	-	6.9	3.2	13.3	8.8	25.0	-	-	-
Gadidae	**23.1**	**-**	**19.4**	**-**	**-**	**-**	**-**	**16.7**	**10.0**
Theragra chalcogramma	23.1	-	19.4	-	-	-	-	16.7	10.0
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**3.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	3.4	-	-	-	-	-	-	-
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	-
Hexagrammidae	**15.4**	**65.6**	**87.1**	**53.3**	**23.5**	**25.0**	**-**	**16.7**	**20.0**
Hexagrammos decagrammus	15.4	51.7	25.8	13.3	23.5	25.0	-	16.7	20.0
H. lagocephalus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	-	-	-	33.3	-	-	-	-	-
Pleurogrammus monopterygius	-	27.6	61.3	13.3	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Hemilepidotus spp.	-	-	-	-	-	-	-	-	-
Hemitripteridae	**-**	**3.4**	**3.2**	**-**	**-**	**-**	**-**	**-**	**-**
Blepsias bilobus	-	3.4	3.2	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Aspidophoroides monopterygius	-	-	-	-	-	-	-	-	-
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**3.2**	**-**	**-**	**-**	**-**	**-**	**10.0**
Zaprora silenus	-	-	3.2	-	-	-	-	-	10.0
Ptilichthyidae	**-**	**3.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ptilichthys goodei	-	3.4	-	-	-	-	-	-	-
Ammodytidae	**-**	**3.4**	**9.7**	**13.3**	**55.9**	**-**	**-**	**-**	**36.7**
Ammodytes hexapterus	-	3.4	9.7	13.3	55.9	-	-	-	36.7
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Chirolophis spp.	-	-	-	-	-	-	-	-	-
Pleuronectidae	**-**	**3.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	3.4	-	-		-	-	-	-
Unid. Teleostei	7.7	17.2	-	-	-	8.3	41.7	-	3.3
Unid. prey	-	-	-	-	-	-	-	-	-

Table 96 (continued). Frequency of occurrence of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each prey item was present; values in bold are totals for those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	2006	2007	2008	2009	2010	2011	2012
No. samples	45	12	19	7	28	*no samples*	22
Invertebrates	**13.3**	**58.3**	**47.4**	**42.9**	**78.6**	**-**	**59.1**
Cephalopoda	**13.3**	**58.3**	**47.4**	**42.9**	**78.6**	**-**	**54.5**
Dechabrachia	**13.3**	**50.0**	**47.4**	**42.9**	**78.6**	**-**	**54.5**
Gonatus middendorffi	-	-	-	-	-	-	-
Berryteuthis magister	-	-	-	-	-	-	-
Gonatopsis makko	-	-	-	-	-	-	-
Unid. squid	13.3	50.0	47.4	42.9	78.6	-	54.5
Octopoda	**-**	**8.3**	**-**	**-**	**3.6**	**-**	**-**
Unid. octopus	-	8.3	-	-	3.6	-	-
Unid. Cephalopoda	-	8.3	-	-	-	-	-
Euphausiaceae	**-**	**16.7**	**-**	**-**	**3.6**	**-**	**4.5**
Thysanoessa longipes	-	-	-	-	-	-	-
T. spinifera	-	16.7	-	-	3.6	-	4.5
Thysanoessa spp.	-	8.3	-	-	-	-	-
Decapoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. shrimp	-	-	-	-	-	-	-
Fish	**95.6**	**83.3**	**73.7**	**100.0**	**64.3**	**-**	**59.1**
Salmonidae	**-**	**-**	**-**	**-**	**3.6**	**-**	**-**
Oncorhynchus spp.	-	-	-	-	3.6	-	-
Myctophidae	**-**	**-**	**5.3**	**-**	**7.1**	**-**	**4.5**
Stenobrachius leucopsarus	-	-	-	-	7.1	-	-
Unid. Myctophidae	-	-	5.3	-	-	-	4.5
Gadidae	**60.0**	**25.0**	**-**	**28.6**	**3.6**	**-**	**22.7**
Theragra chalcogramma	60.0	16.7	-	-	3.6	-	22.7
Unid. Gadidae	-	8.3	-	28.6	-	-	-
Scorpaenidae	**-**	**25.0**	**-**	**14.3**	**3.6**	**-**	**-**
Unid. Scorpaenidae	-	25.0	-	14.3	3.6	-	-
Anoplopomatidae	**-**	**8.3**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	8.3	-	-	-	-	-
Hexagrammidae	**37.8**	**33.3**	**-**	**28.6**	**10.7**	**-**	**22.7**
Hexagrammos decagrammus	37.8	-	42.1	-	-	-	-
H. lagocephalus	-	-	-	-	-	-	4.5
Hexagrammos spp.	-	-	-	-	-	-	18.2
Pleurogrammus monopterygius	-	33.3	42.1	28.6	10.7	-	-
Cottidae	**-**	**41.7**	**15.8**	**-**	**39.3**	**-**	**9.1**
Hemilepidotus hemilepidotus	-	16.7	10.5	-	10.7	-	4.5
H. jordani	-	41.7	10.5	-	32.1	-	9.1
Hemilepidotus spp.	-	-	-	-	10.7	-	-
Hemitripteridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Blepsias bilobus	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**14.3**	**-**	**-**	**4.5**
Aspidophoroides monopterygius	-	-	-	14.3	-	-	-
Unid. Agonidae	-	-	-	-	-	-	4.5
Zaproridae	**13.3**	**8.3**	**-**	**14.3**	**3.6**	**-**	**9.1**
Zaprora silenus	13.3	8.3	-	14.3	3.6	-	9.1
Ptilichthyidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ptilichthys goodei	-	-	-	-	-	-	-
Ammodytidae	**13.3**	**-**	**-**	**-**	**-**	**-**	**-**
Ammodytes hexapterus	13.3	-	-	-	-	-	-
Stichaeidae	**-**	**8.3**	**-**	**-**	**3.6**	**-**	**-**
Chirolophis spp.	-	8.3	-	-	3.6	-	-
Pleuronectidae	**-**	**-**	**15.8**	**14.3**	**17.9**	**-**	**22.7**
Reinhardtius stomias	-	-	15.8	14.3	17.9	-	22.7
Unid. Pleuronectidae	-	-	-	-	-	-	-
Unid. Teleostei	6.7	-	5.3	-	-	-	4.5
Unid. prey	-	-	-	-	-	-	4.5

Table 97. Species composition of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year) ; values in bold are totals for those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	1988	1989	1990	1991	1992	1993	1994	1995	1996
No. samples	39	30	23	42	4	*no*	39	*no*	17
No. individuals	258	175	117	166	22	*samples*	129	*samples*	66
Invertebrates	**10.9**	**27.4**	**82.9**	**31.9**	**27.3**	**-**	**58.1**	-	**27.3**
Cephalopoda	**10.5**	**27.4**	**82.9**	**31.9**	**27.3**	**-**	**58.1**	**-**	**27.3**
Dechabrachia	**10.5**	**27.4**	**82.9**	**31.9**	**27.3**	**-**	**58.1**	**-**	**27.3**
Gonatus middendorffi	-	-	-	-	-	-	-	-	22.7
Berryteuthis magister	-	-	-	-	-	-	-	-	1.5
Gonatopsis makko	-	-	-	-	-	-	-	-	-
Unid. squid	10.5	27.4	82.9	31.9	27.3	-	58.1	-	3.0
Octopoda	-	-	-	-	-	-	-	-	-
Unid. octopus	-	-	-	-	-	-	-	-	-
Unid. Cephalopoda	-	-	-	-	-	-	-	-	-
Euphausiaceae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thysanoessa longipes	-	-	-	-	-	-	-	-	-
T. spinifera	-	-	-	-	-	-	-	-	-
Thysanoessa spp.	-	-	-	-	-	-	-	-	-
Decapoda	**0.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. shrimp	0.4	-	-	-	-	-	-	-	-
Fish	**89.1**	**72.6**	**17.1**	**68.1**	**72.7**	**-**	**41.9**	**-**	**72.7**
Salmonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Oncorhynchus spp.	-	-	-	-	-	-	-	-	-
Myctophidae	**-**	**-**	**-**	**-**	**4.5**	**-**	**2.3**	**-**	**-**
Stenobrachius leucopsarus	-	-	-	-	-	-	-	-	-
Unid. Myctophidae	-	-	-	-	4.5	-	2.3	-	-
Gadidae	**3.9**	**6.3**	**7.7**	**39.8**	**68.2**	**-**	**20.2**	**-**	**-**
Theragra chalcogramma	3.9	6.3	7.7	39.8	68.2	-	20.2	-	-
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**18.2**
Unid. Scorpaenidae	-	-	-	-	-	-	-	-	18.2
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	1.5
Hexagrammidae	**4.3**	**26.2**	**6.0**	**23.5**	**-**	**-**	**15.5**		**31.8**
Hexagrammos decagrammus	-	1.1	-	-	-	-	15.5	-	27.3
H. lagocephalus		-							
Hexagrammos spp.	4.3	25.1	-	1.2	-	-	-	-	4.5
Pleurogrammus monopterygius	-	-	6.0	22.3	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6.1**
Hemilepidotus hemilepidotus	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-
H. jordani	-	-	-	-	-	-	-	-	-
Hemilepidotus spp.	-	-	-	-	-	-	-	-	6.1
Hemitripteridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Blepsias bilobus	-	-	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Aspidophoroides monopterygius	-	-	-	-	-	-	-	-	-
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Zaprora silenus	-	-	-	-	-	-	-	-	-
Ptilichthyidae	**-**	**0.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ptilichthys goodei	-	0.6	-	-	-	-	-	-	-
Ammodytidae	**76.0**	**39.4**	**2.6**	**1.2**	**-**	**-**	**1.6**	**-**	**-**
Ammodytes hexapterus	76.0	39.4	2.6	1.2	-	-	1.6	-	-
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Chirolophis spp.	-	-	-	-	-	-	-	-	-
Pleuronectidae	**-**	**-**	**-**	**-**	**-**	**-**	**2.3**	**-**	**4.5**
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	-	-	-	-	-	2.3	-	4.5
Unid. Teleostei	5.0	-	0.9	3.6	-	-	-	-	10.6
Unid. prey	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table 97 (continued). Species composition of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	13	29	31	16	34	12	24	6	30
No. individuals	45	88	87	68	163	37	103	22	174
Invertebrates	**77.8**	**47.7**	**19.5**	**70.6**	**28.2**	**73.0**	**86.4**	**77.7**	**54.0**
Cephalopoda	**77.8**	**23.9**	**19.5**	**70.6**	**27.6**	**73.0**	**86.4**	**77.3**	**54.0**
Dechabrachia	**77.8**	**23.9**	**19.5**	**70.6**	**27.6**	**73.0**	**86.4**	**77.3**	**54.0**
Gonatus middendorffi	75.6	-	-	-	-	-	-	-	-
Berryteuthis magister	-	-	-	-	-	-	-	-	-
Gonatopsis makko	2.2	-	-	-	-	-	-	-	-
Unid. squid	-	23.9	19.5	70.6	27.6	73.0	86.4	77.3	54.0
Octopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. octopus	-	-	-	-	-	-	-	-	-
Unid. Cephalopoda	-	-	-	-	-	-	-	-	-
Euphausiaceae	**-**	**23.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Thysanoessa longipes	-	13.6	-	-	-	-	-	-	-
T. spinifera	-	-	-	-	-	-	-	-	-
Thysanoessa spp.	-	10.2	-	-	-	-	-	-	-
Decapoda	**-**	**-**	**-**	**-**	**0.6**	**-**	**-**	**-**	**-**
Unid. shrimp	-	-	-	-	0.6	-	-	-	-
Fish	**22.2**	**52.3**	**80.5**	**29.4**	**71.8**	**27.0**	**13.6**	**22.3**	**46.0**
Salmonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Oncorhynchus spp.	-	-	-	-	-	-	-	-	-
Myctophidae	**6.7**	**3.4**	**1.1**	**2.9**	**1.8**	**8.1**	**-**	**-**	**-**
Stenobrachius leucopsarus	6.7	1.1	-	-	-	-	-	-	-
Unid. Myctophidae	-	2.3	1.1	2.9	1.8	8.1	-	-	-
Gadidae	**8.9**	**-**	**25.3**	**-**	**-**	**-**	**-**	**18.2**	**2.3**
Theragra chalcogramma	8.9	-	25.3	-	-	-	-	18.2	2.3
Unid. Gadidae	-	-	-	-	-	-	-	-	-
Scorpaenidae	**-**	**1.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. Scorpaenidae	-	1.1	-	-	-	-	-	-	-
Anoplopomatidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	-	-	-	-	-	-	-	-
Hexagrammidae	**4.4**	**35.2**	**48.2**	**20.5**	**6.1**	**16.2**	**-**	**4.5**	**7.5**
Hexagrammos decagrammus	4.4	22.7	10.3	2.9	6.1	16.2	-	4.5	7.5
H. lagocephalus	-	-	-	-	-	-	-	-	-
Hexagrammos spp.	-	-	-	14.7	-	-	-	-	-
Pleurogrammus monopterygius	-	12.5	37.9	2.9	-	-	-	-	-
Cottidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hemilepidotus hemilepidotus	-	-	-	-	-	-	-	-	-
H. jordani	-	-	-	-	-	-	-	-	-
Hemilepidotus spp.	-	-	-	-	-	-	-	-	-
Hemitripteridae	**-**	**1.1**	**1.1**	**-**	**-**	**-**	**-**	**-**	**-**
Blepsias bilobus	-	1.1	1.1	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Aspidophoroides monopterygius	-	-	-	-	-	-	-	-	-
Unid. Agonidae	-	-	-	-	-	-	-	-	-
Zaproridae	**-**	**-**	**1.1**	**-**	**-**	**-**	**-**	**-**	**2.3**
Zaprora silenus	-	-	1.1	-	-	-	-	-	2.3
Ptilichthyidae	**-**	**1.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ptilichthys goodei	-	1.1	-	-	-	-	-	-	-
Ammodytidae	**-**	**1.1**	**3.4**	**5.9**	**63.8**	**-**	**-**	**-**	**33.3**
Ammodytes hexapterus	-	1.1	3.4	5.9	63.8	-	-	-	33.3
Stichaeidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Chirolophis spp.	-	-	-	-	-	-	-	-	-
Pleuronectidae	**-**	**2.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Reinhardtius stomias	-	-	-	-	-	-	-	-	-
Unid. Pleuronectidae	-	2.3	-	-	-	-	-	-	-
Unid. Teleostei	2.2	6.8	-	-	-	2.7	13.6	-	0.6
Unid. prey	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table 97 (continued). Species composition of prey in diets of tufted puffin chicks at Buldir Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each prey item (sums to 100% each year); values in bold are totals for those taxa. Samples consist of bill loads observed (1990) and collected from (1988-1989 and 1991-2012) adults returning to the colony to feed chicks; prey were identified and measured in the field (1990 and 2003) and the laboratory (1988-1989, 1991-2002, and 2004-2012).

Prey	2006	2007	2008	2009	2010	2011	2012
No. samples	45	12	19	7	28	*no samples*	22
No. individuals	248	94	54	25	134		87
Invertebrates	**2.8**	**43.6**	**35.2**	**44.0**	**55.9**	**-**	**37.9**
Cephalopoda	**2.8**	**37.2**	**35.2**	**44.0**	**55.2**	**-**	**36.8**
Dechabrachia	**2.8**	**33.0**	**35.2**	**44.0**	**54.5**	**-**	**36.8**
Gonatus middendorffi	-	-	-	-	-	-	-
Berryteuthis magister	-	-	-	-	-	-	-
Gonatopsis makko	-	-	-	-	-	-	-
Unid. squid	2.8	33.0	35.2	44.0	54.5	-	36.8
Octopoda	**-**	**2.1**	**-**	**-**	**0.7**	**-**	**-**
Unid. octopus	-	2.1	-	-	0.7	-	-
Unid. Cephalopoda	-	2.1	-	-	-	-	-
Euphausiaceae	**-**	**8.5**	**-**	**-**	**0.7**	**-**	**1.1**
Thysanoessa longipes	-	-	-	-	-	-	-
T. spinifera	-	7.4	-	-	0.7	-	1.1
Thysanoessa spp.	-	1.1	-	-	-	-	-
Decapoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unid. shrimp	-	-	-	-	-	-	-
Fish	**97.2**	**56.4**	**64.8**	**56.0**	**44.1**	**-**	**62.1**
Salmonidae	**-**	**-**	**-**	**-**	**0.7**	**-**	**-**
Oncorhynchus spp.	-	-	-	-	0.7	-	-
Myctophidae	**-**	**-**	**1.9**	**-**	**2.2**	**-**	**1.1**
Stenobrachius leucopsarus	-	-	-	-	2.2	-	-
Unid. Myctophidae	-	-	1.9	-	-	-	1.1
Gadidae	**76.6**	**3.2**	**-**	**20.0**	**0.7**	**-**	**9.2**
Theragra chalcogramma	76.6	2.1	-	-	0.7	-	9.2
Unid. Gadidae	-	1.1	-	20.0	-	-	-
Scorpaenidae	**-**	**10.6**	**-**	**16.0**	**0.7**	**-**	**-**
Unid. Scorpaenidae	-	10.6	-	16.0	0.7	-	-
Anoplopomatidae	**-**	**1.1**	**-**	**-**	**-**	**-**	**-**
Anoplopoma fimbria	-	1.1	-	-	-	-	-
Hexagrammidae	**10.9**	**5.3**	**22.2**	**8.0**	**4.5**	**-**	**5.7**
Hexagrammos decagrammus	10.9	-	-	-	-	-	-
H. lagocephalus		-	-	-	-	-	1.1
Hexagrammos spp.	-	-	-	-	-	-	-
Pleurogrammus monopterygius	-	5.3	22.2	8.0	4.5	-	4.6
Cottidae	**-**	**31.9**	**31.5**	**-**	**29.1**	**-**	**5.7**
Hemilepidotus hemilepidotus	-	9.6	5.6	-	3.0	-	1.1
H. jordani	-	22.3	25.9	-	15.7	-	4.6
Hemilepidotus spp.	-	-	-	-	10.4	-	-
Hemitripteridae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Blepsias bilobus	-	-	-	-	-	-	-
Agonidae	**-**	**-**	**-**	**4.0**	**-**	**-**	**1.1**
Aspidophoroides monopterygius	-	-	-	4.0	-	-	-
Unid. Agonidae	-	-	-	-	-	-	1.1
Zaproridae	**2.8**	**1.1**	**-**	**4.0**	**0.7**	**-**	**2.3**
Zaprora silenus	2.8	1.1	-	4.0	0.7	-	2.3
Ptilichthyidae	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Ptilichthys goodei	-	-	-	-	-	-	-
Ammodytidae	**6.5**	**-**	**-**	**-**	**-**	**-**	**-**
Ammodytes hexapterus	6.5	-	-	-	-	-	-
Stichaeidae	**-**	**1.1**	**-**	**-**	**1.5**	**-**	**-**
Chirolophis spp.	-	1.1	-	-	1.5	-	-
Pleuronectidae	**-**	**-**	**7.4**	**4.0**	**3.7**	**-**	**-**
Reinhardtius stomias	-	-	7.4	4.0	3.7	-	34.5
Unid. Pleuronectidae	-	-	-	-	-	-	-
Unid. Teleostei	0.4	-	1.9	-	-	-	1.1
Unid. prey	-	-	-	-	-	-	1.1

Table 98. Numbers of birds detected during off-road point count survey (route 315) at Buldir 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.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Aleutian cackling goose	133	112	85	22	*no count*	*no count*	70	2	76	*no count*	-	31	*no count*	*no count*	*no count*	*no count*	-	*no count*
Fork-tailed storm-petrel	6	0	1	1			0	0	0		0	-					0	
Leach's storm-petrel	0	1	0	0	-	-	0	0	0	-	0	-	-	-	-	-	0	-
Parasitic jaeger	2	2	8	5	-	-	1	2	1	-	0	8	-	-	-	-	0	-
Glaucous-winged gull	60	142	161	66	-	-	18	20	34	-	-	54	-	-	-	-	2	-
Parakeet auklet	1	3	12	0	-	-	1	0	0	-	0	-	-	-	-	-	0	-
Tufted puffin	0	0	0	1	-	-	0	0	0	-	0	-	-	-	-	-	0	-
Bald eagle	1	0	0	0	-	-	0	0	0	-	0	0	-	-	-	-	0	-
Peregrine falcon	0	0	0	0	-	-	0	0	0	-	0	1	-	-	-	-	0	-
Pacific wren	1	6	9	1	-	-	5	4	7	-	3	3	-	-	-	-	6	-
Song sparrow	10	10	8	3	-	-	2	1	2	-	9	5	-	-	-	-	5	-
Lapland longspur - total	30	26	22	14	-	-	18	31	18	-	22	30	-	-	-	-	9	-
male	24	22	17	11	-	-	-	-	13	-	17	-	-	-	-	-	3	-
female	5	3	3	0	-	-	-	-	0	-	5	-	-	-	-	-	0	-
unknown	1	1	2	3	-	-	18	31	5	-	0	-	-	-	-	-	6	-
Snow bunting	9	6	14	1	-	-	2	8	0	-	11	11	-	-	-	-	3	-
Rosy finch	2	4	1	9	-	-	1	5	0	-	7	4	-	-	-	-	9	-
Common rosefinch	0	0	1	0	-	-	0	0	0	-	0	0	-	-	-	-	0	-
Brambling	0	0	0	0	-	-	0	0	0	-	0	1	-	-	-	-	0	-
Date	8 Jun	9 Jun	12 Jun	18 Jun	-	-	12 Jun	17 Jun	14 Jun	-	15 Jun	15 Jun	-	-	-	-	15 Jun	-
Survey design[a]	xx[b]	xx	xx	xx	-	-	xx	xx	xx	-	xx	xx	-	-	-	-	B	-

[a]A=5-minute counts, < and > 50m; B=5-minute counts, distance estimation out to 400m.
[b]xx indicates data potentially exist but have not yet been summarized.

Table 99. Mean numbers of birds detected on beach transect surveys along North Bight Beach, Buldir Island, Alaska. Data represent species' presence but not necessarily absence in all years.

Species	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Harlequin duck	N/A[a]	N/A	xx[b]	N/A	N/A	N/A	*no count*	*no count*	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Horned grebe	0	0	xx	0	0	0			<1	0	0	0	0	0	0	0
Lesser sand (Mongolian) plover	0	0	xx	<1	0	0	-	-	0	0	0	<1	0	0	0	0
Wandering tattler	0	0	xx	<1	0	0	-	-	0	0	0	0	1	0	0	0
Wood sandpiper	0	0	xx	0	0	0	-	-	1	0	0	0	0	0	0	0
Whimbrel	0	0	xx	0	0	0	-	-	<1	0	0	0	0	0	0	0
Bar-tailed godwit	0	0	xx	0	<1	0	-	-	0	0	0	0	0	0	0	0
Ruddy turnstone	0	0	xx	<1	0	0	-	-	1	0	0	0	1	0	0	0
Red-necked stint	0	0	xx	0	0	0	-	-	<1	0	0	0	0	0	0	0
Rock sandpiper	0	<1	xx	0	0	0	-	-	0	0	0	0	0	0	0	0
Dunlin	0	<1	xx	0	0	0	-	-	0	0	0	0	0	0	0	0
Parasitic jaeger	0	0	xx	0	0	0	-	-	0	0	0	0	<1	0	0	0
Black-backed woodpecker	0	<1	xx	0	0	0	-	-	0	0	0	0	0	0	0	0
Pacific wren	2	2	xx	3	4	5	-	-	2	3	7	6	3	8	8	7
Lanceolated warbler	0	0	xx	0	0	0	-	-	0	0	<1	0	0	0	0	0
Eastern yellow wagtail	0	1	xx	<1	<1	0	-	-	0	<1	0	0	0	1	0	0
Song sparrow	8	2	xx	3	3	2	-	-	5	4	9	6	8	6	11	7
Lapland longspur	0	1	xx	1	<1	2	-	-	3	2	3	1	1	0	3	2
Gray-crowned rosy finch	<1	1	xx	2	0	0	-	-	3	1	1	2	4	6	8	8
n	5	5	xx	5	4	5	-	-	5	5	4	3	5	4	5	5
First survey	6 Jun	4 Jun	xx	5 Jun	1 Jun	8 Jun	-	-	7 Jun	2 Jun	7 Jun	4 Jun	2 Jun	1 Jun	6 Jun	7 Jun
Last survey	16 Jun	9 Jun	xx	12 Jun	14 Jun	14 Jun	-	-	16 Jun	12 Jun	14 Jun	8 Jun	14 Jun	13 Jun	19 Jun	15 Jun

[a]N/A indicates species may not have been counted during surveys, so presence is unknown.
[b]xx indicates data potentially exist but have not yet been summarized.

Table 100. Numbers of birds detected on beach transect along North Bight Beach, Buldir Island, Alaska in 2012.

Species	Date					Mean	SD
	7 Jun	12 Jun	13 Jun	14 Jun	15 Jun		
Pacific wren	5	6	7	7	8	7	1
Eastern yellow wagtail	0	0	0	0	0	0	0
Song sparrow	3	6	9	6	8	7	2
Lapland longspur	2	2	3	2	1	2	1
Gray-crowned rosy finch	5	7	9	8	10	8	2
Start time (AKST)	0715	0652	0710	0712	0715	-	-
End time (AKST)	0735	0715	0734	0730	0728	-	-

Table 101. Mean numbers of individuals found and encounter rates during COASST surveys along Transect A, Buldir Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and do 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 (0.8 km for Transect A) divided by the number of surveys.

Species	2006		2007		2008		2009		2010		2011		2012	
	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
Aleutian cackling goose	-	-	0.3	1.3	-	-	-	-	-	-	-	-	-	-
Greater scaup	-	-	-	-	-	-	-	-	-	-	0.2	1.0	-	-
Common eider	-	-	-	-	0.3	0.3	-	-	-	-	-	-	-	-
Laysan albatross	-	-	-	-	-	-	0.2	1.8	-	-	-	-	-	-
Northern fulmar	1.0	1.3	-	-	-	-	-	-	-	-	-	-	0.2	0.3
Fork-tailed storm-petrel	-	-	-	-	-	-	-	-	0.3	0.8	-	-	-	-
Leach's storm-petrel	-	-	-	-	-	-	0.2	0.3	0.5	0.6	-	-	-	-
Red-faced cormorant	-	-	0.3	0.9	-	-	0.2	1.3	-	-	-	-	-	-
Pelagic cormorant	-	-	0.3	0.6	0.3	0.9	0.6	3.5	0.2	0.4	-	-	-	-
Unidentified cormorant	-	-	0.3	0.3	-	-	-	-	-	-	0.2	0.3	-	-
Black-legged kittiwake	-	-	-	-	-	-	-	-	0.3	0.4	-	-	-	-
Herring gull	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-
Glaucous-winged gull	-	-	-	-	1.8	4.4	1.4	7.0	0.2	0.8	0.2	0.5	1.4	3.3
Unidentified gull	1.0	1.3	0.3	0.6	-	-	-	-	-	-	-	-	-	-
Common murre	-	-	0.3	0.3	-	-	-	-	-	-	-	-	-	-
Thick-billed murre	-	-	-	-	-	-	0.2	1.5	0.3	1.3	-	-	-	-
Unidentified murre	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.2
Pigeon guillemot	-	-	0.5	0.6	-	-	-	-	-	-	-	-	-	-
Ancient murrelet	-	-	-	-	0.5	0.9	0.4	0.5	0.2	0.2	-	-	1.1	1.5
Parakeet auklet	-	-	0.3	0.3	0.5	0.6	0.4	0.5	0.2	0.2	0.2	0.3	0.6	1.3
Least auklet	-	-	-	-	-	-	-	-	0.3	0.6	-	-	-	-
Crested auklet	1.0	1.3	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified auklet	-	-	-	-	0.5	0.9	-	-	-	-	0.2	0.8	0.2	0.3
Horned puffin	-	-	-	-	-	-	0.2	0.5	0.2	0.6	0.2	1.0	-	-
Tufted puffin	1.0	1.3	0.5	0.6	-	-	0.8	2.0	-	-	-	-	0.2	0.5
Unidentified alcid	-	-	0.5	0.6	-	-	-	-	-	-	-	-	-	-
All species	4.0	5.0	3.0	6.6	3.8	8.1	4.6	18.8	2.8	6.3	1.2	3.8	3.6	7.3
n	1		4		5		5		6		5		5	
First survey	15 Aug		7 Jun		31 May		4 Jun		5 Jun		10 Jun		1 Jun	
Last survey	-		25 Aug		2 Aug		19 Aug		20 Aug		17 Aug		9 Aug	

Table 102. Mean numbers of individuals found and encounter rates during COASST surveys along Transect B, Buldir Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and do 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 (0.5 km for Transect B) divided by the number of surveys.

Species	2006		2007		2008		2009		2010		2011		2012	
	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
Aleutian cackling goose	0.2	0.8	-	-	-	-	0.2	1.2	0.2	0.2	0.2	0.8	0.2	0.3
Common eider	-	-	-	-	-	-	-	-	0.3	0.4	-	-	-	-
Harlequin duck	-	-	-	-	0.3	1.0	-	-	-	-	-	-	-	-
Red-breasted merganser	-	-	-	-	-	-	-	-	-	-	0.2	0.5	-	-
Red-necked grebe	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.3
Laysan albatross	-	-	-	-	-	-	0.2	0.4	-	-	-	-	-	-
Northern fulmar	0.2	0.4	0.3	1.5	-	-	0.4	3.6	0.3	0.4	-	-	0.2	0.3
Short-tailed shearwater	0.2	0.4	-	-	-	-	0.2	1.2	0.2	0.2	-	-	-	-
Fork-tailed storm-petrel	-	-	-	-	-	-	-	-	0.3	1.0	-	-	-	-
Red-faced cormorant	-	-	-	-	0.3	1.0	-	-	-	-	0.2	0.3	-	-
Pelagic cormorant	-	-	-	-	0.3	1.0	0.2	2.0	0.2	0.2	0.2	0.8	-	-
Unidentified cormorant	0.2	0.4	0.3	1.5	0.3	1.0	-	-	-	-	-	-	-	-
Black-legged kittiwake	0.2	0.4	-	-	-	-	0.4	1.6	-	-	-	-	-	-
Unidentified kittiwake									0.2	0.2	-	-	-	-
Glaucous-winged gull	1.2	2.4	1.0	3.0	0.5	1.5	2.6	18.4	1.3	4.0	1.4	3.5	3.6	10.8
Unidentified gull	-	-	0.3	0.5	-	-	-	-	-	-	-	-	-	-
Common murre	-	-	-	-	-	-	0.2	0.4	-	-	-	-	-	-
Thick-billed murre	-	-	-	-	-	-	0.4	3.2	0.7	1.7	0.4	1.5	-	-
Unidentified murre	-	-	-	-	-	-	0.4	3.2	0.2	0.2	-	-	-	-
Ancient murrelet	-	-	-	-	-	-	0.2	0.4	-	-	-	-	-	-
Parakeet auklet	-	-	-	-	-	-	0.2	0.4	-	-	-	-	-	-
Whiskered auklet	-	-	-	-	-	-	-	-	-	-	0.2	0.3	-	-
Horned puffin	-	-	-	-	-	-	0.2	0.8	-	-	-	-	-	-
Tufted puffin	-	-	-	-	-	-	0.4	2.0	-	-	0.2	0.3	-	-
Unidentified bird	-	-	0.3	0.5	-	-	-	-	-	-	-	-	-	-
All species	2.2	4.8	2.0	7.0	1.5	5.0	6.2	38.8	3.8	8.5	3.0	7.8	4.2	12.0
n	5		4		4		5		6		5		5	
First survey	17 Jun		7 Jun		31 May		4 Jun		5 Jun		10 Jun		1 Jun	
Last survey	15 Aug		25 Aug		2 Aug		19 Aug		20 Aug		17 Aug		9 Aug	

Table 103. Mean numbers of individuals found and encounter rates during COASST surveys along Transect C, Buldir Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and do 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 km for Transect C) divided by the number of surveys.

Species	2006		2007		2008		2009		2010		2011		2012	
	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
Aleutian cackling goose	-	-	-	-	0.3	0.8	-	-	0.3	0.4	-	-	-	-
Pelagic cormorant	-	-	-	-	-	-	0.2	0.2	-	-	0.2	0.8	-	-
Unidentified cormorant	-	-	0.5	0.5	-	-	-	-	-	-	-	-	-	-
Peregrine falcon	-	-	0.5	1.3	-	-	-	-	-	-	-	-	-	-
Black-legged kittiwake	-	-	0.3	0.5	-	-	-	-	-	-	-	-	-	-
Red-legged kittiwake	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-
Unidentified kittiwake	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-
Glaucous-winged gull	1.0	1.0	0.3	0.8	0.3	0.5	0.4	0.6	0.2	0.2	0.4	0.5	0.6	0.6
Unidentified gull	-	-	0.3	0.8	-	-	-	-	-	-	-	-	-	-
Ancient murrelet	-	-	-	-	0.3	0.5	-	-	0.2	0.4	-	-	-	-
Parakeet auklet	-	-	0.3	0.3	0.3	0.3	-	-	-	-	-	-	-	-
Crested auklet	-	-	-	-	1.0	2.0	-	-	0.3	0.8	-	-	0.2	0.2
Unidentified auklet	-	-	-	-	1.3	2.3	-	-	-	-	-	-	-	-
Horned puffin	-	-	-	-	-	-	0.2	1.0	-	-	-	-	0.4	0.4
Tufted puffin	-	-	-	-	0.5	1.0	-	-	-	-	-	-	-	-
Unidentified puffin	-	-	0.5	0.5	0.3	0.5	-	-	-	-	-	-	-	-
All species	1.0	1.0	2.5	4.5	4.0	7.8	0.8	1.8	1.3	2.3	0.6	1.3	1.2	1.2
n	1		4		4		5		6		5		5	
First survey	15 Aug		13 Jun		31 May		4 Jun		5 Jun		11 Jun		1 Jun	
Last survey	-		20 Aug		2 Aug		19 Aug		20 Aug		17 Aug		9 Aug	

Table 104. Mean numbers of individuals found and encounter rates during COASST surveys along Transect D, Buldir Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and do 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 km for Transect D) divided by the number of surveys.

Species	2006		2007		2008		2009		2010		2011		2012	
	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
Aleutian cackling goose	-	-	0.5	1.0	-	-	0.3	0.7	0.2	0.2	*no survey*		*no survey*	
Northern fulmar	-	-	-	-	0.3	0.3	1.0	1.3	0.2	0.6	-	-	-	-
Fork-tailed storm-petrel	-	-	-	-	0.3	0.7	-	-	0.2	0.4	-	-	-	-
Leach's storm-petrel	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-
Pelagic cormorant	-	-	0.5	1.0	-	-	0.3	0.3	-	-	-	-	-	-
Unidentified cormorant	-	-	0.5	1.0	-	-	-	-	-	-	-	-	-	-
Bald eagle	-	-	0.5	1.0	-	-	-	-	-	-	-	-	-	-
Black-legged kittiwake	3.5	3.5	5.0	6.0	6.3	11.3	3.3	6.3	8.2	13.5	-	-	-	-
Red-legged kittiwake	-	-	-	-	1.0	1.7	-	-	0.5	0.8	-	-	-	-
Unidentified kittiwake	0.5	1.0	-	-	-	-	-	-	-	-	-	-	-	-
Glaucous-winged gull	0.5	0.5	-	-	0.7	0.7	0.3	0.7	0.5	1.3	-	-	-	-
Unidentified gull	-	-	1.0	1.0	-	-	-	-	-	-	-	-	-	-
Common murre	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-
Thick-billed murre	-	-	2.0	2.5	1.0	2.0	2.3	3.3	2.8	7.1	-	-	-	-
Unidentified murre	-	-	-	-	-	-	0.7	1.0	-	-	-	-	-	-
Ancient murrelet	-	-	0.5	0.5	0.3	0.3	-	-	-	-	-	-	-	-
Cassin's auklet	-	-	-	-	0.3	0.3	-	-	-	-	-	-	-	-
Parakeet auklet	1.0	1.0	1.0	1.0	1.0	1.3	2.0	2.0	3.2	6.7	-	-	-	-
Crested auklet	-	-	-	-	0.3	0.7	0.7	0.7	0.2	0.2	-	-	-	-
Unidentified auklet	-	-	-	-	0.3	0.7	-	-	-	-	-	-	-	-
Horned puffin	-	-	-	-	0.3	0.3	0.3	0.7	0.5	1.0	-	-	-	-
Tufted puffin	1.0	1.0	0.5	0.5	0.7	0.7	-	-	-	-	-	-	-	-
Unidentified alcid	-	-	2.5	2.5	1.0	0.7	-	-	-	-	-	-	-	-
All species	7.5	7.5	14.5	17.5	14.0	22.7	11.3	17.0	16.5	32.1	-	-	-	-
n	2		2		3		3		6		-		-	
First survey	12 Jun		11 Jun		16 Jun		5 Jun		11 Jun		-		-	
Last survey	17 Aug		11 Jul		29 Jul		1 Aug		21 Aug		-		-	

Table 105. Mean numbers of individuals found and encounter rates during COASST surveys along Transect E, Buldir Island, Alaska. Mean number of individuals comprises the average number of new birds found per survey and do 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 (1.4 km for Transect E) divided by the number of surveys.

Species	2006		2007		2008		2009		2010		2011		2012	
	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
Aleutian cackling goose	-	-	-	-	0.3	0.2	0.5	0.4	0.7	2.1	-	-	-	-
Laysan albatross	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.2
Northern fulmar	-	-	-	-	-	-	-	-	0.2	0.4	-	-	-	-
Unidentified shearwater	-	-	-	-	-	-	-	-	0.2	0.4	-	-	-	-
Fork-tailed storm-petrel	1.0	0.7	-	-	-	-	-	-	0.2	0.2	-	-	-	-
Leach's storm-petrel	-	-	-	-	-	-	-	-	-	-	0.3	0.4	-	-
Pelagic cormorant	-	-	1.0	0.7	0.3	0.7	-	-	0.2	0.4	-	-	0.3	0.2
Parasitic jaeger	-	-	-	-	-	-	0.5	0.4	-	-	-	-	-	-
Glaucous-winged gull	-	-	-	-	-	-	-	-	-	-	0.3	0.4	-	-
Common murre	-	-	-	-	-	-	0.5	0.4	-	-	-	-	-	-
Thick-billed murre	-	-	-	-	-	-	0.5	0.4	-	-	-	-	-	-
Ancient murrelet	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-
Parakeet auklet	-	-	-	-	0.3	0.7	-	-	1.0	1.3	-	-	0.3	0.2
Crested auklet	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.2
Unidentified auklet	-	-	-	-	0.7	0.7	-	-	-	-	-	-	-	-
Horned puffin	-	-	1.0	0.7	-	-	-	-	-	-	-	-	-	-
Tufted puffin	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-
Unidentified alcid	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-
All species	1.0	0.7	1.0	1.4	1.7	2.4	2.0	1.4	2.8	5.4	0.7	0.8	1.3	1.0
n	1		1		3		2		6		3		3	
First survey	15 Aug		5 Jun		2 Jun		11 Jun		6 Jun		7 Jun		1 Jun	
Last survey	-		-		12 Jul		4 Jul		17 Aug		15 Aug		5 Aug	

Table 106. Numbers of birds found during COASST surveys along Transect A, Buldir Island, Alaska in 2012. Data represent numbers of new individuals found each survey; numbers of birds still present and re-encountered on each survey are shown parentheses.

Species	Date										Individuals[a]			Encounters[b]	
	1 Jun		24 Jun		7 Jul		22 Jul		9 Aug		Total	Mean	SD	Total	Enc.rate[c]
Northern fulmar	0	(0)	0	(0)	0	(0)	1	(0)	0	(0)	1	0.2	0.4	1	0.3
Glaucous-winged gull	2	(0)	0	(1)	0	(2)	0	(1)	5	(2)	7	1.4	2.2	13	3.3
Unidentified murre	0	(0)	0	(0)	0	(0)	0	(0)	1	(0)	1	0.2	0.4	1	0.3
Ancient murrelet	0	(0)	0	(0)	0	(0)	2	(0)	2	(2)	4	0.8	1.1	6	1.5
Parakeet auklet	0	(0)	0	(0)	0	(0)	2	(0)	1	(2)	3	0.6	0.9	5	1.3
Unidentified auklet	0	(0)	0	(0)	0	(0)	0	(0)	1	(0)	1	0.2	0.4	1	0.3
Tufted puffin	0	(0)	0	(0)	1	(0)	0	(1)	0	(0)	1	0.2	0.4	2	0.5
Total new individuals	2		0		1		5		10		18	3.6	4.0	-	-
Total encounters	2		1		3		7		16		-	-	-	29	7.3

[a]Individuals represent new birds seen on surveys only and do not include birds still present and re-encountered on surveys.
[b]Encounters represent all birds seen on surveys, including both new individuals and all instances of re-encountered birds.
[c]Encounter rate = number of birds encountered / km beach surveyed (0.8 km for Transect A) / number of surveys.

Table 107. Numbers of birds found during COASST surveys along Transect B, Buldir Island, Alaska in 2012. Data represent numbers of new individuals found each survey; numbers of birds still present and re-encountered on each survey are shown parentheses.

Species	Date										Individuals[a]			Encounters[b]	
	1 Jun		24 Jun		7 Jul		22 Jul		9 Aug		Total	Mean	SD	Total	Enc.rate[c]
Aleutian cackling goose	0	(0)	0	(0)	0	(0)	1	(0)	0	(0)	1	0.2	0.4	1	0.3
Red-necked grebe	0	(0)	0	(0)	0	(0)	0	(0)	1	(0)	1	0.2	0.4	1	0.3
Northern fulmar	0	(0)	0	(0)	0	(0)	0	(0)	1	(0)	1	0.2	0.4	1	0.3
Glaucous-winged gull	1	(0)	0	(1)	1	(1)	3	(2)	13	(5)	18	3.6	5.4	27	10.8
Total new individuals	1		0		1		4		15		21	4.2	6.2	-	-
Total encounters	1		1		2		6		5		-	-	-	30	12.0

[a]Individuals represent new birds seen on surveys only and do not include birds still present and re-encountered on surveys.
[b]Encounters represent all birds seen on surveys, including both new individuals and all instances of re-encountered birds.
[c]Encounter rate = number of birds encountered / km beach surveyed (0.5 km for Transect B) / number of surveys.

Table 108. Numbers of birds found during COASST surveys along Transect C, Buldir Island, Alaska in 2012. Data represent numbers of new individuals found each survey; numbers of birds still present and re-encountered on each survey are shown parentheses.

Species	Date										Individuals[a]			Encounters[b]	
	1 Jun		24 Jun		7 Jul		22 Jul		9 Aug		Total	Mean	SD	Total	Enc.rate[c]
Glaucous-winged gull	0	(0)	0	(0)	0	(0)	1	(0)	2	(0)	3	0.6	0.9	3	0.6
Crested auklet	1	(0)	0	(0)	0	(0)	0	(0)	0	(0)	1	0.2	0.4	1	0.2
Horned puffin	0	(0)	0	(0)	1	(0)	1	(0)	0	(0)	2	0.4	0.5	2	0.4
Total new individuals	1		0		1		2		2		6	1.2	0.8	-	-
Total encounters	1		0		1		2		2		-	-	-	6	1.2

[a]Individuals represent new birds seen on surveys only and do not include birds still present and re-encountered on surveys.
[b]Encounters represent all birds seen on surveys, including both new individuals and all instances of re-encountered birds.
[c]Encounter rate = number of birds encountered / km beach surveyed (1 km for Transect C) / number of surveys.

Table 109. Numbers of birds found during COASST surveys along Transect E, Buldir Island, Alaska in 2012. Data represent numbers of new individuals found each survey; numbers of birds still present and re-encountered on each survey are shown parentheses.

Species	Date						Individuals[a]			Encounters[b]	
	1 Jun		22 Jul		5 Aug		Total	Mean	SD	Total	Enc. rate[c]
Laysan albatross	1	(0)	0	(0)	0	(0)	1	0.3	0.6	1	0.2
Pelagic cormorant	0	(0)	0	(0)	1	(0)	1	0.3	0.6	1	0.2
Parakeet auklet	0	(0)	1	(0)	0	(0)	1	0.3	0.6	1	0.2
Crested auklet	0	(0)	1	(0)	0	(0)	1	0.3	0.6	1	0.2
Total new individuals	1		2		1		4	1.3	0.6	-	-
Total encounters	1		2		1		-	-	-	4	1.0

[a]Individuals represent new birds seen on surveys only and do not include birds still present and re-encountered on surveys.
[b]Encounters represent all birds seen on surveys, including both new individuals and all instances of re-encountered birds.
[c]Encounter rate = number of birds encountered / km beach surveyed (1.4 km for Transect E) / number of surveys.

Table 110. Numbers of sea otters counted at Buldir Island, Alaska.

Year	Date(s)	Segment						Total	Survey type	Source
		A-B	B-C	C-D	D-E	E-F	F-A			
1959[a]	19 May	0	0	0	0	0	0	0	aerial	?
1962[b]	25-28 Jun	-	-	-	-	-	-	7	boat	Jones 1963
1963[c]	7-19 Jul	14		-	-	-	-	14	boat	Kenyon 1969
1965	2 May	-	-	-	-	-	-	15	aerial	Kenyon 1969
1972[d]	7 Jul	-	-	-	-	-	-	>27	boat	Byrd 1972
1974[e]	18 Jul	-	-	-	-	-	20	>20	boat	G. V. Byrd, unpubl. data
1979	23-24 Jun	4	2	0	4	11	15	36	boat	Day et al. 1979
1988[f]	26 Jun	-	-	-	-	-	-	95	boat	?
1989[g]	13 Jun	11	14	3	13	14	3	58	boat	USFWS unpubl. data
1990	*no data*	-	-	-	-	-	-	-	-	-
1991	*no data*	-	-	-	-	-	-	-	-	-
1992	April	-	-	-	-	-	-	11	aerial	Evans et al. 1997
1993	*no data*	-	-	-	-	-	-	-	-	-
1994	*no data*	-	-	-	-	-	-	-	-	-
1995	28 Jun	0	0	2	0	0	0	2	boat	USFWS unpubl. data
1996	*no data*	-	-	-	-	-	-	-	-	-
1997	3 Jun	-	-	-	-	-	-	4	boat	USFWS unpubl. data
1998	13 Jun	0	1	5	3	1	0	10	boat	USFWS unpubl. data
1999	1 Jul	0	0	0	0	2	2	4	boat	USFWS unpubl. data
2000	20 Jun	0	0	0	0	5	0	5	boat	USFWS unpubl. data
2001	5 Jun	0	0	0	0	0	0	0	boat	USFWS unpubl. data
2002	2 Jul	0	0	0	6	0	1	7	boat	USFWS unpubl. data
2003	*no data*	-	-	-	-	-	-	-	-	-
2004	*no data*	-	-	-	-	-	-	-	-	-
2005	10 Jun	0	0	-	-	-	0[h]	0	boat	USFWS unpubl. data
2006	7 Jun	0	0	0	0	0	0	0	boat	USFWS unpubl. data
2007	2 Jun	0	1	0	1	0	0	2	boat	USFWS unpubl. data
2008	3 Jun	0	0	0	0	0	0	0	boat	USFWS unpubl. data
2009	3 Jun	0	0	0	0	0	0	0	boat	USFWS unpubl. data
2010	*no data*	-	-	-	-	-	-	-	-	-
2011	*no data*	-	-	-	-	-	-	-	-	-
2012	*no data*	-	-	-	-	-	-	-	-	-

[a]Aerial count conducted in less than ideal conditions.
[b]Includes one male and three females with pups.
[c]Includes five females with pups and four lone adults along the north coast of the island (A-B and B-C).
[d]Partial count by boat around Northwest Point only.
[e]Partial count by boat.
[f]Partial count by boat from East Cape to Peregrine Point only (approximately C-D and D-E); includes 75 adults and 20 pups.
[g]Includes two pups.
[h]Partial count by boat from A to Bull Point only.

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 probably (observations of pairs or territorial behavior)
- Resident non-breeder: occurs throughout season but does not breed at site
- Migrant: through-migrant, recorded regularly but only during migratory period
- Vagrant: recorded outside known breeding, wintering, and migrating range (category added in 2012)

Birds

Aleutian cackling goose (*Branta hutchinsii leucopareia*). Abundant breeder. Frequently observed during May and June; geese become much less conspicuous between mid-July and early August, however, when they are flightless and seek cover in dense vegetation. During this time, many leave low-lying areas in favor of higher elevation sites. Sixteen nests were located in 2012. All nests were found between 30 May and 3 June, corresponding to between two and eight days post-egg laying based on phenology calculations. Average clutch size was 4.1 eggs per nest, average lay date (determined by floating eggs) was 28 May, and average hatch date (determined by projecting forward 28 days from lay dates or observations of chicks) was 25 June (Figure 67).

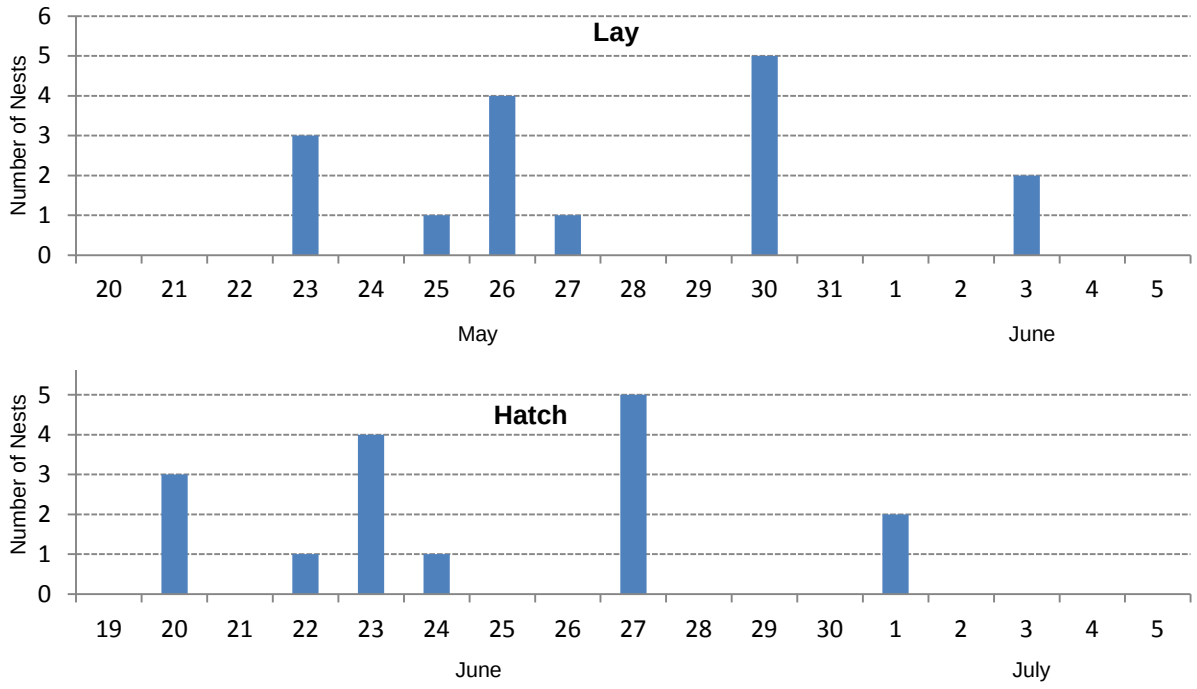

Figure 67. Lay and hatch date distributions for Aleutian cackling goose nests (*n*=16) at Buldir Island, Alaska in 2012. Lay dates were determined by floating eggs, hatch dates were determined by projecting 28 days from lay dates or observations of chicks.

Greater white-fronted goose (*Anser albifrons*). Casual migrant. A single individual was observed in South Marsh between 13 and 15 June. This is the second record for Buldir (Figure 68).

Emperor goose (*Chen canagica*). Rare spring migrant. A single bird was seen on the sand at Inner Rock on 30, 31 May and 5 June.

Eurasian wigeon (*Anas penelope*). Uncommon to common spring migrant. Birds were frequently observed at Bean Goose Pond and in sheltered coastal stretches near Northwest Point during late May and early June. A maximum of 15 birds were seen on 27 May and the last record was on 8 June.

Mallard (*Anas platyrhynchos*). Uncommon migrant and resident. A single drake was seen on Whale Pond on 14 and 18 June and a female was flushed in Glissade Valley on 16 June.

Northern pintail (*Anas acuta*). Uncommon spring migrant and rare summer resident. Birds were seen sporadically throughout the season. Our first sighting was on 26 May and a high count of 6 individuals was made on 14 June.

Aleutian green-winged teal (*Anas crecca nimia*). Uncommon migrant and rare summer resident. Birds were observed through mid-July. Our highest count was four individuals. All individuals observed were of the expected *A. c. nimia* subspecies.

Common eider (*Somateria mollissima*). Uncommon breeder. Birds were seen regularly throughout the season. Two nests were found – one on the beach below Northwest Ridge and one near the top of Northwest Ridge. Several broods of four to six were seen around the north of the island as well as from Spike camp.

Harlequin duck (*Histrionicus histrionicus*). Common resident non-breeder. Single birds or pairs were a common sight on nearshore waters during the entire season.

White-winged scoter (*Melanitta fusca*). Rare migrant. A pair was seen from North Bight Beach between 1 and 9 June. A single bird was seen on 2 July below Spike Camp.

Long-tailed duck (*Clangula hyemalis*). Rare migrant. A single female was seen in near shore waters just east of North Rocks on 24 June.

Common goldeneye (*Bucephala clangula*). Rare migrant. A single bird was seen from North Bight Beach on 27 May.

Bufflehead (*Bucephala albeola*). Rare migrant. A single bird was seen from North Bight Beach on 31 May.

Common merganser (*Mergus merganser*). Individuals were seen on 5 and 11 June as well as 2 and 5 July.

Red-breasted merganser (*Mergus serrator*). Birds were seen sporadically between 27 May and 30 June. A high count of four individuals was made on 1 and 10 June.

Horned grebe (*Podiceps auritus*). Casual migrant. A single breeding plumage bird was seen off North Bight Beach from 27 to 29 May.

Red-necked grebe (*Podiceps grisegena*). Casual migrant. A single bird was seen in near shore waters on 29 and 31 May (Figure 69).

Red-throated loon (*Gavia stellata*). Rare migrant/summer resident. Individuals were seen and heard on 27 May, 24 June and 20 July from Main Camp.

Bittern sp. (*Botaurus* sp.). Accidental vagrant. A single bird was first flushed from the grass at the outlet of Whale Pond on 13 June. The bird (presumably the same one) was again flushed from the same location and photographed on 25 June. It was tentatively identified as a Eurasian bittern (*Botarus stellaris*) but observations and photographs were not definitive (Figures 70-72). The following is the sighting report by USFWS volunteer Ronan Dugan (ronan.dugan@gmail.com):

"*June 13th 2012*

On the evening of June 13th at around 2000 Michelle Goh (Memorial University volunteer) and I went out for a short walk. We walked from Main Camp into South Marsh and to Whale Pond. When we were about 10 metres from the outlet of Whale Pond, a huge heron like bird flushed from the long grass. The bird flushed with a 'springing' jump, excreted some runny whitewash and then flew away from us with slow steady flapping wing beats. A long bill and legs were clearly visible and appeared creamy/pale green in colour. A 'neck bulge' was also clearly visible. Some dark bluish/gray streaking was also visible on the body. At this time there were many glaucous-winged gulls nesting in South Marsh and they made quick work of mobbing and harassing this bird which we flushed from Whale Pond. The bird appeared to be the same size or slightly larger than the glaucous-winged gulls. We both watched the bird fly around 300 metres and then it disappeared into a steep gully. My camera was switched off with lens cap on, so I opted not to try to take a picture but concentrated on getting a good look at the bird. As the bird moved further away I watched it through 10x42 binoculars. We walked into the gully where it flew but we never saw it again that evening. At that point I was totally unfamiliar with East Asian heron species and was unsure what I had seen and did not jump to any conclusions. I had been warned that anything could show up on Buldir Island. Michelle Goh suggested that it was a bittern. On return to camp that evening I made some notes and a quick sketch. We looked extensively at guide books (Nat. Geo. Birds of North America, Birds of Japan...) and Ian Jones (Memorial University, ianljones60@gmail.com) provided excellent and very helpful descriptions of American and Eurasian bitterns and black-crowned night herons. We searched the area the following morning and routinely over the next few days but saw no further sign of the bird. Weather on the evening of 13th June: Overcast but dry, no fog and little wind in South Marsh. Good visibility.

June 25th 2012

It was mid-afternoon when I decided to go for a walk. I was on my own this time. I walked from Main Camp into South Marsh and to Whale Pond. When I was about 30 metres from the outlet of Whale Pond, a Eurasian bittern flushed from the vegetation at the edge of the pond. The bird flushed from an area of shorter vegetation this time. I am presuming that this is the same individual that was seen on 13 June. The bird flew across me for about 100 metres (providing excellent views) before flying directly away to a distance of around 300 metres, at which point it was again harassed by glaucous-winged gulls. It then turned and flew back towards me. Gaining height and continually being harassed by gulls, it flew past about 150 metres away and I managed to take the following three images. The images were taken with a Canon G12 compact 5x optical digital camera. The bittern then flew north into the fog and was never seen again.

Due to the extensive referencing and discussion with regards to the previous sighting on the 13 June, this time I was able to pin down the field marks and clearly identify it as a Eurasian bittern. I

continued on my walk and returned to Main Camp in the early evening. Ian Jones and I downloaded the images and blew them up on a 15" MacBook. Ian helped confirm my observation.

Exclusion of other species:

I am excluding the possibility of an American bittern because of the following two reasons: 1. No continuous dark primaries (distinguishable on my photographs). 2. A dark crown is distinguishable on my photographs I am excluding the possibility of a juvenile black-crowned night heron because of size and plumage. Weather on the afternoon of 25th June: Overcast but dry. Foggy in South Marsh, low ceilings. Calm. Poor visibility."

Laysan albatross (*Phoebastria immutabilis*). Uncommon to common migrant (pelagic). Sea watching was limited but this species was common offshore when we used a scope and seas were calm. At least 100 birds were present in mid-July with thousands of fulmars and shearwaters feeding north of Main Talus.

Northern fulmar (*Fulmarus glacialis*). Abundant breeder. Nests colonially at East Cape, Kittiwake Lane, and Spike Camp. All breeding birds were dark morph. Thousands congregated offshore about 1-2 km north of Main Talus in mid-July (including a small proportion of light-morph birds).

Short-tailed shearwater (*Puffinus tenuirostris*). Uncommon to common migrant. Sea watching was limited but this species was common offshore when we used a scope and seas were calm. Flocks several thousand strong were observed feeding with fulmars and Laysan albatross north of Main Talus in mid-July.

Fork-tailed storm-petrel (*Oceanodroma furcata*). Abundant breeder. Nests in burrows and crevices throughout lower elevations of the island.

Leach's storm-petrel (*Oceanodroma leucorhoa*). Abundant breeder. Nests sympatrically with fork-tailed storm-petrel.

Red-faced cormorant (*Phalacrocorax urile*). Uncommon breeder. Nests on sea-facing cliffs around the island, but generally most activity confined to the south side. Four nests were found between Main Talus and kittiwake Lane and one nest was observed close to Cormorant Rocks.

Pelagic cormorant (*Phalacrocorax pelagicus*). Common breeder. Nests on sea-facing cliffs around the island. Thirty-one nests were monitored between Main Talus and Kittiwake Lane.

Bald eagle (*Haliaeetus leucocephalus*). Rare breeder. Three adults and one immature (2nd year) were seen. A nest site was found on a narrow ridge above Bunting Creek. An adult was observed incubating on 8 and 13 June but as of 25 June the nest was abandoned. Three adults were observed on 14 July. One adult was seen alarming on the west side of the island on 14 July. A single adult was seen on 3, 12 and 25 August.

Peregrine falcon (*Falco peregrinus*). Uncommon breeder. Adults were observed throughout the season. Nest sites were recorded at Peregrine Point and Gull Slide. Numerous adults were seen flying along Northwest Ridge so a nest site could be possible on Middle or Outer Rock. Newly fledged birds were observed at Peregrine Point and Main Camp from mid-July onwards.

Lesser sand-plover (*Charadrius mongolus*). Rare or uncommon spring migrant. A single individual was seen on North Bight Beach between 5 and 8 July and two were present 9 and 10 July (Figure 73).

Common sandpiper (*Actitis hypoleucos*). Rare spring migrant. One bird was seen near Northwest Point on 27 May.

Gray-tailed tattler (*Tringa brevipes*). Uncommon migrant. A single bird was seen and heard calling on North Bight Beach on 28 May. Our first fall record was a singe bird on 4 August on North Bight Beach (Figure 74).

Wandering tattler (*Tringa incana*). Uncommon migrant. An individual was first seen on 27 May and a maximum of five were seen on 30 May. Individuals were then seen on 15 and 25 June, 23 and 29 July and 15 August (Figure 75).

Wood sandpiper (*Tringa glareola*). Uncommon migrant. An individual was first seen along Cuckoo Creek on 25 May. Two were seen on 27 May and then individuals were seen near the mouth of Camp Creek on 28 and 29 May. Late in the season, birds were seen on 18, 20 and 25 August with a high count of four in South Marsh on 20 August (Figure 76).

Ruddy turnstone (*Arenaria interpres*). Uncommon spring and fairly common fall migrant. Birds were seen sporadically throughout the season. Our first record was on 1 June, and then two individuals were seen on North Bight Beach between 10 and 15 June. Individuals were seen on North Bight Beach on 15, 19 and 21 July. A call was heard in Gentle Valley on 9 July. This species was then seen regularly between 4 and 21 August with a high count of four on 14 and 15 August.

Long-toed stint (*Calidris subminuta*). Rare migrant. A single adult was first seen at the mouth of Tattler Creek on 1 August. Presumably, the same bird was seen again on 2, 3, 7 and 8 August. Two birds were seen between 14 and 16 August while only one individual was located on 17 and 18 August.

Pectoral sandpiper (*Calidris melanotos*). Casual migrant. A single bird was flushed from the vegetation near the bridges over Camp Creek on 30 May. A second bird was seen in Midden Pond on 30 August.

Common snipe (*Gallinago gallinago*). Rare migrant. A single snipe was flushed in South Marsh on 25 May and another was seen on 24 August.

Eurasian oystercatcher (*Haematopus ostralegus osculans*). Accidental vagrant. A single bird was observed daily on the north side of the island from 26 May until 13 June. This sighting represents a first record for Alaska (Figures 77 and 78).

Black-legged kittiwake (*Rissa tridactyla*). Abundant breeder. Black-legged kittiwakes nest in large colonies at East Cape, Kittiwake Lane, Spike Camp, and Middle and Outer Rocks.

Red-legged kittiwake (*Rissa brevirostris*). Abundant breeder. Less abundant of the two kittiwake species, red-leggeds nest in large colonies sympatrically with black-legged kittiwakes.

Glaucous-winged gull (*Larus glaucescens*). Abundant breeder. Nests were recorded from the boulder beaches to the high alpine tundra. During 2012 we found and recorded 53 nests that were followed from initiation through hatching.

Black-headed gull (*Chroicocephalus ridibundus*). Casual migrant. A single breeding plumage bird was seen at the mouth of Tattler Creek on 25 July.

Parasitic jaeger (*Stercorarius parasiticus*). Common breeder. Parasitic jaegers (all dark morph birds) were commonly observed throughout the island, with the greatest concentrations breeding at higher elevations. A total of three nests were found; one on the eastern portion of Extra Plateau, a second west of Mossy Pond and a third was found near the summit of Slide Mountain.

Common murre (*Uria aalge*). Abundant breeder. Common murres nest sympatrically with thick-billed murres, but in much smaller numbers. Only five sites within productivity plots had eggs and could be monitored in 2012.

Thick-billed murre (*Uria lomvia*). Abundant breeder. This species nests in large colonies at East Cape, Kittiwake Lane, Spike Camp and on Middle and Outer Rocks.

Pigeon guillemot (*Cepphus columba*). Uncommon breeder. Pigeon guillemots were regularly seen on nearshore waters around the island with a maximum count of 20 individuals. The first bird carrying a fish was observed 30 July.

Ancient murrelet (*Synthliboramphus antiquus*). Abundant breeder. Although seen only occasionally during the day, this species nests on Buldir Island in large numbers. Fledging events were frequently heard from early through mid-July as the birds called to their young at night.

Cassin's auklet (*Ptychoramphus aleuticus*). Abundant breeder. Nocturnal - rarely observed during the day and not monitored intensively as are the other auklet species. We first captured an adult that regurgitated a food load on 4 July.

Parakeet auklet (*Aethia psittacula*). Abundant breeder. Parakeet auklets nest in crevices or burrows at many lower elevation sites across the island. 2012 marked the first of a multi-year geolocation study to determine the wintering areas of this species. A total of 19 geolocator tags were deployed in crevices along the northwestern shore as well as near Spike Camp.

Least auklet (*Aethia pusilla*). Abundant breeder. This auklet, the second most abundant on Buldir, is most common at Main Talus.

Whiskered auklet (*Aethia pygmaea*). Abundant breeder. This nocturnal auklet nests throughout coastal areas of the island, and is most common at Northwest Ridge, Main Talus, and Crested Point. A few individuals were heard calling near population plot 2 and two adults were captured in a mist net along the beach below Spike Camp.

Crested auklet (*Aethia cristatella*). Abundant breeder. Crested auklets are the most abundant auklet species on Buldir Island with the greatest breeding concentrations at Main Talus. Large flocks were also observed originating from the 1000' ridge above Bottle Hill at Spike Camp. An additional colony of around 100 birds was discovered in boulders just above the high tide mark and to the south of Bull Point.

Horned puffin (*Fratercula corniculata*). Abundant breeder. Horned puffins nest in crevices and burrows throughout the island and are abundant at Main Talus and above Spike Camp

Tufted puffin (*Fratercula cirrhata*). Abundant breeder. Tufted puffins nest in burrows on grassy and rocky slopes around the island and in dense numbers on Northwest Ridge and Middle Rock.

Short-eared owl *(Asio flammeus)*. Rare migrant. A single bird was encountered in North Marsh on 14 June and 12 July. A feather was found along with the remains of a leach's storm-petrel in North Marsh on 26 July. Perhaps this indicates that a bird was present on the island at this time.

Common raven (*Corvus corax*). An individual was seen at several locations on the island from 2 July through the end of the season.

Pacific wren (*Troglodytes pacificus*). Common breeder. The first brood of fledglings appeared in late June, and adults were still provisioning second broods of nestlings in late August.

Eastern yellow wagtail (*Motacilla tschutschensis*). Rare spring migrant. Individuals were observed in North Marsh on 28 May and on the beach below Gull Slide on 30 May.

Song sparrow (*Melospiza melodia*). Common breeder. Fledglings were first observed in early June.

Lapland longspur (*Calcarius lapponicus*). Abundant breeder. This species is present in a wider variety of habitats than song sparrows. It was commonly seen at all elevations.

Snow bunting (*Plectrophenax nivalis*). Common breeder. This resident species is found at higher elevations with shorter vegetation and/or rocky areas. An adult male was seen gathering insects to feed nestlings on 16 July at the top of Petrel Valley.

Gray-crowned rosy-finch (*Leucosticte tephrocotis*). Common breeder across the island.

Barn swallow (*Hirundo rustica*). Uncommon non-resident. Two pale breasted individuals were first seen on 20 June and remained until 14 July. They were seen foraging along the beach and over both creeks in North Marsh. They roosted each night under the west gable of the sleeping cabin (Figure 79).

Common redpoll (*Carduelis flammea*). Uncommon migrant. Our first record was on 3 July when four individuals were seen in Gentle Valley. A single individual was then seen on the beach near Main Talus on 4 July. On 13 July, six were seen together near the Bowling Alley and a single individual was seen near the summit of Round Mountain on 16 July.

Hawfinch (*Coccothraustes coccothraustes*). Rare spring migrant. A single bird was observed from Main Camp on 5 June (Figure 80).

Oriental greenfinch (*Carduelis sinica*). Casual migrant. A single male was seen in North Marsh on 2 June and another or the same individual was seen in The Dip on 21 June.

Marine Mammals

Sea otter (*Enhydra lutris*). No sea otters were observed in 2012.

Harbor seal (*Phoca vitulina*). Harbor seals were seen frequently on the north side of the island. A total of 5 individuals were seen hauled out on Inner Rock.

Northern fur seal (*Callorhinus ursinus*). A single female was seen in near shore waters off of North Bight Beach on 24 August.

Steller sea lion (*Eumetopias jubatus*). Sea lions were occasionally seen during the 2012 season. Most sightings were of lone individuals. Animals were seen on 5 and 24 June, and 7 and 13 July. The crew of the Tiglax recorded one bull on South Bight beach on 27 June marking the only instance of an animal on shore.

Orca (*Orcinus orca*). Orcas were observed from shore on several occasions during the 2012 season. On 19 June three individuals passed through North Bight Bay and continued west beyond Middle Rock. No males were present in this pod. On 22 June an estimated eight individuals, including two large males were seen north of Main Talus and heading east. Again, on 17 July a pod of five, including one large male, were seen north of Main Talus. A pod of eight to twelve individuals, including two males and several immature animals, was again seen from North Bight Beach on 26 and 27 August.

Minke whale (*Balaenoptera acutorostrata*). A single whale was observed from Spike Camp on 2 July.

Sperm whale (*Physeter macrocephalos*). Individuals or their distinctive blow profile were seen off shore to the North of the island during calm weather. Two whales were seen on 20 and 25 June and two were seen on 19 July.

Photos of interest (Photos by Ronan Dugan/FWS)**:**

Figure 68. Greater white-fronted goose in South Marsh.

Figure 69. Red-necked grebe near Northwest Point.

Figure 70. Potential Eurasian bittern (right) with glaucous-winged gull flying over South Marsh in the fog.

Figure 71. Potential Eurasian bittern flying over South Marsh in the fog.

Figure 72. Potential Eurasian bittern flying over South Marsh in the fog.

Figure 73. Lesser sandplover on North Bight Beach.

Figure 74. Gray-tailed tattler on North Bight Beach.

Figure 75. Wandering tattler near Kittiwake Lane.

Figure 76. Wood sandpiper in Cuckoo Creek.

Figure 77. Eurasian oystercatcher at North Bight Beach.

Figure 78. Eurasian oystercatcher in flight showing the diagnostic white on lower back and rump.

Figure 79. Barn swallow flying over Tattler Creek.

Figure 80. Hawfinch seen at Main Camp.

Table 111. Observations and breeding status of birds and selected mammals at Buldir 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 come from annotated lists in annual refuge monitoring reports; data were collected before 1998 but have not yet been summarized from historic sources.

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	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bean goose	-	X	X	-	-	X	-	-	X	X	-	-	-	-	-
Greater white-fronted goose	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Emperor goose	X	X	X	-	-	-	-	-	-	-	-	-	X	-	X
Brant	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Aleutian cackling goose	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Tundra swan	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Tundra swan - Bewick's subsp.	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Eurasian wigeon	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
American wigeon	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-
Mallard	X	-	P	X	X	X	-	X	X	X	X	X	X	X	X
Northern shoveler	X	-	-	-	-	-	-	X	X	-	-	-	X	X	X
Northern pintail	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X
Garganey	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Baikal teal	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Aleutian green-winged teal	X	B	P	X	X	X	X	X	X	B	X	B	P	P	P
American green-winged teal	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Common pochard	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-
Tufted duck	-	-	-	-	-	-	X	-	X	X	X	-	X	X	-
Greater scaup	-	X	-	-	X	-	X	X	X	X	X	X	X	-	-
Steller's eider	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-
Common eider	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Harlequin duck	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
White-winged scoter	-	-	X	-	-	-	-	-	X	X	X	X	X	-	X
American (formerly black) scoter	-	-	-	-	X	-	-	-	-	X	X	-	X	X	-
Bufflehead	-	-	X	-	-	-	-	-	-	-	-	-	X	-	X
Common goldeneye	-	-	-	-	X	-	-	-	X	-	-	X	X	X	X
Smew	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Common merganser	-	-	X	X	X	X	-	X	X	-	-	X	-	X	X
Red-breasted merganser	X	X	X	X	X	-	-	X	X	X	X	X	X	X	X
Red-throated loon	-	-	X	X	X	-	-	-	-	X	-	X	X	X	X
Arctic loon	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
Common loon	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-
Horned grebe	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
Red-necked grebe	X	-	-	-	-	-	-	X	-	X	-	X	-	-	X
Laysan albatross	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-footed albatross	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-
Short-tailed albatross	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Northern fulmar	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Mottled petrel	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Short-tailed shearwater	-	-	X	X	X	-	-	X	X	X	-	-	X	-	-
Fork-tailed storm-petrel	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
Red-faced cormorant	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

Table 111 (continued). Observations and breeding status of birds and selected mammals at Buldir 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 come from annotated lists in annual refuge monitoring reports; data were collected before 1998 but have not yet been summarized from historic sources.

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Species	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pelagic cormorant	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Bittern sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Great egret	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Intermediate egret	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Little egret	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Black-crowned night-heron	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Bald eagle	X	X	B	X	B	B	B	B	B	B	B	B	P	B	B
Rough-legged hawk	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Gyrfalcon	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-
Peregrine falcon	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Sandhill crane	-	-	X	-	X	-	-	X	X	-	X	-	X	-	-
Black-bellied plover	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
American golden-plover	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Pacific golden-plover	-	-	-	-	X	X	-	-	-	X	-	X	-	-	-
Lesser sand-(Mongolian) plover	X	X	X	X	X	X	X	X	X	-	X	X	-	X	X
Common ringed plover	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Semipalmated plover	X	-	X	X	-	-	-	-	X	-	-	-	X	X	-
Black oystercatcher	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Eurasian oystercatcher	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Terek sandpiper	-	-	-	-	X	-	X	-	-	X	-	-	-	-	-
Common sandpiper	X	-	X	X	X	-	X	X	X	X	-	-	X	X	X
Gray-tailed tattler	X	-	X	X	-	X	X	X	X	X	-	X	X	-	X
Wandering tattler	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X
Common greenshank	-	-	X	X	-	-	-	X	-	-	-	-	X	X	-
Marsh sandpiper	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Wood sandpiper	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X
Whimbrel	X	X	X	X	X	-	-	X[a]	X	-	X	-	-	-	-
Far-eastern curlew	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Black-tailed godwit	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-
Bar-tailed godwit	X	-	X	X	X	-	X	-	-	X	-	-	X	X	-
Ruddy turnstone	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sanderling	-	-	-	X	X	X	-	-	-	-	X	-	X	-	-
Western sandpiper	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Red-necked stint	X	-	-	-	X	-	X	X	X	X	-	-	X	-	-
Little stint	X	-	-	-	-	-	-	-	X	-	X	X	-	-	-
Temmick's stint	-	-	X	-	-	-	-	X	X	X	-	-	-	-	-
Long-toed stint	X	-	X	X	X	-	X	X	X	X	X	X	X	X	X
Pectoral sandpiper	-	-	-	X	-	-	X	-	-	X	X	-	X	-	X
Rock sandpiper	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Dunlin	X	-	-	-	X	-	-	-	X	-	-	X	-	-	-
Buff-breasted sandpiper	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Ruff	-	-	-	-	X	-	-		X	-	-	-	-	-	-

[a]Species not recorded by monitoring crew but observed by Ian Jones and Sampath Seneviratne 29 May-6 June 2005.

Table 111 (continued). Observations and breeding status of birds and selected mammals at Buldir 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 come from annotated lists in annual refuge monitoring reports; data were collected before 1998 but have not yet been summarized from historic sources.

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Species	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Long-billed dowitcher	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-
Dowitcher sp.	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Common snipe	-	-	P	X	X	-	X	X	X	X	X	X	-	-	X
Snipe sp.	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X
Red-necked phalarope	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-
Black-legged kittiwake	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Red-legged kittiwake	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Black-headed gull	X	-	X	X	X	X	X	X	X	X	-	X	X	-	X
Black-tailed gull	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Herring gull	-	-	-	-	X	-	-	-	-	X	-	-	X	-	-
Slaty-backed gull	X	-	X	X	-	X	X	P	P	X	X	X	X	X	-
Glaucous-winged gull	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Glaucous gull	-	-	-	-	X	-	-	X	-	X	X	-	-	-	-
Least tern	-	-	-	-	-	-	-	?[a]	-	-	-	-	-	-	-
Pomarine jaeger	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Parasitic jaeger	B	X/B?	B	X/B?	B	B	B	B	B	B	B	B	B	B	B
Common murre	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Thick-billed murre	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Pigeon guillemot	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Marbled murrelet	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ancient murrelet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Cassin's auklet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Parakeet auklet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Least auklet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Whiskered auklet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Crested auklet	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Horned puffin	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Tufted puffin	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Common cuckoo	-	-	X	-	-	X	X	X	X	X	-	-	-	-	-
Cuckoo sp.	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Snowy owl	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Short-eared owl	-	X	X	X	X	X	-	-	X	X	X	-	-	X	X
Common raven	-	-	-	-	-	-	X	-	-	-	X	-	-	X	X
Tree swallow	X	-	-	-	-	-	X	-	X	-	-	X	-	-	-
Bank swallow	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-
Cliff swallow	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Barn swallow	-	-	-	-	-	-	X	-	-	X	X	-	-	-	X
Pacific (formerly winter) wren	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Middendorff's grasshopper-warbler	-	-	-	-	-	X	-	X[b]	-	-	-	-	-	-	-
Lanceolated warbler	-	-	-	-	-	-	-	-	-	B	-	-	-	-	-
Arctic warbler	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-

[a]"?" indicates probable identification as least tern (as opposed to little tern) but not confirmed because field crew could not identify bird in hand or take pictures.
[b]Species not recorded by monitoring crew but observed by Ian Jones and Sampath Seneviratne 29 May-6 June 2005.

Table 111 (continued). Observations and breeding status of birds and selected mammals at Buldir 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 come from annotated lists in annual refuge monitoring reports; data were collected before 1998 but have not yet been summarized from historic sources.

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	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Red-breasted flycatcher	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-
Taiga flycatcher	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Dark-sided (Siberian) flycatcher	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-
Gray-streaked flycatcher	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-
Asian brown flycatcher	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Siberian rubythroat	-	-	X	-	X	X	X	X	-	X	-	-	-	X	-
Red-flanked bluetail	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-
Northern wheatear	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Gray-cheeked thrush	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Eyebrowed thrush	X	-	X	X	X	X	X	X	X	-	-	X	-	-	-
Eastern yellow wagtail	X	-	X	X	X	X	X	X	X	X	-	-	X	X	X
Gray wagtail	-	-	X	X	-	X	X	-	X	-	-	X	-	-	-
White wagtail (black-backed subsp.)	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Olive-backed pipit	X	-	X		X	-	-	X	-	X	-	X	-	-	-
Pechora pipit	X	-	-	X	-	-	-	X[a]	-	X	-	-	-	-	-
Red-throated pipit	X	-	-	-	-	-	-	X	-	X	-	-	-	-	-
American pipit	-	-	-	X	-	-	-	X[a]	X	-	-	-	-	-	-
Song sparrow	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Lapland longspur	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Rustic bunting	-	-	X	X	-	-	X	X	-	X	-	X	X	-	-
Reed bunting	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Snow bunting	B	-	B	B	B	B	B	B	B	B	B	B	B	B	B
Brambling	X	-	X	X	-	X	X	X	X	X	-	X	X	X	-
Gray-crowned rosy-finch	B	-	B	B	B	B	B	B	B	B	B	X	B	B	B
Common rosefinch	-	-	X	-	-	-	X	-	-	X	-	X	X	-	-
Common redpoll	-	-	X	X	-	-	-	X	X	X	X	-	X	-	X
Siskin sp.	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Oriental greenfinch	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X[c]
Hawfinch	-	-	X	-	-	X	X	X	-	X	-	X	-	X	X
Sea otter	B	B	B	NR[b]	B	X	X	X	X	X	-	-	-	-	-
Harbor seal	B	X/B?	B	NR	B	X/B?	B	B	B	X/B?	X/B?	X	X	X	X
Northern fur seal	-	-	X	NR	X	-	X	-	-	-	-	-	-	-	X
Steller's sea lion	X/B?	X/B?	B	NR	B	X/B?	X/B?	B	X/B?	B	X/B?	X	X	X	X
Northern elephant seal	-	-	X	NR	-	-	-	-	-	-	-	-	-	-	-
Dall's porpoise	-	-	-	NR	-	-	X	-	-	-	-	-	-	-	-
Orca	X	-	X	NR	X	-	-	-	X	X	X	-	X	X	X
Sperm whale	-	X	-	NR	-	X	X	X	X	X	X	X	-	-	X
Observation dates	22 May-28 Aug	21 Jun-29 Aug	27 May-29 Aug	24 May-5 Sep	24 May-5 Sep	1 Jun-5 Sep	26 May-23 Aug	29 May-26 Aug	24 May-30 Aug	29 May-27 Aug	26 May-27 Aug	29 May-25 Aug	29 May-27 Aug	28 May-28 Aug	25 May-30 Aug

[a]Species not recorded by monitoring crew but observed by Ian Jones and Sampath Seneviratne 29 May-6 June 2005.
[b]Mammals not recorded (NR) in all years.
[c]Species not recorded by monitoring crew but observed only by Ian Jones.

Table 112. First flowering dates of plants identified on Buldir 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. Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in years not listed.

Family	Species	2000	2002	2004	2006	2010
Lycopodiaceae	*Lycopodium selago selago*	-	-	-	-	-
	Lycopodium annotinum annotinum	-	-	-	-	-
Equisetaceae	*Equisetum arvense*	-	-	-	-	-
	Athyrium felix-femma cyclosorum	-	-	-	-	-
Graminae	*Poa* spp.	-	-	-	-	-
	Bromus sitchensis	-	15 Aug	-	-	-
	Elymus arenarius mollis	30 Jun	5 Jul	-	-	-
	Calamagrostis canadensis	-	-	-	-	-
	Calamagrostis nutkatensis	-	7 Aug	-	-	-
	Festuca rubra aucta	-	10 Aug	-	-	-
	Phleum commutatum americanum	-	28 Jun	-	-	-
	Puccinella langeana	-	13 Jun	-	-	-
Cyperacea	*Carex macrochaeta*	23 Jun	28 Jun	-	-	-
	Carex lyngbyaei	2 Jul	13 Jun	-	-	-
	Carex kelloggi	-	-	late Jun	-	
Juncaceae	*Luzula multiflora multiflora*	-	-	late Jun	-	-
	Luzula multiflora Kobayasii	-	-	-	-	-
	Luzula spp.	24 Jun	22 Jun	-	-	-
	Juncus arcticus sitchensis	23 Jul	-	-	-	-
Liliaceae	*Fritillaria camschatcensis*	28 Jun	14 Jun	21 Jun	25 Jun	21 Jun
	Streptopus amplexifolius	21 Jun	4 Jul	-	-	-
Orchidaceae	*Platanthera convallariaefolia*	5 Jul	5 Jul	-	mid Jul	20 Jul
	Platanthera dilatata	-	1 Jul	-	-	-
	Listera chordata	-	20 Aug	-	-	-
Salicaceae	*Salix arctica crassijulis*	19 Jun	31 May	10 Jul	30 Jun	-
	Salix rotundifolia	-	31 May	-	-	-
Polygonaceae	*Oxyria digyna*	29 Jul	20 Jun	-	-	-
	Rumex fenestratus	22 Jul	15 Jul	-	-	-
	Polygonum viviparum	-	-	-	-	-
Portulaceae	*Claytonia sibirica*	early Jun	11 Jun	-	-	24 Jun
	Montia fontana Fontana	-	-	-	-	-
Caryophyllaceae	*Honkenya peploides major*	5 Jul	-	-	-	1 Jul
	Cerastium beeringianum grandiflorum	-	-	-	-	-
	Cerastium fischerianum	-	-	-	-	-
	Moehringia lateriflora	-	-	-	-	-
	Stellaria media	-	-	-	-	-
	Stellaria ruscifolia	-	-	-	-	-
Caryophyllaceae	*Sagina crassicaulis*	-	-	-	-	18 Jun
	Cerastium aleuticum	-	1 Jul	-	-	-
	Cerastium fisherianum	-	5 Jul	-	-	-
Ranunculaceae	*Coptis trifolia*	-	17 Jul	-	30 Jun	-
	Ranunculus hyperboreus	-	-	-	-	14 Jun
	Ranunculus occidentalis	-	9 Jun	9 Jun	-	14 Jun

Table 112 (continued). First flowering dates of plants identified on Buldir 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. Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in years not listed.

Family	Species	2000	2002	2004	2006	2010
Ranunculaceae (con'd)	*Ranunculus eschscholtzii*	-	-	-	-	-
	Ranunculus grandis	-	4 Jul	-	-	-
	Anemone narcissiflora villosissiflora	-	-	-	-	-
Cruciferae	*Draba hyperborea*	8 Jun	6 Jun	-	1 Jul	-
	Draba borealis	8 Jun	6 Jun	-	-	-
	Cardemine umbellata	17 Jun	6 Jun	-	1 Jul	-
	Cochlearia officialis oblongifolia	13 Jun	6 Jul	-	-	-
Saxifragaceae	*Saxifraga punctata insularis*	16 Jun	31 May	26 Jun	-	-
	Saxifraga bracteata	2 Jun	28 May	3 Jun	25 Jun	4 Jun
	Saxifraga aleutica	-	28 May	-	-	-
	Chrysosplenium wrightii	-	29 May	-	-	-
Rosaceae	*Rubus arcticus stellatus*	16 Jul	19 Jun	25 Jun	30 Jun	30 Jun
	Rubus chamaemorus	-	11 Jun	-	-	12 Jun
	Sibbaldia procumens	4 Jul	9 Jul	-	-	-
	Potentilla villosa	4 Jul	15 Jul	-	-	-
	Potentilla egeaii	-	26 Jun	-	-	-
	Potentilla hyperarctica	-	7 Jul	-	-	-
	Geum macrophyllum	-	12 Jun	-	23 Jun	-
	Geum calthifolium	-	17 Jul	10 Jul	-	-
	Geum rossii	-	6 Jul	-	-	-
Geraniaceae	*Geranium erianthum*	27 Jun	17 Jun	-	23 Jun	30 Jun
Violaceae	*Viola epipsila repens*	-	-	21 Jun	18 Jun	
	Viola langsdorffii	7 Jul	12 Jun	-	-	30 Jun
Onagraceae	*Epilobium glandulosum*	<28 Aug	17 Jul	-	-	-
	Epilobium behringianum	-	17 Jul	18 Jul	19 Jul	-
Apiaceae	*Heracleum lanatum*	21 Jul	30 Jul	-	-	29 May
	Angelica lucida	2 Jul	11 Jul	-	-	-
	Ligusticum scoticum-Hultenii	16 Jul	25 Jul	-	-	-
	Conioselinum chinense	21 Jul	4 Aug	-	-	-
Cornaceae	*Cornus suecica*	7 Jul	12 Jun	21 Jun	18 Jun	-
	Cornus canadensis	-	-	-	-	-
Ericaceae	*Rhododendron camtschaticum*	-	5 Aug	-	-	-
	Cassiope lycopioides	-	16 Jul	15 Jul	-	-
	Vaccinum vitis-idaea minus	-	-	20 Jul	-	-
	Loiseleuria procumbens	-	17 Jul	-	-	-
	Phyllodoce aleutica	-	13 Jul	-	-	-
Empetraceae	*Empetrum nigrum*	mid Jul	-	-	-	-
Primulaceae	*Trientalis europaea arctica*	-	1 Jul	20 Jul	-	-
	Primula cuneifolia	19 Jun	11 Jun	26 Jun	-	8 Jun
Gentianaceae	*Gentiana amarelle acuta*	-	-	-	-	-
	Gentiana aleutica	-	15 Aug	-	-	-
Scrophulariaceae	*Veronica stelleri*	-	17 Jun	24 Jun	30 Jun	-
	Veronica grandiflora	4 Jul	22 Jun	20 Jun	29 Jun	-

Table 112 (continued). First flowering dates of plants identified on Buldir 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. Identifications are made by field personnel on-island and have not been confirmed by other authorities. No data were collected in years not listed.

Family	Species	2000	2002	2004	2006	2010
Scrophulariaceae (con'd)	*Veronica serpyllifolia humifusa*	-	21 Jun	-	6 Jul	-
	Veronica americana	-	19 Aug	-	-	-
	Rhinanthus minor boreales	-	8 Aug	-	-	-
Plantaginaceae	*Plantago macrocarpa*	-	19 Jun	-	-	-
	Hippuris montana	-	-	-	-	-
Campanulaceae	*Campanula lasiocarpa lasiocarpa*	-	8 Aug	-	16 Aug	-
Asteraceae	*Achillea borealis*	16 Jul	29 Jul	-	19 Jul	-
Compositeae	*Senecio pseudo-arnica*	16 Jul	17 Jul	20 Jul	19 Jul	-
	Arnica unalaskanesis	-	25 Jul	-	-	-
	Erigeron peregrinus	mid Jul	9 Jul	14 Jul	6 Jul	-
	Artemesia unalaskensis aleutica	-	7 Aug	15 Aug	-	-
	Chrysanthemum articum	12 Jul	14 Jul	early Aug	23 Jul	-
	Cacalia auriculata kamtschatica	-	-	16 Aug	-	-
	Anaphalis margaritacea	-	7 Aug	-	-	-
	Tataxicum trigonolobum	-	19 Jun	-	-	-

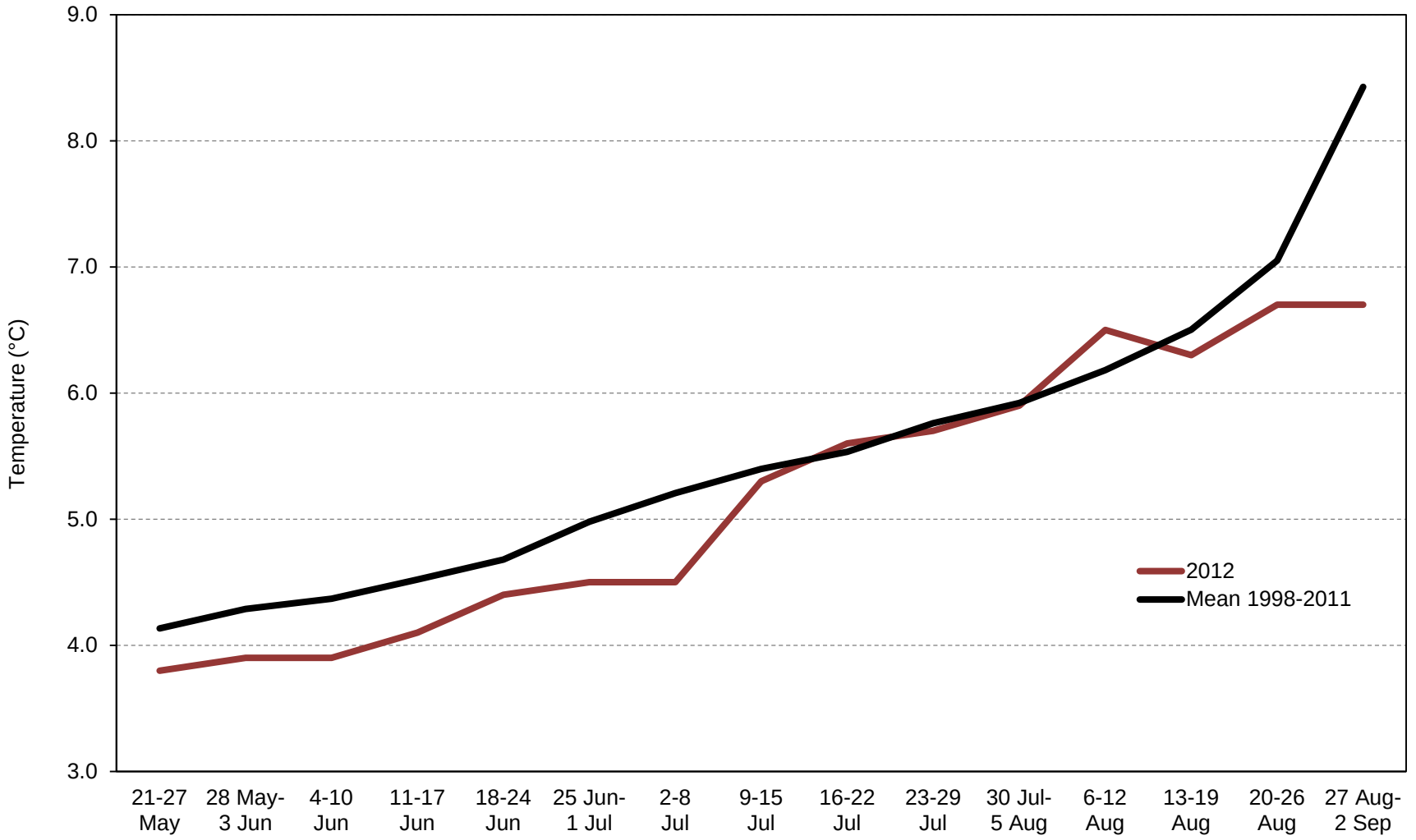

Figure 68. Mean weekly sea surface temperatures (°C) at Buldir Island, Alaska.

Table 113. Mean weekly sea surface temperatures (°C) at Buldir Island, Alaska.

Week	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
21-27 May	4.6	-	-	3.6	4.4	4.1	-	-	-	4.2	-	3.9	-	-	-	3.8
28 May-3 Jun	4.9	4.0	-	3.8	4.6	4.2	4.4	-	4.6	4.2	4.2	4.0	4.4	3.9	4.4	3.9
4-10 Jun	5.0	4.0	-	3.8	4.8	4.2	4.7	4.5	4.6	4.6	4.3	4.0	4.0	4.0	4.5	3.9
11-17 Jun	5.5	4.3	-	4.1	4.7	4.4	4.8	4.6	4.8	4.7	4.4	4.1	4.3	4.1	4.5	4.1
18-24 Jun	5.0	4.5	4.6	4.3	4.7	4.7	5.3	4.9	4.9	4.8	4.7	4.4	4.5	4.5	4.6	4.4
25 Jun-1 Jul	5.5	4.9	4.5	4.6	4.9	5.0	5.3	5.1	5.7	5.1	4.9	4.6	4.5	4.9	5.0	4.5
2-8 Jul	5.6	5.0	5.0	4.4	5.0	5.7	5.4	5.1	5.9	5.6	5.0	4.6	4.7	5.5	5.4	4.5
9-15 Jul	6.0	5.1	4.9	4.7	5.9	5.1	5.8	5.8	6.1	5.3	5.2	4.9	5.0	5.5	5.6	5.3
16-22 Jul	5.8	5.1	5.1	5.0	5.5	5.6	6.0	5.8	5.9	5.3	5.8	5.1	5.1	6.2	5.6	5.6
23-29 Jul	6.0	6.1	5.7	5.3	5.8	5.3	5.8	6.4	5.9	5.2	5.7	5.7	5.5	6.7	5.4	5.7
30 Jul-5 Aug	6.1	6.0	5.8	6.0	6.0	6.2	6.2	6.2	6.1	5.9	5.7	5.1	5.1	6.5	5.9	5.9
6-12 Aug	7.0	6.0	5.7	5.3	7.2	5.7	6.5	6.3	6.9	5.7	5.8	6.0	5.7	7.1	5.8	6.5
13-19 Aug	6.7	6.2	6.2	6.3	6.5	6.6	7.4	6.5	6.8	6.4	6.9	6.1	5.5	6.4	7.2	6.3
20-26 Aug	-	-	6.5	7.6	6.8	6.6	6.6	7.7	6.3	7.2	6.2	6.0	5.7	6.0	6.7	6.7
27 Aug-2 Sep	-	-	6.3	6.9	7.1	7.5	6.9	-	-	8.6	-	-	-	-	-	6.7
3-9 Sep	-	-	-	-	7.1	5.8	6.8	-	-	-	-	-	-	-	-	-

Table 114. History of official visits to Buldir Island, Alaska.

Year	Dates	Type of work	Number	Names	Source
1936	27 & 31 Jul	faunal recon	3	Olaus Murie, Homer Jewell, Douglas Gray,	?
1937	18 Jun	faunal recon	1+	Olaus Murie	13
1943	?	U.S. Army weather station	5	Dave Grehl, 3 groups of 5 for around 7 mo. each	1
1947	19-22 Jul	geological reconnaissance	2	Robert R. Coats, Will F. Thompson	2
1962	25-27Jun	ACG survey	2	Robert Jones, Vern Berns	14
1963	6-19 Jul	obtain ACG goslings	6	Vern Berns, Erwin Boeker, Robert Jones, Karl Kenyon, Alexander Peden, Milsted Zhan	3
1972	30 June-8 Jul	ACG, faunal recon.	6	Vernon Byrd, Palmer Sekora, Glen Smart, Clayton White, Allen McCartney, Dan Gibson	4
1974	9 May-6 Sep	ACG biology	4	Vernon Byrd, Chris Dau, Matt Dick, John Trapp*	
	16-24 Jul	ACG capture	3	Dave Spencer, Jim Shaw, Jim Bartonek	
1975	18 May-5 Sep	ACG biology	5	Vernon Byrd*, Dennis Woolington, Eric Hoberg, Elaine Rhode*, John Trapp*, John Sarvis*	
	3-25 Jul	Film Chain of Life	2	Tom Ramsey, Cecilia Ramsey	
	17 May-5 Sep	ACG, puffins	2	D.H.S. Wehle, Bob Day	7
1976	18 May-28 Sep	ACG	5	Vernon Byrd, Dennis Woolington, Thede Tohish, Erik Knudtson, Bill Rodstrom	
1977	25 May-2 Jul	ACG nest census	5	Dennis Woolington, Bob Day, Eric Knudtson, Tom Early, Bob Schulmeister*	
1979	4-30 Jun	ACG nest survey, petrels	4	Tom Early, Bill Henry, Andy Taber, Jonathan Beall	
	23-24 Jun	faunal survey	4	Bob Day, Tom Early, Brian Lawhead, Elaine Rhode	6
1980	?	ACG capture	4	Leslie Slater, John Mueller, Jack Arnold, Tom Early	4
1982	29 May-28 Jun	ACG nest census	6	Van Klett, Fred Deines, Mark Ostwald, Tom Early, Don Dragoo, Dana Bradley	15
	28 Jul-30 Jul	ACG capture	8	Mike Amaral, Fred Deines, Don Dragoo, Tom Early, Doug Forsell, Van Klett, Natasha Kline, Konrad Schmidt	20
1983	27 Jul-5 Aug	ACG capture	10	Mike Amaral, Chris Ambroz, Brenda Becker, Dan Benfield, Fred Deines, Don Dragoo, Natasha Kline, Leslie Slater, Susan Steinacher, Fred Zeillemaker	21
1984	8-25 Jun	ACG eggs, petrel work	2	Anthony DeGange, Richard Wood	5
1987	1-9 Aug	ACG capture	13	Donna Dewhurst, Jim Fuller, Martha Gillham, Greg McClellen, Daniel Niven, Dave Nysewander, William Penning, Kevin Rayor, Leslie Slater, Amy Snyder, David Watson, John Andrew, Lon Lauber	
1988	7 Jun-7 Sep	Refuge monitoring	4	Colleen Baggot, Lisa Climo, Dave Backstrom*, Hector Douglas*, Vernon Byrd*	
	19 Jun-5 Jul	Seabird investigations	3	John Piatt, John Wells , Andrea Mc Charles	
	29 Jul-10 Aug	ACG capture & seabirds	5	Alan Springer, Gus Van Vliet, Greg McClellan, Mark Pfost, Brian Anderson	
1989	29 May	BIA ANSCA site visit	4	Ken Pratt, Randall Cooper, Brian Hoffman, Robert Drozda	19
1990	28 May-17 Aug	Refuge monitoring	3	Hector Douglas, Mark Hipfner, Greg Zuberbier	
	?	Refuge monitoring	4	Elizabeth Mayock, Karen Kreisel, Mark Hipfner, Scott Richardson*	
	?	Auklet biology	1	Ian Jones	
1991	4 Jun-14 Aug	Refuge monitoring	4	Jeff Williams, Mark Hipfner, Ron Walder, Ken Russell	
	25-29 Jul	ACG capture	4	Jim Schneeweiss, Vernon Byrd, Jim Fuller, Rob Lewis	
	4 Jun-6 Aug	Auklet biology	2	Ian Jones, Christine Adkins	
	25 Jul-6 Aug	Photography	1	Ed Steele	
	25 July-6 Aug	Archaeology	3	Doug Siegel-Causey, Debbie Corbett, C. Lefevre	12
1992	31 May-14 Aug	Refuge monitoring	4	Jeff Williams, Hugh Knechtel, Andrew Durand, Geoff Beyersdorff	
	31 May-1 Aug	Auklet biology	2	Ian Kones, Fiona Hunter	
1993	30 May-31 Aug	Refuge monitoring	2	Jeff Williams, Julian Fischer	
	30 May-31 Aug	Auklet biology	2	Victor Zubakin, Nikolai Konyukhov	
	30 May -?	Auklet biology	2	Ian Jones, Fiona Hunter	
	31 May-17 Jun	Archaeology	7	Dixie West, Debbie Corbett, Christine Lefevre, Liz Wilmerding, Stephen Loring, Tom Corbett, Ann Andres	10
1994	?	Refuge monitoring	4	Julian Fischer, Scott Hall, Peter Duley, Wendy Cruso	
	?	Auklet biology	2	Ian Jones, Fiona Hunter	
1995	1 Jun-21 Aug	Refuge monitoring	3	Julian Fischer, Mari Ortwerth, Lisa Meehan	18
	?	Auklet biology	2	Ian Jones, Fiona Hunter	
1996	4 Jun-24 Aug	Refuge monitoring	4	Julian Fischer, Lisa Meehan, Pat Ryan, Dave Clutter	17
	4 Jun -?	Auklet biology	?	Gail Fraser, ?	

* indicates that a person only spent a portion of the time period on the island.

Table 114 (continued). History of official visits to Buldir Island, Alaska.

Year	Dates	Type of work	Number	Names	Source
1997	21 May-24 Aug	Refuge monitoring	4	Mary Ortwerth, Nora Rojek, Emily Drew, Jeff Williams*	16
	5-23 May	Archaeology	6	Christine Lefevre, Debbie Corbett, Carole Fritz, Margaret Beck, Gena Weinberger, Anne Young	11
	5 May-7 Aug	Auklet biology	4	Ian Jones, Fiona Hunter, Gail Fraser, Laura Cowen	
1998	3 Jun-28 Aug	Refuge monitoring	4	Julian Fischer, Angela Palmer, Susan Hootman, Kim Elkin	9
	3 Jun-?	Auklet biology	1+	Gail Fraser, ?	
1999	22 Jun-29 Aug	Refuge monitoring	6	Jason Daniels, Jessica Peterson, Jeff Williams*	8
	?	Auklet biology	3	Allison Veit, Nicole Winter, Nicolai Konyukhov	
2000	27 May-29 Aug	Refuge monitoring	4	Heather Moore, Karen Brenneman, Graeme Loh, Sarah Lantz	
	27 May-6 Aug	Auklet biology	4	Ian Jones, Martin Renner, Jolene Sutton, Josh Pennell	
2001	25 May-5 Sep	Refuge monitoring	3	Heather Moore, Peter Kappes, Matthew Grinnell	
	25 May-5 Sep	PAAU/HOPU attendance	2	Nikolai Konyukhov, Kyle Juk	
	1 Aug-5 Sep	Archaeology	5	Debbie Corbett, Dixie West, Ginny Hatfield, Kale Brennerman	
	25 May-1 Aug	Auklet biology	3	Martin Renner, Fiona Hunter, Heather Major, Ian Jones*	
	28 May-1 Aug	CRAU smell	2	Julie Hagelin, Peter Elsner	
2002	24 May-5 Sep	Refuge monitoring	3	Erica Sommer, Trevor Joyce, Nikolai Konyukhov	
	24 May- 7 Aug	Auklet biology	3	Martin Renner, Jason Wade, Greg McClelland	
2003	1 Jun-5 Sep	Refuge monitoring	3	Nathan Jones, Martin Murphy, Naomi Sugimura*	
	1 Jun-5 Sep	Regime forcing project	2	Hector Douglas, Brie Drummond	
	1 Jun-7 Aug	Auklet biology	1	Travis Clarke, Ian Jones*	
2004	26 May-25 Aug	Refuge monitoring	2	Martin Murphy, Slade Sapora	
	26 May-? Aug	Auklet biology	1	Christina Bourne	
	26 May-7 Jun	Auklet biology	2	Ian Jones, Dan Roby	
	26 May-25 Aug	Regime Forcing project	2	John Citta, Joe Seyfried	
2005	29 May-27 Aug	Refuge monitoring	4	Erik Andersen, Trevor Joyce, Meredith Barrett, Aaron Stoertz	
	29 May-10 Aug	Auklet biology	1	Paul Regular	
	29 May-7 Jun	Auklet biology	4	Ian Jones, Sampath Seneviratne, Chris Eggleston, Cari Eggleston	
2006	24 May-30 Aug	Refuge monitoring	3	Rachael Orben, Corey Van Stratt, Stephan Lorenz	
	24 May-13 Aug	Auklet biology	3	Sampath Seneviratne, Grant Humphries, Adam Hunt, Ian Jones*	
	13 Aug-30 Aug	Cabin building	2	Jeff Williams, Craig Williams	
2007	29 May-27 Aug	Refuge monitoring	4	Erik Andersen, Scott Freeman, Nick Seferovic, Cornelius Schlawe	
	29 May-4 Aug	Auklet biology	4	Sampath Seneviratne, Stephan Lorenz, Pam Woodman, Chris Smalls	
2008	26 May-27 Aug	Refuge monitoring	3	Scott Freeman, Kevin Payne, Bob Keller	
	26 May-5 Aug	Auklet biology	2	Jessica Fowler, Patrick Leveque	
	26 May-6 Jun	Auklet biology	2	Ian Jones, Rachel Buxton	
2009	29 May-25 Aug	Refuge monitoring	3	Scott Freeman, Ray Buchheit, Kyle Morrison	
	29 May-3 Aug	Auklet biology	2	Hannah Munro, Allie Patrick	
	29 May-3 Aug	ACG biology	2	Joshua Cocke, Steve Alton	
	29 May-18 Jun	Auklet biology	1	Ian Jones	
2010	29 May-27 Aug	Refuge monitoring	3	Alexis Will, Steve Tucker, Alex Wang	
	29 May-18 Jun	Auklet biology	2	Ian Jones, Paul Jones	
	29 May-3 Aug	Auklet biology	2	Hannah Munro, Sarah Kennedy	
	3 Aug-27 Aug	Botany	1	Monte Garroutte	
2011	28 May-28 Aug	Refuge monitoring	2	John Warzybok, David Cockerill	
	28 May-5 Aug	Refuge monitoring	1	Jaime Neill	
	28 May-15 Jul	Auklet biology	1	Ian Jones	
	28 May-5 Aug	Auklet biology	2	Jill Robinson, Michelle Valliant	
	7 Aug-28 Aug	Botany	1	Monte Garroutte	

* indicates that a person only spent a portion of the time period on the island.

Table 114 (continued). History of official visits to Buldir Island, Alaska.

Year	Dates	Type of work	Number	Names	Source
2012	25 May-30 Aug	Refuge monitoring	2	John Warzybok, Matt Henschen	
	25 May-11 Aug	Refuge monitoring	1	Ronan Dugan	
	25 May-11 Aug	Auklet biology	4	Jill Robinson, Michelle Goh, Carley Schacter, Ian Jones	

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