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BIOLOGICAL MONITORING AT BULDIR ISLAND, ALASKA IN 2006: SUMMARY APPENDICES

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Key words: *Aethia cristatella*, *Aethia psittacula*, *Aethia pusilla*, *Aethia pygmaea*, Aleutian Islands, black-legged kittiwake, breeding chronology, Buldir Island, crested auklet, food habits, fork-tailed storm-petrel, *Fratercula cirrhata, Fratercula corniculata*, glaucous-winged gull, horned puffin, *Larus glaucescens*, Leach's storm-petrel, least auklet, *Oceanodroma furcata*, *Oceanodroma leucorhoa*, parakeet auklet, pelagic cormorant, *Phalacrocorax pelagicus*, populations, productivity, red-legged kittiwake, *Rissa brevirostris*, *Rissa tridactyla*, thick-billed murre, tufted puffin, reproductive success, survival, *Uria lomvia*, whiskered auklet

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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*

TABLE OF CONTENTS

INTRODUCTION

The Alaska Maritime National Wildlife Refuge (AMNWR) annually monitors selected species of seabirds at 9 ecological monitoring sites throughout Alaska. The objective of this long term program is to collect baseline status and trend information for a suite of species representing piscivorous and planktivorous trophic guilds. Members of these guilds include species which feed in both nearshore and offshore waters and include key species that serve as indicators of ecosystem health. Many of these species such as puffins (*Fratercula* spp.), kittiwakes (*Rissa* spp.), auklets (*Aethia* spp.), and murres (*Uria* spp.) are particularly well-suited as indicators of fluctuations in the marine food web. By correlating data with 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.

Seabirds at Buldir Island, one of the nine monitoring sites, have been studied annually since 1988 when intensive season-long monitoring began. However, historical data exists from as early as 1974, particularly for storm-petrels and auklets, and these are used for comparison purposes. 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 2006 were to estimate: 1) reproductive success indices for 15 seabird species, 2) breeding chronology for kittiwakes, puffins, auklets and murres, 3) population indices for burrow nesting birds, 3) food habits data for storm-petrels, kittiwakes, auklets, and puffins, and 4) survival data for adult red-legged kittiwakes.

Detailed results of the 2006 monitoring program are contained in these appendices and archived at the Refuge headquarters in Homer, Alaska. Summary data were entered into the Pacific Seabird Monitoring Database and will be included in the annual Alaska Consolidated Seabird Monitoring report of the Alaska Maritime National Wildlife Refuge.

STUDY AREA

Buldir Island (52°21' N, 176°56' E) is the westernmost island in the Rat Islands group of the Aleutian chain. 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 7.7^{o}C in the summer and 3.7^{o}C 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 10m. 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 (655m), 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 800m 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 300m 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 lowland 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 (60-100m) to the Buldir Depression, an 18x55 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 3-4° C in late May and rise to 5-6° C in August. Occasionally, anomalous events occur such as in 1998 when sea surface temperature rose to an unusually high 12° C.

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: Three USFWS observers were present on Buldir from 24 May through 30 August 2006. Rachael Orben served as camp leader and was assisted by Corey Van Stratt and Stephan Lorenz. Sampath Seneviratne, Grant Humphries and Adam Hunt were present from 24 May through 13 August. Sampath Seneviratne conducted research on whiskered auklet biology with the assistance of Grant Humphries who also conducted research on storm-petrels. Adam Hunt resighted banded least and crested auklets through early August. Dr. Ian Jones worked on survival of least and created auklets from 24 May through 8 June. 13-30 August Jeff Williams and Craig Williams finished building a new main camp cabin and demolished the old main cabin which lasted 31 years.

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

- Plot 8 for storm-petrels was monitored, but the number of burrows was hard to quantify so it was not included in the summary of the year.
- Food collection for black-legged and red-legged kittiwakes began in mid-July after the black-legged kittiwake chicks were about a week old instead of in early August.
- An earthquake on 27 June caused a large number of black-legged kittiwake nests to fail and two new plots were started up afterwards in response. The earthquake occurred prior to chick hatch.
- Sampath Seneviratne monitored 29 whiskered auklet nests. He visited the nests every other day during hatch and fledge and handled both adults and chicks. These nests were not used in the productivity and chronology data presented here.
- Food samples were collected from FTSP, LESP, HOPU, TUPU, BLKI, RLKI, LEAU, CRAU, PAAU, and WHAU.

INTERESTING OBSERVATIONS & OCCURANCES

- Overall, 2006 was a high productivity year for all seabird species studied. The parakeet auklets, black-legged kittiwakes and red-legged kittiwakes experienced exceptionally high productivity.
- In late May and early June four Black-crowned Night-Heron (*Nycticorax nycticorax*) carcasses were collected along with two Great Egrets (*Ardea alba*) and one Intermediate Egret (*Egretta intermedia*). The Intermediate Egret represents the first North American record of the species. The Black-crowned Night-Herons and Great Egrets were confirmed to be old world forms.
- Traps were set for sticklebacks in Bean Goose Pond, Stink Creek & Tattler Creek. None were caught confirming suspicions that they are not present on Buldir. Dolly Vardens were caught and preserved and will be analyzed by Frank von Hippel of University of Alaska Anchorage.

- On 27June, a 6.2 magnitude earthquake occurred approximately 22km SSE of Buldir while we were monitoring kittiwake and murre plots from vantage points along the top of the cliffs near Spike Camp. Many birds flushed from their nests and many large rocks fell to the beach. We flushed inland and were very glad that there were no sizable aftershocks.

- In May, the foundation and floor for a new main cabin were constructed with the help of William Pepper, Jeff Williams, and John Faris. In August, they returned for a day to help raise the walls along with Jeff Williams and Craig Williams, who stayed for about two additional weeks to complete the job. The old cabin was dismantled along with the 30 years of additions and modifications that made it a comfortable home in the Aleutians for so many people. We hope that the new cabin will be even more comfortable and a bit easier to dismantle in 50 years!

ACKNOWLEDGMENTS

This monitoring program would not exist without the guiding influences and visions 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. Finally, we would like to thank the crew of the M/V *Tiglax* for safe transport to and from the island.

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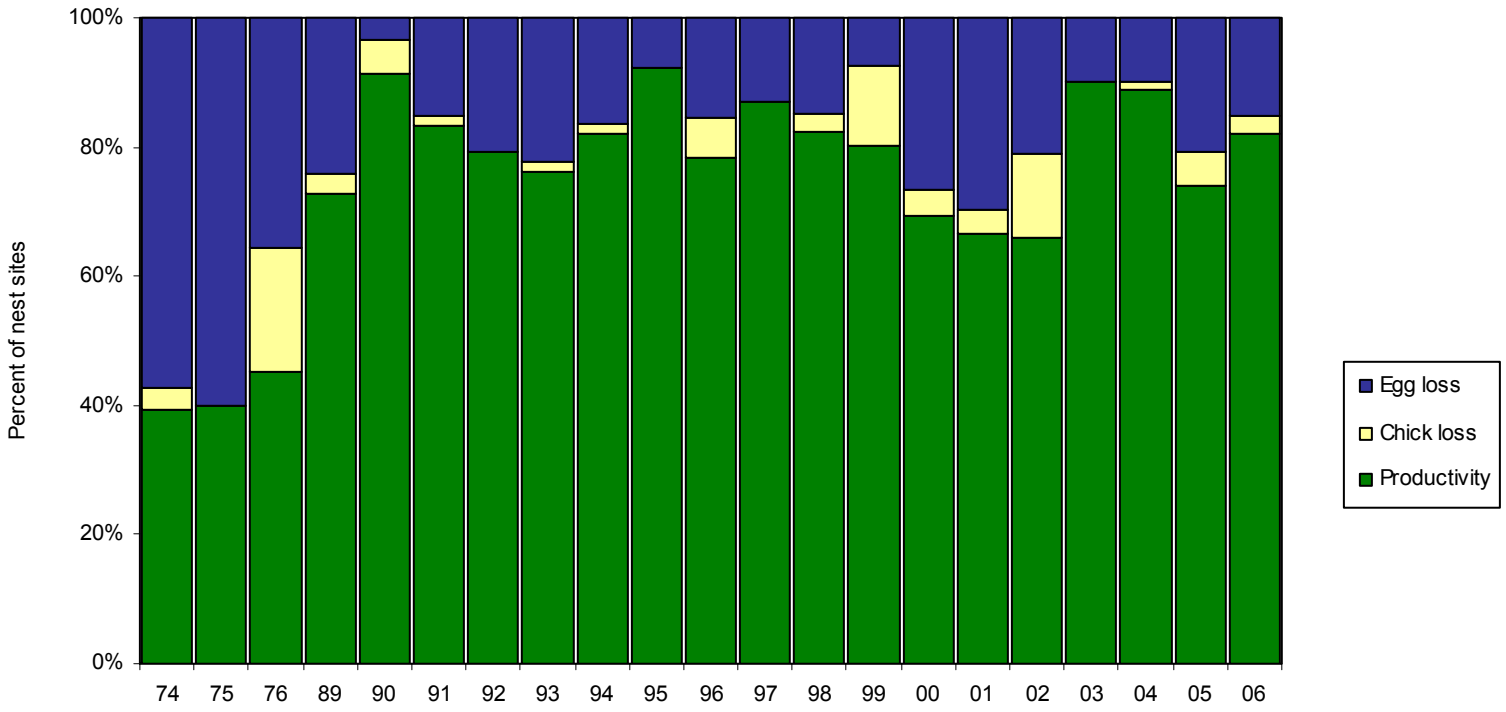

Figure 1. Reproductive performance of Leach's storm-petrels at Buldir Island, Alaska. These values represent the maximal reproductive potential. Actual values were undoubtedly lower. Egg loss=(C-D)/C; Chick loss=(D-E)/C; Productivity=E/C, where C=number of eggs, D=number of eggs hatched, E=number of chicks fledged or still alive at last check.

Table 1. Productivity and burrow occupancy rates of Leach's storm-petrels at Buldir Island, Alaska.

Parameter	1974	1975	1976	1989	1990	1991	1992	1993	1994	1995
Burrows with known contents (A)	69	71	113	232	285	287	294	249	297	280
Occupied burrows (B)	28	20	31	85	75	82	87	74	72	78
Eggs with known fate (C)	28	20	31	66	57	66	48	63	61	64
Eggs lost to disappearance	-	-	-	10	10	1	10	10	14	10
Eggs lost to abandonment	-	-	-	3	3	1	0	0	0	0
Eggs lost to breakage	-	-	-	3	3	0	0	0	0	0
Eggs remaining at last visit (unknown fate)[a]	-	-	-	18	18	18	16	39	11	11
Chicks (D)	12	8	20	50	50	55	56	38	49	51
Chicks lost to disappearance[b]	-	-	0	0	0	3	0	0	0	0
Chicks lost to death	-	-	6	2	2	2	1	0	1	1
Chicks potentially successful (E)	11	8	14	48	48	52	55	38	48	50
Chicks disappeared at unknown age or >55d	-	-	0	0	0	0	0	0	1	0
Chicks still present at last visit	11	8	14	48	48	52	55	38	47	50
Occupancy rate (B/A)	0.41	0.28	0.27	0.37	0.26	0.29	0.30	0.30	0.24	0.28
Hatching success (D/C)	0.43	0.40	0.65	0.72	0.96	0.85	0.79	0.78	0.82	0.92
Fledging success (E/D)[c]	0.92	1.00	0.70	0.96	0.95	0.98	1.00	0.98	0.98	1.00
Reproductive success (E/C)[c]	0.39	0.40	0.45	0.68	0.91	0.83	0.79	0.76	0.82	0.92

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.

Table 1 continued. Productivity and burrow occupancy rates of Leach's storm-petrels at Buldir Island, Alaska.

Parameter	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Burrows with known contents (A)	308	277	282	265	304	189	285	116	283	222	195
Occupied burrows (B)	89	90	52	91	75	56	85	45	93	81	72
Eggs with known fate (C)	78	77	40	66	75	54	85	40	81	77	72
Eggs lost to disappearance	12	6	2	1	7	14	7	2	6	10	7
Eggs lost to abandonment	0	2	1	4	4	0	9	0	0	3	0
Eggs lost to breakage	0	2	0	0	2	2	0	2	2	1	0
Eggs remaining at last visit (unknown fate)[a]	10	7	14	17	7	1	2	0	4	2	4
Chicks (D)	66	67	34	61	55	38	67	36	73	61	61
Chicks lost to disappearance[b]	4	0	0	2	3	2	8	0	1	4	2
Chicks lost to death	1	0	1	6	0	0	3	0	0	2	0
Chicks potentially successful (E)	61	67	33	53	52	36	56	36	72	57	59
Chicks disappeared at unknown age or >55d	0	0	0	0	0	0	0	0	0	0	0
Chicks still present at last visit	61	67	30	53	52	36	56	36	72	57	59
Occupancy rate (B/A)	0.29	0.32	0.18	0.34	0.25	0.30	0.30	0.39	0.33	0.37	0.37
Hatching success (D/C)	0.85	0.87	0.85	0.92	0.73	0.70	0.79	0.90	0.90	0.79	0.85
Fledging success (E/D)[c]	0.92	1.00	0.97	0.87	0.95	0.95	0.84	1.00	0.99	0.93	0.97
Reproductive success (E/C)[c]	0.78	0.87	0.83	0.80	0.69	0.67	0.66	0.90	0.89	0.74	0.82

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.

Table 2. Productivity and burrow occupancy rates of Leach's storm-petrels at Buldir Island, Alaska, 2006.

	Plot							
Parameter	1	2	3	4	7	8[d]	Plots 1-7	SD
Burrows with known contents (A)	17	56	24	44	54	--	195	
Occupied burrows (B)	4	21	4	13	30	11	72	
Eggs with known fate (C)	4	21	4	13	30	11	72	
Eggs lost to disappearance	0	3	1	0	3	0	7	
Eggs lost to abandonment	0	0	0	0	0	0	0	
Eggs lost to breakage	0	0	0	0	0	0	0	
Eggs remaining at last visit (unknown fate)[a]	0	3	0	1	0	0	4	
Chicks (D)	4	15	3	12	27	11	61	
Chicks lost to disappearance[b]	0	0	1	1	0	0	2	
Chicks lost to death	0	0	0	0	0	0	0	
Chicks potentially successful (E)	4	15	2	11	27	11	59	
Chicks disappeared at unknown age or >55d	0	0	0	0	0	0	0	
Chicks still present at last visit	4	15	2	11	27	11	59	
Occupancy rate (B/A)	0.24	0.38	0.17	0.30	0.56	--	0.37	0.15
Hatching success (D/C)	1.00	0.71	0.75	0.92	0.90	1.00	0.85	0.12
Fledging success (E/D)[c]	1.00	1.00	0.67	0.92	1.00	1.00	0.97	0.14
Reproductive success (E/C)[c]	1.00	0.71	0.50	0.85	0.90	1.00	0.82	0.19

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.
[d] Unoccupied burrows were not quantified for Plot 8 and were not included in this summary.

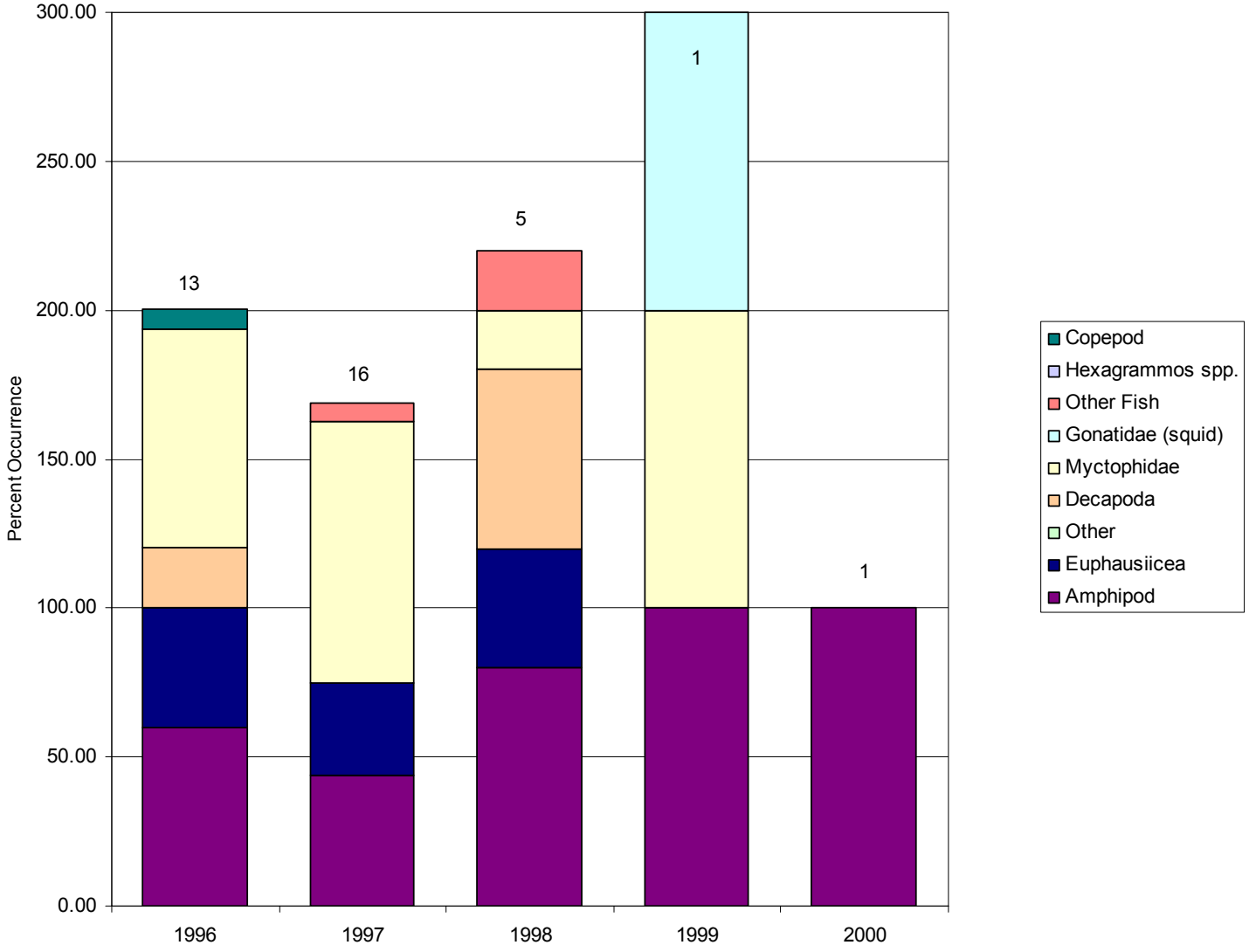

Figure 2. Percent occurrence of prey in diets of Leach's storm-petrels at Buldir Island, Alaska.

Table 3. Relative biomass of prey in diets of Leach's storm-petrels at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

	1996	1997	1998	1999	2000
No. samples	15	16	5	1	1
Total mass (g)	55.1	146.8	5.7	10.5	<1.0
Cephalopoda					
Gonatidae	--	--	--	14.3	--
Copepoda					
Neocalanus cristatus	<0.1	--	1.1	--	--
Amphipoda					
Unid Amphipod	--	--	--	0.2	--
Hyperiidea					
Hyperoche medusarum	0.2	--	--	--	--
Parathemisto pacifica	0.1	--	--	--	--
Gammaridea					
Lysianassidae	2.9	1.5	17.5	--	100.0
Unid. Gammarid	--	--	0.9	--	--
Euphausiacea					
Thysanoessa spp.	5.4	1.4	--	--	--
Unid. Euphausiid	--	--	38.4	--	--
Decapoda					
Shrimp zoea	<0.1	--	--	--	--
Shrimp	0.5	--	--	--	--
Crab zoea	<0.1	--	--	--	--
Atelecyclidae megalopa	--	--	14.0	--	--
Fish					
Myctophidae					
Stenobrachius leucopsarus	--	33.7	22.8	--	--
Myctophid, not *S. leucopsarus*	--	15.7	--	--	--
Unid. Myctophidae[a]	90.7	40.9	--	85.6	--
Unid. fish	--	6.8	5.3	--	--

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

Table 4. Frequency of occurrence of prey in diets of Leach's storm-petrels at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1996	1997	1998	1999	2000
No. samples	15	16	5	1	1
Cephalopoda					
Gonatidae	--	--	--	100.0	--
Copepoda					
Neocalanus cristatus	6.7	--	20.0	--	--
Amphipoda					
Unid. Amphipod	--	--	--	100.0	--
Hyperiidea					
Hyperoche medusarum	20.0	--	--	--	--
Parathemisto pacifica	20.0	--	--	--	--
Gammaridea					
Lysianassidae	20.0	43.8	60.0	--	100.0
Euphausiacea					
Thysanoessa spp.	40.0	31.3	--	--	--
Unid. Euphausiid	--	--	40.0	--	--
Decapoda					
Shrimp zoea	6.7	--	--	--	--
Shrimp	6.7	--	--	--	--
Crab zoea	6.7	--	--	--	--
Atelecyclidae megalopa	--	--	60.0	--	--
Fish					
Myctophidae					
Stenobrachius leucopsarus	--	25.0	20.0	--	--
Myctophid, not *S. leucopsarus*	--	6.3	--	--	--
Unid. Myctophidae[a]	73.3	56.3	--	100.0	--
Unid. fish	--	6.3	20.0	--	--

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

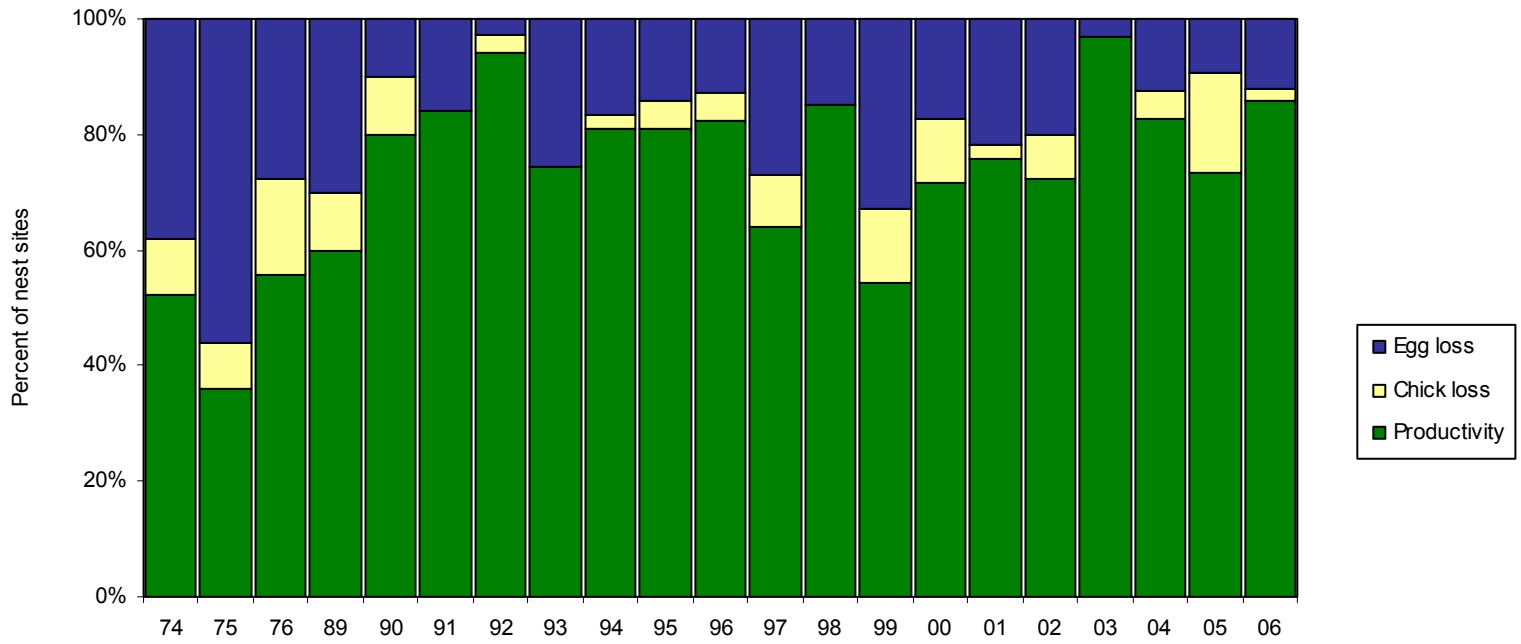

Figure 3. Reproductive performance of fork-tailed storm-petrels at Buldir Island, Alaska. These values represent the maximal reproductive potential. Actual values were undoubtedly lower. Egg loss=(C-D)/C; Chick loss=(D-E)/C; Productivity=E/C, where C=number of eggs, D=number of eggs hatched, E=number of chicks fledged or still alive at last check.

Table 5. Productivity and burrow occupancy rates of fork-tailed storm-petrels at Buldir Island, Alaska.

Parameter	1974	1975	1976	1989	1990	1991	1992	1993	1994	1995
Burrows with known contents (A)	69	71	113	232	285	287	294	249	297	280
Occupied burrows (B)	21	25	18	68	76	68	74	82	78	74
Eggs with known fate (C)	21	25	18	60	70	56	69	70	73	63
Eggs lost to disappearance	-	-	1	15	3	9	2	18	10	9
Eggs lost to abandonment	-	-	0	0	2	0	0	0	2	0
Eggs lost to breakage	-	-	4	3	2	0	0	0	0	0
Eggs remaining at last visit (unknown fate)[a]	-	-	-	7	4	11	4	11	5	11
Chicks (D)	13	11	13	42	63	47	67	52	61	54
Chicks lost to disappearance[b]	-	-	0	2	3	0	0	0	0	2
Chicks lost to death	-	-	3	4	4	0	2	0	2	1
Chicks potentially successful (E)	11	9	10	36	56	47	65	52	59	51
Chicks disappeared at unknown age or >55d	-	-	0	0	0	0	3	5	14	0
Chicks still present at last visit	11	9	10	36	56	47	62	47	45	51
Occupancy rate (B/A)	0.30	0.35	0.16	0.29	0.27	0.24	0.25	0.33	0.26	0.26
Hatching success (D/C)	0.62	0.44	0.72	0.70	0.90	0.84	0.97	0.74	0.84	0.86
Fledging success (E/D)[c]	0.85	0.82	0.77	0.86	0.89	1.00	0.97	1.00	0.97	0.94
Reproductive success (E/C)[c]	0.52	0.36	0.56	0.60	0.80	0.84	0.94	0.74	0.81	0.81

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.

Table 5 continued. Productivity and burrow occupancy rates of fork-tailed storm-petrels at Buldir Island, Alaska.

Parameter	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Burrows with known contents (A)	308	277	282	265	304	189	285	116	283	222	195
Occupied burrows (B)	90	69	81	75	81	42	78	38	69	66	57
Eggs with known fate (C)	85	67	74	70	81	41	65	31	64	64	57
Eggs lost to disappearance	2	1	2	17	0	0	5	0	6	4	2
Eggs lost to abandonment	0	3	0	0	5	3	2	1	0	1	3
Eggs lost to breakage	9	14	9	6	8	5	6	0	2	0	1
Eggs remaining at last visit (unknown fate)[a]	5	2	4	1	1	0	0	0	0	0	1
Chicks (D)	74	49	63	47	67	32	52	30	56	58	50
Chicks lost to disappearance	3	1	0	5	7	1	3	0	0	8	1
Chicks lost to death	1	5	0	4	2	0	2	0	3	4	0
Chicks potentially successful (E)	70	43	63	38	58	31	47	30	53	47	49
Chicks disappeared at unknown age or >55d	65	42	58	38	48	31	40	20	9	4	12
Chicks still present at last visit	5	1	5	0	10	0	7	8	44	43	37
Occupancy rate (B/A)	0.29	0.25	0.21	0.28	0.27	0.22	0.27	0.33	0.24	0.30	0.29
Hatching success (D/C)	0.87	0.73	0.85	0.67	0.83	0.78	0.80	0.97	0.88	0.91	0.88
Fledging success (E/D)[c]	0.95	0.88	1.00	0.81	0.87	0.97	0.90	1.00	0.95	0.81	0.98
Reproductive success (E/C)[c]	0.83	0.64	0.85	0.54	0.72	0.76	0.72	0.97	0.69	0.73	0.86

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.

Table 6. Productivity and burrow occupancy rates of fork-tailed storm-petrels at Buldir Island, Alaska, 2006.

	Plot							
Parameter	1	2	3	4	7	8[d]	Plots 1-7	SD
Burrows with known contents (A)	17	56	24	44	54	--	195	
Occupied burrows (B)	6	14	10	17	10	16	57	
Eggs with known fate (C)	6	14	10	17	10	16	57	
Eggs lost to disappearance	1	0	0	1	0	1	2	
Eggs lost to abandonment	0	2	1	0	0	0	3	
Eggs lost to breakage	0	1	0	0	0	0	1	
Eggs remaining at last visit (unknown fate)[a]	0	0	0	1	0	0	1	
Chicks (D)	5	11	9	15	10	15	50	
Chicks lost to disappearance[b]	0	0	0	0	1	0	1	
Chicks lost to death	0	0	0	0	0	1	0	
Chicks potentially successful (E)	5	11	9	15	9	14	49	
Chicks disappeared at unknown age or >55d	1	2	3	4	2	4	12	
Chicks still present at last visit	4	9	6	11	7	10	37	
Occupancy rate (B/A)	0.35	0.25	0.42	0.39	0.20	--	0.29	0.10
Hatching success (D/C)	0.83	0.79	0.90	0.88	1.00	0.94	0.88	0.08
Fledging success (E/D)[c]	1.00	1.00	1.00	1.00	0.90	0.93	0.98	0.04
Reproductive success (E/C)[c]	0.83	0.79	0.90	0.88	0.90	0.88	0.86	0.05

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.
[d] Unoccupied burrows were not quantified for Plot 8 and were not included in this summary.

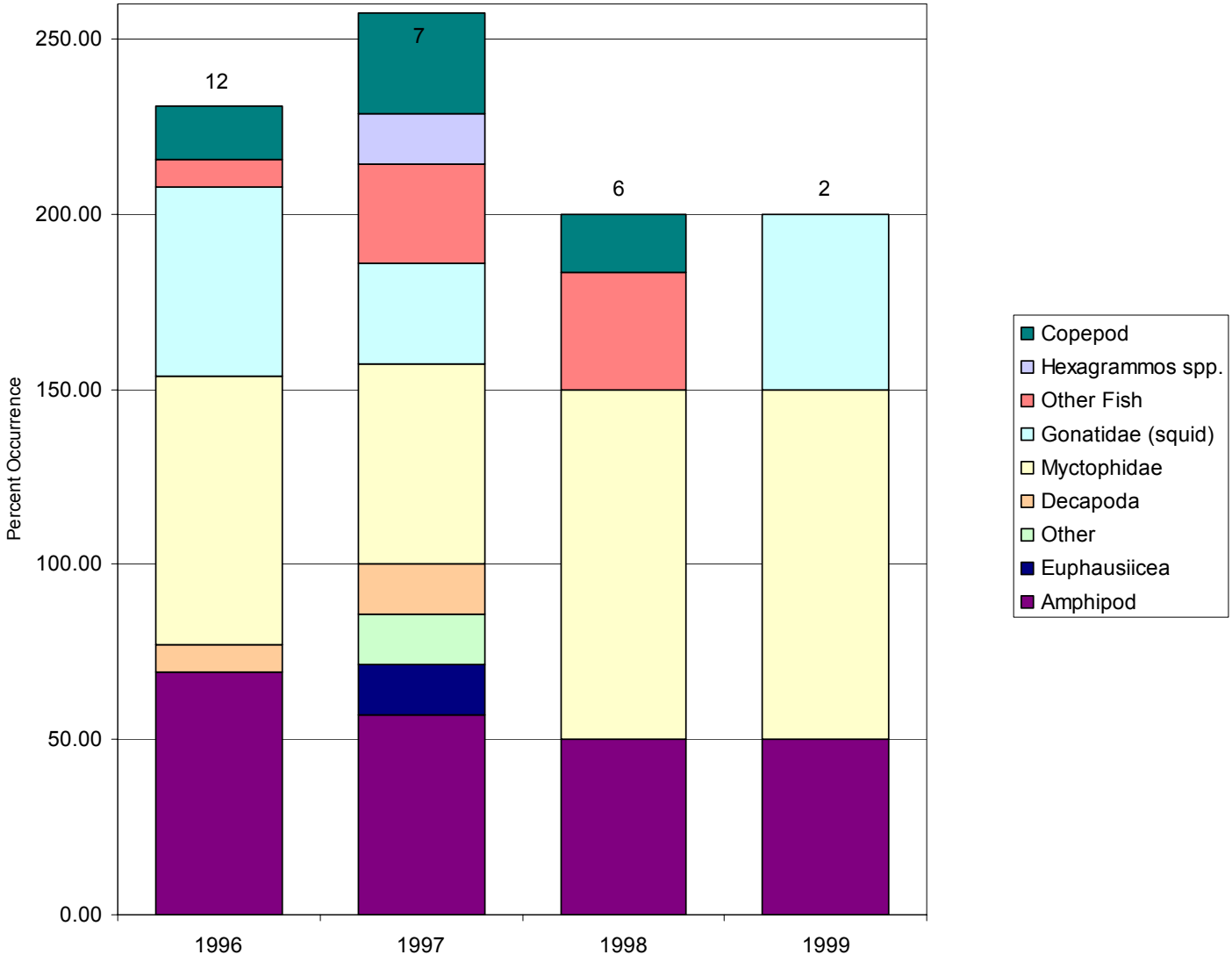

Figure 4. Percent occurrence of prey in diets of fork-tailed storm-petrels at Buldir Island, Alaska.

Table 7. Relative biomass of prey in diets of fork-tailed storm-petrels at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

	1996	1997	1998	1999
No. samples	13	7	6	2
Total mass (g)	101.7	24.8	53.2	15.0
Cephalopoda - squid	27.5	12.1	--	0.1
Copepoda				
Neocalanus plumchrus	0.2	4.2	0.5	--
Amphipoda				
Unid. Amphipod	--	--	--	12.0
Hyperiidea				
Hyperoche medusarum	<0.1	--	--	--
Parathemisto pacifica	0.1	--	--	--
Gammaridea				
Lysianassidae	2.3	4.7	1.9	--
Euphausiacea				
Thysanoessa spp.	--	4.4	--	--
Decapoda				
Shrimp zoea	<0.1	--	--	--
Fish				
Myctophidae				
Stenobrachius leucopsarus	--	8.1	97.1	--
Unid. Myctophidae[a]	69.4	28.2	--	87.9
Hexagrammos spp.	--	24.2	--	--
Unid. fish	0.5	14.1	0.6	--

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

Table 8. Frequency of occurrence of prey in diets of fork-tailed storm-petrels at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1996	1997	1998	1999
No. samples	13	7	6	2
Cephalopoda - squid	53.8	28.6	--	50.0
Copepoda				
Neocalanus plumchrus	15.4	28.6	16.7	--
Amphipoda				
Unid. Amphipod	--	--	--	50.0
Hyperiidea				
Hyperoche medusarum	7.7	--	--	--
Parathemisto pacifica	15.4	--	--	--
Gammaridea				
Lysianassidae	46.2	57.1	50.0	--
Euphausiacea				
Thysanoessa spp.	--	14.3	--	--
Decapoda				
Shrimp zoea	7.7	--	--	--
Unid. Crustacea	--	14.3	--	--
Fish				
Myctophidae				
Stenobrachius leucopsarus	--	14.3	100.0	--
Unid. Myctophidae[a]	76.9	42.9	--	100.0
Hexagrammos spp.	--	14.3	--	--
Unid. fish	7.7	28.6	--	--
(Plastic - not prey)	--	14.3	33.3	--

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

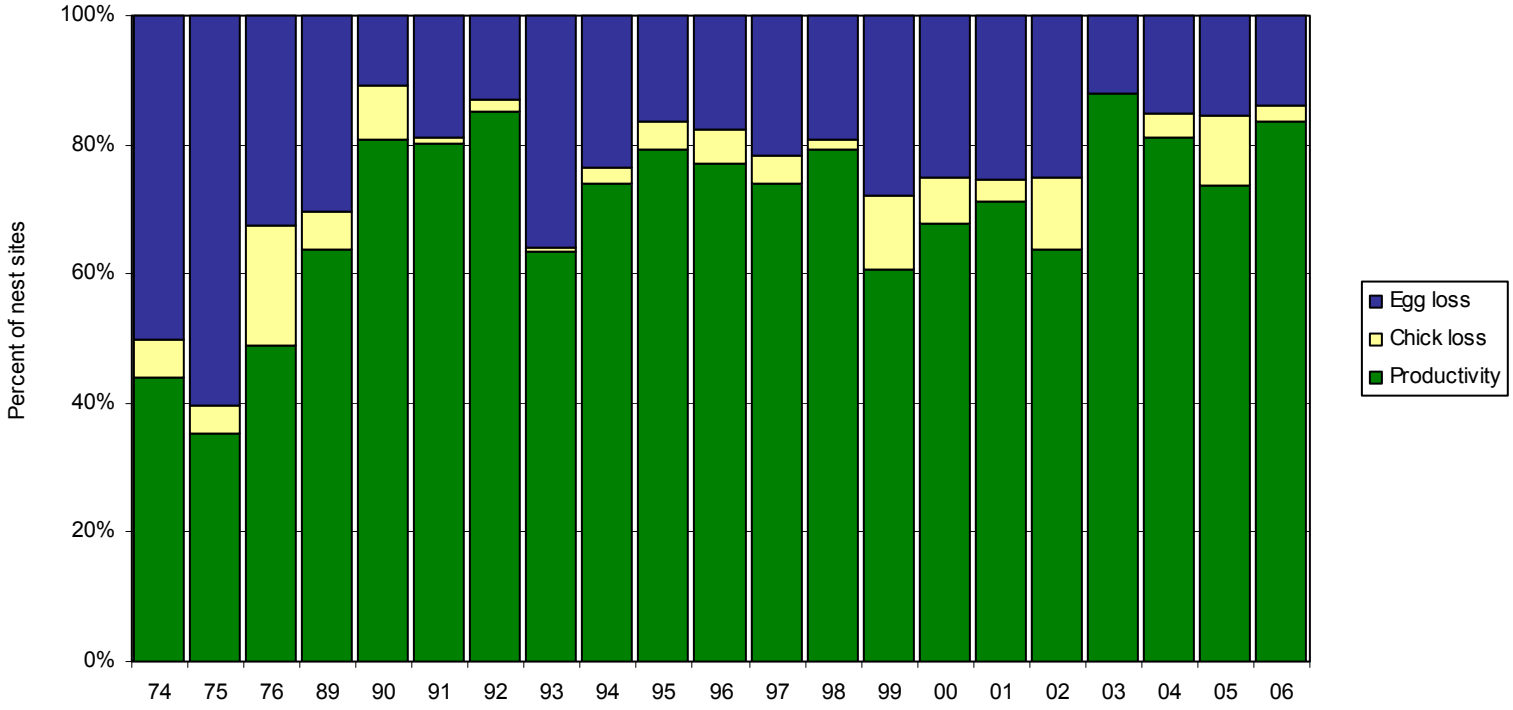

Figure 5. Reproductive performance of storm-petrels (Leach's, fork-tailed and unknown species) at Buldir Island, Alaska. These values represent the maximal reproductive potential. Actual values were undoubtedly lower. Egg loss=(C-D)/C; Chick loss=(D-E)/C; Productivity=E/C, where C=number of eggs, D=number of eggs hatched, E=number of chicks fledged or still alive at last check.

Table 9. Productivity and burrow occupancy rates of storm-petrels (Leach's, fork-tailed, and unknown spp.) at Buldir Island, Alaska.

Parameter	1974	1975	1976	1989	1990	1991	1992	1993	1994	1995
Burrows with known contents (A)	69	71	113	232	285	287	294	249	297	280
Occupied burrows (B)	50	48	49	160	181	163	180	170	183	168
Eggs with known fate (C)	50	48	49	132	146	132	122	162	166	139
Eggs lost to disappearance	-	-	28	10	25	16	37	27	18	28
Eggs lost to abandonment	-	-	26	29	30	57	27	17	28	26
Eggs lost to breakage	-	-	5	2	0	0	0	12	5	5
Eggs remaining at last visit (unknown fate)[a]	-	-	7	4	0	0	1	0	0	7
Chicks (D)	25	19	33	92	130	107	106	104	127	116
Chicks lost to disappearance[b]	-	-	0	2	6	0	0	0	0	4
Chicks lost to death	-	-	9	6	8	1	2	1	4	2
Chicks potentially successful (E)	22	17	0	0	1	0	3	6	22	0
Chicks disappeared at unknown age or >55d	-	-	24	84	118	106	104	103	123	110
Chicks still present at last visit	22	17	24	84	117	106	101	97	101	110
Occupancy rate (B/A)	0.72	0.68	0.43	0.69	0.64	0.57	0.61	0.68	0.62	0.60
Hatching success (D/C)	.50	0.40	0.67	0.70	0.89	0.81	0.87	0.64	0.77	0.83
Fledging success (E/D)[c]	0.88	0.89	0.73	0.91	0.91	0.99	0.98	0.99	0.97	0.95
Reproductive success (E/C)[c]	0.44	0.35	0.49	0.64	0.81	0.80	0.85	0.64	0.74	0.79

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.

Table 9 continued. Productivity and burrow occupancy rates of storm-petrels (Leach's, fork-tailed, and unknown spp.) at Buldir Island, Alaska.

Parameter	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Burrows with known contents (A)	308	277	282	265	304	189	285	116	283	222	195
Occupied burrows (B)	190	168	149	182	164	103	191	94	185	147	129
Eggs with known fate (C)	170	153	125	150	164	94	179	75	158	141	129
Eggs lost to disappearance	26	25	14	11	18	19	19	3	15	14	9
Eggs lost to abandonment	4	3	10	31	5	0	19	1	0	5	3
Eggs lost to breakage	0	5	0	0	10	5	4	5	9	1	1
Eggs remaining at last visit (unknown fate)[a]	17	9	20	16	8	1	3	0	5	2	5
Chicks (D)	140	120	101	108	123	70	134	66	134	119	111
Chicks lost to disappearance[b]	7	1	0	7	10	3	12	0	1	12	3
Chicks lost to death	2	6	2	13	2	0	8	0	5	6	0
Chicks potentially successful (E)	126	111	91	91	101	67	107	58	128	104	108
Chicks disappeared at unknown age or >55d	5	2	5	0	10	0	7	8	9	4	12
Chicks still present at last visit	131	113	99	91	111	67	114	66	119	99	96
Occupancy rate (B/A)	0.62	0.61	0.53	0.69	0.54	0.54	0.67	0.81	0.65	0.66	0.66
Hatching success (D/C)	0.82	0.78	0.81	0.72	0.75	0.75	0.75	0.88	0.85	0.84	0.86
Fledging success (E/D)[c]	0.77	0.74	0.79	0.61	0.68	0.71	0.64	0.88	0.96	0.87	0.97
Reproductive success (E/C)[c]	0.94	0.94	0.98	0.84	0.90	0.96	0.85	1.00	0.81	0.74	0.84

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.

Table 10. Productivity and burrow occupancy rates of fork-tailed and Leach's storm-petrels (incl. unknown spp.) at Buldir Island, Alaska, 2006.

	Plot						
Parameter	1	2	3	4	7	All Plots	SD
Burrows with known contents (A)	17	56	24	44	54	195	
Occupied burrows (B)	10	35	14	30	40	129	
Eggs with known fate (C)	10	35	14	30	40	129	
Eggs lost to disappearance	1	3	1	1	3	9	
Eggs lost to abandonment	0	2	1	0	0	3	
Eggs lost to breakage	0	1	0	0	0	1	
Eggs remaining at last visit (unknown fate)[a]	0	3	0	2	0	5	
Chicks (D)	9	26	12	27	37	111	
Chicks lost to disappearance[b]	0	0	1	1	1	3	
Chicks lost to death	0	0	0	0	0	0	
Chicks potentially successful (E)	9	26	11	26	36	108	
Chicks disappeared at unknown age or >55d	1	2	3	4	2	12	
Chicks still present at last visit	8	24	8	22	34	96	
Occupancy rate (B/A)	0.59	0.63	0.58	0.68	0.74	0.66	0.07
Hatching success (D/C)	0.90	0.74	0.86	0.90	0.93	0.86	0.11
Fledging success (E/D)[c]	1.00	1.00	0.92	0.96	0.97	0.97	0.05
Reproductive success (E/C)[c]	0.90	0.74	0.79	0.87	0.90	0.84	0.09

[a] Eggs still present, apparently viable, regardless of age not included in analysis
[b] Chicks known to be <55 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum reproductive potential. Actual values were undoubtedly lower.

Table 11. Pelagic cormorant productivity at Buldir Island, Alaska in early to mid-August.

Parameter	1974[a]	1989	1990	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total number of nests (A)	53	37	34	35	21	28	14	17	22	29	24	48	64	66	73	79	63	92
Date of maximum nest count	5 Jun	16 Jun	13 Aug	11 Jun	12 Jun	15 Jun	13 Jun	1 Aug	25 May	22 Jun	24 Jun	6 Jun	10 Jun	16 Jun	13 Jun	27 Jun	8 Jun	17 May
Total number of chicks (B)	23	--	61	25	13	36	17	13	24	18	31	52	55	59	39	72	51	79
Date of maximum chick count	19 Aug	-- --	13 Aug	2 Aug	19 Aug	9 Aug	10 Aug	5 Aug	10 Aug	7 Aug	12 Aug	4 Aug	29 Jul	5 Aug	1 Aug	3 Aug	7 Aug	4 Aug
Number of large chicks in nest[b]:																		
0	--	--	7	25	14	10	5	9	13	14	7	3	18	0	26	17	20	9
1	--	--	4	0	3	6	3	3	0	0	2	8	9	9	8	2	4	8
2	--	--	12	5	2	6	4	5	3	6	8	10	18	19	11	15	10	17
3	--	--	11	5	2	6	2	0	6	2	5	0	3	4	3	12	4	11
4	--	--	0	0	0	0	0	0	--	--	--	--	--	--	--	1	--	1
Number of nests with chicks (C)	--	--	27	10	7	18	9	8	9	8	15	25	33	32	22	30	23	37
Mean brood size (B/C)	--	--	2.3	2.5	1.9	2.0	1.9	1.6	2.7	2.3	2.1	2.1	1.7	1.8	1.8	2.4	2.2	2.1
SD	--	--	0.7	0.5	0.9	0.8	0.8	0.5	0.5	0.5	0.7	0.9	0.6	0.6	0.7	0.7	0.67	0.79
% of nests w/ chicks ((C/A)X100)	68.8[c]	--	79.4	28.6	33.3	64.3	64.3	47.1	40.9	27.6	62.5	52.1	51.6	48.5	30.1	38.0	36.5	40.2
Productivity[d] (B/A)	1.4[b]	--	1.8	0.7	0.6	1.3	1.2	0.8	1.1	0.6	1.3	1.1	0.9	0.9	0.5	0.9	0.8	0.9

[a] Nest contents were not recorded in 1974 or 1989. Data from 1974 from Byrd (1978). In all years, observers counted cormorant nests along 2 transects each year: Main Talus to Petrel Valley, and Petrel Valley to East Gull Slide.
[b] On date of maximum chick count.
[c] From a subsample of 16 nests.
[d] Number of chicks present per nest, including empty nests.

Table 12. Red-faced cormorant productivity at Buldir Island, Alaska.

Parameter	2003	2004	2005	2006
Total number of nests (A)	4	9	6	2
Date of maximum nest count	19 Jun	17 Jun	8 Jun	17 Jun
Total number of chicks (B)	5	11	7	6
Date of maximum chick count	25 Jun	3 Aug	2 Aug	4 Aug
Max. count of large chicks in nest[a]:				
0	1	2	1	0
1	1	1	1	0
2	2	2	1	0
3	0	2	1	2
Number of nests with chicks (C)	3	5	3	2
Mean brood size (B/C)	1.7	2.2	2.3	3.0
SD	0.60	0.8	0.58	--
% of nests with chicks ((C/AX100))	75.0	55.6	50.0	100
Productivity[b] (B/A)	1.3	1.2	1.2	3.0

[a] On date of maximum chick count
[b] Number of chicks present per nest, including empty nests.

Table 13. Pelagic cormorant productivity at Buldir Island, Alaska in 2006.

		No. nests containing ≥ *X* chicks					No. nests	
Date	No. nests	0	1+	2+	3+	4+	w/ chick	no. chicks
26 May	52	52	-	-	-	-	-	-
1 Jun	75	75	-	-	-	-	-	-
5 Jun	78	78	-	-	-	-	-	-
17 Jun	92	92	-	-	-	-	-	-
23 Jun	69	69	-	-	-	-	-	-
12 Jul[a]	54	47	3	3	1	-	7	12
22 Jul	57	39	9	5	3	1	18	32
30 Jul	52	15	15	12	10	0	37	69
4 Aug	46	9	8	17	11	1	37	79
9 Aug	46	6	9	23	8	0	40	79
15 Aug	45	8	10	17	9	1	37	75

[a] Inactive nests were not monitored after 12 Jul.

Table 14. Red-faced cormorant productivity at Buldir Island, Alaska in 2006.

		No. nests containing ≥ *X* chicks					No. nests	
Date	No. nests	0	1+	2+	3+	4+	w/ chick	no. chicks
26 May	0	0	-	-	-	-	-	-
1 Jun	1	1	-	-	-	-	-	-
5 Jun	1	1	-	-	-	-	-	-
17 Jun	2	2	-	-	-	-	-	-
23 Jun	1	1	-	-	-	-	-	-
12 Jul	2	2	-	-	-	-	-	-
22 Jul	2	2	-	-	-	-	-	-
30 Jul	2	-	-	1	1	-	2	5
4 Aug	2	-	-	-	2	-	2	6
9 Aug	2	-	-	-	2	-	2	6
15 Aug	2	-	1	-	1	-	2	4

Table 15. Glaucous-winged gull productivity at Buldir Island, Alaska. Measures of success are based on eggs as the sample unit monitored between E. Main Talus and E. Kittiwake Lane.

Parameter		1979[a]	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total no. nests (A)		--	209	199	180	133	175	88	75	20	54	40	38	23	31	39	9
No. eggs in nest:																	
	0	0	49	66	49	82	40	63	18	17	11	6	9	0	5	15	0
	1	1	28	26	15	5	15	6	8	0	3	3	2	2	3	4	2
	2	10	48	35	40	20	35	10	26	2	10	12	4	1	4	4	0
	3	56	84	72	75	26	85	9	22	1	30	19	23	13	15	16	3
	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Clutch size:	mean:	2.82	2.35	2.35	2.47	2.41	2.52	2.12	2.25	2.3	2.8	2.5	2.7	2.69	2.55	2.50	2.60
	n (B)	67	160	133	131	51	135	25	56	3	43	34	29	16	16	24	5
	SD	0.42	0.76	0.79	0.70	0.67	0.67	0.78	0.69	0.58	0.43	0.66	0.59	0.70	0.74	0.78	0.55
Max. no. eggs (C)[b]		--	376	312	324	123	340	53	126	7	113	84	81	53	69	60	11
Maximum no. chicks seen (D)		--	122	35	49	34	83	28	28	2	17	12	33	22	23	17	5
Chicks seen on last visit before fledging (E)		--	89	8	48	14	34	15	9	0	12	8	15	19	22	9	5
Laying success (B/A)		--	0.77	0.67	0.73	0.38	0.77	0.28	0.75	0.15	0.80	0.85	0.76	0.70	0.52	0.62	0.56
Hatch success (D/C)		--	0.32	0.11	0.15	0.28	0.24	0.53	0.22	0.29	0.15	0.14	0.41	0.42	0.33	0.28	0.45
Fledge success (E/D)		--	0.73	0.23	0.98	0.41	0.41	0.54	0.32	0.00	0.71	0.67	0.45	0.86	0.07	0.53	1.00
Breeding success (E/C)		--	0.24	0.03	0.15	0.11	0.10	0.28	0.07	0.00	0.11	0.10	0.19	0.36	0.31	0.15	0.45
Overall prod (E/A)		--	0.43	0.04	0.27	0.11	0.19	0.17	0.12	0.00	0.22	0.20	0.39	0.83	0.71	0.23	0.56

[a] Data for 1979 were collected at plots located in the interior of Buldir (Day et al. 1980) and are comparable only for estimates of clutch size with other years.
[b] Observers counted glaucous-winged gulls from E. Main Talus to East Kittiwake Lane.

Table 16. Glaucous-winged gull productivity at Buldir Island, Alaska. Measures of success are based on nests as the sample unit. No data were collected in 2001.

Parameter	1997	1998	1999	2000	2002	2003	2004	2005	2006[c]
No. nests (A)[a]	47	30	20	28	37	23	34	39	--
No. nests ≥ 1 egg (B)	10	26	3	24	31	22	27	24	23
No. eggs (C)	22	58	7	63	89	56	78	60	56
No. nests ≥ 1 chick (D)	8	13	1	10	26	20	18	14	16
No. chicks (E)	14	21	2	18	57	38	38	17	37
Laying success (B/A)	0.21	0.87	0.15	0.86	0.84	0.96	0.79	0.62	--
Nesting success (D/B)	0.80	0.50	33.3	0.42	0.84	0.91	0.67	0.58	0.70
Hatching success (E/C)	0.64	0.36	0.29	0.29	0.64	0.68	0.49	0.28	0.66
Mean hatch date	11 July	2 July	23 Jun	23 Jun	21 Jun	--[b]	15 Jun	17 Jun	20 Jun
n	5	13	1	7	14	--	18	20	14
SD	2.2	3.4	--	6.2	6.4	--	7.4	4.7	4.6

[a] Number of nests represents maximum number of nests during the season.
[b] Hatch dates not calculated; chicks were present on the first visit.
[c] Empty nest bowls were not quantified since the nests followed came from multiple locations: five nests with eggs were followed on the Main Talus to Kittiwake Lane transect; 11 nests were followed in South Marsh; six nests were followed below Main Talus, and one nest was followed on North Bight Beach.

Table 17. Clutch size of glaucous-winged gulls from the East Main Talus to Kittiwake Lane transect, Buldir Island, Alaska in 2006.

Date	No. nests	No. nests containing *X* eggs				Total No. eggs	No. chicks[a]
		0	1	2	3		
26 May	9	5	1	2	1	8	0
29 May	5	1	1	0	3	10	0
1 June	4	0	1	0	3	10	0
5 June	5	0	2	0	3	11	0
9 June	6	1	2	0	3	11	0
17 June	5	0	0	1	2	8	0
23 June	5	0	1	0	1	4	2
12 July	1	0	0	0	0	0	5

[a] Due to chick mobility, chicks counted by section rather than by individual nests.

Table 17a. Minimum Clutch Size of glaucous-winged gulls at Buldir Island, Alaska in 2006

Date	No. nests	No. nests containing *X* eggs			Total No. eggs	Average Clutch Size	SD
		1	2	3			
6 June[a]	20	3	6	11	48	2.40	0.75

[a] Only nests located on and prior to 6 June were used in this analysis.

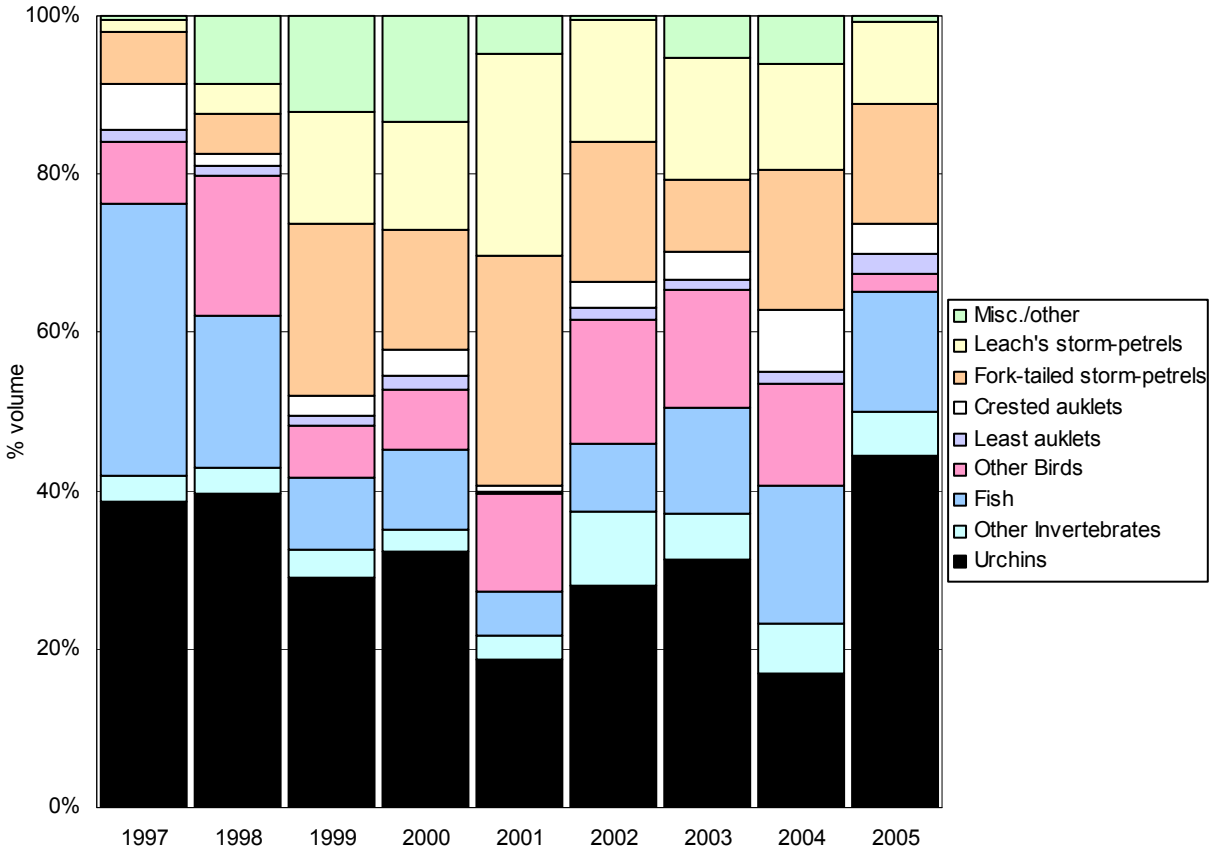

Figure 6. Percent volume of food items in regurgitated pellets of glaucous-winged gulls at Buldir Island, Alaska. Composite value for invertebrates does not include urchins. Composite value for birds is inclusive of all species except crested auklet, least auklet, fork-tailed storm-petrel and Leach's storm-petrel.

Table 18. Occurrence of food items (%) in regurgitated pellets of glaucous-winged gulls of Buldir Island, Alaska through 1974-76 and 1997-2006.

	1974-76[a]	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
sample size	655	158	210	505	279	281	247	660	301	552	316
Invertebrates[b]	1.9	46.2	49.5	38.4	42.3	28.1	46.6	47.4	31.2	50.9	29.7
sea urchin	1.1	39.9	42.8	33.5	37.3	22.4	31.6	35.9	22.3	44.9	23.7
blue mussel	--	3.2	2.4	2.4	2.9	2.1	3.2	2.4	3.7	2	1.9
snail	--	0.6	1	0.2	1.1	0.4	4	0.5	--	--	0.9
limpet	--	1.3	--	1	0.4	1.8	4.5	6.7	1.3	4	0.9
chiton	--	--	1.9	0.2	0.4	--	0.8	--	3.7	--	0.3
crab	--	0.6	0.5	0.2	0.4	0.4	--	0.3	--	--	--
Unid. bivalve	--	0.6	0.5	0.4	--	0.7	--	--	0.3	--	0.3
Unid. shellfish	--	--	--	0.2	--	0.4	1.2	1.7	--	--	0.9
amphipod	--	--	--	0.2	--	--	0.4	--	--	--	--
beetle	--	--	--	0.2	--	--	--	--	--	--	--
Unid. kelp fly	0.08	--	--	--	--	--	--	--	--	--	--
euphausiid	--	--	--	--	--	--	0.8	--	--	--	0.6
Fish	19.5	36.1	21.4	11.3	12.2	6.4	13.8	18.3	25.2	15.4	36.1
<10 cm	--	8.9	10	6.5	2.5	1.8	6.1	12.1	9.3	0.7	6.0
10-20 cm	--	12	9.5	4.2	6.1	3.9	6.1	0.2	14.6	14.5	28.2
>20 cm	--	15.2	1.9	0.6	3.6	0.7	1.6	1.5	0.3	0.2	1.6
unknown size	--	--	--	--	--	--	--	4.5	0.7	--	0.3
Birds	79.2	24.1	31.9	48.5	44.8	70.1	60.7	48.9	59.5	34.4	38.3
crested auklet	2.9	6.3	1	2.4	3.6	0.7	4	3.8	8.6	4	3.2
least auklet	1.4	1.3	1.4	1.4	1.8	0.4	1.6	1.2	1.7	2.4	1.9
whiskered auklet	--	--	--	0.2	0.4	0.4	--	--	--	--	--
parakeet auklet	--	--	0.5	0.2	2.5	1.1	1.6	2.7	0.7	0.4	0.3
Cassin's auklet	0.2	--	0.5	--	0.4	--	--	0.9	--	--	--
ancient murrelet	10.1	--	0.5	0.2	2.9	14.3	6.9	2	1	--	0.6
Unid. sm. auklet	--	1.3	--	--	0.7	--	--	0.2	--	0.2	--
Unid med. auklet	--	1.3	--	0.4	--	--	--	--	0.7	--	1.6
Unid. auklet	1.4	3.8	0.5	0.4	0.7	0.7	3.6	--	1	--	4.7
fork-tailed storm-petrel	40	7	5.7	22.2	16.1	29.5	18.2	9.1	18.6	15	12.3
Leach's storm-petrel	20	1.3	3.8	15.4	14.3	26.3	16.2	16.1	14.3	10.3	9.8
Unid. storm-petrel	0.8	1.9	4.8	2.2	--	--	2	1.5	--	--	1.6
black-legged kittiwake	0.2	--	--	--	--	--	0.4	--	--	--	--
Unid. kittiwake	--	--	--	--	--	--	--	1.2	7.6	--	--
murre chick	--	--	--	--	--	--	--	--	0.3	--	--
tufted puffin	0.2	--	--	--	--	--	0.8	--	--	--	--
Unid. puffin	--	--	--	--	--	--	--	0.2	--	--	--
Cackling goose gosling	--	--	--	0.2	0.4	--	0.8	--	--	--	--
Cackling goose eggs	--	--	--	--	--	--	--	1.2	--	--	--
Unid. sm. bird	0.3	0.6	13.3	1.4	1.1	5.3	0.8	6.4	1	1.8	1.9
Unid. bird eggs	1.7	--	--	2	--	1.4	4	1.2	4	0.4	0.3
glaucous-winged gull	--	--	--	--	--	0.4	--	--	--	--	--
gull eggs	--	--	--	--	--	--	--	1.4	--	--	--
Miscellaneous	6.8	1.3	10	18	21.5	1.4	1.6	8.3	15.9	1.1	17.4
terrestrial vegetation	2.5	--	--	0.4	2.2	--	--	0.5	0.3	0.2	--
Unid. marine algae	--	1.3	5.7	15.8	15.1	3.9	2	7.4	13	0.9	15.5
pebbles	0.8	--	4.3	1.8	1.4	1.9	0.8	0.3	2.3	--	1.6
sea lion hair	3.5	--	--	--	--	--	--	--	--	--	--
plastic	--	--	--	--	2.9	--	2	0.2	0.3	--	0.3

[a] From Trapp 1979
[b] All values represent percent occurrence in total sample. Values in bold are composite totals.

Table 19. Percent volume of food in regurgitated pellets of glaucous-winged gulls on Buldir Island, Alaska from 1997-2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
sample size	158	210	505	279	281	247	660	301	552	316
Invertebrates[a]	42	42.9	32.6	35.1	21.7	37.3	37.1	23.1	50	23.7
sea urchin	38.7	39.6	29.1	32.3	18.6	28.2	31.2	16.8	44.5	20.8
blue mussel	2.3	1.8	1.9	1.5	1	2.2	0.8	2.5	1.9	1.1
snail	<0.1	<0.1	0.2	1.1	<0.1	1.9	0.2	--	--	0.3
limpet	0.8	--	0.8	0.2	1.3	3.2	3.9	0.9	3.6	0.3
chiton	--	<0.1	0.2	0.1	--	0.6	--	2.9	--	0.3
crab	<0.1	<0.1	<0.1	<0.1	0.3	--	--	--	--	--
Unid. bivalve	0.1	--	0.2	--	0.4	--	--	--	--	<0.1
Unid. shellfish	--	<0.1	<0.1	--	<0.1	0.4	0.9	--	--	0.1
amphipod	--	--	--	--	--	<0.1	--	--	--	--
beetle	--	--	<0.1	--	--	--	--	--	--	--
Unid. kelp fly	--	--	--	--	--	--	--	--	--	--
euphausiid	--	--	--	--	--	0.8	--	--	--	0.6
Fish[b]	34.3	19.3	9	10	5.6	8.8	13.3	17.5	15.1	36.1
<10 cm	7.4	9.9	4.8	1.6	1	4.8	9.4	5.4	0.5	4.6
10-20 cm	11.7	5.1	3.8	5.2	3.9	3.4	0.1	11.5	14.5	24.2
>20 cm	15.2	4.3	0.4	3.2	0.7	0.6	1.3	0.3	0.2	1.6
unidentified	--	--	--	--	--	--	2.4	0.4	--	<0.1
Birds	23.1	29.2	46.2	41.5	67.9	53.6	44.4	53.1	34.1	38.3
crested auklet	6	1.4	2.4	3.3	0.7	3.5	3.6	8	4	3.1
least auklet	1.3	1.4	1.4	1.8	0.4	1.4	1.2	1.4	2.4	1.8
whiskered auklet	--	--	0.2	0.4	0.4	--	--	--	--	--
parakeet auklet	--	0.5	0.2	2.5	1.1	1.4	2.6	0.7	0.4	0.3
Cassin's auklet	--	0.5	--	0.4	--	--	0.8	--	--	--
ancient murrelet	--	0.5	0.2	2.7	4	6.2	2	0.9	--	0.6
Unid. sm. auklet[c]	0.3	--	--	<0.1	--	--	--	--	0.2	--
Unid. med. auklet[c]	0.6	--	0.4	--	--	--	--	0.6	--	1.6
Unid. auklet	4.4	0.5	0.4	0.7	0.7	3.6	--	1	--	3.6
fork-tailed storm-petrel	6.7	5.2	21.7	15.1	29	17.5	9	17.4	15	11.9
Leach's storm-petrel	1.3	3.8	14.2	13.6	25.5	15.6	15.5	13.5	10.3	9.6
Unid. storm-petrel	1.9	3.8	2	--	--	1.3	1.4	--	--	0.6
black-legged kittiwake	--	--	--	--	--	0.4	--	--	--	--
unidentified kittiwake	--	--	--	--	--	--	1.1	7.5	--	--
murre chick	--	--	--	--	--	--	--	0.3	--	--
tufted puffin	--	--	--	--	--	1	--	--	--	--
unidentified puffin	--	--	--	--	--	--	0.1	--	--	--
Cackling goose gosling	--	--	0.2	0.4	--	0.5	--	--	--	--
glaucous-winged gull	--	--	--	--	<0.1	--	--	--	--	--
Unid. sm. bird	0.6	11	1.3	0.7	5	0.1	4.3	0.4	1.6	1.2
gull egg	--	--	--	--	--	--	1.4	--	--	--
goose egg	--	--	--	--	--	--	1	--	--	--
Unid. bird eggs	--	0.8	1.6	--	1.2	0.5	0.4	1.4	0.2	<0.1
Miscellaneous	0.6	8.5	12	13.4	4.9	0.4	5.2	5.9	0.9	17.4
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	5.2	0.8	10.8
pebbles	--	3.6	0.7	0.6	2.7	<0.1	0.1	0.5	--	0.4
sea lion hair	--	--	--	--	--	--	--	--	--	--
plastic	--	--	--	0.2	--	0.1	--	--	--	<0.1

[a] All values represent percent of the volume of all samples comprised by each item. Values in bold are composite totals for invertebrates, fish, birds, and miscellaneous

[b] Regurgitated fish masses were not identifiable to species.

[c] Some identifications to species were difficult because of the age or condition of the pellet or that insufficient materials for a complete identification were available. Unidentified small auklet means the specimen was believed to have been a Least or Whiskered Auklet. Unidentified medium auklet means the specimen was believed to have been a Parakeet or Crested Auklet.

Table 20. Occurrence of food items in 316 regurgitated pellets of glaucous-winged gulls at Buldir Island, Alaska, 2006.

Food item	no. samples	min. no. birds/orgs.	% occurrence[a]
Invertebrates	**95**	**2651**	**30.1**
sea urchin	75	75	23.7
blue mussel		6	30 1.9
snail	3	30	0.9
limpet	3	7	0.9
chiton	1	5	0.3
crab	-	-	-
Unid. shellfish	3	3	0.9
Unid. bivalve	1	1	0.3
euphausid[b]	2	2000	0.6
amphipod	1	500	0.3
Fish	**114**	**114**	**36.1**
<10 cm	19	19	6.0
10-20 cm	89	89	28.2
>20 cm	5	5	1.6
unk. size	1	1	0.3
Birds	**121**	**121**	**38.3**
crested auklet	10	10	3.2
least auklet	6	6	1.9
parakeet auklet	1	1	0.3
Cassin's auklet	-	-	-
ancient murrelet	2	2	0.6
Unid. alcid	15	15	4.7
crested auk. or parakeet auk.	5	5	1.6
Unid. kittiwake	-	-	-
murre chick	-	-	-
fork-tailed storm-petrel	39	39	12.3
Leach's storm-petrel	31	31	9.8
Unid. storm-petrel	5	5	1.6
Unid. small bird	6	6	1.9
murre egg	-	-	-
goose egg	-	-	-
Unid. egg	1	1	0.3
Miscellaneous	**55**	**62**	**17.5**
terr. plant material	-	-	-
Unid. marine algae	49	49	15.5
pebbles	5	11	1.6
plastic	1	2	0.3

[a] All values represent percent occurrence in total sample. Values in bold are composite totals for invertebrates, fish, birds, and miscellaneous. Summation of columns exceeds 100% because of overlap (i.e. occurrence of more than 1 prey species per pellet).

[b] Samples containing Euphausiid were estimated to contain at least 1000 individuals; they likely contained more.

Table 21. Breeding chronology dates for black-legged kittiwakes at Buldir Island, Alaska.

Year	mean hatch	SD	n[a]	median hatch	no. nests monitored[b]	first lay	last lay	first hatch	last hatch	first fledge
1988	3 Jul	--	246	--	--	--	--	--	--	--
1989	16 Jul	--	52	--	--	--	--	--	--	--
1990	3 Jul	--	474	--	--	--	--	--	--	--
1991	17 Jul	--	124	--	--	--	--	--	--	--
1992	3 Jul	7.8	389	30 Jun	--	--	--	--	--	--
1993	8 Jul	--	119	--	--	--	--	--	--	--
1994	1 Jul	--	165	--	--	--	--	--	--	--
1995	13 Jul	9.9	39	13 Jul	359	<15 Jun	13 Jul	28 Jun	8 Aug	3 Aug
1996	4 Jul	12.0	223	2 Jul	426	<14 Jun	23 Jul	<14 Jun	4 Aug	19 Jul
1997	9 Jul	8.1	276	9 Jul	493	<9 Jun	9 Jul	17 Jun	7 Aug	31 Jul
1998	6 Jul	8.1	160	5 Jul	280	<14 Jun	5 Jul	16 Jun	4 Aug	4 Aug
1999	11 Jul	7.6	27	9 Jul	237	<24 Jun	9 Jul	28 Jun	4 Aug	16 Aug
2000	3 Jul	8.6	184	3 Jul	324	<11 Jun	10 Jul	12 Jun	1 Aug	1 Aug
2001	23 Jun	4.0	17	26 Jun	178	<17 Jun	20 Jun	17 Jun	1 Jul	>22 Aug
2002	27 Jun	5.3	147	29 Jun	299	<12 Jun	29 Jun	15 Jun	11 Jul	28 Jul
2003	10 Jul	4.3	21	8 Jul	272	<17 Jun	3 Jul	<22 Jun	<23 Jul	11 Aug
2004	27 Jun	5.4	34	28 Jun	239	<15 Jun	1 Jul	18 Jun	11 Jul	14 Aug
2005	12 Jul	10.7	6	11 Jul	412	<15 Jun	28 Jul	<27 Jun	6 Aug	10 Aug
2006	7 Jul	6.7	88	7 Jul	248	<9 Jun	29 Jun	23 Jun	25 Jul	4 Aug

[a] Sample size is for the calculation of mean and median hatch dates. These data are a subsample for which we have observations ≤ 7 days apart from egg to chick.

[b] The total used for estimating the remaining parameters. These dates might contain observations > 7 days apart or estimated event dates (e.g. “no egg” on first visit followed by “bird incubating” on the next visit).

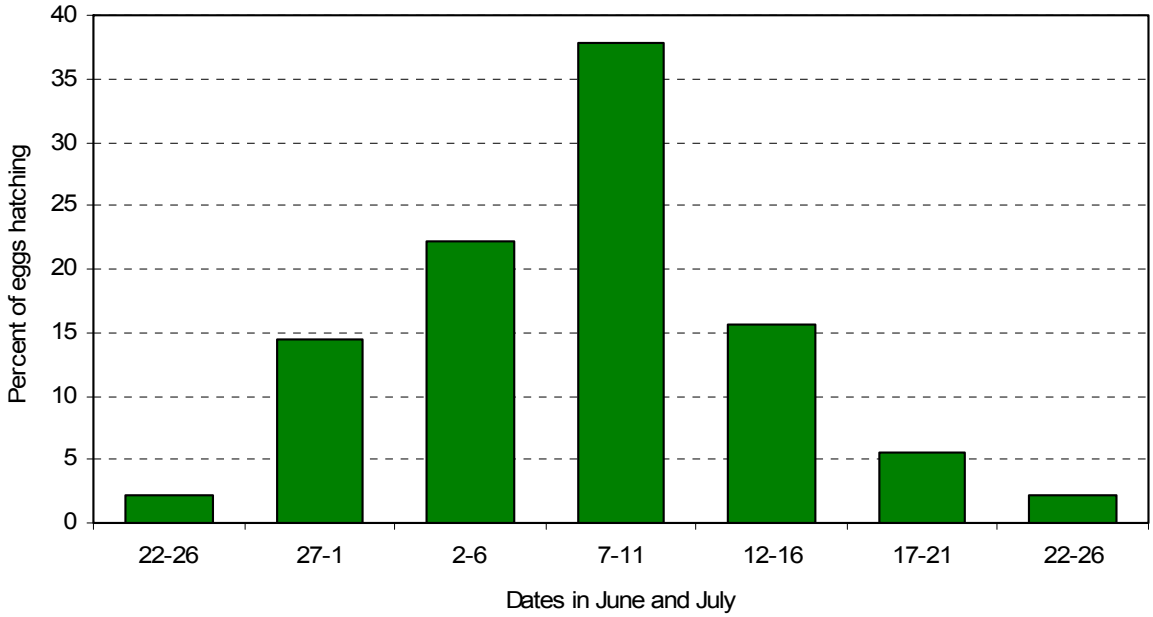

Figure 7. Hatching chronology of black-legged kittiwakes at Buldir Island, Alaska in 2006 (n = 88).

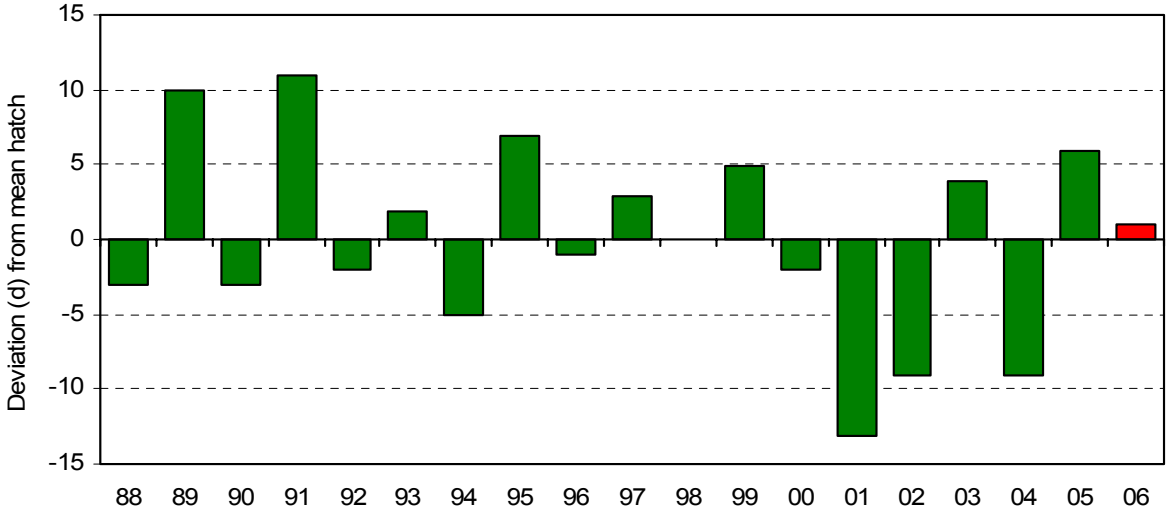

Figure 8. Yearly hatch date deviation (from the 1988-2005 average of 6 July) for black-legged kittiwakes at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

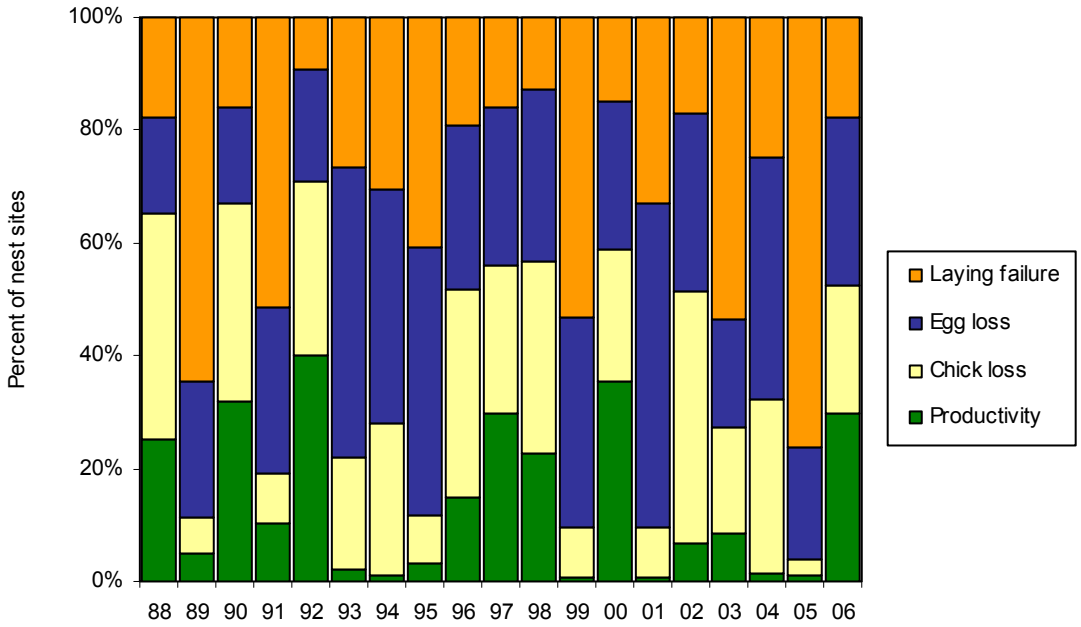

Figure 9. Reproductive performance of black-legged kittiwakes at Buldir Island, Alaska. Laying Failure=(A-B)/A; Egg Loss=(B-D)/A; Chick Loss=(D-F)/A; Productivity=F/A, where A=total number of nests; B=number of nests with ≥ 1 egg; D=number of nests with ≥ 1 chick; F=number of nests with ≥ 1 fledged chick.

Table 22. Reproductive performance of black-legged kittiwakes at Buldir Island, Alaska.

Year	total nests (A)	mean clutch	no. nests w/ eggs (B)	no. nests w/ chicks (D)	no. nests w/ fledged chick (F)	laying success (B/A)	nesting success (D/B)	fledging success (F/D)	reproductive success (F/B)	productivity (F/A)
1976	--	1.61	--	--	--	--	--	--	--	--
1988	617	1.78	508	403	156	0.82	0.79	0.39	0.31	0.25
1989	564	1.22	201	64	28	0.36	0.32	0.44	0.14	0.05
1990	906	1.76	762	608	288	0.84	0.80	0.47	0.38	0.32
1991	719	1.35	350	138	74	0.49	0.39	0.54	0.21	0.10
1992	508	1.79	461	360	203	0.91	0.78	0.56	0.44	0.40
1993	533	1.58	391	118	12	0.73	0.30	0.11	0.03	0.02
1994	468	1.66	325	131	5	0.69	0.40	0.04	0.02	0.01
1995	359	1.41	213	42	11	0.59	0.20	0.29	0.05	0.03
1996	426	1.69	344	220	64	0.81	0.64	0.29	0.19	0.15
1997	493	1.73	415	277	146	0.84	0.67	0.53	0.35	0.30
1998	280	1.75	244	159	64	0.87	0.65	0.40	0.26	0.23
1999	237	1.49	111	26	2	0.47	0.23	0.08	0.02	0.01
2000	324	1.79	276	191	115	0.85	0.69	0.60	0.42	0.35
2001	178	--	119	17	1	0.67	0.14	0.06	0.01	0.01
2002	299	1.79	248	154	20	0.83	0.62	0.13	0.08	0.07
2003	213	1.51	99	58	18	0.46	0.59	0.31	0.18	0.08
2004	239	1.11	180	77	3	0.75	0.43	0.04	0.02	0.01
2005	412	1.11	98	16	4	0.24	0.16	0.25	0.04	0.01
2006	227	1.65	187	119	68	0.82	0.64	0.57	0.36	0.30

Table 23. Black-legged kittiwake clutch sizes at Buldir Island, Alaska.

	1976[a]	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
mean[b]	1.61	1.78	1.22	1.76	1.35	1.79	1.58	1.66	1.41	1.69	1.73	1.75	1.49	1.79	1.72	1.79	1.51	1.11	1.11	1.65
n	74	462	220	761	350	462	391	323	213	344	415	244	237	324	81	299	99	239	412	227
No. nests containing X eggs:																				
0	--	--	--	--	--	--	--	--	145	82	78	36	126	48	--	51	114	69	360	40
1	--	--	--	--	--	--	--	--	126	107	111	64	57	59	23	54	49	75	40	65
2	--	--	--	--	--	--	--	--	87	236	304	178	54	216	58	193	50	95	12	121
3	--	--	--	--	--	--	--	--	0	1	0	2	0	1	0	1	0	0	0	1

[a] Data from Byrd and Day (1986).
[b] Nest sites used as sample units, not plots

Table 24. Reproductive performance of black-legged kittiwakes on index plot at Buldir Island, Alaska, in 2006.

Parameter	Spike Camp Plots 40b*	36	45	46	37	39d	total	n	mean	SD
Total # nests (A)	52	32	41	35	29	38	227			
No. nests ≥1 egg (B)	44	27	35	28	25	28	187			
Total # eggs[a] (C)	77	39	52	48	47	47	310			
No. nests ≥1 chick (D)	28	15	23	22	17	14	119			
Total Chick (E)	41	16	33	25	19	16	150			
No. nests ≥1 chick fledged (F)	20	6	19	16	3	4	68			
Total chicks fledged (G)	20	6	19	17	3	4	69			
No. nests with 0 eggs	8	5	6	7	4	10	40			
No. nests with 1 egg	11	15	18	9	3	9	65			
No. nests with 2 eggs	33	12	17	18	22	19	121			
No. nests with 3 eggs	0	0	0	1	0	0	1			
laying succ. (B/A)	0.85	0.84	0.85	0.80	0.86	0.74	0.82	6	0.82	0.05
clutch size (C/B)	1.75	1.44	1.49	1.71	1.88	1.68	1.66	6	1.66	0.17
nesting succ. (D/B)	0.64	0.56	0.66	0.79	0.68	0.50	0.64	6	0.64	0.10
hatching success (E/C)	0.53	0.41	0.63	0.52	0.40	0.34	0.48	6	0.47	0.11
chick succ. (G/E)	0.49	0.38	0.58	0.68	0.16	0.25	0.46	6	0.42	0.20
egg success (G/C)	0.26	0.15	0.37	0.35	0.06	0.09	0.22	6	0.21	0.13
fledging success (F/D)	0.71	0.40	0.83	0.73	0.18	0.29	0.57	6	0.52	0.27
reproductive success (F/B)	0.45	0.22	0.54	0.57	0.12	0.14	0.36	6	0.34	0.20
overall productivity (F/A)	0.38	0.19	0.46	0.46	0.10	0.11	0.30	6	0.28	0.17

[a] All egg counts refer to minimum number of eggs possible.

* On 27 June, a 6.2 magnitude earthquake approximately 22km SSE of Buldir caused all 26 nests in plot 40a to fail. Of these nests, 16 contained 0 eggs, 4 had 1 egg, and 6 had 2 eggs. In addition, plots 36, 46, 37, 39d lost a combined 18 nests (Total nests:0 egg:1 egg:2 eggs; Plot 36:4:4:0:0; Plot 46:5:1:2:2; Plot37:1:0:0:2; Plot 39d:8:3:1:4). These nests are not included in the above productivity. If these 44 nests and 20 eggs are included, the overall productivity is 0.23 (n=7, sd= 0.18)

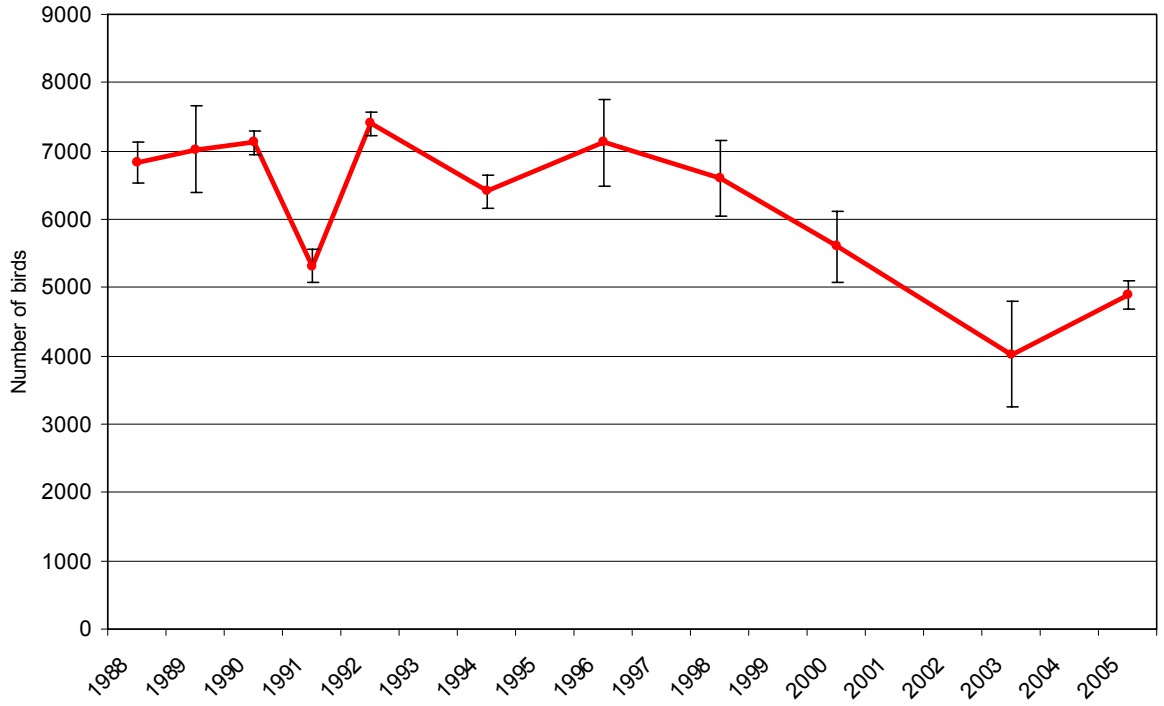

Figure 10. Counts of black-legged kittiwakes on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year.

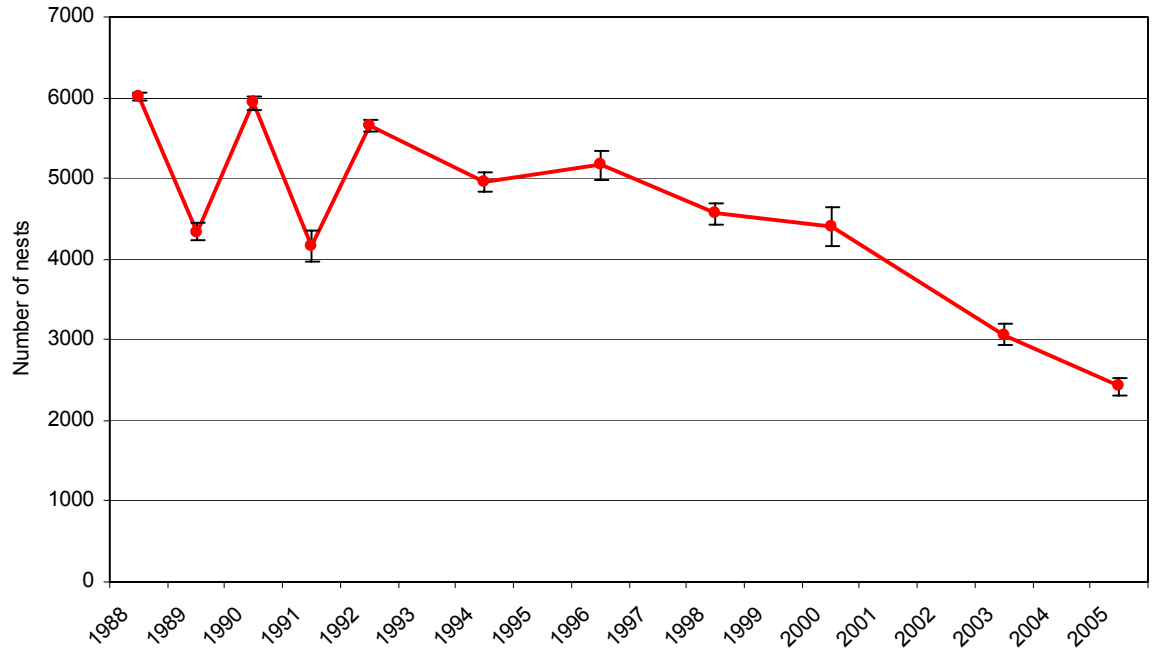

Figure 11. Counts of black-legged kittiwake nests on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year.

Table 25. Black-legged kittiwake nest population counts at Buldir Island, Alaska (The Dip, Kittiwake Lane East and Kittiwake Lane West combined).

Count	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005
1	5972	4452	5844	4079	5569	5106	4966	4393	4464	3122	2531
2	6070	4194	5845	4432	5663	5004	5246	4697	4786	3028	2561
3	6013	4403	6020	4254	5757	4867	5329	4711	4179	3200	2354
4	--	4247	6012	3949	5625	4856	4969	4545	4339	2885	2365
5	--	4393	5934	4088	--	--	5297	4471	4246	--	2324
mean	6027.0	4337.8	5931.0	4160.4	5653.5	4958.3	5161.4	4564.4	4402.8	3058.8	2427.0
n	3	5	5	5	4	4	5	5	5	4	5
SD	50.1	111.0	85.8	186.5	79.1	119.3	179.5	137.7	239.4	135.5	98.5
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun
last survey	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul

Table 26. Black-legged kittiwake bird population counts at Buldir Island, Alaska (The Dip, Kittiwake Lane East and Kittiwake Lane West combined).

Count	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005
1	6797	6534	6977	5125	7226	6185	6072	5821	5272	4848	5096
2	6998	6276	7042	5671	7607	6721	7036	6969	6020	4157	4719
3	6418	7048	7423	5145	7302	6463	7382	7263	5150	4084	4891
4	7115	7812	7141	5177	7484	6271	7483	6398	5267	2979	5111
5	--	7450	7019	5468	--	--	7639	6600	6291	--	4649
mean	6832.0	7024.0	7120.4	5317.2	7404.8	6410.0	7122.4	6610.2	5600.0	4017.0	4893.2
n	4	5	5	5	4	4	5	5	5	4	5
SD	305.7	633.0	98.9	242.0	172.9	237.7	627.5	552.9	518.4	772.9	189.0
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun
last survey	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul

Table 27. Numbers of black-legged kittiwake nests on index plots at Buldir Island, Alaska in 2005.

Plot (segment)	Count 1	2	3	4	5	mean	SD	max.
The Dip								
1	0	0	0	0	0	0.0	0	0
2	0	0	0	0	0	0.0	0	0
3	36	34	30	27	30	31.4	3.6	36
4	3	1	2	1	1	1.6	0.9	3
5	150	140	141	126	119	135.2	12.5	150
6	433	406	374	463	419	419.0	32.9	463
7	45	22	36	27	26	31.2	9.3	45
Total	667	603	583	644	595	618.4	35.5	667
Kittiwake Lane								
15(1)	172	201	167	148	193	176.2	21.2	201
16(2)	231	267	200	242	241	236.2	24.2	267
17(3)	326	351	312	308	301	319.6	19.8	351
18(4)	298	272	271	252	248	268.2	19.9	298
19(5)	195	186	188	173	135	175.4	23.9	195
20(6)	114	121	123	127	125	122.0	5.0	127
21(7)	131	144	144	138	140	139.4	5.4	144
22(8)	155	135	125	109	125	129.8	16.9	155
23(9)	91	98	93	82	80	88.8	7.6	98
24(10)	38	39	29	21	24	30.2	8.1	39
25(11)	32	41	40	48	46	41.4	6.2	48
26(12)	4	36	35	35	32	28.4	13.7	36
27(13)	49	43	39	32	33	39.2	7.1	49
28(14)	18	19	5	7	6	11.0	6.9	19
29(15)	10	5	0	0	0	3.0	4.5	10
KWLE[a]	1027	1091	950	950	983	1000.2	59.8	1091
KWLW	837	867	821	772	746	808.6	49.1	867
KWL total	1864	1958	1771	1721	1729	1808.6	101.0	1958
Index plot total[b]	2531	2561	2354	2365	2324	2427	110.2	2561

[a] KWLE is Kittiwake Lane East (plots15-18), KWLW is Kittiwake Lane West (plots 19-29).
[b] Consists of all plots at The Dip and Kittiwake Lane combined.

Table 28. Numbers of black-legged kittiwakes on index plots at Buldir Island, Alaska in 2005.

Plot (segment)	Count 1	2	3	4	5	mean	SD	max.
The Dip								
1	0	0	0	0	0	0	0	0
2	0	0	0	3	5	1.6	2.1	5
3	65	42	63	67	49	57.2	9.9	67
4	13	4	16	13	8	10.8	4.3	16
5	291	205	321	272	244	266.6	39.7	321
6	821	644	881	900	517	752.6	148.5	900
7	83	39	82	48	43	59.0	19.4	83
Total	1273	934	1363	1303	866	1147.8	205.5	1363
Kittiwake Lane								
15(1)	316	367	320	339	301	328.6	22.7	367
16(2)	498	478	413	501	483	474.6	32.0	501
17(3)	682	602	529	544	526	576.6	59.4	682
18(4)	434	423	498	419	521	459.0	42.2	521
19(5)	332	318	328	311	299	317.6	11.9	332
20(6)	235	216	220	212	236	223.8	9.9	236
21(7)	239	281	282	291	301	278.8	21.2	301
22(8)	331	320	302	400	384	347.4	37.9	400
23(9)	221	247	253	246	251	243.6	11.6	253
24(10)	147	137	100	128	145	131.4	17.1	147
25(11)	132	98	118	191	148	137.4	31.4	191
26(12)	115	121	78	107	82	100.6	17.4	121
27(13)	93	117	81	106	89	97.2	12.8	117
28(14)	41	51	6	11	15	24.8	17.8	51
29(15)	7	9	0	2	2	4.0	3.4	9
KWLE[a]	1930	1870	1760	1803	1831	1838.8	58.0	1930
KWLW	1893	1915	1768	2005	1952	1906.6	79.0	1952
KWL total	3823	3785	3528	3808	3783	3745.4	109.7	3823
Index plot total[b]	5096	4719	4891	5111	4649	4893.2	189.0	5111

[a] KWLE is Kittiwake Lane East (plots15-18), KWLW is Kittiwake Lane West (plots 19-29).
[b] Consists of all plots at The Dip and Kittiwake Lane combined.

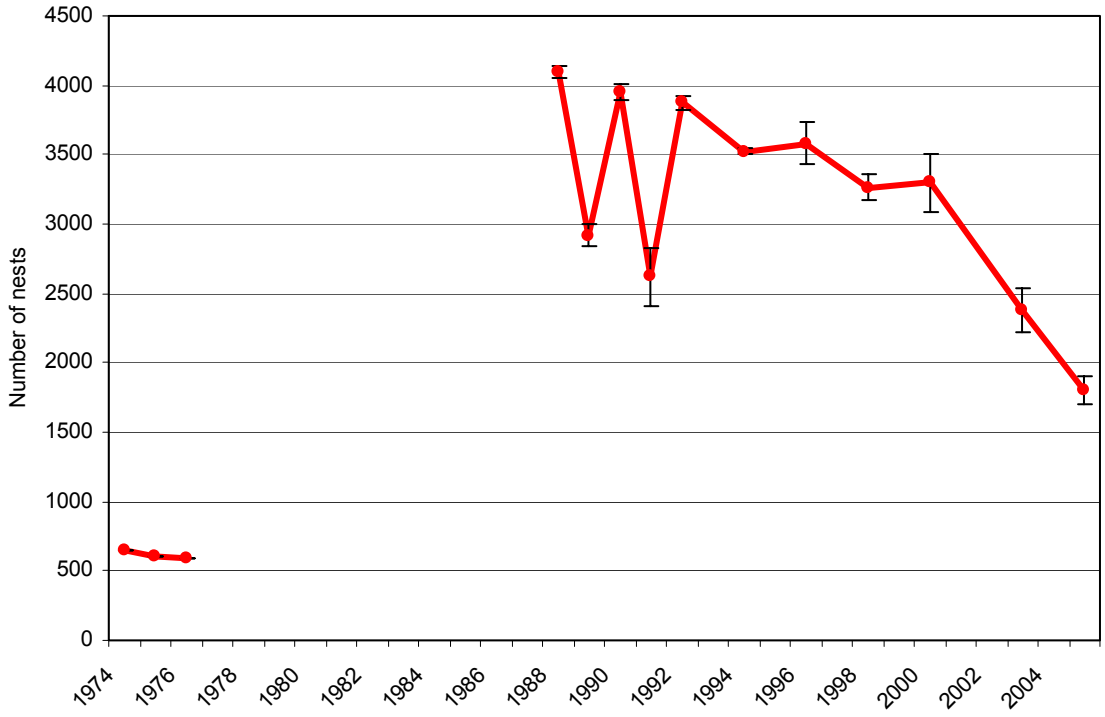

Figure 12. Counts of black-legged kittiwake nests at Kittiwake Lane, Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year. Note that the general trend at Kittiwake Lane from 1988 on mirrors that of the island counts in Fig. 11.

Table 29. Black-legged kittiwake nest counts by sub-area at Kittiwake Lane (Slide Mountain Colony), Buldir Island, Alaska.

Segment (Plot)	1974	1975	1976	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005
1 (15)	--	137	--	563	424	542	241	515	344	352	338	300	256	176
2 (16)	--	133	--	637	510	580	296	595	509	415	460	351	317	236
3 (17)	--	76	--	728	568	642	378	586	566	515	405	381	297	320
4 (18)	--	123	--	628	271	474	351	449	448	436	401	335	255	268
5 (19)	--	63	--	368	237	361	300	346	376	360	268	281	159	175
6 (20)	--	39	--	284	180	298	230	297	301	280	202	209	101	122
7 (21)	--	24	--	341	215	290	256	324	299	325	279	274	185	139
8 (22)	--	5	--	264	236	343	277	329	244	317	297	303	213	130
9 (23)	--	0	--	219	230	344	251	355	264	244	238	268	153	89
10 (24)	--	0	--	10	9	26	11	23	43	114	115	185	90	30
11 (25)	--	0	--	7	5	11	9	12	35	48	52	90	69	41
12 (26)	--	0	--	18	11	19	8	7	19	49	77	163	121	28
13 (27)	--	0	--	15	9	4	1	14	29	52	58	71	86	39
14 (28)	--	0	--	18	9	20	9	22	49	74	71	84	64	11
15 (29)	--	0	--	0	0	0	0	0	0	0	0	4	17	3
Total	649[a]	600	597	4100	2914	3954	2618	3874	3526	3581	3262	3299	2383	1809
SD[b]	–	–	–	40.5	79.7	60.0	208.6	45.9	19.6	147.8	94.0	208.7	158.0	101.2
n	1	1	1	3	5	5	5	4	4	5	5	5	4	5
first survey	[c]	[c]	[c]	5 Jul	29 Jun	30 Jun	8 Jul	6 Jul	4 Jul	28 Jun	4 Jul	27 Jun	9 Jul	23 Jun
last survey	[c]	[c]	[c]	27 Jul	16 Jul	18 Jul	18 Jul	20 Jul	19 Jul	18 Jul	24 Jul	20 Jul	25 Jul	18 Jul

[a] Includes 44 *Rissa* spp.
[b] SD based on replicate counts of all plots, not the sum of the plot means as presented above.
[c] From Byrd (1978); figures are from single counts made early to mid-July 1974, 1975, and 1976.

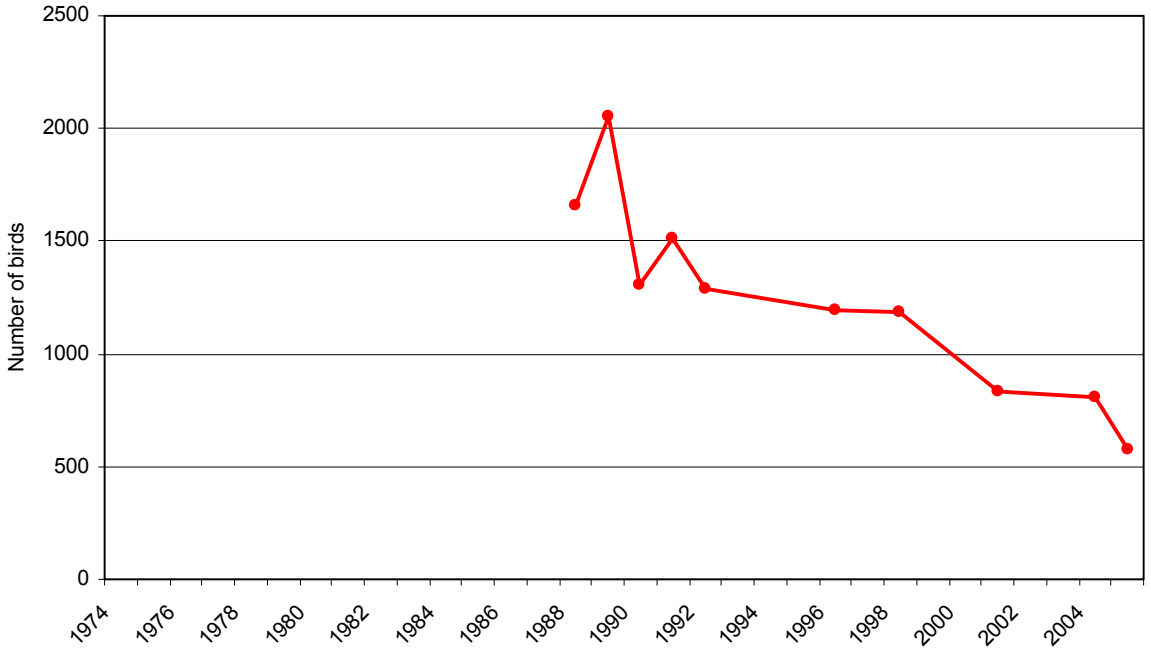

Figure 13. Counts of black-legged kittiwakes at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

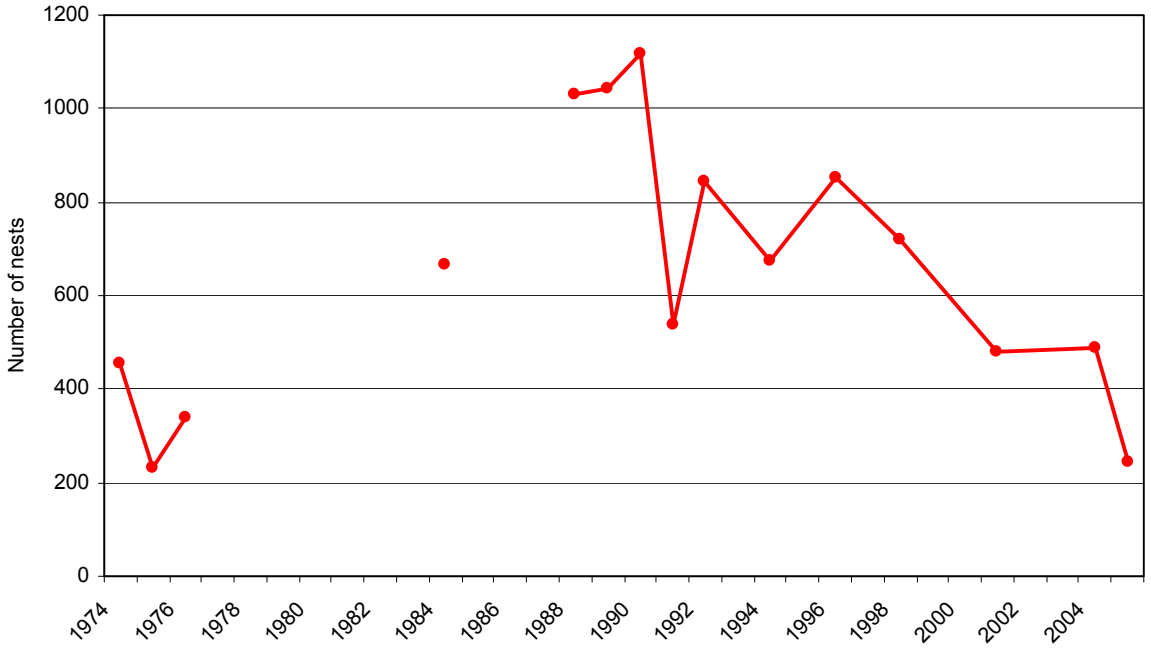

Figure 14. Counts of black-legged kittiwake nests at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

Table 30. Black-legged kittiwake nest counts by sub-area at Middle Rock, Buldir Island, Alaska.

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

[a] Partial count, not for comparison.

Table 31. Black-legged kittiwake counts by sub-area at Middle Rock, Buldir Island, Alaska.

Segment (Plot)	1974	1975	1976	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005
I	--	--	--	--	206	342	211	229	239	--	161	125	136	122	76
II	--	--	--	--	135	225	128	111	120	--	96	111	139	132	49
III	--	--	--	--	241	175	125	68	106	--	40	102	0	0	0
IV	--	--	--	--	210	97	80	85	34	--	92	51	30	11	1
V	--	--	--	--	135	402	232	263	211	--	201	210	109	137	54
VI	--	--	--	--	300	296	203	309	236	--	241	271	94	92	76
VII	--	--	--	--	428	519	323	445	339	--	366	315	322	313	323
Total	--	--	--	--	1655	2056	1302	1510	1285	--	1197	1185	830	807	579
survey date	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

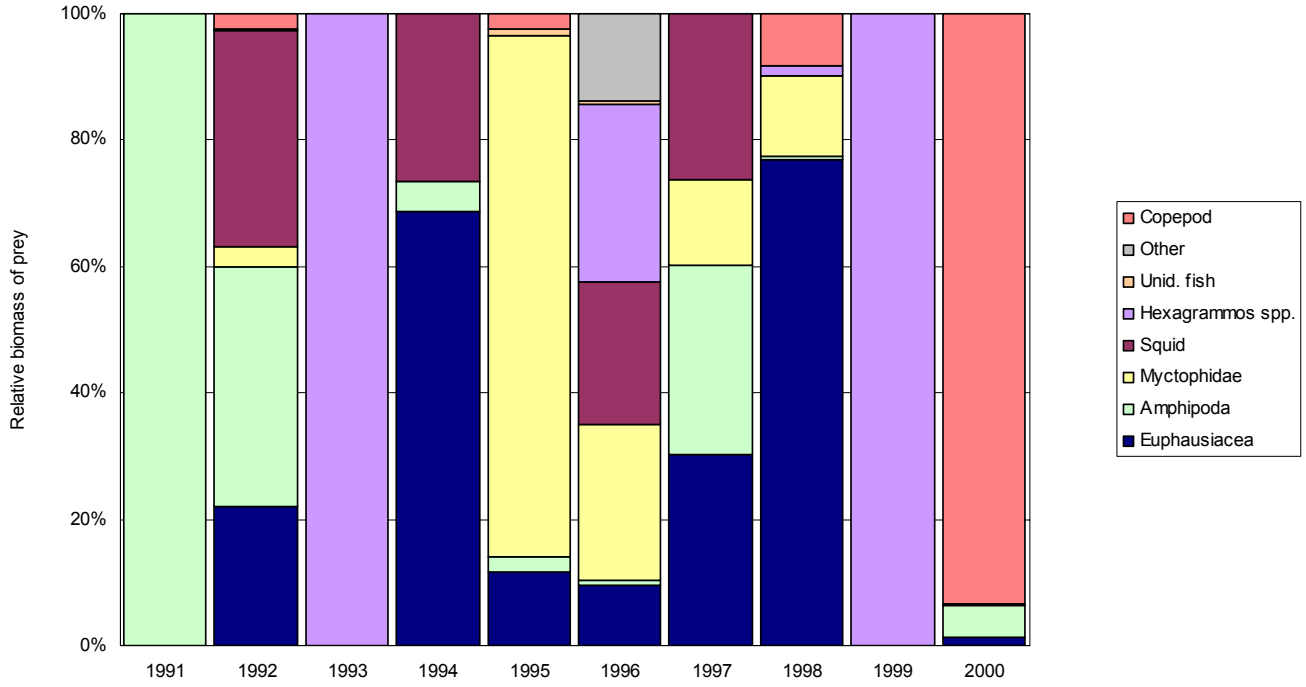

Figure 15. Relative biomass of prey in diets of black-legged kittiwakes at Buldir Island, Alaska.

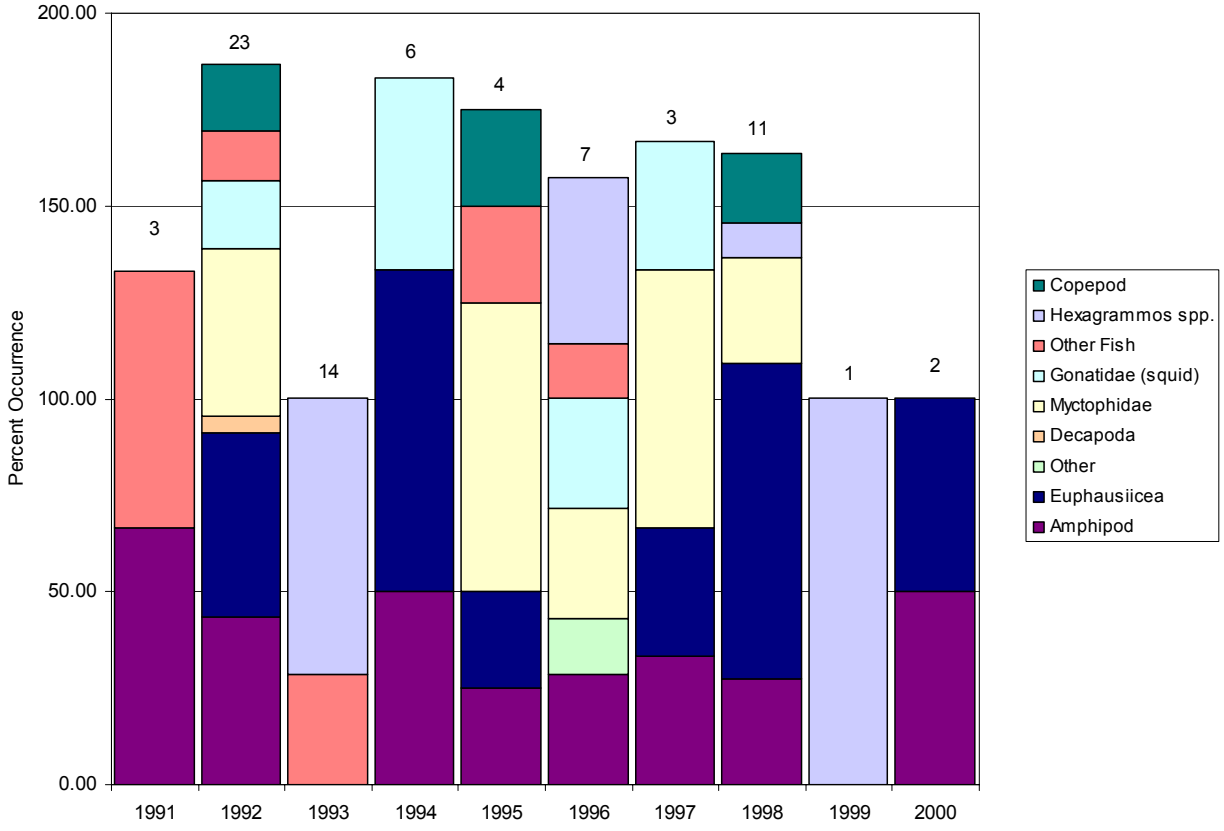

Figure 16. Frequency of prey occurrence in diets of black-legged kittiwakes at Buldir Island, Alaska.

Table 32. Relative biomass of prey in diets of black-legged kittiwakes at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
No. samples	3	23	14	6	4	7	3	11	1	2
Total mass (g)	0.9	158.4	249.0	104.1	118.9	181.7	30.5	309.5	49.0	52.2
Cephalopoda - squid	--	34.1	--	26.4	--	22.6	26.2	--	--	--
Copepoda										
Neocalanus plumchrus	--	--	--	--	2.3	--	--	--	--	--
N. cristatus	--	2.4	--	--	--	--	--	8.2	--	93.4
N. spp	--	--	--	--	--	--	--	--	--	5.1
Amphipoda										
Hyperiidea										
Parathemisto pacifica	--	23.3	--	4.9	2.3	0.6	30.2	0.2	--	0.1
Parathemisto spp.	43.2	13.0	--	--	--	--	--	--	--	--
Gammaridea										
Lysianassidae	56.8	0.3	--	--	--	0.1	--	0.1	--	--
Unid. Amphipoda	--	1.3	--	--	--	--	--	--	--	--
Euphausiacea										
Thysanoessa spp.	--	22.1		68.7	11.8	9.6	30.2	--	--	--
Unid. Euphausiid	--	--	--	--	--	--	--	77.0	--	1.3
Decapoda - shrimp	--	0.3	--	--	--	--	--	--	--	--
Pandalid zoea	--	--	--	--	--	--	--	--	--	0.1
Fish										
Myctophidae										
Stenobrachius leucopsarus	--	--	--	--	--	--	13.4	12.9	--	--
Unid. Myctophidae	--	3.2	--	--	82.4	24.8	--	--	--	--
Hexagrammos spp.	--	--	100.0	--	--	28.1	--	1.6	100.0	--
Unid. fish	--	--	--	--	1.3	0.6	--	--	--	--
Offal	--	--	--	--	13.8	--	--	--	--	--

Table 33. Frequency of occurrence of prey in diets of black-legged kittiwakes at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
No. samples	3	23	14	6	4	7	3	11	1	2
Cephalopoda - squid	--	17.4	--	50.0	--	28.6	33.3	--	--	--
Copepoda										
Neocalanus plumchrus	--	--	--	--	25.0	--	--	--	--	--
N. cristatus	--	13.0	--	--	--	--	--	18.2	--	50.0
Unid. Copepoda	--	4.3	--	--	--	--	--	--	--	50.0
Amphipoda										
Hyperiidea										
Parathemisto pacifica	--	13.0	--	50.0	25.0	14.3	33.3	18.2	--	50.0
Parathemisto spp.	33.3	17.4	--	--	--	--	--	--	--	--
Gammaridea										
Lysianassidae	33.3	4.3	--	--	--	14.3	--	9.1	--	--
Unid. Amphipoda	--	8.7	--	--	--	--	--	--	--	--
Euphausiacea										
Thysanoessa spp.	--	47.8	--	83.3	25.0	14.3	33.3	--	--	--
Unid. Euphausiid	--	--	--	--	--	--	--	81.8	--	--
Decapoda - shrimp	--	4.3	--	--	--	--	--	--	--	--
Pandalid zoea	--	--	--	--	--	--	--	--	--	50.0
Fish										
Myctophidae										
Stenobrachius leucopsarus	--	--	--	--	--	--	66.7	27.3	--	--
Unid. Myctophidae	--	43.5	--	--	75.0	28.6	--	--	--	--
Ammodytes hexapterus	33.3	8.7	--	--	--	--	--	--	--	--
Hexagrammos spp.	--	--	71.4	--	--	42.9	--	9.1	100.0	--
Unid. fish	33.3	4.3	28.6	--	25.0	14.3	--	--	--	--
Offal	--	--	--	--	14.3	--	--	--	--	--

Table 34. Breeding chronology dates for red-legged kittiwakes at Buldir Island Alaska.

Year	mean hatch	SD	n[a]	median hatch	no. nests monitored[b]	first lay	last lay	first hatch	last hatch	first fledge
1988	8 Jul	6.7	59	7 Jul	144	<21 Jun	28 Jun	28 Jun	1 Aug	6 Aug
1989	12 Jul	2.2	31	13 Jul	233	<12 Jun	25 Jun	8 Jul	13 Jul	>15 Aug
1990	7 Jul	6.9	110	5 Jul	218	3 Jun	3 Aug	22 Jun	25 Jul	31 Jul
1991	13 Jul	5.6	38	10 Jul	194	<14 Jun	27 Jul	1 Jul	22 Jul	10 Aug
1992	8 Jul	6.8	137	7 Jul	269	<4 Jun	20 Jul	20 Jun	30 Jul	5 Aug
1993	12 Jul	6.3	35	13 Jul	187	<7 Jun	13 Jul	1 Jul	23 Jul	16 Aug
1994	11 Jul	10.8	24	6 Jul	272	<15 Jun	30 Jun	25 Jun	6 Aug	12 Aug
1995	16 Jul	7.4	33	13 Jul	328	<15 Jun	17 Jul	7 Jul	8 Aug	>14 Aug
1996	12 Jul	9.7	62	13 Jul	206	<14 Jun	18 Jul	24 Jun	3 Aug	15 Jul
1997	15 Jul	7.1	73	13 Jul	259	<9 Jun	4 Jul	28 Jun	31 Jul	13 Aug
1998	13 Jul	6.0	62	12 Jul	147	<14 Jun	20 Jul	1 Jul	29 Jul	14 Aug
1999	13 Jul	10.7	18	11 Jul	126	<24 Jun	4 Jul	27 Jun	4 Aug	>19 Aug
2000	9 Jul	5.9	71	10 Jul	134	<11 Jun	10 Jul	27 Jun	27 Jul	13 Aug
2001	4 Jul	5.0	14	1 Jul	60	<17 Jun	26 Jun	26 Jun	17 Jul	none
2002	2 Jul	5.2	23	3 Jul	43	<6 Jun	<23 Jun	22 Jun	19 Jul	1 Aug
2003	13 Jul	--	1	13 Jul	17	<17 Jun	5 Jul	<30 Jun	13 Jul	16 Aug
2004	9 Jul	5.6	7	9 Jul	80	<15 Jun	13 Jul	25 Jun	<24 Jul	19 Aug
2005	27 Jul	8.7	3	25 Jul	36	<20 Jun	4 Aug	3 Jul	6 Aug	10 Aug
2006	14 Jul	7.1	22	11 Jul	61	<9 Jun	16 Jul	<27 Jun	28 Jul	20 Aug

[a] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations ≤7 days apart from egg to chick.

[b] The total used for estimating the remaining parameters. These dates might contain observations > 7 days apart or estimated event dates (e.g. No Egg on first visit followed by Bird Incubating on the next visit).

Table 35. Hatching dates of red-legged kittiwakes at Buldir Island, Alaska, 2006.

	July																														
Plot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
All			2				3	1			6	1				3			1		2				2			1			

[a] Hatching dates are the mid-point or, if no mid-point, the even Julian date between plot visits. If more than 1 egg hatched, the date of the first egg was used.

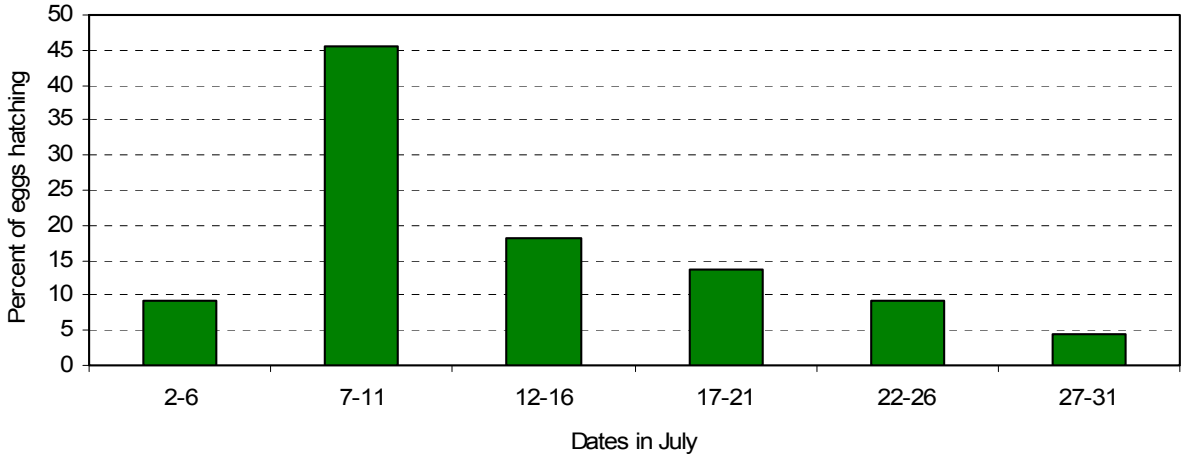

Figure 17. Hatching chronology of red-legged kittiwakes at Buldir Island, Alaska in 2006 (n=22).

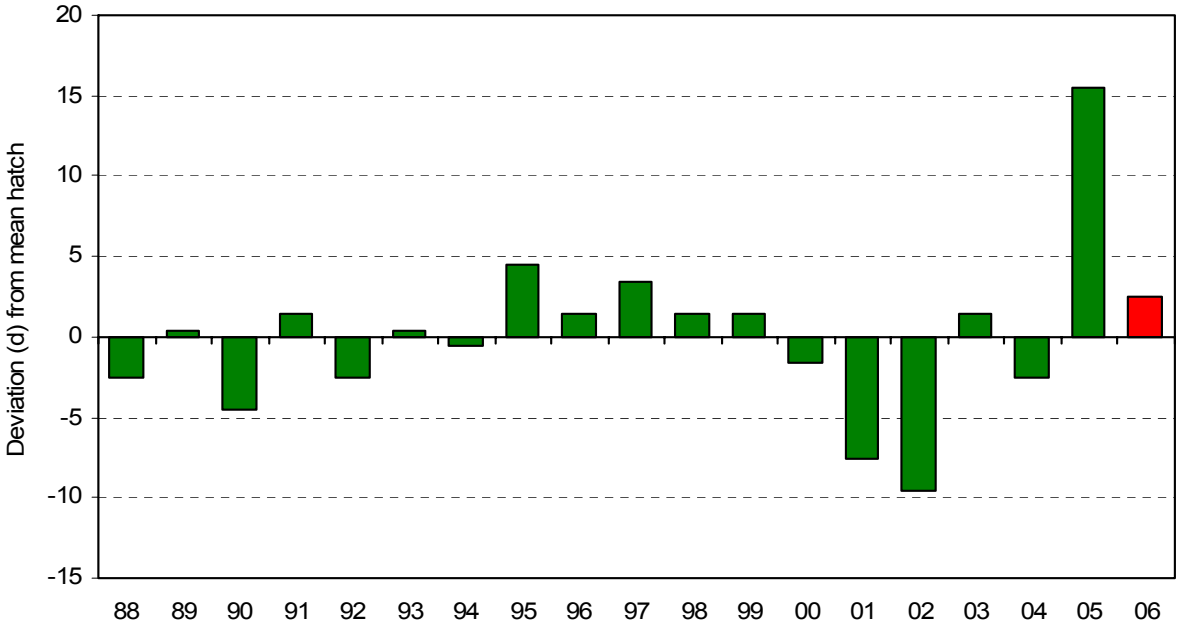

Figure 18. Yearly hatch date deviation (from the 1988-2005 average of 12 July) for red-legged kittiwakes at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

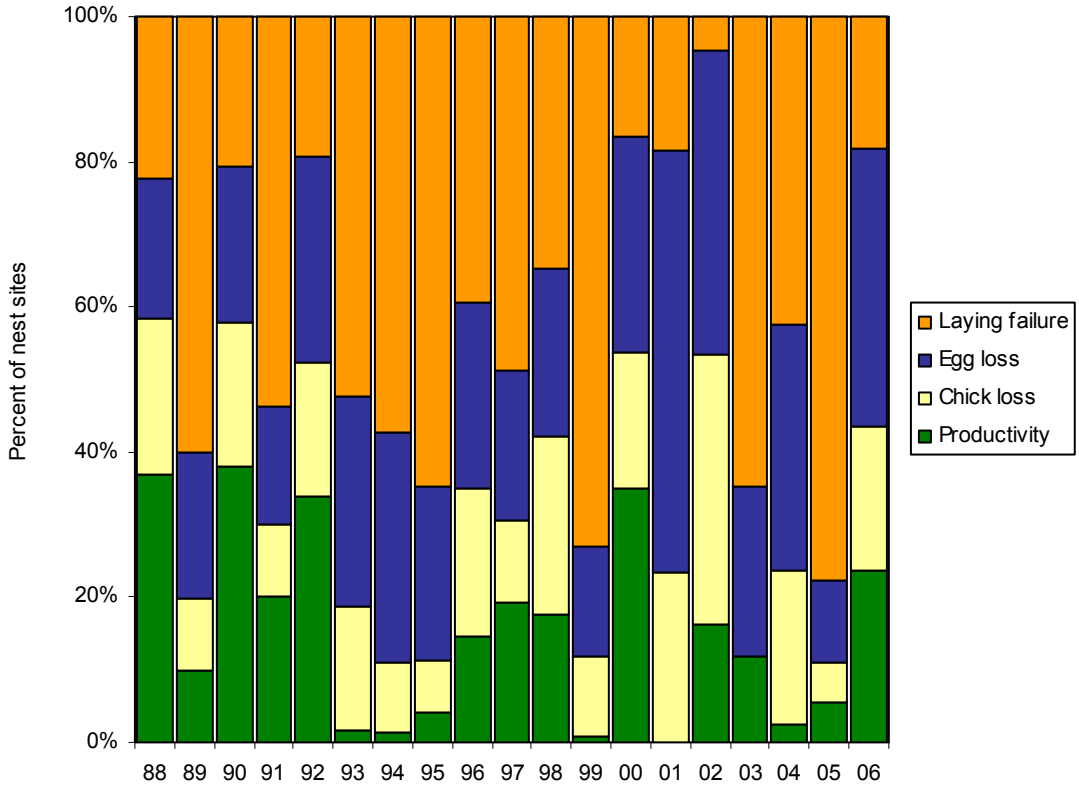

Figure 19. Reproductive performance of red-legged kittiwakes at Buldir Island, Alaska. Laying Failure=(A-B)/A; Egg Loss=(B-C)/A; Chick Loss=(C-D)/A; Productivity=D/A, where A=total number of nests; B=number of nests with ≥ 1 egg; C=number of nests with ≥ 1 chick; D= number of nests with ≥ 1 fledged chick.

Table 36. Reproductive performance of red-legged kittiwakes at Buldir Island, Alaska.

Year	total nests (A)	no. nests w/ eggs (B)	no. nests w/ chicks (C)	no. nests w/ fledged chick (D)	laying success (B/A)	nesting success (C/B)	fledging success (D/C)	reproductive success (D/B)	productivity (D/A)
1988	144	112	84	53	0.78	0.75	0.58	0.45	0.35
1989	233	93	46	23	0.40	0.49	0.50	0.25	0.10
1990	218	173	126	83	0.79	0.73	0.66	0.48	0.41
1991	194	90	58	39	0.46	0.64	0.67	0.43	0.20
1992	269	217	141	91	0.81	0.65	0.65	0.42	0.34
1993	187	89	35	3	0.48	0.44	0.09	0.03	0.02
1994	272	116	30	4	0.43	0.26	0.13	0.03	0.01
1995	328	116	37	14	0.35	0.32	0.38	0.12	0.04
1996	206	125	72	30	0.61	0.58	0.42	0.24	0.15
1997	259	133	79	50	0.51	0.59	0.63	0.38	0.19
1998	147	96	62	26	0.65	0.65	0.42	0.27	0.18
1999	126	34	15	1	0.27	0.44	0.07	0.03	0.01
2000	134	112	72	47	0.84	0.64	0.65	0.42	0.35
2001	60	47	14	0	0.78	0.30	0.00	0.00	0.00
2002	43	41	23	7	0.95	0.56	0.30	0.17	0.16
2003	17	6	2	2	0.35	0.33	1.00	0.33	0.12
2004	80	46	19	2	0.58	0.41	0.11	0.04	0.03
2005	36	8	4	2	0.22	0.50	0.50	0.25	0.06
2006[a]	55	45	24	13	0.82	0.53	0.54	0.29	0.24

[a] On 27 June, a 6.2 magnitude earthquake approximately 22km SSE of Buldir caused a total of 5 nests with a combined 2 eggs to fail. The reproductive performance presented in this table does not include the nests and eggs lost in the earthquake. If one includes the nests and eggs lost to the earthquake, the laying success = 0.78, nesting success = 0.51, reproductive success = 0.28, and the productivity = 0.22.

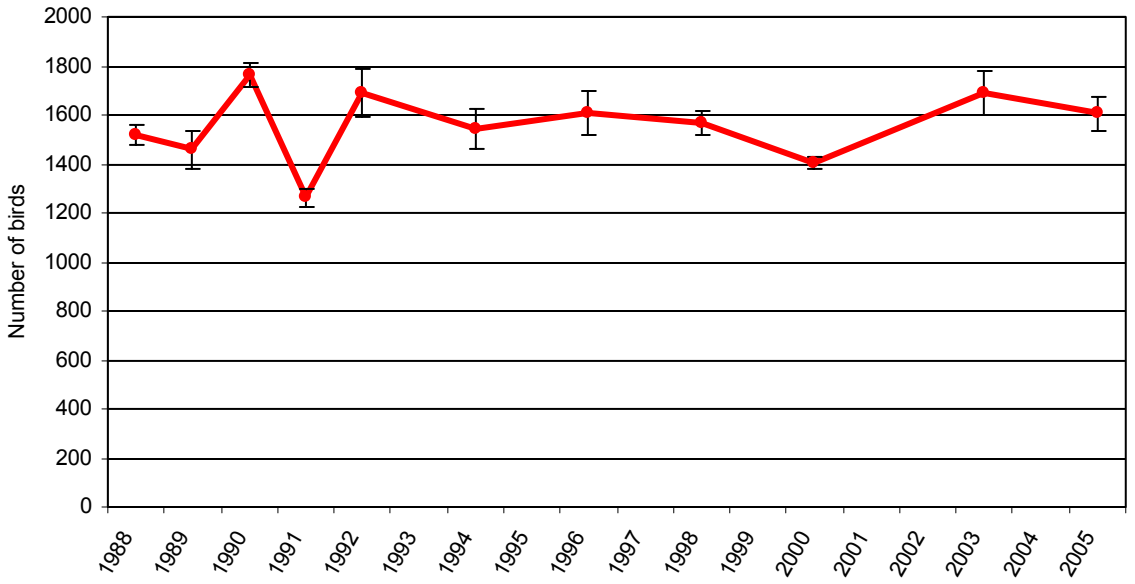

Figure 20. Counts of red-legged kittiwakes on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

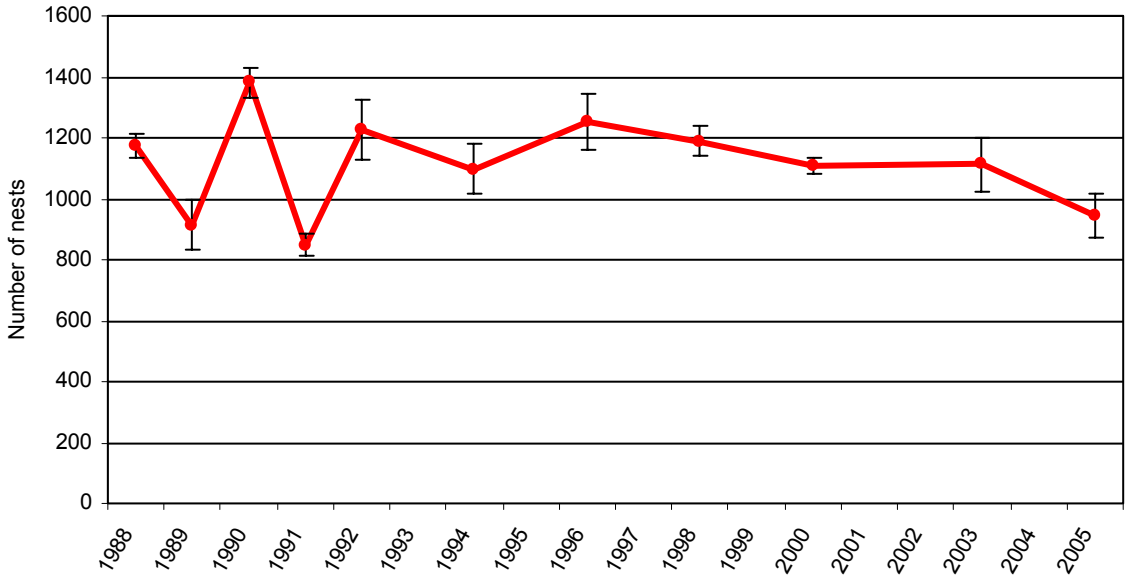

Figure 21. Counts of red-legged kittiwake nests on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

Table 37. Red-legged kittiwake nest counts at Buldir Island, Alaska (The Dip, Kittiwake Lane East and Kittiwake Lane West combined).

Count	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005
1	1182	826	1441	806	1094	1030	1133	1168	1120	984	829
2	1130	828	1415	835	1237	1060	1196	1112	1147	1139	954
3	1208	973	1315	874	1251	1082	1299	1239	1092	1156	937
4	--	957	1366	828	1330	1217	1366	1210	1084	1179	956
5	--	988	1367	895	--	--	1274	1215	1099	--	1030
mean	1173.3	914.4	1380.8	847.6	1228.0	1097.3	1253.6	1188.8	1108.4	1114.5	941.2
n	3	5	5	5	4	4	5	5	5	4	5
SD	39.7	80.5	48.8	36.1	98.3	82.6	90.8	50.0	25.4	88.5	72.2
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun
last survey	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul

Table 38. Red-legged kittiwake counts at Buldir Island, Alaska (The Dip, Kittiwake Lane East and Kittiwake Lane West combined).

Count	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005
1	1279	1220	1823	1139	1470	1387	1422	1506	1396	1630	1488
2	1558	1389	1727	1165	1752	1466	1565	1487	1394	1790	1612
3	1614	1533	1695	1320	1695	1565	1625	1582	1371	1742	1503
4	1633	1560	1774	1320	1854	1747	1747	1605	1389	1602	1707
5	--	1585	1811	1373	--	--	1697	1664	1455	--	1714
mean	1521.0	1457.4	1766.0	1258.8	1692.8	1541.3	1611.2	1568.8	1401.0	1691.0	1604.8
n	4	5	5	5	4	4	5	5	5	4	5
SD	164.4	152.9	54.5	101.7	162.4	155.3	126.4	72.8	31.8	89.5	107.7
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun
last survey	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul

Table 39. Numbers of red-legged kittiwake nests on index plots at Buldir Island, Alaska in 2005.

Plot (segment)	Count 1	2	3	4	5	mean	SD	max.
The Dip								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	1	1	1	1	0	0.8	0.4	1
4	0	0	0	0	0	0	0	0
5	3	3	3	3	2	2.8	0.4	3
6	24	37	35	44	36	35.2	7.2	44
7	0	0	0	0	0	0	0	0
A	124	133	150	158	128	138.6	14.7	158
B	44	64	30	63	67	53.6	16.0	67
C	80	113	84	105	102	96.8	14.2	113
Total	276	351	303	374	335	327.8	38.8	374
Kittiwake Lane								
15 (1)	32	46	35	43	72	45.6	15.8	72
16 (2)	18	29	35	30	41	30.6	8.5	41
17 (3)	78	98	82	86	95	87.8	8.5	98
18 (4)	165	107	143	132	160	141.4	23.3	165
19 (5)	37	44	58	52	69	52.0	12.4	69
20 (6)	48	44	43	41	51	45.4	4.0	51
21 (7)	48	67	69	77	80	68.2	12.5	80
22 (8)	40	49	57	36	42	44.8	8.3	57
23 (9)	52	72	75	51	45	59.0	13.5	75
24 (10)	3	5	3	3	4	3.6	0.9	5
25 (11)	24	27	25	23	23	24.4	1.7	27
26 (12)	4	11	7	7	10	7.8	2.8	11
27 (13)	3	4	2	1	3	2.6	1.1	4
28 (14)	1	0	0	0	0	0.2	0.4	1
29 (15)	0	0	0	0	0	0	0	0
KWLE[a]	293	280	295	291	368	305.4	35.5	368
KWLW	260	323	339	291	327	308.0	32.2	339
KWL total	553	603	634	582	695	613.4	54.4	695
Index plot total[b]	829	954	937	956	1030	941.2	72.2	1030

[a] KWLE is Kittiwake Lane East (plots15-18), KWLW is KWL West (plots 19-28).
[b] Consists of all plots at The Dip and Kittiwake Lane combined.

Table 40. Numbers of red-legged kittiwakes on index plots at Buldir Island, Alaska in 2005.

Plot (segment)	Count 1	2	3	4	5	0	SD	max.
The Dip								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	2	4	1	2	0	1.8	1.5	4
4	0	0	0	0	0	0	0	0
5	8	9	8	10	9	8.8	0.8	10
6	68	91	76	87	68	78	10.7	91
7	0	0	0	0	0	0	0	0
A	275	285	308	366	271	301.0	39.1	366
B	107	103	69	123	112	102.8	20.3	123
C	158	181	166	175	161	168.2	9.6	181
Total	618	673	628	763	621	660.6	61.4	763
Kittiwake Lane								
15(1)	81	97	63	85	118	88.8	20.4	118
16(2)	22	52	51	52	71	49.6	17.6	71
17(3)	99	130	119	127	142	123.4	15.9	142
18(4)	214	167	184	219	219	200.6	23.8	219
19(5)	59	71	72	74	101	75.4	15.5	101
20(6)	62	64	57	61	67	62.2	3.7	67
21(7)	89	104	101	95	125	102.8	13.7	125
22(8)	77	95	92	70	96	86.0	11.8	96.0
23(9)	74	72	75	93	81	79.0	8.5	93
24(10)	13	17	4	5	5	8.8	5.8	17
25(11)	44	41	43	48	50	45.2	3.7	50
26(12)	20	20	10	14	14	15.6	4.3	20
27(13)	5	7	4	1	4	4.2	2.2	7
28(14)	11	2	0	0	0	2.6	4.8	11
29(15)	0	0	0	0	0	0	0	0
KWLE[a]	416	446	417	483	550	462.4	56.1	550
KWLW	454	493	458	461	543	41.8	37.6	543
KWL total	870	939	875	944	1093	944.2	90.1	1093
Index plot total[b]	1488	1612	1503	1707	1714	1604.8	107.7	1714

[a] KWLE is Kittiwake Lane East (plots15-18), KWLW is KWL West (plots 19-28).
[b] Consists of all plots at The Dip and Kittiwake Lane combined.

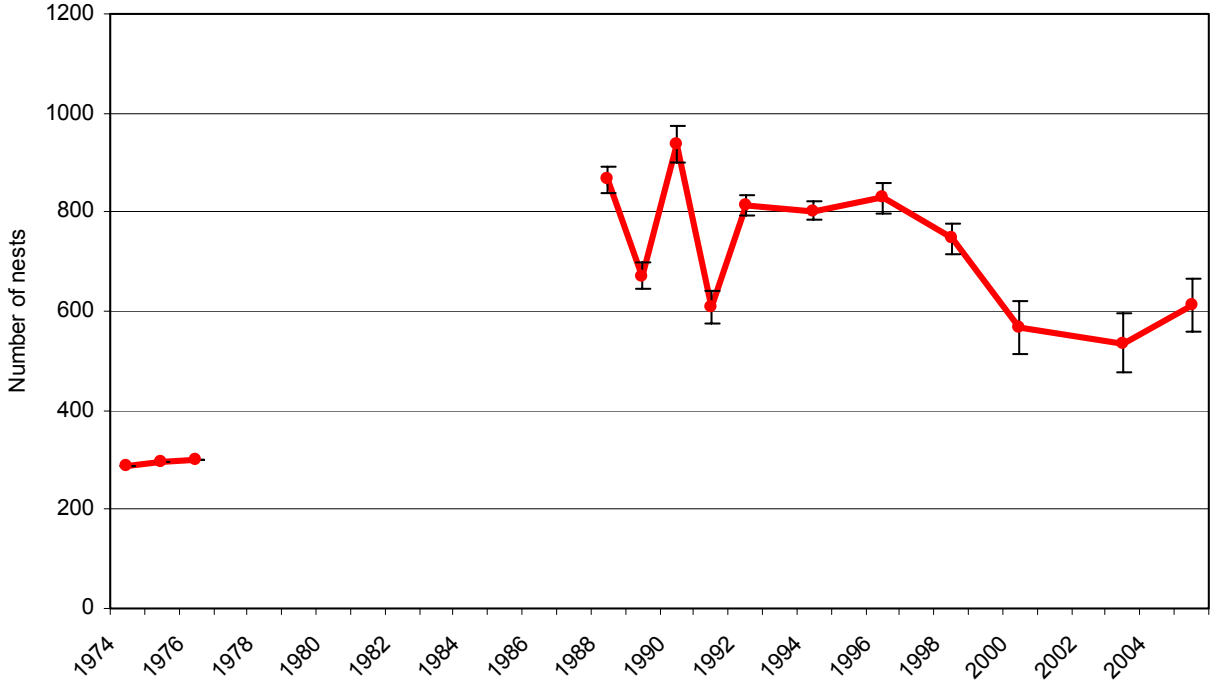

Figure 22. Counts of red-legged kittiwake nests at Kittiwake Lane, Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year. Note that the general trend at Kittiwake Lane does not mirror that of the island counts in Fig. 20.

Table 41. Red-legged kittiwake nest counts by sub-area at Kittiwake Lane (Slide Mountain Colony), Buldir Island, Alaska.

Segment (Plot)	1974	1975	1976	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005
1 (15)	--	80	--	127	95	145	75	96	81	88	81	46	69	46
2 (16)	--	89	--	110	83	108	75	98	95	68	70	37	33	31
3 (17)	--	46	--	149	125	129	63	87	80	79	56	57	53	88
4 (18)	--	49	--	167	75	114	85	123	137	171	135	93	81	141
5 (19)	--	12	--	52	51	75	34	62	66	59	49	46	43	52
6 (20)	--	20	--	109	72	117	44	95	94	81	81	83	38	45
7 (21)	--	0	--	49	49	76	73	70	86	95	95	70	63	68
8 (22)	--	0	--	56	56	78	79	88	82	66	69	31	48	44
9 (23)	--	0	--	46	63	87	80	90	57	44	37	27	31	59
10 (24)	--	0	--	1	1	6	2	4	7	17	26	24	12	4
11 (25)	--	0	--	0	0	0	0	0	5	11	10	11	22	24
12 (26)	--	0	--	0	0	0	0	0	2	12	14	18	28	7
13 (27)	--	0	--	0	0	0	0	0	1	10	8	13	10	3
14 (28)	--	0	--	0	1	3	0	0	9	28	15	12	3	1
15 (29)	--	0	--	0	0	0	0	0	0	0	0	0	2	0
Total	289	296	299	866	671	938	610	813	802	829	746	568	536	613
SD[a]	–	–	–	27.1	25.9	36.5	33.1	21.3	17.9	30.6	31.9	53.8	59.3	54.4
n	1	1	1	3	5	5	5	4	4	5	5	5	4	5
first survey	[b]	[b]	[b]	5 Jul	29 Jun	30 Jun	8 Jul	6 Jul	4 Jul	28 Jun	4 Jul	27 Jun	9 Jul	23 Jun
last survey	[b]	[b]	[b]	27 Jul	16 Jul	18 Jul	18 Jul	20 Jul	19 Jul	18 Jul	24 Jul	20 Jul	25 Jul	18 Jul

[a] SD based on replicate counts of all plots, not the sum of the plot means as presented above.
[b] From Byrd (1978); figures are from single counts made early to mid-July 1974, 1975, and 1976.

Table 42. Red-legged kittiwake nest counts by sub-area at Middle Rock, Buldir Island, Alaska.

Segment (Plot)	1974	1975	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005
I	9	5	0	--	0	0	0	0	0	0	0	0	0	2
II	0	0	0	--	0	0	0	0	1	0	0	2	0	0
III	0	0	0	--	0	0	0	0	2	0	0	0	0	0
IV	0	0	0	--	0	0	0	0	0	0	0	0	0	0
V	1	2	1	--	0	0	0	0	0	0	0	1	0	0
VI	0	0	0	--	0	0	0	0	0	1	9	0	0	0
VII	0	0	0	--	0	2	4	4	0	1	0	2	2	0
Total	10	7	1	--	0	2	4	4	3	2	9	5	2	2
Survey date	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

Table 43. Red-legged kittiwake counts by sub-area at Middle Rock, Buldir Island, Alaska.

Segment (Plot)	1974	1975	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005
I	--	--	--	--	0	0	0	0	0	0	0	0	0	4
II	--	--	--	--	0	0	0	0	0	0	0	2	0	0
III	--	--	--	--	0	0	0	0	0	0	0	0	0	0
IV	--	--	--	--	0	0	0	0	0	0	0	0	0	0
V	--	--	--	--	3	0	0	0	0	0	5	1	0	0
VI	--	--	--	--	0	0	0	0	0	1	13	0	0	3
VII	--	--	--	--	4	3	8	4	0	3	0	4	6	0
Total	--	--	--	--	7	3	8	4	0	4	18	7	6	7
Survey date	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

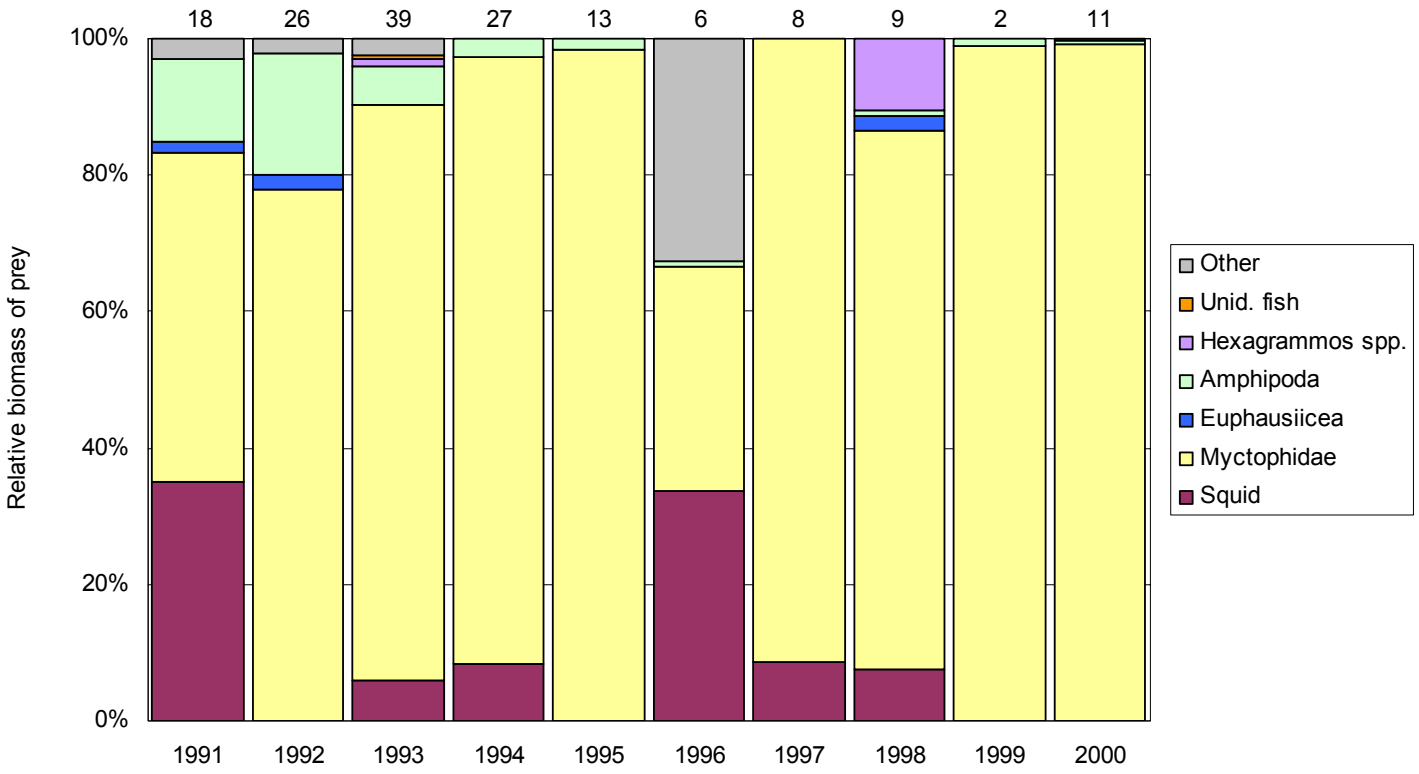

Figure 23. Relative biomass of prey in diets of red-legged kittiwakes at Buldir Island, Alaska.

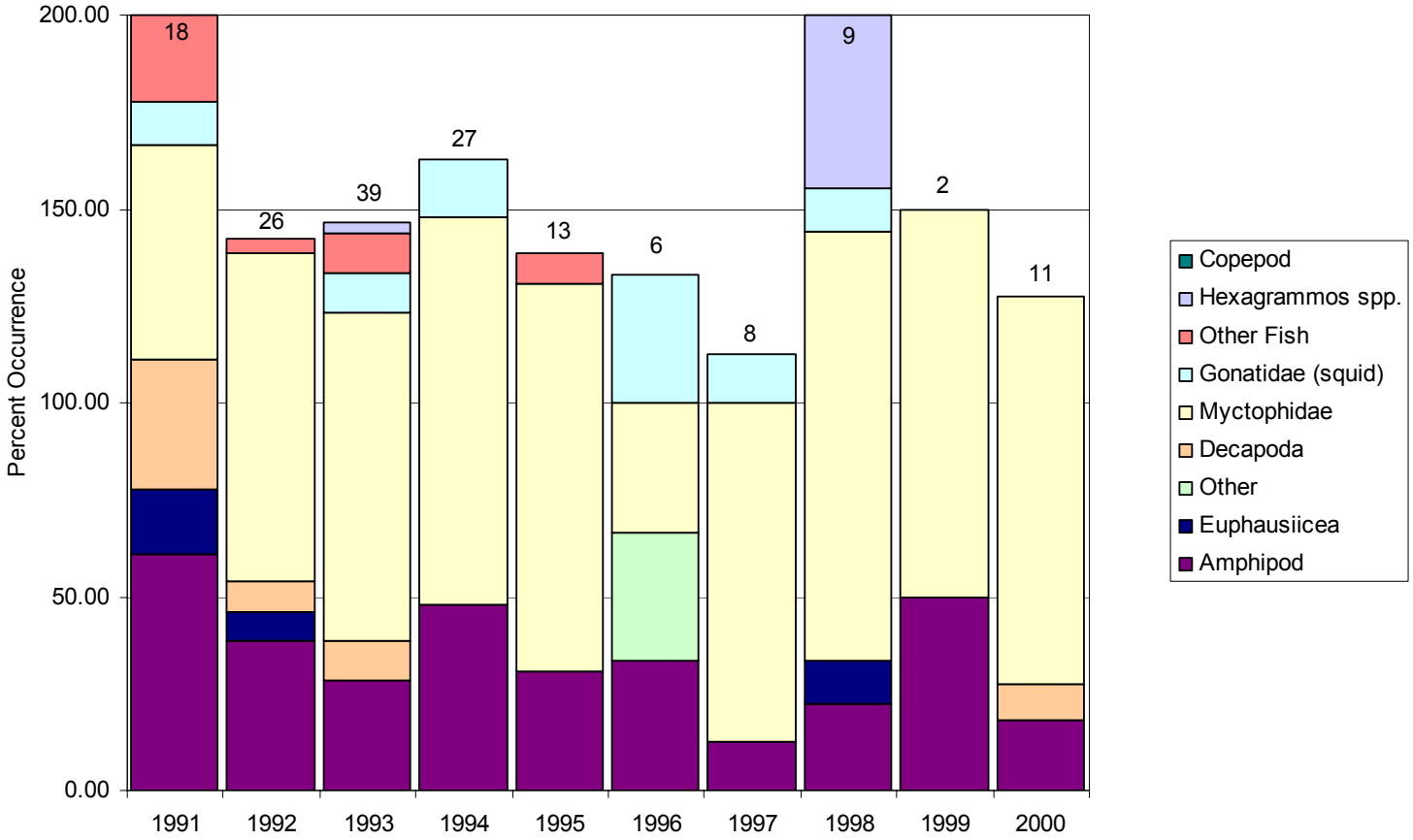

Figure 24. Frequency of prey occurrence in diets of red-legged kittiwakes at Buldir Island, Alaska

Table 44. Relative biomass of prey in diets of red-legged kittiwakes at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
No. samples	18	26	39	27	13	6	8	9	2	11
Total mass (g)	171.5	47.9	189.8	389.3	145.5	136.6	174.4	238.9	57.0	127.0
Cephalopoda - squid	35.0	--	5.8	8.3	--	33.7	8.6	7.5	--	--
Amphipoda										
Hyperiidea										
Parathemisto pacifica	--	--	--	0.2	--	--	--	--	--	--
Parathemisto spp.	--	3.3	0.6	--	--	--	--	--	--	--
Gammaridea										
Lysianassidae	9.6	10.4	5.0	2.4	1.7	0.8	0.1	0.8	0.9	0.5
Unid. Amphipoda	2.6	4.2	--	--	--	--	--	--	--	--
Euphausiacea										
Thysanoessa spp.	1.5	2.0	--	--	--	--	--	--	--	--
Unid Euphausiid	--	--	--	--	--	--	--	2.1	--	--
Decapoda - shrimp	2.9	2.1	1.1	--	--	--	--	--	--	0.4
Fish										
Osmeridae	--	--	1.3	--	--	--	--	--	--	--
Myctophidae										
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
Hexagrammos spp.	--	--	1.1	--	--	--	--	10.5	--	--
Unid. fish	--	--	0.5	--	--	--	--	--	--	--
Offal	--	--	--	--	--	32.6	--	--	--	--

Table 45. Frequency of occurrence of prey in diets of red-legged kittiwakes at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
No. samples	18	26	39	27	13	6	8	9	2	11
Cephalopoda - squid	11.1	--	10.3	14.8	--	33.3	12.5	11.1	--	--
Amphipoda										
Hyperiidea										
Parathemisto pacifica	--	--	--	7.4	--	--	--	--	--	--
Parathemisto spp.	--	15.4	7.7	--	--	--	--	--	--	--
Gammaridea										
Lysianassidae	44.4	19.2	20.5	40.7	30.8	33.3	12.5	22.2	50.0	18.1
Unid. Amphipoda	16.7	3.8	--	--	--	--	--	--	--	--
Euphausiacea										
Thysanoessa spp.	16.7	7.7	--	--	--	--	--	--	--	--
Unid Euphausiid	--	--	--	--	--	--	--	11.1	--	--
Decapoda - shrimp	33.3	7.7	10.3	--	--	--	--	--	--	9.1
Fish										
Osmeridae	--	--	2.6	--	--	--	--	--	--	--
Myctophidae										
Stenobrachius leucopsarus	--	--	82.1	--	--	--	87.5	88.9	--	--
Myctophidae - not *S. leuco.*	--	--	2.6	--	--	--	--	22.2	--	--
Unid. Myctophidae	55.6	84.6	--	100.0	100.0	33.3	--	--	100.0	100.0
Ammodytes hexapterus	5.6	--	--	--	--	--	--	--	--	--
Hexagrammos spp.	--	--	2.6	--	--	--	--	44.4	--	--
Unid. fish	16.7	3.8	10.3	--	7.7	--	--	--	--	--
Offal	--	--	--	--	--	33.3	--	--	--	--

Table 46. Breeding chronology dates for thick-billed murres at Buldir Island Alaska.

Year	mean hatch	SD	n[a]	median hatch	no. nests monitored[b]	first lay	last lay	first hatch	last hatch	first jump	last jump
1988	20 Jul	8.9	38	17 Jul	363	23 Jun	23 Jul	11 Jul	19 Aug	3 Aug	28 Aug
1989	22 Jul	6.1	42	21 Jul	545	14 Jun	22 Jul	14 Jul	10 Aug	2 Aug	>16 Aug
1990	12 Jul	5.7	60	13 Jul	473	6 Jun	10 Jul	7 Jul	3 Aug	23 Jul	>14 Aug
1991	20 Jul	4.4	195	21 Jul	514	14 Jun	19 Jul	15 Jul	27 Jul	3 Aug	>13 Aug
1992	16 Jul	7.1	39	14 Jul	345	7 Jun	17 Jul	4 Jul	3 Aug	29 Jul	>12 Aug
1993	15 Jul	5.5	89	15 Jul	271	14 Jun	12 Jul	5 Jul	31 Jul	24 Jul	>15 Aug
1994	19 Jul	7.6	44	19 Jul	385	13 Jun	22 Jul	5 Jul	12 Aug	25 Jul	26 Aug
1995	19 Jul	5.0	178	19 Jul	288	8 Jun	13 Jul	11 Jul	10 Aug	28 Jul	>17 Aug
1996	13 Jul	5.9	179	14 Jul	308	14 Jun	16 Jul	2 Jul	12 Aug	18 Jul	18 Aug
1997	11 Jul	5.7	182	11 Jul	407	12 Jun	18 Jul	2 Jul	11 Aug	27 Jul	--
1998	16 Jul	5.6	56	15 Jul	271	<14 Jun	15 Jul	5 Jul	13 Aug	20 Jul	21 Aug
1999	22 Jul	5.8	31	21 Jul	269	<27 Jun	19 Jul	16 Jul	12 Aug	2 Aug	>14 Aug
2000	15 Jul	6.5	263	14 Jul	329	<14 Jun	6 Jul	3 Jul	7 Aug	19 Jul	21 Aug
2001	15 Jul	6.5	59	13 Jul	181	<17 Jun	15 Jul	27 Jun	21 Aug	27 Jul	21 Aug
2002	13 Jul	5.2	50	11 Jul	238	<6 Jun	7 Jul	8 Jul	9 Aug	28 Jul	26 Aug
2003	20 Jul	6.9	150	19 Jul	316	<17 Jun	10 Jul	20 Jun	11 Aug	10 Jul	>26 Aug
2004	20 Jul	6.6	97	19 Jul	213	11 Jun	29 Jul	9 Jul	11 Aug	29 Jul	>24 Aug
2005	20 Jul	7.2	75	20 Jul	286	<15 Jun	28 Jul	8 Jul	16 Aug	31 Jul	22 Aug
2006	18 Jul	6.1	160	16 Jul	289	<13 Jun	28 Jul	7 Jul	4 Aug	31 Jul	>22 Aug

[a] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations < 7 days apart from egg to chick.

[b] The total used for estimating the remaining parameters. These dates might contain observations > 7 days apart or estimated event dates (e.g. “no egg” on first visit followed by “bird incubating” on the next visit).

Table 47. Hatching dates of thick-billed murre eggs by plot at Buldir Island, Alaska, 2006[a].

	July																														
Plot	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
36									1			1		2	1			2					1		1								
38A										3				3				7					2										
38B										6		1		7		1		10					3				3						
39A														7				3					3				2						
39B														1				3					1										
40													4	1				8					13				6			1			2
43															3			2					2										
45														5				9					21				1			1			2

[a] Hatching dates are the mid-point or, if no mid-point, the even Julian date between plot visits. If more than 1 egg hatched, the date of the first egg was used.

Table 47 (continued).

	August																																
Plot	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
36																																	
38A																																	
38B						1																											
39A																																	
39B/C																																	
40																																	
43																																	
45						3																											

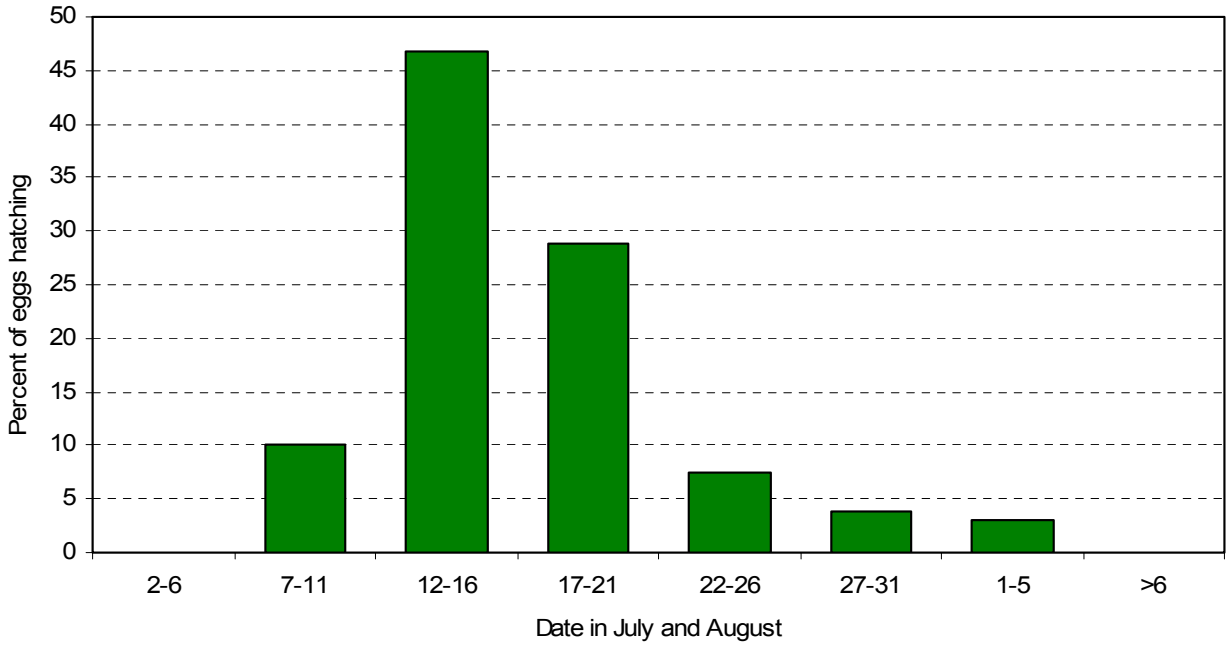

Figure 25. Hatching chronology of thick-billed murres at Buldir Island, Alaska in 2006 (n=160).

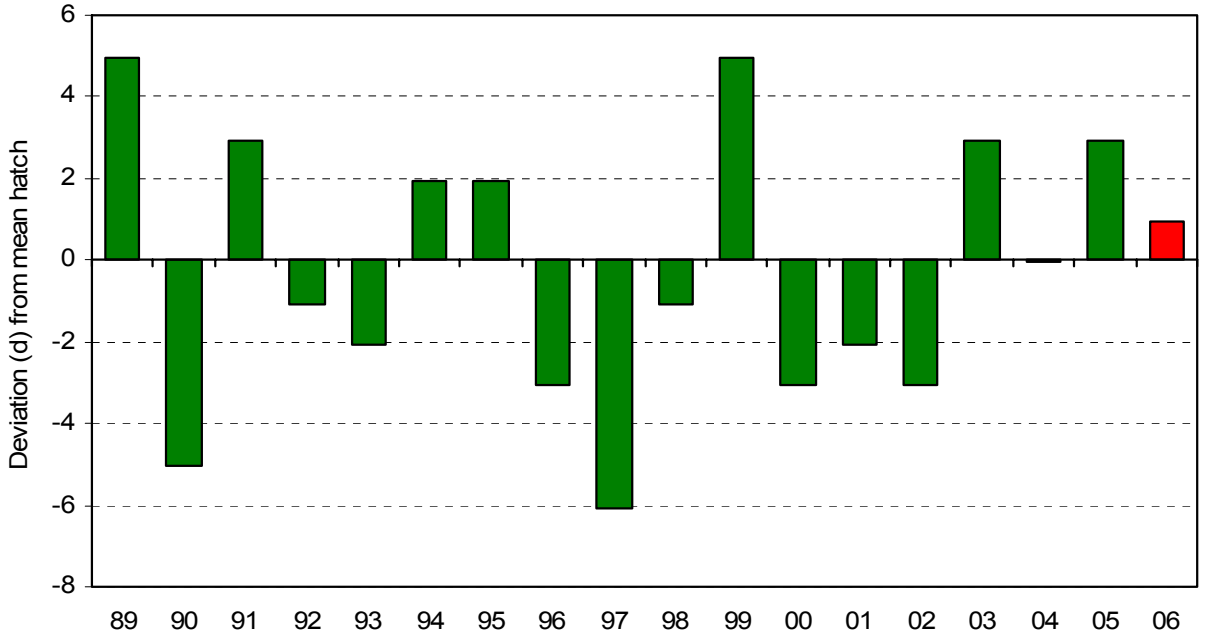

Figure 26. Yearly hatch date deviation (from the 1988-2005 average of 17 July) for thick-billed murres at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

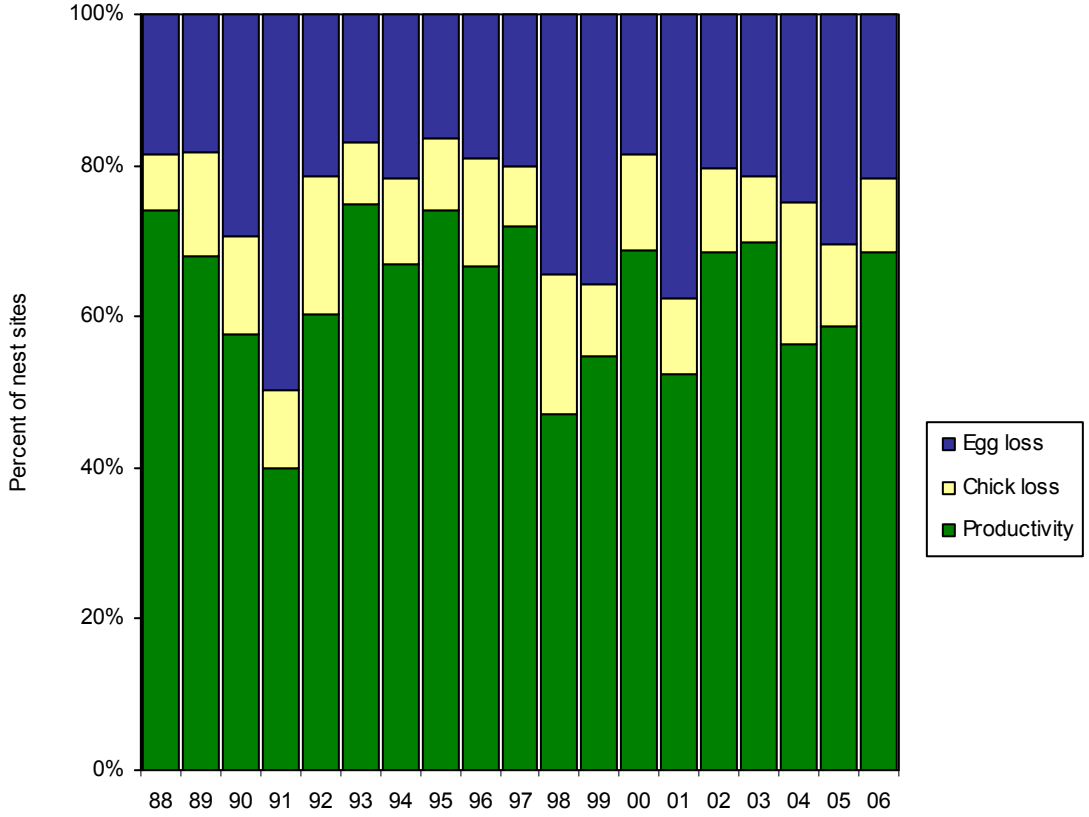

Figure 27. Reproductive performance of thick-billed murres at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick.

Table 48. Reproductive performance of thick-billed murres on index plots at Buldir Island, Alaska.

Year	no. sites w/ egg (A)	no. sites w/ chick (B)	no. sites w/ fledged chick (C)	hatching success (B/A)	fledging success (C/B)	reproductive success (C/A)
1988	362	295	268	0.80	0.90	0.73
1989	329	269	224	0.82	0.83	0.68
1990	473	334	273	0.82	0.94	0.76
1991	514	258	205	0.79	0.80	0.64
1992	350	275	211	0.79	0.77	0.60
1993	272	226	204	0.83	0.90	0.75
1994	385	301	258	0.78	0.86	0.67
1995	288	241	213	0.84	0.88	0.74
1996	308	249	205	0.81	0.82	0.67
1997	407	325	293	0.80	0.90	0.72
1998	270	177	127	0.65	0.71	0.47
1999	268	172	147	0.64	0.85	0.55
2000	329	268	226	0.81	0.84	0.69
2001	181	113	95	0.62	0.84	0.52
2002	239	190	164	0.79	0.86	0.69
2003	316	248	221	0.78	0.89	0.70
2004	213	160	120	0.75	0.75	0.56
2005	286	199	168	0.70	0.84	0.59
2006	271	212	186	0.78	0.86	0.67

Table 49. Reproductive performance of thick-billed murres on index plots at Buldir Island, Alaska, in 2006.

Parameter	Plot 36	38a	38b	39a	39b	40	43	45	Total	n	mean	SD
no. of sites with an egg (A)	38	38	18	21	46	46	15	49	271			
no. of sites with chick (B)	23	23	13	20	39	38	11	45	212			
no. of sites where chick fledged (C)	21	19	9	18	35	32	8	43	186			
hatching success (B/A)	0.61	0.61	0.72	0.95	0.85	0.83	0.73	0.92	0.78	8	0.78	0.12
fledging success (C/B)	0.91	0.83	0.69	0.90	0.90	0.84	0.82	0.96	0.88	8	0.86	0.08
reproductive success (C/A)	0.55	0.50	0.50	0.86	0.76	0.70	0.60	0.88	0.69	8	0.67	0.14

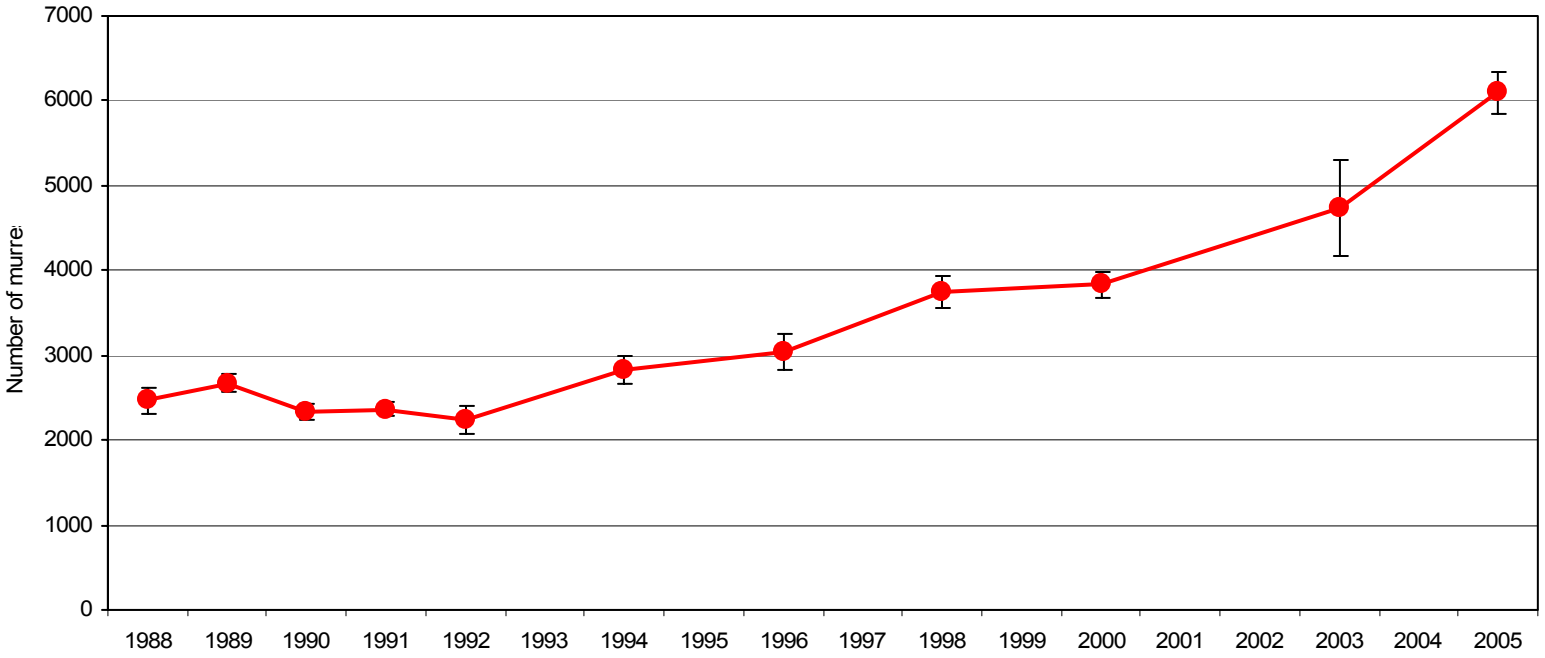

Figure 28. Counts of thick-billed murres on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

Table 50. Thick-billed murre population counts at Buldir Island, Alaska (The Dip and Kittiwake Lane East & West combined).

Count	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005
1	2224	2637	2306	2245	2127	3046	3177	3575	3787	4362	5768
2	2487	2529	2379	2504	2195	2662	2863	3970	3791	4544	5958
3	2602	2798	2488	2354	2476	2758	3064	3812	3704	4482	6397
4	2464	2704	2237	2350	2135	2837	2775	3848	4086	5572	6075
5	2577	2692	2254	2386	--	--	3283	3522	3796	--	6268
mean	2470.8	2672.0	2332.8	2367.8	2233.3	2825.8	3032.4	3745.4	3832.8	4740.0	6093.2
n	5	5	5	5	4	4	5	5	5	4	5
SD	149.8	98.7	102.9	92.8	164.7	163.3	211.9	190.0	146.5	559.8	248.6
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun
last survey	27 Jul	16 Jul	18 Jul	19 Jul	21 Jul	19 Jul	19 Jul	24 Jul	20 Jul	25 Jul	18 Jul

Table 51. Murre population counts on index plots at Buldir Island, Alaska in 2005.

Plot (segment)	Count 1	2	3	4	5	mean	SD	max.
The Dip								
1	0	0	0	0	0	0	0	0
2	16	17	16	14	19	16.4	1.8	19
3	142	146	118	148	152	141.2	13.5	152
4	110	85	143	128	98	112.8	23.1	143
5	162	152	140	130	129	142.6	14.3	162
6	100	127	142	115	113	119.4	15.9	142
7	78	112	127	111	100	105.6	18.2	127
8	210	252	240	237	231	234.0	15.4	252
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	109	99	146	126	114	118.8	18.0	146
12	776	743	664	735	703	724.2	42.5	776
13	202	207	221	224	200	210.8	11.0	224
14	61	34	40	30	33	39.6	12.5	61
A	602	595	727	580	594	619.6	60.6	727
B	662	654	554	648	591	621.8	47.1	662
C	559	721	943	933	945	820.2	174.2	945
Total	3789	3944	4241	4159	4022	4031.0	178.0	4241
Kittiwake Lane								
15(1)	309	202	196	181	212	220.0	51.0	309
16(2)	278	425	482	376	500	412.2	89.5	500
17(3)	411	336	421	341	368	375.4	39.2	421
18(4)	182	184	187	140	186	175.8	20.1	187
19(5)	203	192	199	205	256	211.0	25.6	256
20(6)	193	167	185	169	193	181.4	12.7	193
21(7)	73	92	84	101	124	94.8	19.3	124
22(8)	83	81	111	108	86	93.8	14.5	111
23(9)	3	2	13	3	11	6.4	5.2	13
24(10)	0	0	0	0	0	0	0	0
25(11)	0	0	0	0	0	0	0	0
26(12)	9	10	20	15	12	13.2	4.4	20
27(13)	0	0	4	9	9	4.4	4.5	9
28(14)	202	285	223	225	244	235.8	31.3	285
29(15)	33	38	51	43	45	42.0	6.9	51
KWLE[a]	1180	1147	1286	1038	1266	1183.0	99.8	1286
KWLW	799	867	890	878	980	882.8	64.8	980
KWL total	1979	2014	2176	1916	2246	2066.0	139.0	2246
Index plot total[b]	5768	5958	6417	6075	6268	6097.0	254.8	6417

[a] KWLE is Kittiwake Lane East (plots 15-18), KWLW is KWL West (plots 19-29).
[b] Consists of all plots at The Dip and Kittiwake Lane combined.
[c] Plots 19-28.
[d] Consists of all plots at The Dip and Kittiwake Lane combined.

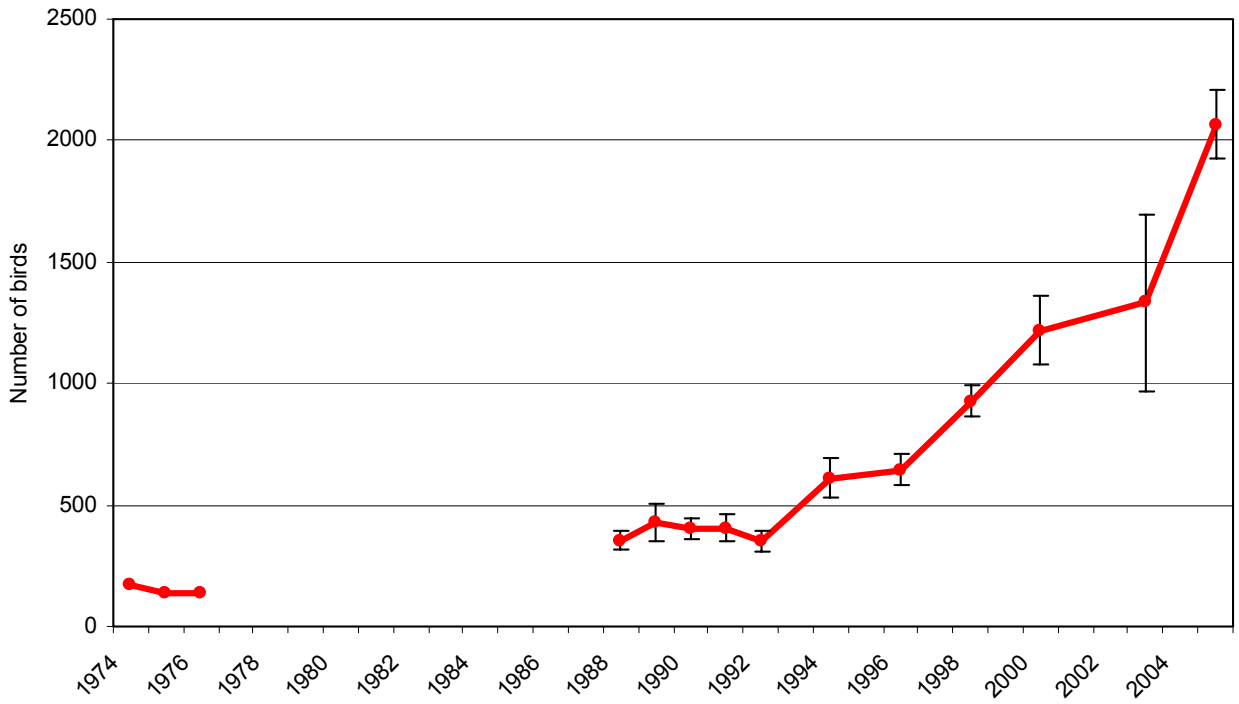

Figure 29. Counts of thick-billed murres at Kittiwake lane, Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

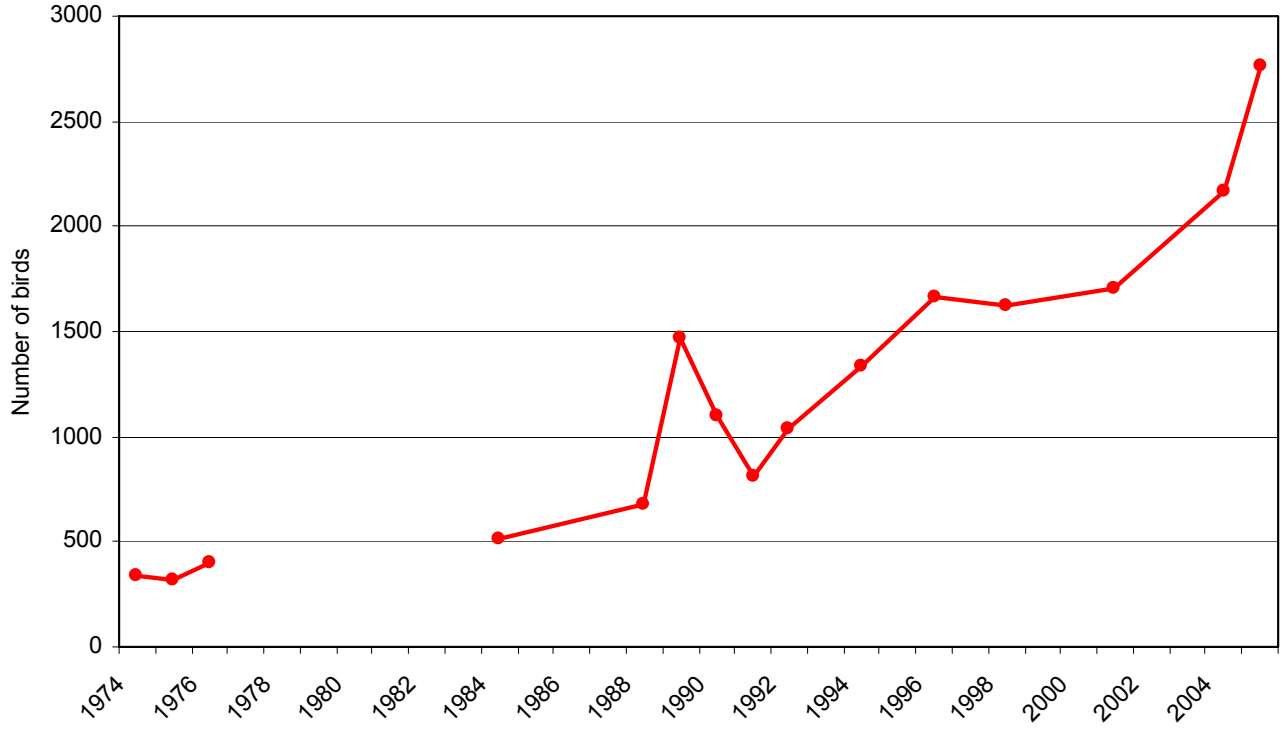

Figure 30. Counts of thick-billed murres at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

Table 52. Murre counts by sub-area at Kittiwake Lane (Slide Mountain Colony), Buldir Island, Alaska.

Segment (Plot)	1974	1975	1976	1988	1989	1990	1991	1992	1994	1996	1998	2000	2003	2005
15 (1)		20		73	70	93	65	73	85	88	163	116	146	220
16 (2)		43		99	167	144	126	119	195	158	370	407	343	412
17 (3)		37		113	125	112	116	78	145	136	101	230	273	375
18 (4)		35		71	67	55	85	57	121	149	94	145	114	176
19 (5)		0		0	0	0	0	0	0	0	31	81	119	211
20 (6)		0		0	0	0	13	22	42	46	88	135	99	181
21 (7)		0		0	0	0	0	0	0	0	0	0	16	95
22 (8)		0		0	0	0	0	0	0	0	0	0	11	94
23 (9)		0		0	0	0	0	0	0	0	0	0	0	6
24(10)		0		0	0	0	0	0	0	0	0	0	0	0
25(11)		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
27(13)		0		0	0	0	0	0	0	0	0	0	0	4
28(14)		0		0	0	0	0	0	24	67	82	103	190	236
29(15)		0		0	0	0	0	0	0	0	0	0	21	42
Total	173	135	135	355	429	404	406	349	612	645	928	1217	1332	2066
SD[a]	–	–	–	38.5	76	40.3	56.4	43.0	79.0	66.3	62.3	140.9	366.5	139.0
n	1	1	1	6	5	5	5	4	4	5	5	5	4	5
first survey	[b]	[b]	[b]	5 Jul	29 Jun	30 Jun	8 Jul	6 Jul	4 Jul	28 Jun	4 Jul	27 Jun	9 Jul	23 Jun
last survey	[b]	[b]	[b]	27 Jul	16 Jul	18 Jul	18 Jul	20 Jul	19 Jul	18 Jul	24 Jul	20 Jul	25 Jul	18 Jul

[a] SD based on replicate counts of all plots, not the sum of the plot means as presented above
[b] From Byrd (1978); figures are from single counts made early to mid-July 1974, 1975, and 1976.

Table 53. Murre counts by sub-area at Middle Rock, Buldir Island, Alaska.

Segment (Plot)	1974	1975	1976	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005
I	--	170	--	208[c]	147[d]	306	194	170	241	309	398	307	266	476	530
II	--	70	--	69	74	133	85	51	63	115	155	132	244	283	522
III	--	10	--	69	47	34	37	0	24	46	20	61	42	31	46
IV	--	0	--	149	28	111	104	39	62	253	188	196	184	162	249
V	--	65	--	23	0	72	58	34	56	42	172	129	146	282	293
VI	--	0	--	0	44	69	56	65	67	82	89	102	120	114	148
VII	--	0	--	0	341	740	566	456	520	485	641	697	701	823	979
Total	340[a]	315	405[b]	518	681	1465	1100	815	1033	1332	1663	1624	1703	2171	2767
survey date	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

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

Table 54. Breeding chronology dates for common murres at Buldir Island, Alaska.

Parameter	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
mean hatch	22 Jul	21 Jul	30 Jul	14 Jul	12 Jul	13 Jul	21 Jul	15 Jul	8 Jul	15 Jul
SD (days)	13.3	9.5	4.2	7.8	1.7	5.1	8.3	3.1	-	5.8
n[a]	8	4	2	15	3	7	7	6	1	5
median hatch	18 Jul	18 Jul	--	9 Jul	13 Jul	11 Jul	19 Jul	13 Jul	8 Jul	12 Jul
mean jump	6 Aug	16 Aug	--	6 Aug	9 Aug	3 Aug	13 Aug	3 Aug	16 Aug	5 Aug
SD (days)	6.4	6.0	--	10.6	5.0	6.5	6.1	8.1	-	7.1
n[b]	11	6	--	12	3	5	6	3	1	2
median jump	11 Aug	17 Aug	>14 Aug	7 Aug	6 Aug	5 Aug	11 Aug	29 Jul	16 Aug	10 Aug
no. nests monitored[c]	18	11	8	22	7	10	15	16	8	16
first hatch	11 Jul	15 Jul	27 Jul	6 Jul	10 Jul	7 Jul	13 Jul	13 Jul	8 Jul	11 Jul
last hatch	6 Aug	4 Aug	2 Aug	2 Aug	13 Jul	23 Jul	31 Jul	2 Aug	19 Jul	25 Jul
first jump	6 Aug	4 Aug	>14 Aug	24 Jul	6 Aug	23 Jul	6 Aug	29 Jul	25 Jul	31 Jul
last jump	16 Aug	19 Aug	>14 Aug	21 Aug	15 Aug	9 Aug	24 Aug	22 Aug	16 Aug	14 Aug

[a] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations < 7 days apart from egg to chick.
[b] Sample size is for the calculation of mean and median jump dates.
[c] The total used for estimating the remaining parameters. These dates might contain observations > 7 days apart or estimated event dates (e.g. “no egg” on first visit followed by “bird Incubating” on the next visit).

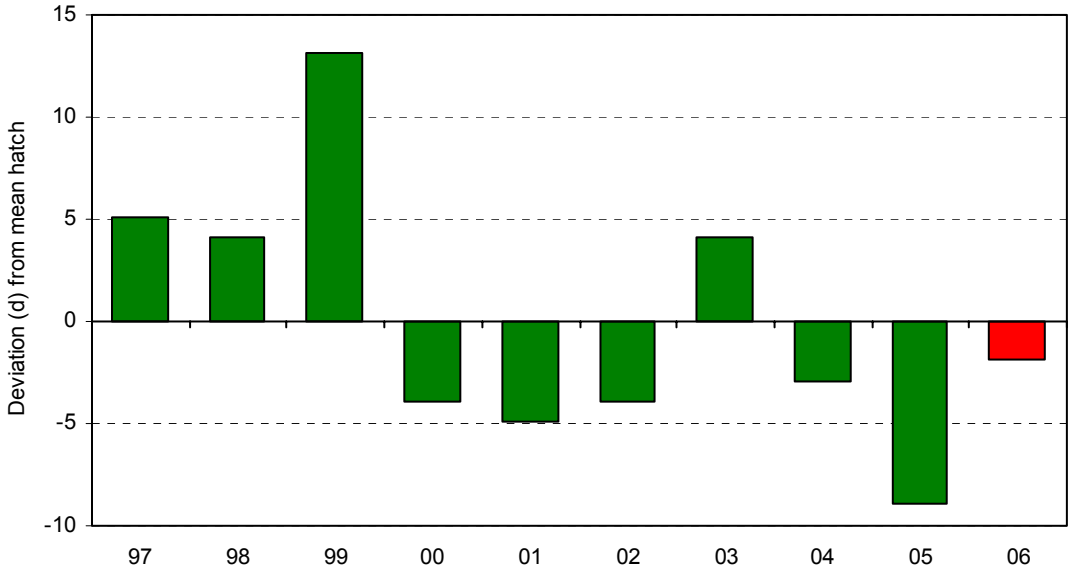

Figure 31. Yearly hatch date deviation (from the 1997-2005 average of 17 July) for common murres at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

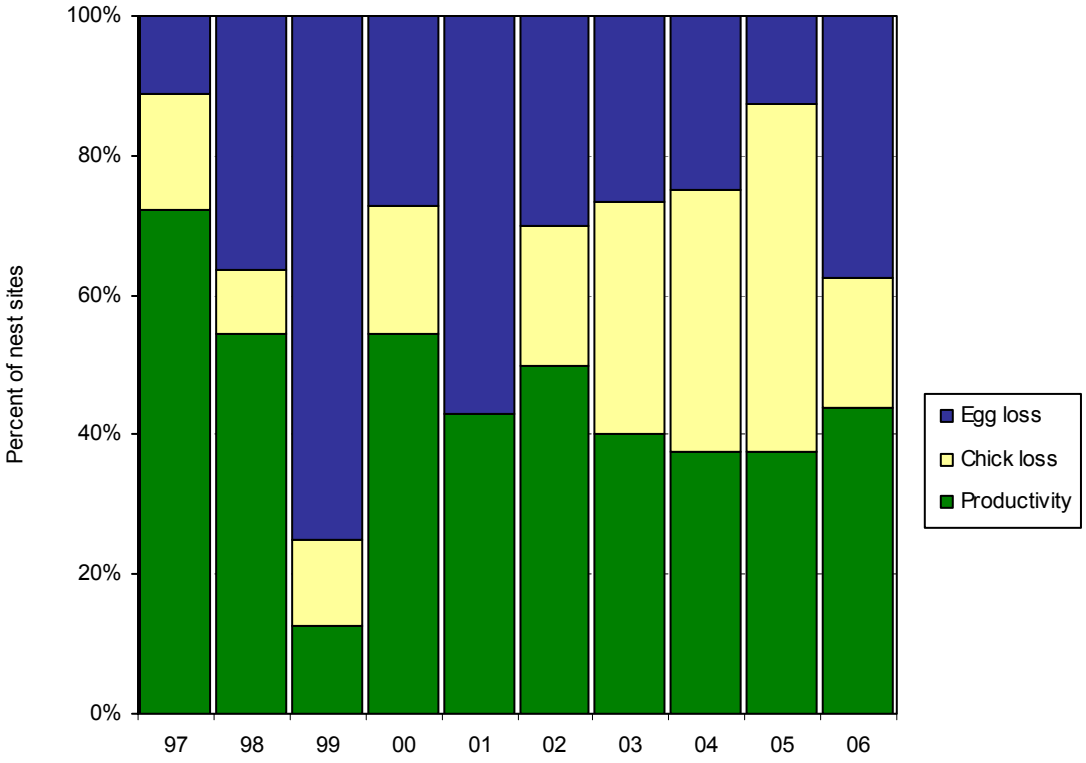

Figure 32. Reproductive performance of common murres at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick.

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

Parameter	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
no. sites w/ egg (A)	18	11	8	22	7	10	15	16	8	16
no. sites w/ chick (B)	16	7	2	16	3	7	11	12	7	10
sites where chick fledged (C)	13	6	1	12	3	5	6	6	3	7
hatching success (B/A)	0.89	0.64	0.25	0.73	0.43	0.70	0.73	0.75	0.88	0.63
fledging success (C/B)	0.81	0.86	0.50	0.75	1.00	0.71	0.55	0.50	0.43	0.70
reproductive success (C/A)	0.72	0.55	0.13	0.55	0.43	0.50	0.40	0.38	0.38	0.44

Table 56. Counts of pigeon guillemots at Buldir Island, Alaska.

Coastline section	1972[a]	1979	1997	1998	1999	2000	2001	2002	2005[b]	2006
A-B	--	15	13	8	18	5	11	9	5	1
B-C	--	9	10	3	15	4	4	15	4	1
C-D	--	19	1	6	11	5	7	3	-	7
D-E	--	8	11	8	9	2	7	9	-	0
E-F	--	8	20	6	4	6	7	14	-	9
F-A	--	14	12	5	18	7	6	14	3[c]	7
Total	60	73	67	36	75	29	42	64	12	25
Date		**24 Jun**	3 Jun	13 Jun	1 Jul	20 Jun	5 Jun	2 Jul	10 Jun	7 Jun

[a] Boat count conducted by Byrd (1972) 7 July 1972 on south side of island (50 individuals). Approximately 10 individuals were counted along the north shore 30 June - 8 July 1972.
[b] Circumnavigation not completed due to technical difficulties.
[c] Surveyed only from the beginning of section A to Bull Point.

Table 57. Breeding chronology dates for least auklets at Buldir Island, Alaska.

Year	mean hatch	SD	n[b]	median hatch	mean fledge	SD	n[c]	median fledge	no. nests monitored[d]	first hatch	last hatch	first fledge	last fledge
1976[a]	2 Jul	3.6	15	2 Jul	--	--	--	--	15	27 Jun	10 Jun	--	--
1990	27 Jun	6.3	10	1Jul	--	--	23	28 Jul	61	21 Jun	9 Jul	19 Jul	>1 Aug
1991	30 Jun	3.4	9	3 Jul	--	--	50	1 Aug	81	21 Jun	12 Jul	25 Jul	6 Aug
1992	29 Jun	8.0	12	23 Jun	--	--	43	26 Jul	89	16 Jun	13 Jun	13 Jul	5 Aug
1993	26 Jun	5.3	8	24 Jun	25 Jul	4.0	22	27 Jul	44	16 Jun	9 Jul	19 Jul	27 Jul
1994	24 Jun	4.3	26	24 Jun	21 Jul	5.1	26	23 Jul	64	19 Jun	15 Jul	15 Jul	1 Aug
1995	29 Jun	5.2	49	26 Jun	29 Jul	5.2	45	30 Jul	64	21 Jun	15 Jul	21 Jul	10 Aug
1996	25 Jun	6.5	23	22 Jun	25 Jul	5.7	34	26 Jul	57	16 Jun	12 Jul	12 Jul	1 Aug
1997	27 Jun	5.1	35	25 Jun	27 Jul	5.3	50	29 Jul	84	20 Jun	15 Jul	16 Jul	8 Aug
1998	30 Jun	5.5	44	29 Jun	28 Jul	5.3	34	29 Jul	76	19 Jun	9 Jul	19 Jul	8 Aug
1999	--	not monitored			--	--	--	--	--	26 Jun	--	27 Jul	14 Aug
2000	25 Jun	7.2	30	23 Jun	25 Jul	4.8	33	22 Jul	69	18 Jun	8 Jul	17 Jul	1 Aug
2001	26 Jun	5.0	20	29 Jun	27 Jul	4.7	34	29 Jul	65	21 Jun	3 Jul	20 Jul	8 Aug
2002	25 Jun	5.0	13	27 Jun	25 Jul	4.9	30	27 Jul	50	17 Jun	10 Jul	14 Jul	8 Aug
2003	27 Jun	5.3	14	26 Jun	26 Jul	3.9	28	27 Jul	83	13 Jun	9 Jul	21 Jul	1 Aug
2004	28 Jun	3.2	22	27 Jun	27 Jul	2.9	18	27 Jul	81	19 Jun	9 Jul	23 Jul	5 Aug
2005	25 Jun	5.8	33	25 Jun	24 Jul	5.6	40	21 Jul	73	11 Jun	11 Jul	16 Jul	6 Aug
2006	30 Jun	5.3	34	27 Jun	29 Jul	6.5	63	27 Jul	101	18 Jun	11 Jul	16 Jul	16 Aug

[a] Hatch dates in 1976 were assumed to be the midpoint of the interval reported in Knudtson and Byrd (1982).
[b] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations ≤ 7 days apart from Egg to Chick in all years except 1990: ≤ 10 days Egg to Chick.
[c] Sample size is for the calculation of mean and median fledge dates.
[d] The total used for estimating the remaining parameters. These dates might contain observations > 7 days, but less than 10 days apart or estimated event dates (e.g. “bird Incubating” on first visit followed by “chick” on the next visit).

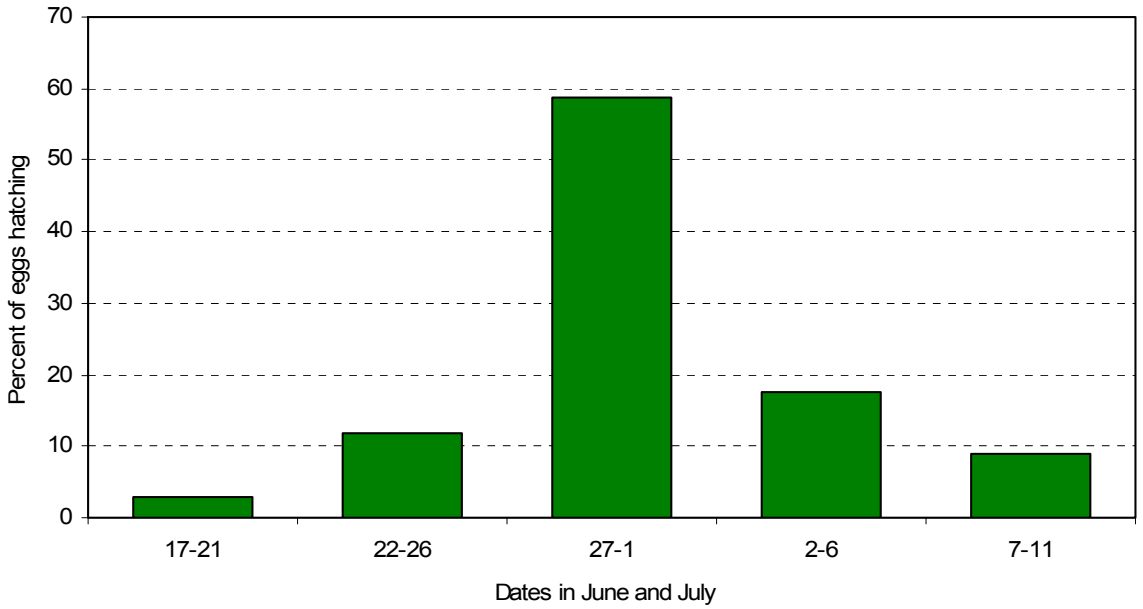

Figure 33. Hatching chronology of least auklets at Buldir Island, Alaska in 2006 (n=34).

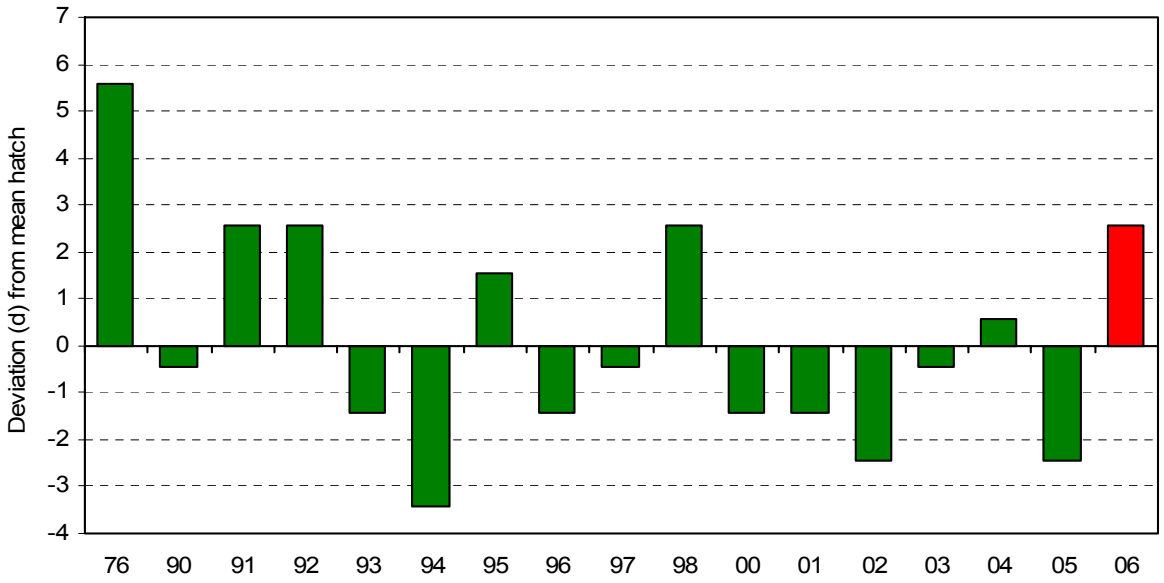

Figure 34. Yearly hatch date deviation (from the average of 28 June, excluding 2006) for least auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

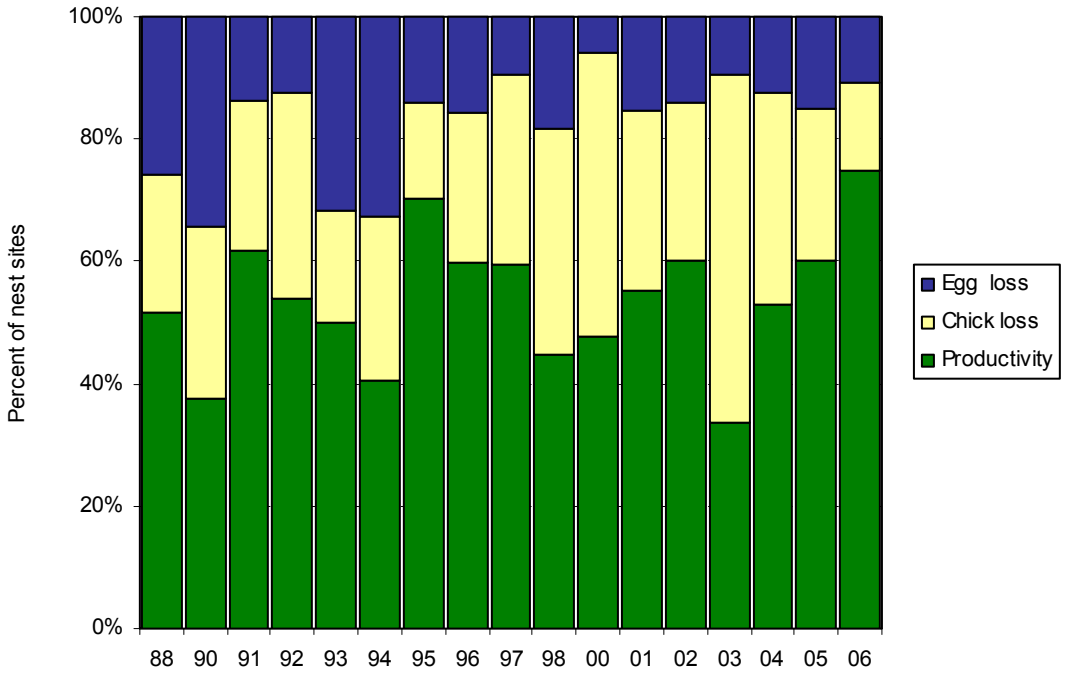

Figure 35. Reproductive performance of least auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick.

Table 58. Reproductive performance of least auklets at Buldir Island, Alaska.

Parameter[a]	1976	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. eggs found (A)	28	31	60	61	81	89	44	64	64	57	84	76	0	69	65	50	83	81	73	84
No. eggs lost to:																				
disappearance	--	6	18	18	9	9	9	14	3	6	7	8	--	4	5	4	2	3	4	10
abandonment	--	0	2	2	0	1	3	6	3	1	0	6	--	0	5	3	4	4	7	4
breakage	--	2	3	1	2	1	2	1	3	2	1	0	--	0	0	0	2	3	0	0
No. eggs hatched (B)	19	23	37	40	70	78	30	43	55	48	76	62	--	65	55	43	75	71	62	75
No. chicks lost to:																				
disappearance	--	5	--	16	14	26	4	10	9	7	22	24	--	26	15	10	39	19	15	10
death	--	2	--	1	6	4	4	7	1	7	3	4	--	6	4	3	8	9	3	2
No. chicks fledged (C)	--	16	--	23	50	48	22	26	45	34	50	34	--	33	36	30	28	43	44	63
Hatching success (B/A)	0.68	0.74	0.62	0.66	0.86	0.88	0.68	0.67	0.86	0.84	0.91	0.82	--	0.94	0.85	0.86	0.90	0.88	0.85	0.89
Fledging success (C/B)[b]	--	0.70	--	0.58	0.71	0.61	0.73	0.60	0.81	0.71	0.66	0.55	--	0.51	0.65	0.70	0.37	0.61	0.71	0.84
Reproductive success (C/A)	--	0.52	--	0.38	0.62	0.54	0.50	0.41	0.70	0.60	0.60	0.45	--	0.48	0.55	0.60	0.34	0.53	0.60	0.75
Productivity (hs x fs)	--	0.52	--	0.38	0.61	0.54	0.50	0.40	0.70	0.60	0.60	0.45	--	0.48	0.55	0.60	0.33	0.54	0.60	0.75

[a] Data are from nest sites for which visit intervals at hatching and fledging were ≤ 12 days.
[b] For chicks to be considered fledged, they had to have attained the age of 25 days before disappearing or 21 days at time of last visit if chicks were still present.

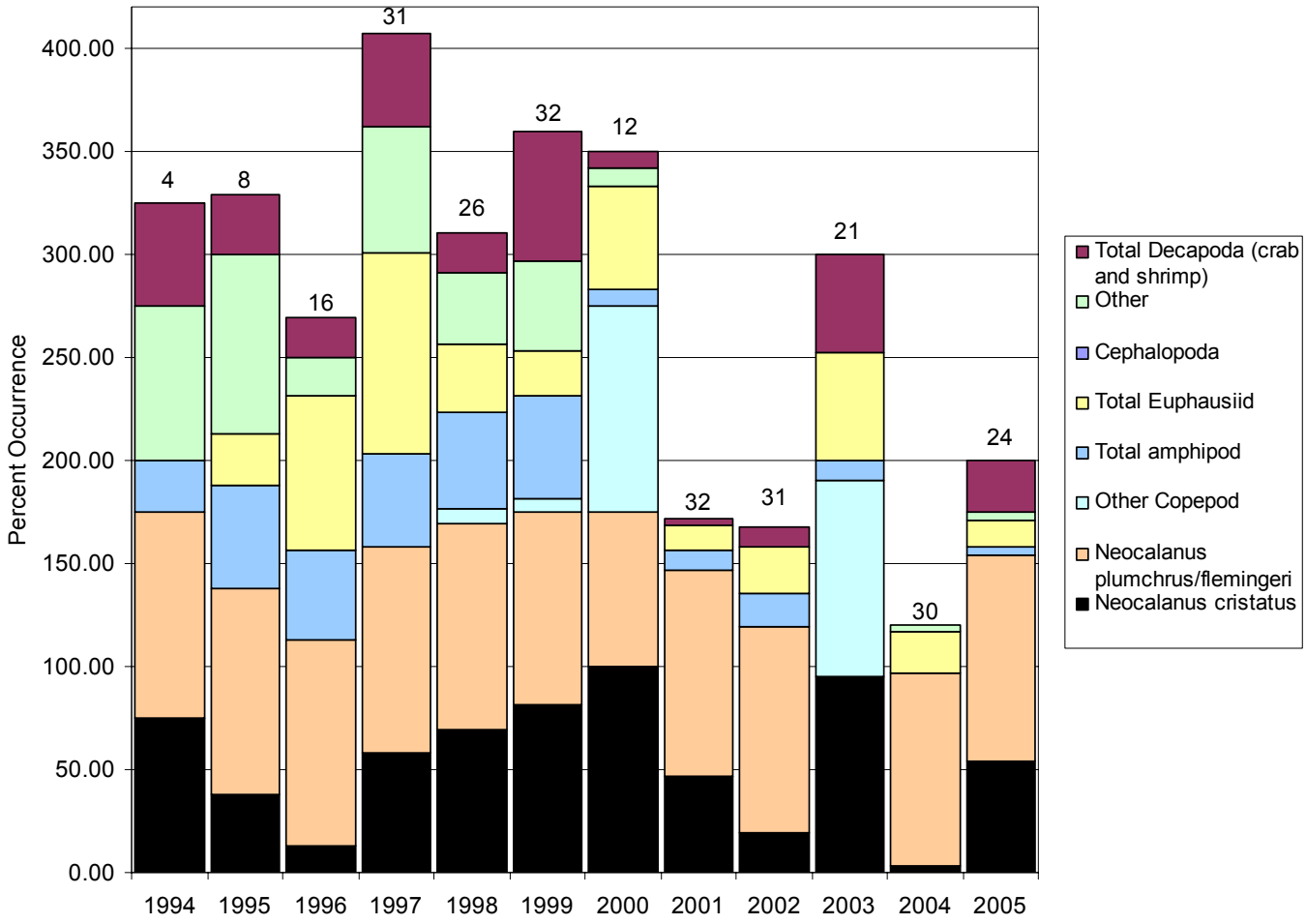

Figure 36. Frequency of prey occurrence in diets of least auklets at Buldir Island, Alaska.

Table 59. Relative biomass of prey in diets of least auklets at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species. Biomass data 2000-2005 not presently available.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	4	8	16	31	26	32	12	32	31	21	30	24
Total mass (g)	12.1	18.2	46.3	97.6	87.1	146.1	--	--	--	--	--	--
Gonatidae	--	--	--	--	--	0.1	--	--	--	--	--	--
Gastropoda												
Unid. snail	0.6	--	--	--	--	--	--	--	--	--	--	--
Limacina helicina	--	--	--	--	0.2	--	--	--	--	--	--	--
Pteropoda	--	5.3	0.3	4.4	--	0.3	--	--	--	--	--	--
Copepoda												
Neocalanus plumchrus/flemingeri	64.2	77.1	84.5	73.0	73.9	48.7	--	--	--	--	--	--
N. cristatus	11.1	1.5	7.2	10.2	19.5	46.3	--	--	--	--	--	--
N. spp.	--	--	--	--	--	--	--	--	--	--	--	--
Calanus marshallae	--	--	--	--	<0.1	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	--	--	--	--	--
Pachyptilus pacificus	--	--	--	--	--	<0.1	--	--	--	--	--	--
Pareuchaeta birostrata	--	--	--	--	--	<0.1	--	--	--	--	--	--
Unid. Copepod	--	--	--	--	--	--	--	--	--	--	--	--
Amphipoda												
Hyperiidea												
Hyperoche medusarum	--	3.6	0.1	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	7.5	1.3	0.6	1.2	<0.1	0.6	--	--	--	--	--	--
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	--	--
Primno macropa	3.3	--	--	1.8	--	1.1	--	--	--	--	--	--
Gammaridea												
Erichtonius spp.	--	--	--	--	2.7	--	--	--	--	--	--	--
Euphausiacea												
Thysanoessa spp.	--	1.5	6.7	5.4	--	--	--	--	--	--	--	--
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--	--
Euphausiid furcilla	--	--	--	--	1.0	0.3	--	--	--	--	--	--
Unid. Euphausiid	--	--	--	--	2.5	0.7	--	--	--	--	--	--
Decapoda												
Pandalid shrimp	--	--	--	--	--	--	--	--	--	--	--	--
Larval shrimp	--	--	--	--	--	--	--	--	--	--	--	--
Shrimp zoea	12.4	7.0	0.2	0.4	0.1	0.1	--	--	--	--	--	--
Crab zoea	--	--	--	0.3	--	0.1	--	--	--	--	--	--
Crab megalopa	--	--	0.4	1.9	--	--	--	--	--	--	--	--
Hippolytidae juvenile	--	--	--	--	--	1.1	--	--	--	--	--	--
Atelecyclidae megalopa	--	--	--	--	0.1	0.1	--	--	--	--	--	--
Paguridae megalopa	--	--	--	--	--	0.3	--	--	--	--	--	--
Fish	0.1	2.8	--	1.3	--	0.1	--	--	--	--	--	--

Table 60. Frequency of occurrence of prey in diets of least auklets at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	4	8	16	31	26	32	12	32	31	21	30	24
Gonatidae	--	--	--	--	--	3.1	--	--	--	--	--	--
Gastropoda												
Unid. snail	50.0	--	--	--	--	--	--	--	--	--	--	--
Limacina helicina	--	--	--	--	34.6	--	--	--	--	--	--	--
Pteropoda	--	75.0	18.8	54.8	--	40.6	--	--	--	--	--	4.2
Copepoda												
Neocalanus plumchrus/flemingeri	100.0	100.0	100.0	100.0	100.0	93.8	75.0	100.0	100.0	--	93.3	100.0
N. cristatus	75.0	37.5	12.5	58.1	69.2	81.3	100.0	46.9	19.4	95.2	3.3	54.2
N. spp.	--	--	--	--	--	--	--	--	--	95.2	--	--
Calanus marshallae	--	--	--	--	7.7	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	41.7	--	--	--	--	--
Pachyptilus pacificus	--	--	--	--	--	3.1	--	--	--	--	--	--
Pareuchaeta birostrata	--	--	--	--	--	3.1	--	--	--	--	--	--
Unid. Copepod	--	--	--	--	--	--	--	--	--	95.2	--	--
Amphipoda												
Hyperiidea												
Hyperoche medusarum	--	50.0	12.5	--	--	--	--	--	3.2	--	--	--
Parathemisto pacifica	75.0	50.0	31.3	19.4	11.5	31.3	8.3	9.4	9.7	--	--	4.2
Parathemisto spp.	--	--	--	--	--	--	--	--	--	4.8	--	--
Primno macropa	25.0	--	--	25.8	--	18.8	--	--	3.2	4.8	--	--
Gammaridea												
Erichitonius spp.	--	--	--	--	34.6	--	--	--	--	--	--	--
Euphausiacea												
Thysanoessa spp.	--	25.0	75.0	35.5	--	--	--	--	--	23.8	--	--
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--	4.2
Euphausiid furcilla	--	--	--	--	61.5	6.3	--	--	--	--	--	--
Unid. Euphausiid	--	--	--	--	26.9	21.9	50.0	12.5	22.6	28.6	20.0	8.3
Decapoda												
Pandalid shrimp	--	--	--	--	--	--	--	--	--	--	--	4.2
Larval shrimp	--	--										12.5
Shrimp zoea	50.0	25.0	6.3	19.4	19.2	15.6	--	--	--	--	--	--
Crab zoea	--	--	--	3.2	--	3.1	--	--	--	42.9	--	--
Crab megalopa	--	--	6.3	22.6	--	--	8.3	--	--	4.8	--	8.3
Hippolytidae megalopa	--	--	--	--	--	37.5	--	--	--	--	--	--
Atelecyclidae megalopa	--	--	--	--	3.8	6.3	--	--	--	--	--	--
Paguridae megalopa	--	--	--	--	--	6.3	--	--	--	--	--	--
Fish	25.0	12.5	--	6.5	3.1	--	--	--	--	3.3	--	--

Table 61. Breeding chronology dates for crested auklets at Buldir Island, Alaska.

Year	mean hatch	SD	n[b]	median hatch	mean fledge	SD	n[c]	median fledge	no. nests monitored[d]	first hatch	last hatch	first fledge	last fledge
1976[a]	7 Jul	3.2	36	6 Jul	--	--	--	--	36	2 Jul	14 Jul	--	--
1990	25 Jun	5.1	12	21 Jun	--	--	26	28 Jul	68	21 Jun	19 Jul	19 Jul	>1 Aug
1991	29 Jun	5.2	6	30 Jun	--	--	43	1 Aug	74	21 Jun	12 Jul	25 Jul	8 Aug
1992	26 Jun	6.2	10	27 Jun	--	--	43	26 Jul	79	12 Jun	7 Jul	13 Jul	>10 Aug
1993	27 Jun	7.1	12	24 Jun	--	--	38	27 Jul	49	16 Jun	15 Jul	23 Jul	>31 Jul
1994	25 Jun	5.8	38	25 Jun	--	--	46	28 Jul	67	14 Jun	15 Jul	15 Jul	14 Aug
1995	29 Jun	6.7	48	26 Jun	31 Jul	4.1	51	30 Jul	66	21 Jun	21 Jul	26 Jul	16 Aug
1996	26 Jun	6.6	14	29 Jun	31 Jul	4.8	40	3 Aug	66	16 Jun	12 Jul	20 Jul	14 Aug
1997	28 Jun	6.4	11	25 Jun	--	--	62	29 Jul	82	15 Jun	15 Jul	16 Jul	8 Aug
1998	5 Jul	5.2	10	7 Jul	8 Aug	4.4	53	10 Aug	70	20 Jun	21 Jul	27 Jul	18 Aug
1999	--		not	monitored	--	--	--	--	--	26 Jun	23 Jul	27 Jul	19 Aug
2000	29 Jun	3.6	19	27 Jun	1 Aug	3.7	48	1 Aug	78	23 Jun	8 Jul	22 Jul	7 Aug
2001	29 Jun	4.6	16	28 Jun	31 Jul	4.0	42	29 Jul	75	22 Jun	2 Jul	23 Jul	8 Aug
2002	25 Jun	4.9	26	25 Jun	30 Jul	5.3	49	31 Jul	81	17 Jun	5 Jul	14 Jul	8 Aug
2003	2 Jul	4.6	9	4 Jul	31 Jul	5.5	6	1 Aug	45	23 Jun	<18 Jul	21 Jul	7 Aug
2004	5 Jul	4.7	17	7 Jul	7 Aug	4.3	7	10 Aug	67	22 Jun	17 Jul	27 Jul	10 Aug
2005	25 Jun	3.2	29	25 Jun	30 Jul	4.9	58	1 Aug	79	16 Jun	11 Jul	21 Jul	12 Aug
2006	9 Jul	6.7	28	10 Jul	11 Aug	5.7	46	11 Aug	102	27 Jun	27 Jul	27 Jul	22 Aug

[a] Hatch dates in 1976 were assumed to be the midpoint of the interval reported in Knudtson and Byrd (1982).
[b] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations ≤ 7 days apart from Egg to Chick in all years except 1990: ≤ 10 days Egg to Chick and 1992: ≤ 8 days Egg to Chick.
[c] Sample size is for the calculation of mean and median fledge dates.
[d] The total used for estimating the remaining parameters. These dates might contain observations > 7, but less than 10 days apart or estimated event dates (e.g. “bird incubating” on first visit followed by “chick” on the next visit)

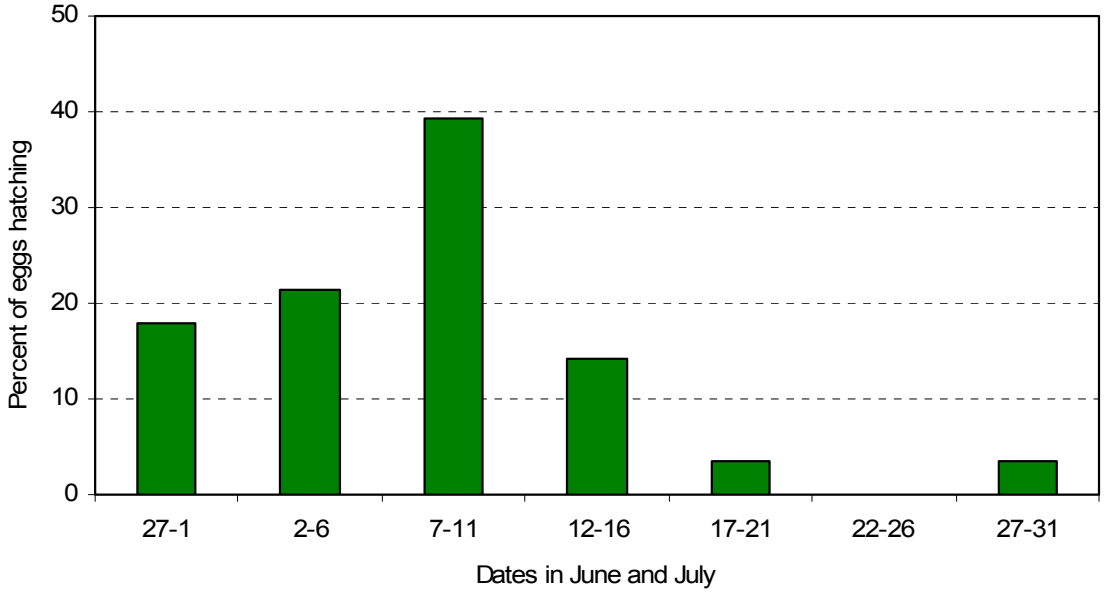

Figure 37. Hatching chronology of crested auklets at Buldir Island, Alaska in 2006 (n=28).

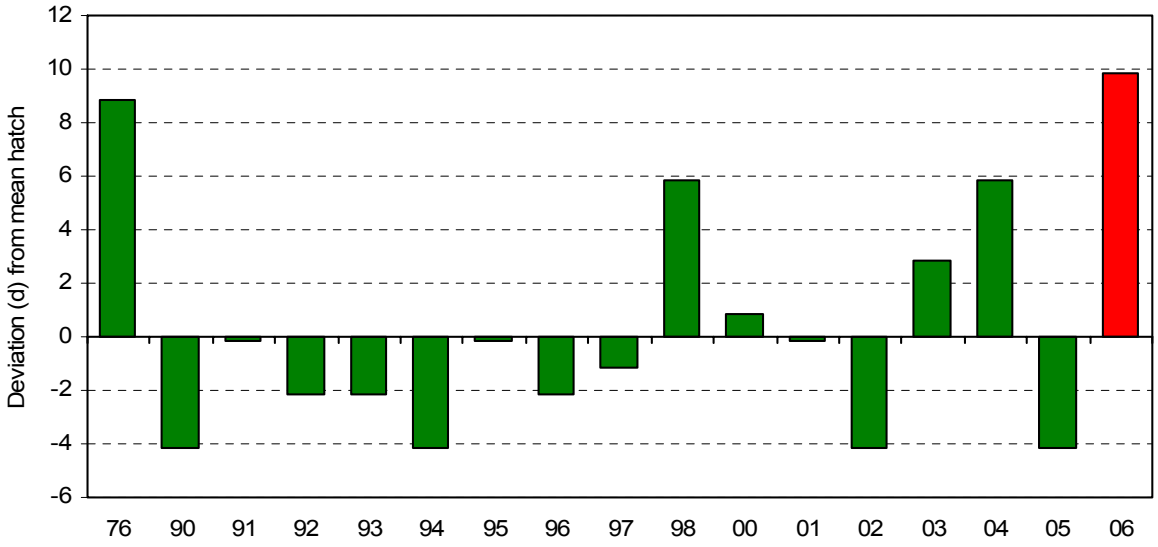

Figure 38. Yearly hatch date deviation (from the average of 29 June, excluding 2006) of crested auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

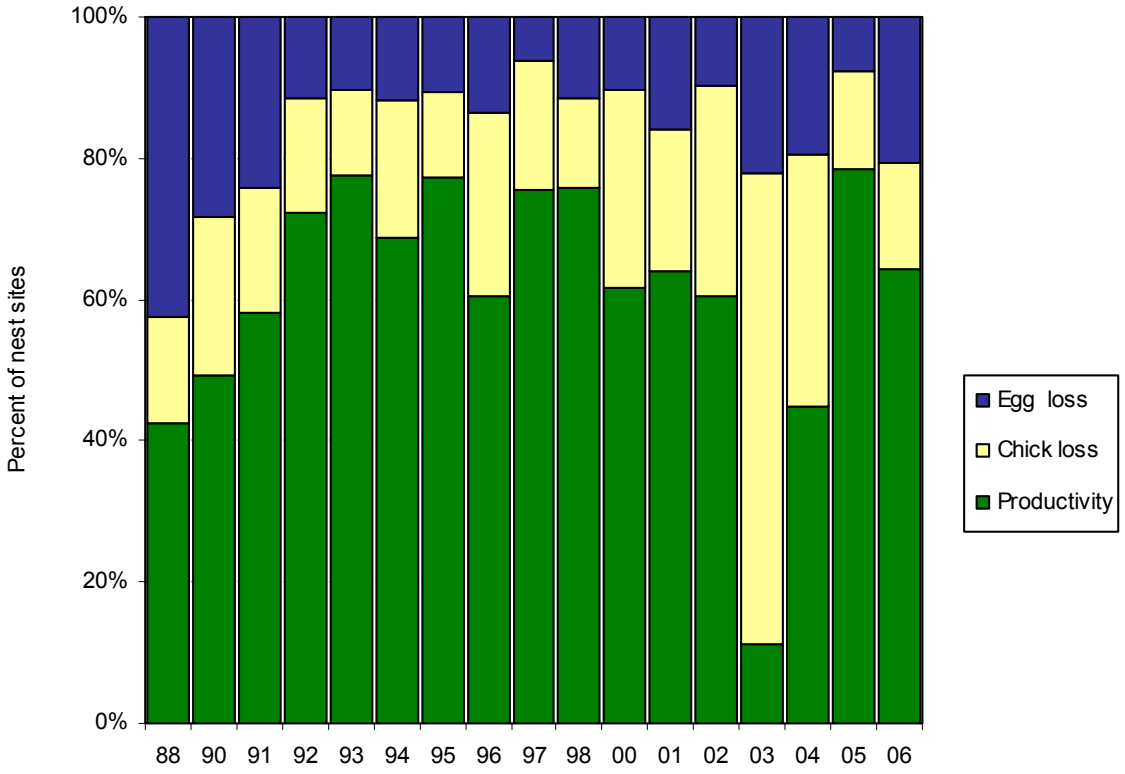

Figure 39. Reproductive performance of crested auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick.

Table 62. Reproductive performance of crested auklets at Buldir Island, Alaska.

Parameter[a]	1976	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. eggs found (A)	59	33	83	67	74	79	49	67	66	66	82	70	0	78	75	81	45	67	79	73
No. eggs lost to:																				
disappearance	--	4	23	15	13	7	3	4	5	7	2	4	--	6	6	3	4	6	4	0
abandonment/death	--	9	4	3	3	2	2	2	1	2	2	4	--	1	6	5	6	5	2	15
breakage	--	1	3	1	2	0	0	2	1	0	1	0	--	1	0	0	0	2	0	0
No. eggs hatched (B)	45	19	53	48	56	70	44	59	59	57	77	62	--	70	63	73	35	54	73	58
No. chicks lost to:																				
disappearance	--	1	--	13	12	12	6	9	7	9	14	9	--	17	8	16	14	13	5	4
death	--	4	--	2	1	1	0	4	1	8	1	0	--	5	7	8	16	11	6	7
No. chicks fledged (C)	--	14	--	33	43	57	38	46	51	40	62	53	--	48	48	49	5	30	62	47
Hatching success (B/A)	0.76	0.58	0.64	0.72	0.76	0.87	0.90	0.88	0.89	0.86	0.94	0.89	--	0.90	0.84	0.90	0.78	0.81	0.92	0.79
Fledging success (C/B)[b]	--	0.74	--	0.69	0.77	0.81	0.86	0.78	0.86	0.70	0.81	0.85	--	0.69	0.76	0.67	0.14	0.56	0.85	0.81
Reproductive success (C/A)	--	0.42	--	0.49	0.58	0.72	0.78	0.69	0.77	0.61	0.76	0.76	--	0.62	0.64	0.60	0.11	0.45	0.79	0.64
Productivity (hs x fs)	--	0.42	--	0.49	0.59	0.70	0.78	0.69	0.77	0.60	0.76	0.76	--	0.62	0.64	0.60	0.11	0.45	0.78	0.64

[a] Data are from nest sites for which visit intervals at hatching and fledging were ≤ 12 days.
[b] For chicks to be considered fledged, they had to have attained the age of 26 days before disappearing or 22 days at time of last visit if chicks were still present.

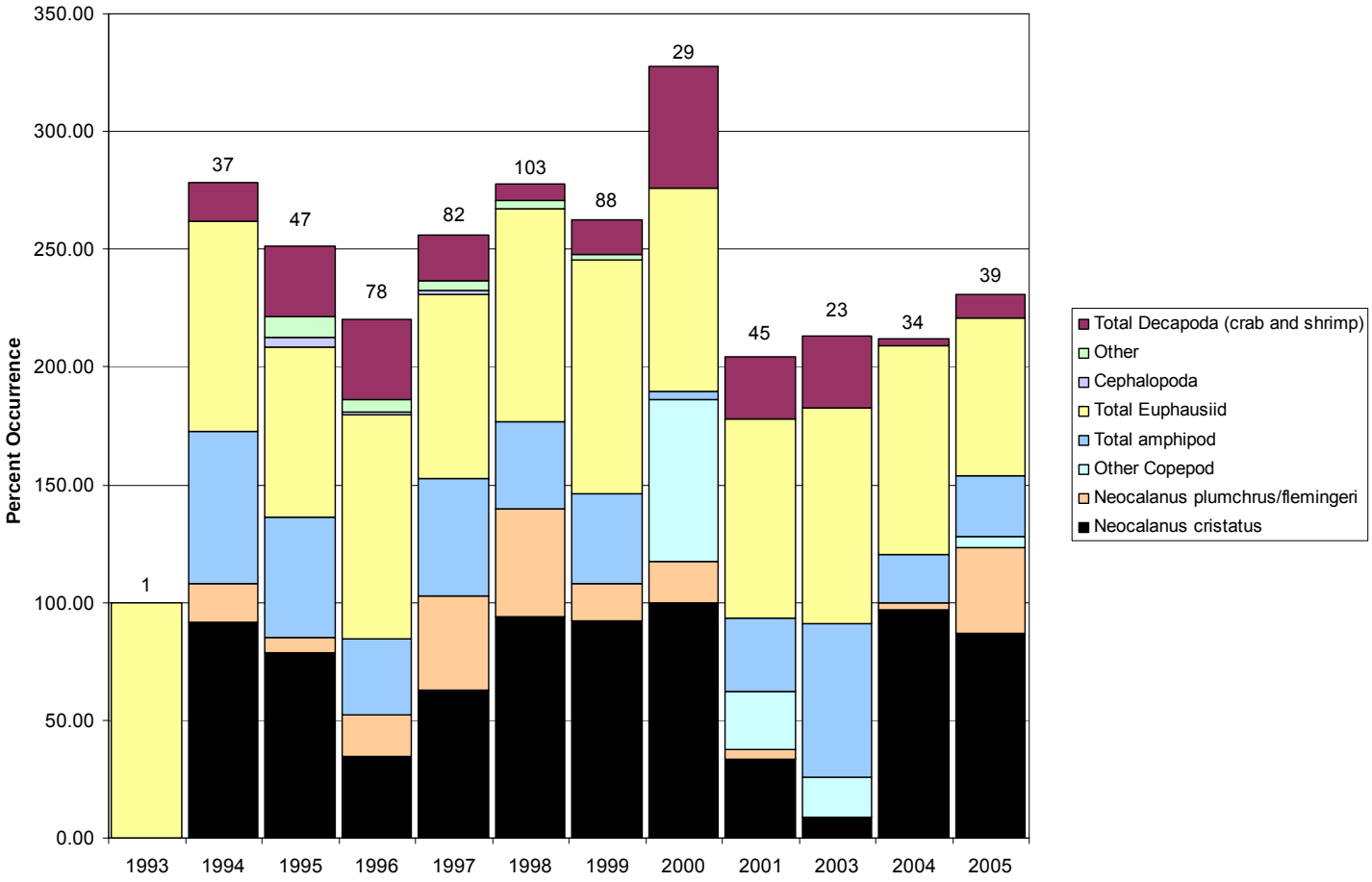

Figure 40. Frequency of prey occurrence in diets of crested auklets at Buldir Island, Alaska.

Table 63. Relative biomass of prey in diets of crested auklets at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species. Biomass data 2000-2005 not presently available.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	1	37	47	78	82	103	88	29	45	--	23	34	39
Total mass (g)	1.2	335.4	487.6	745.0	904.7	1102.9	908.6	--	--	--	--	--	--
Pteropoda	--	--	--	<0.1	--	--	--	--	--	--	--	--	--
Cephalopoda - squid	--	--	0.2	0.1	<0.1	<0.1	--	--	--	--	--	--	--
Copepoda													
Neocalanus plumchrus/flemingeri	--	0.1	0.1	1.0	8.1	1.0	7.5	--	--	--	--	--	--
N. cristatus	--	55.8	41.6	19.3	30.7	49.5	50.2	--	--	--	--	--	--
N. spp.	--	--	--	--	--	--	--	--	--	--	--	--	--
Calanus marshallae	--	--	--	--	--	--	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	--	--	--	--	--	--
Unid. Copepod	--	--	--	--	--	--	--	--	--	--	--	--	--
Amphipoda													
Hyperiidea													
Hyperoche medusarum	--	--	--	<0.1	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	--	5.6	3.7	0.3	1.2	0.3	2.3	--	--	--	--	--	--
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	--	--	--
Primno macropa	--	0.7	--	--	--	--	0.1	--	--	--	--	--	--
Euphausiacea													
Thysanoessa spp.	100.0	35.2	50.9	78.1	59.6	--	--	--	--	--	--	--	--
Unid. Euphausiid	--	--	--	--	--	49.3	46.2	--	--	--	--	--	--
Euphausiid furcilla	--	--	--	--	--	--	<0.1	--	--	--	--	--	--
Decapoda													
Pandalid shrimp	--	--	--	--	--	--	--	--	--	--	--	--	--
Larval shrimp	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrimp zoea	--	2.6	2.5	0.9	0.1	<0.1	--	--	--	--	--	--	--
Crab zoea	--	<0.1	0.7	--	<0.1	<0.1	0.1	--	--	--	--	--	--
Crab megalopa	--	--	--	0.1	0.2	--	--	--	--	--	--	--	--
Paguridae megalopa	--	--	--	--	--	--	<0.1	--	--	--	--	--	--
Hippolytidae juvenile	--	--	--	--	--	--	0.1	--	--	--	--	--	--
Fish	--	0.3	0.2	0.1	--	<0.1	<0.1	--	--	--	--	--	--

Table 64. Frequency of occurrence of prey in diets of crested auklets at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present. Data for 2002 not yet analyzed.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	1	37	47	78	82	103	88	29	45	--	23	34	39
Pteropoda	--	--	--	1.3	--	--	--	--	--	--	--	--	--
Cephalopoda - squid	--	--	4.3	1.3	2.2	1.0	--	--	--	--	--	--	--
Copepoda													
Neocalanus plumchrus/flemingeri	--	16.2	6.4	17.9	39.6	45.6	15.9	17.2	4.4	--	--	2.9	35.9
N. cristatus	--	91.9	78.7	34.6	63.0	94.2	92.0	100.0	33.3	--	8.7	97.1	87.2
N. spp.	--	--	--	--	--	--	--	69.0	--	--	17.4	--	--
Calanus marshallae	--	--	--	--	--	--	--	--	--	--	--	--	5.1
Calanoid spp.	--	--	--	--	--	--	--	--	24.4	--	--	--	--
Unid. Copepod	--	--	--	--	--	--	--	69.0	24.4	--	17.4	--	5.1
Amphipoda													
Hyperiidea													
Hyperoche medusarum	--	--	--	2.6	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	--	43.2	51.1	32.1	50.3	36.9	37.5	3.4	15.6	--	--	20.6	2.6
Parathemisto spp.	--	--	--	--	--	--	--	--	15.6	--	65.2	--	23.1
Primno macropa	--	21.6	--	--	--	--	1.1	--	--	--	--	--	--
Euphausiacea													
Thysanoessa spp.	100.0	89.2	72.3	94.9	77.6	--	--	17.2	28.9	--	65.2	14.7	10.3
Unid. Euphausiid	--	--	--	--	--	90.3	97.7	69.0	55.6	--	26.1	73.5	56.4
Euphausiid furcilla	--	--	--	--	--	--	1.1	--	--	--	--	--	--
Decapoda													
Pandalid shrimp	--	--	--	--	--	--	--	--	--	--	--	--	10.2
Larval shrimp	--	--	--	--	--	--	--	--	24.4	--	--	--	--
Shrimp zoea	--	13.5	25.5	25.6	6.9	5.8	--	51.7	2.2	--	30.4	2.9	--
Crab zoea	--	2.7	4.3	--	3.4	1.0	5.7	--	--	--	--	--	--
Crab megalopa	--	--	--	9.0	9.1	--	--	--	--	--	--	--	--
Paguridae megalopa	--	--	--	--	--	--	1.1	--	--	--	--	--	--
Hippolytidae juvenile	--	--	--	--	--	--	8.0	--	--	--	--	--	--
Fish	--	8.5	3.8	4.2	--	3.9	2.3	--	--	--	--	--	--
(Nematodes - probably not prey)	--	--	--	--	28.3	--	--	--	--	--	--	--	--

Table 65. Breeding chronology dates for whiskered auklets at Buldir Island, Alaska.

Year	mean hatch	SD	n[b]	median hatch	mean fledge	SD	n[c]	median fledge	no. nests monitored[d]	first hatch	last hatch	first fledge	last fledge
1976[a]	30 Jun	4.6	6	27 Jun	--	--	--	--	7	27 Jun	6 Jul	--	--
1990	24 Jun	5.4	5	20 Jun	--	--	5	28 Jul	9	10 Jun	30 Jun	18 Jul	27 Jul
1991	27 Jun	3.6	9	26 Jun	3 Aug	4.2	23	4 Aug	46	18 Jun	8 Jul	24 Jul	8 Aug
1992	18 Jun	10.7	10	14 Jun	--	--	33	26 Jul	58	10 Jun	5 Jul	13 Jul	5 Aug
1993	22 Jun	8.2	13	19 Jun	--	--	31	27 Jul	54	13 Jun	9 Jul	15 Jul	12 Aug
1994	19 Jun	7.6	37	17 Jun	--	--	44	23 Jul	57	9 Jun	8 Jul	15 Jul	14 Aug
1995	25 Jun	6.3	50	21 Jun	--	--	45	30 Jul	68	15 Jun	25 Jul	21 Jul	16 Aug
1996	22 Jun	9.8	27	19 Jun	--	--	40	26 Jul	57	10 Jun	20 Jul	20 Jul	14 Aug
1997	24 Jun	7.9	33	21 Jun	30 Jul	5.9	59	29 Jul	90	11 Jun	18 Jul	24 Jul	14 Aug
1998	23 Jun	9.8	61	19 Jun	31 Jul	9.3	41	29 Jul	78	9 Jun	11 Jul	19 Jul	27 Aug
1999	--	not monitored			--	--	--	--	--	--	22 Jul	22 Jul	13 Aug
2000	16 Jun	5.2	27	18 Jun	25 Jul	6.3	32	27 Jul	70	6 Jun	13 Jul	17 Jul	13 Aug
2001	22 Jun	6.2	36	20 Jun	28 Jul	4.2	26	29 Jul	75	9 Jun	15 Jul	15 Jul	2 Aug
2002	24 Jun	8.5	36	21 Jun	29 Jul	5.4	48	27 Jul	100	15 Jun	15 Jul	21 Jul	14 Aug
2003	25 Jun	2.9	4	25 Jun	30 Jul	7.1	25	1 Aug	44	9 Jun	4 Jul	15 Jul	12 Aug
2004	21 Jun	4.7	28	21 Jun	28 Jul	3.7	17	30 Jul	66	16 Jun	12 Jul	22 Jul	4 Aug
2005	18 Jun	6.0	29	16 Jun	26 Jul	6.2	53	21 Jul	70	9 Jun	5 Jul	16 Jul	12 Aug
2006	27 Jun	4.7	20	27 Jun	5 Aug	5.4	42	6 Aug	97	19 Jun	5 Jul	25 Jul	26 Aug

[a] Hatch dates in 1976 were assumed to be the midpoint of the interval reported in Knudtson and Byrd (1982).
[b] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations $\leq$ 7 days apart from Egg to Chick in all years except 1990: $\leq$ 10 days Egg to Chick.
[c] Sample size is for the calculation of mean and median fledge dates.
[d] The total used for estimating the remaining parameters. These dates might contain observations > 7, but less than 10 days apart or estimated event dates (e.g. “bird Incubating” on first visit followed by “chick” on the next visit).

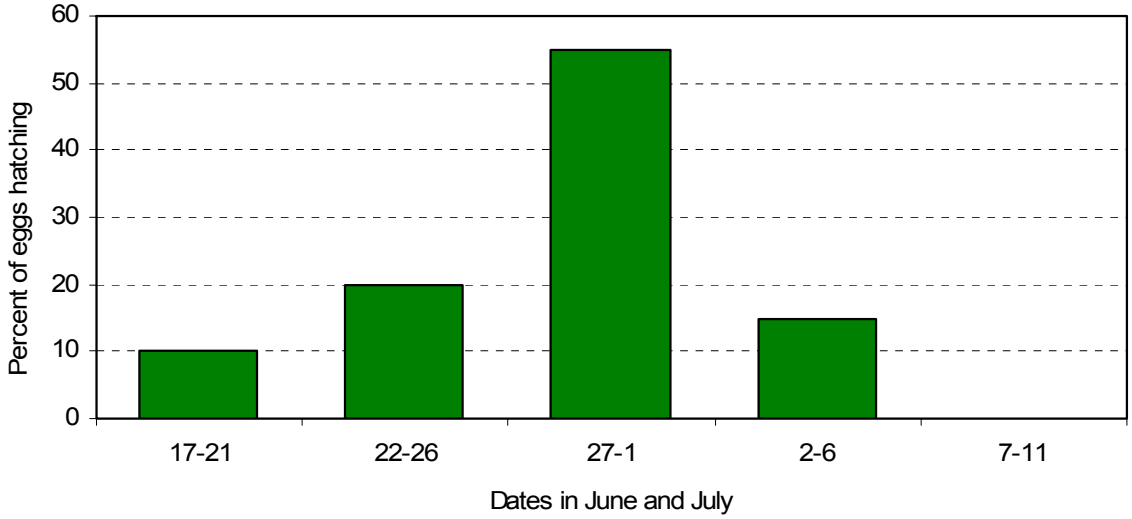

Figure 41. Hatching chronology of whiskered auklets at Buldir Island, Alaska in 2006 (n=20).

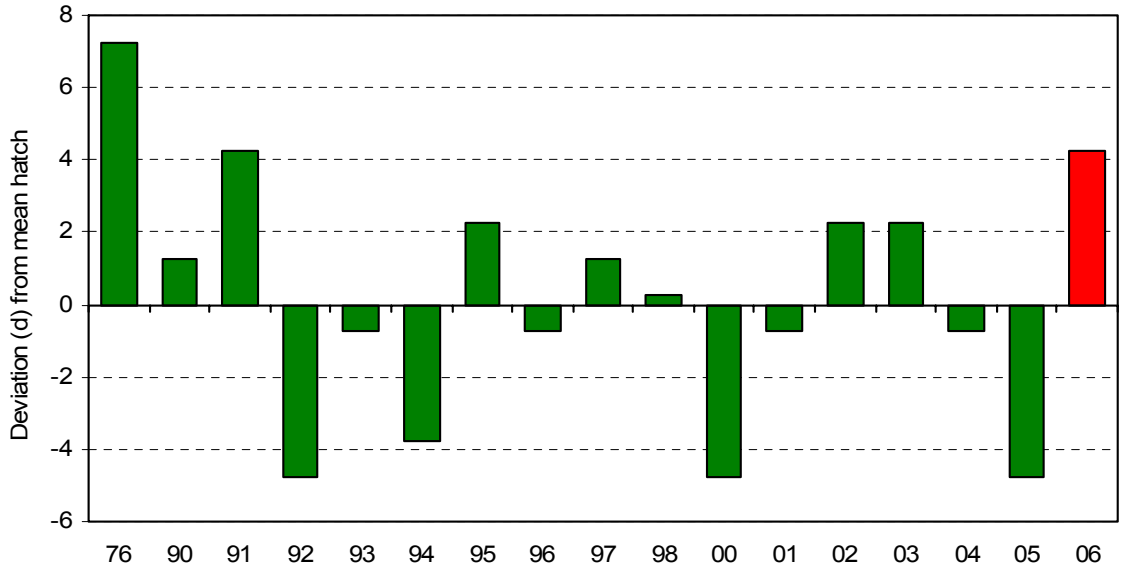

Figure 42. Yearly hatch date deviation (from the 1976-2005 average of 23 June) of whiskered auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

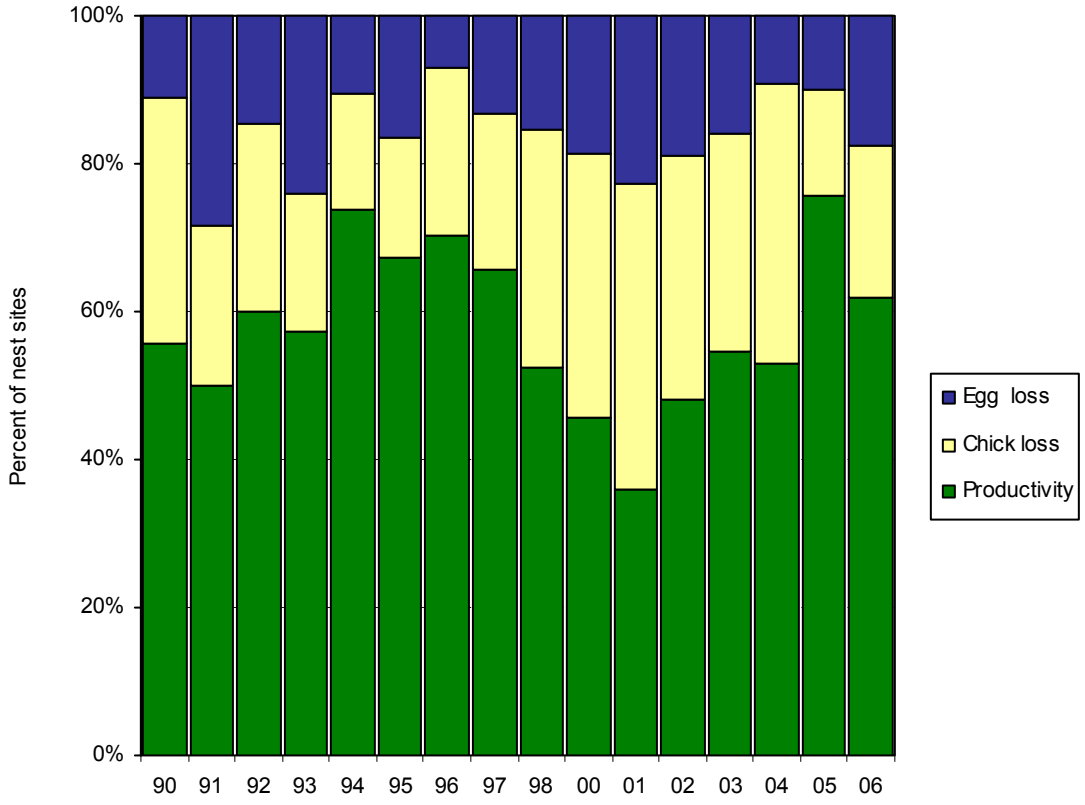

Figure 43. Reproductive performance of whiskered auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick.

Table 66. Reproductive performance of whiskered auklets at Buldir Island, Alaska.

Parameter[a]	1976	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. eggs found (A)	7	7	16	9	46	55	54	57	67	57	90	78	-	70	75	100	44	66	70	68
No. eggs lost to:																				
disappearance	-	0	1	1	5	5	8	4	2	1	8	9	-	4	5	6	3	3	3	2
abandonment	-	0	2	0	4	3	4b	2	9	3	3	2	-	9	12	10	4	2	2	8
breakage	-	0	2	0	4	0	1	0	0	0	1	1	-	0	0	3	0	1	2	2
No. eggs hatched (B)	6	7	11	8	33	47	41	51	56	53	78	66	-	57	58	81	37	60	63	56
No. chicks lost to:																				
disappearance	-	-	-	2	7	9	6	6	10	6	17	20	-	20	5	21	9	12	7	4
death	-	-	-	1	3	5	4	3	1	7	2	5	-	5	26	12	4	13	3	0
No. chicks fledged (C)	-	-	-	5	23	33	31	42	45	40	59	41	-	32	27	48	24	35	53	42
Hatching success (B/A)	0.86	1.00	0.69	0.89	0.72	0.85	0.76	0.89	0.84	0.93	0.87	0.85	-	0.81	0.77	0.81	0.84	0.91	0.90	0.82
Fledging success (C/B)[b]	-	-	-	0.63	0.70	0.70	0.76	0.82	0.80	0.75	0.76	0.62	-	0.56	0.47	0.59	0.65	0.58	0.84	0.75
Reproductive success (C/A)	-	-	-	0.56	0.50	0.60	0.57	0.74	0.67	0.70	0.66	0.53	-	0.46	0.36	0.48	0.55	0.53	0.76	0.62
Productivity (hs x fs)	-	-	-	0.56	0.50	0.60	0.58	0.73	0.67	0.70	0.66	0.53	-	0.46	0.36	0.48	0.55	0.53	0.76	0.62

[a] Data are from nest sites for which visit intervals at hatching and fledging were $\leq$ 12 days.
[b] For chicks to be considered fledged, they had to have attained the age of 32 days before disappearing or 29 days at time of last visit, if chicks were still present.

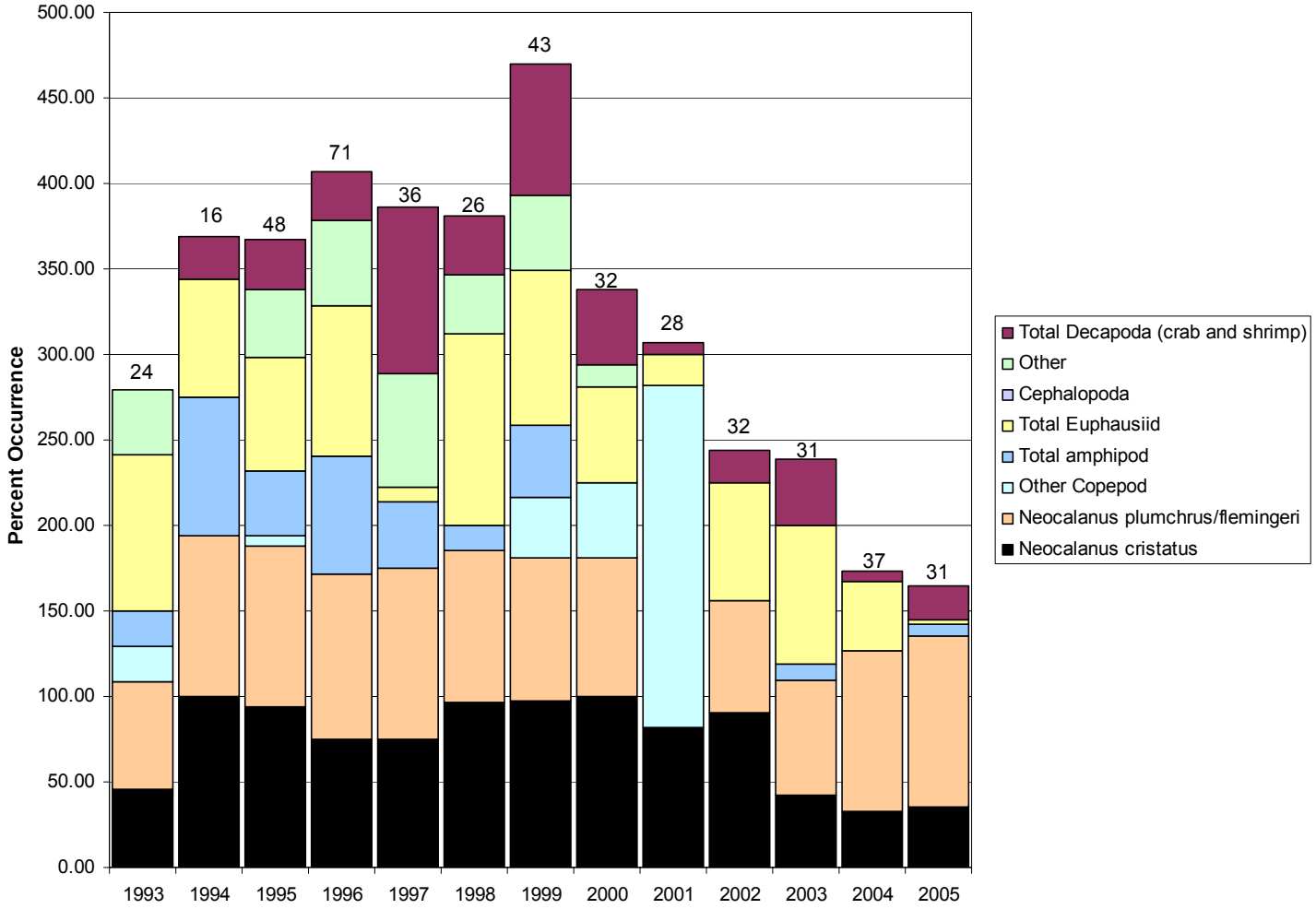

Figure 44. Frequency of prey occurrence in diets of whiskered auklets at Buldir Island, Alaska.

Table 67. Relative biomass of prey in diets of whiskered auklets at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species. Biomass data 2000-2005 not presently available.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. samples	24	16	48	71	36	26	43	32	28	32	31	37	31
Total mass (g)	53.4	93.9	387.5	481.3	300.2	214.1	434.1	--	--	--	--	--	--
Gastropoda													
Unid. snail	--	0.2	--	--	--	--	--	--	--	--	--	--	--
Pteropoda (*Limacina helicina)*	1.5	--	0.7	0.3	2.1	0.2	0.2	--	--	--	--	--	--
Copepoda													
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	--	--	--	--	--	--
Calanus pacifica	--	--	0.1	--	--	--	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	--	--	--	--	--	--
Pachyptilus pacificus	--	--	--	--	--	--	1.0	--	--	--	--	--	--
Pareuchta birostrata	--	--	--	--	--	--	0.7	--	--	--	--	--	--
Pareuchaeta elongata	--	--	--	--	--	--	--	--	--	--	--	--	--
Lophotrix frontalis	--	--	--	--	--	--	<0.1	--	--	--	--	--	--
Unid. Copepoda	13.8	--	0.9	--	--	--	--	--	--	--	--	--	--
Amphipoda (unidentified)	--	--	--	--	--	--	--	--	--	--	--	--	--
Hyperiidea													
Hyperoche medusarum	--	--	1.7	0.5	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	3.9	0.5	0.1	<0.1	<0.1	--	--	--	--	--	--	--	--
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	--	--	--
Primno macropa	0.3	7.9	--	--	1.3	0.7	2.1	--	--	--	--	--	--
Gammaridea													
Talitridae	--	--	--	0.1	--	--	--	--	--	--	--	--	--
Euphausiacea													
Thysanoessa spp.	19.5	42.5	18.5	23.6	0.6	--	--	--	--	--	--	--	--
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--	--	--
Unid. Euphausiid	--	--	--	--	--	8.4	7.9	--	--	--	--	--	--
Euphausiid furcilla	--	--	--	--	--	0.2	--	--	--	--	--	--	--
Decapoda													
Pandalid shrimp	--	--	--	--	--	--	--	--	--	--	--	--	--
Larval shrimp	--	--	--	--	--	--	--	--	--	--	--	--	--
Unid. Shrimp	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrimp zoea	--	3.6	3.6	0.1	1.5	0.1	0.6	--	--	--	--	--	--
Crab zoea	--	--	--	<0.1	0.6	--	--	--	--	--	--	--	--
Crab megalopa	--	--	--	0.1	1.6	--	--	--	--	--	--	--	--
Hippolytidae juvenile	--	--	--	--	--	--	0.3	--	--	--	--	--	--
Fish - *Hexagrammos* spp.	20.6	--	--	--	--	--	0.2	--	--	--	--	--	--

Table 68. Frequency of occurrence of prey in diets of whiskered auklets at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Number	24	16	48	71	36	26	43	32	28	32	31	37	31
Scyphozoa	--	--	--	1.4	--	--	--	--	--	--	--	--	--
Gastropoda													
Unid. snail	--	25.0	--	--	--	--	--	--	--	--	--	--	--
Pteropoda (*Limacina helicina)*	4.2	--	39.6	50.7	66.7	34.6	44.2	12.5	--	--	--	--	--
Copepoda													
Neocalanus cristatus	45.8	100.0	93.8	74.6	75.0	96.2	97.7	100.0	82.1	90.6	41.9	32.4	35.5
N. plumchrus/flemingeri	62.5	93.8	93.8	97.2	100.0	88.5	83.7	81.3	--	65.6	67.7	94.6	100.0
Calanus pacifica	--	--	4.2	--	--	--	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	43.8	100.0	--	--	--	--
Pachyptilus pacifica	--	--	--	--	--	--	14.0	--	--	--	--	--	--
Pareuchta birostrata	--	--	--	--	--	--	18.6	--	--	--	--	--	--
Pareuchaeta elongata	--	--	--	--	--	--	--	--	7.1	9.4	--	--	--
Lophotrix frontinalis	--	--	--	--	--	--	2.3	--	--	--	--	--	--
Unid. Copepoda	20.8	--	2.1	--	--	--	--	--	92.9	--	--	--	--
Amphipoda (unidentified)	--	--	--	--	--	--	--	--	--	--	6.5	--	--
Hyperiidea													
Hyperoche medusarum	--	--	31.3	62.0	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	16.7	12.5	6.3	2.8	2.8	--	--	--	--	--	--	--	--
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	--	--	6.5
Primno macropa	4.2	68.8	--	--	36.1	15.4	41.9	--	--	--	--	--	--
Gammaridea													
Talitridae	--	--	--	4.2	--	--	--	--	--	--	--	--	--
Lysianassidae	--	--	--	--	--	--	--	--	--	--	3.2	--	--
Euphausiacea													
Thysanoessa spp.	91.7	68.8	66.7	87.3	8.3	--	--	--	--	12.5	22.6	8.1	--
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--	--	3.2
Unid. Euphausiid	--	--	--	--	--	92.3	90.7	56.3	17.9	56.2	58.1	32.4	25.8
Euphausiid furcilla	--	--	--	--	--	19.2	--	--	--	--	--	--	--
Decapoda													
Pandalid shrimp	--	--	--	--	--	--	--	43.8	--	6.3	35.5	2.7	--
Larval shrimp	--	--	--	--	--	--	--	--	7.1	9.4	3.2	--	6.5
Unid. Shrimp	--	--	--	--	--	--	--	--	--	3.1	--	--	--
Shrimp zoea	--	25.0	29.2	12.7	58.3	34.6	60.5	--	--	--	--	--	--
Crab zoea	--	--	--	9.9	16.7	--	--	--	--	--	--	2.7	6.5
Crab megalopa	--	--	--	5.6	22.2	--	--	--	--	--	--	--	6.5
Hippolytidae juvenile	--	--	--	--	--	--	16.3	--	--	--	--	--	--
Fish													
Hexagrammos spp.	4.2	--	--	--	--	--	--	--	--	--	--	--	--
Unid. fish	--	--	6.3	--	--	--	2.3	--	--	--	--	--	--
(Plastic - not prey)	4.2	--	--	--	--	--	--	--	--	--	--	--	--

Table 69. Breeding chronology dates for parakeet auklets at Buldir Island, Alaska.

Year	mean hatch	SD	n[a]	median hatch	mean fledge	SD	n[b]	median fledge	no. nests monitored[c]	first hatch	last hatch	first fledge	last fledge
1991	5 Jul	5.5	14	5 Jul	--	--	27	9 Aug	53	30 Jun	9 Jul	3 Aug	>14 Aug
1992	5 Jul	6.8	8	4 Jul	--	--	28	4 Aug	43	25 Jun	15 Jul	27 Jul	>12 Aug
1993	4 Jul	7.9	12	1 Jul	--	--	17	4 Aug	35	19 Jun	15 Jul	27 Jul	10 Aug
1994	1 Jul	5.7	37	1 Jul	--	--	33	5 Aug	65	20 Jun	15 Jul	23 Jul	22 Aug
1995	5 Jul	6.1	37	3 Jul	--	--	49	6 Aug	70	21 Jun	17 Jul	30 Jul	>17 Aug
1996	3 Jul	5.0	31	4 Jul	--	--	38	11 Aug	64	16 Jun	20 Jul	26 Jul	14 Aug
1997	3 Jul	5.1	22	1 Jul	7 Aug	5.7	30	6 Aug	62	26 Jun	13 Jul	27 Jul	16 Aug
1998	14 Jul	6.3	34	14 Jul	--	--	43	16 Aug	71	29 Jun	31 Jul	10 Aug	>27 Aug
1999	--	--	--	--	--	--	--	not monitored	--	--	--	--	--
2000	28 Jun	6.6	22	27 Jun	1 Aug	4.7	29	2 Aug	65	12 Jun	14 Jul	23 Jul	13 Aug
2001	27 Jun	2.7	9	29 Jun	none	--	--	n/a	40	22 Jun	29 Jun	n/a	n/a
2002	5 Jul	4.9	19	5 Jul	1 Aug	8.6	7	2 Aug	55	27 Jun	22 Jul	29 Jul	12 Aug
2003	6 Jul	7.0	6	4 Jul	8 Aug	7.7	15	6 Aug	34	19 Jun	19 Jul	25 Jul	18 Aug
2004	3 Jul	5.4	12	4 Jul	8 Aug	3.4	4	9 Aug	37	24 Jun	14 Jul	4 Aug	11 Aug
2005	5 Jul	11.6	10	4 Jul	4 Aug	4.5	17	4 Aug	36	15 Jun	27 Jul	25 Jul	16 Aug
2006	9 Jul	5.4	13	8 Jul	13 Aug	4.4	34	11 Aug	59	1 Jul	21 Jul	4 Aug	26 Aug

[a] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations ≤ 7 days apart from Egg to Chick in all years except 1991: ≤ 9 days egg to Chick, and 1993: ≤ 9 days "egg" to "chick" or "bird incubating" to "chick".
[b] Sample size is for the calculation of mean and median fledge dates.
[c] The total used for estimating the remaining parameters. These dates might contain observations > 7, but < 10 days apart or estimated event dates (e.g. "bird incubating" on first visit followed by "chick" on the next visit).

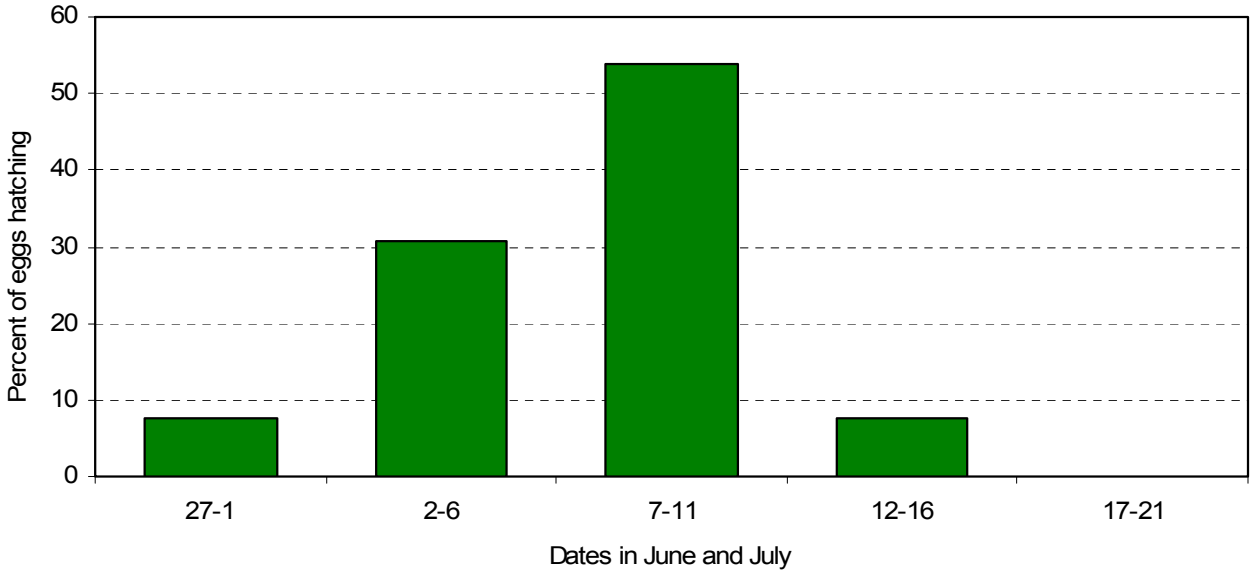

Figure 45. Hatching chronology of parakeet auklets at Buldir Island, Alaska in 2006 (n=13).

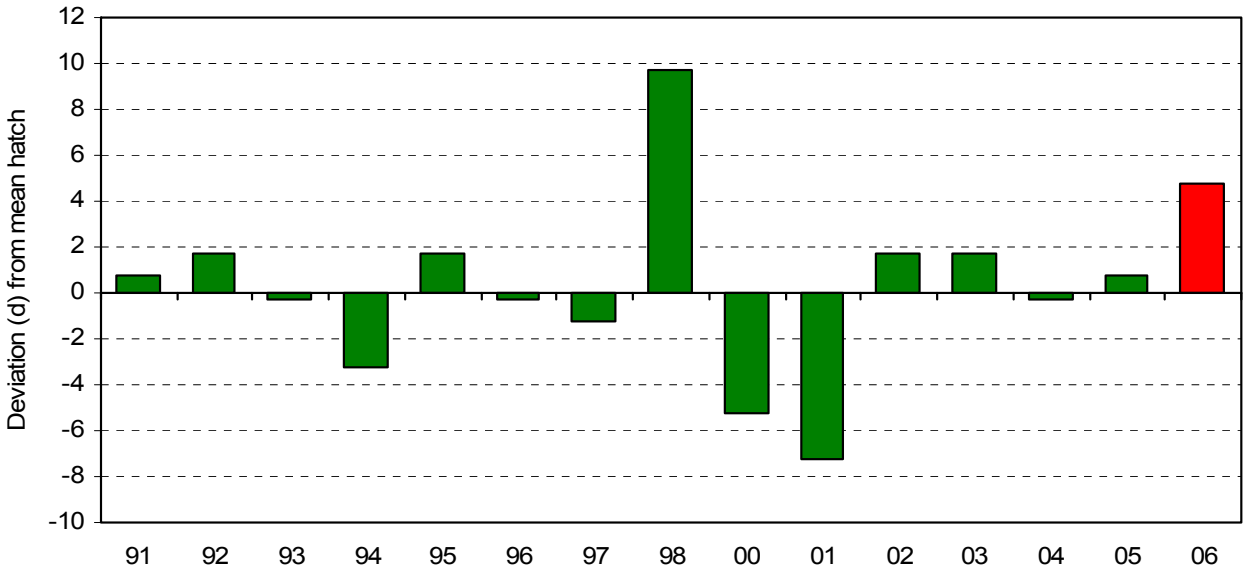

Figure 46. Yearly hatch date deviation (from the 1991-2005 average of 4 July) of parakeet auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

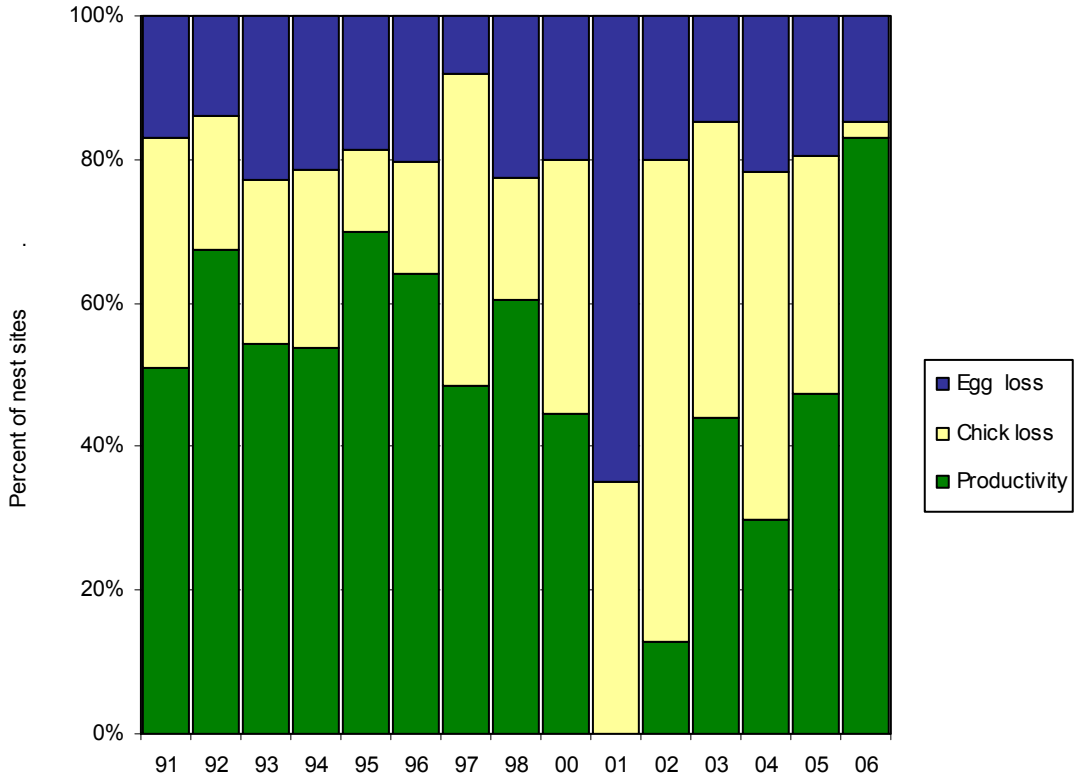

Figure 47. Reproductive performance of parakeet auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick.

Table 70. Reproductive performance of parakeet auklets at Buldir Island, Alaska.

Parameter[a]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. eggs found (A)	53	43	35	65	70	64	62	71	0	65	40	55	34	37	36	41
No. eggs lost to:																
disappearance	2	3	4	6	5	9	1	11	-	10	8	6	0	3	2	1
abandonment	3	3	3	6	6	3[b]	2	5	-	3	18	5	5	3	5	4
breakage	4	0	1	2	2	1	2	0	-	0	0	0	0	2	0	0
No. eggs hatched (B)	44	37	27	51	57	51	57	55	-	52	14	44	29	29	29	35
No. chicks lost to:																
disappearance	8	6	7	12	8	2	9	0	-	22	3	6	10	6	5	0
death	9	2	1	4	0	8	18	12	-	1	11	27	4	12	7	1
No. chicks fledged (C)	27	29	19	35	49	41	30	43	-	29	0	7	15	11	17	34
Hatching success (B/A)	0.83	0.86	0.77	0.78	0.81	0.80	0.92	0.77	-	0.80	0.35	0.80	0.85	0.78	0.81	0.85
Fledging success (C/B)[c]	0.61	0.78	0.70	0.69	0.86	0.80	0.53	0.78	-	0.56	0.00	0.16	0.52	0.38	0.59	0.97
Reproductive success (C/A)	0.51	0.67	0.54	0.54	0.70	0.64	0.48	0.61	-	0.45	0.00	0.13	0.44	0.30	0.47	0.83
Productivity (hs x fs)	0.51	0.67	0.54	0.54	0.70	0.64	0.49	0.60	-	0.45	0.00	0.13	0.44	0.30	0.48	0.80

[a] Data are from nest sites for which visit intervals at hatching and fledging were $\leq$ 12 days.
[b] Two of these nest sites were taken over by horned puffins.
[c] For chicks to be considered fledged, they had to have attained 30 days of age before disappearing or 26 days at the time of the last visit, if chicks were still present.

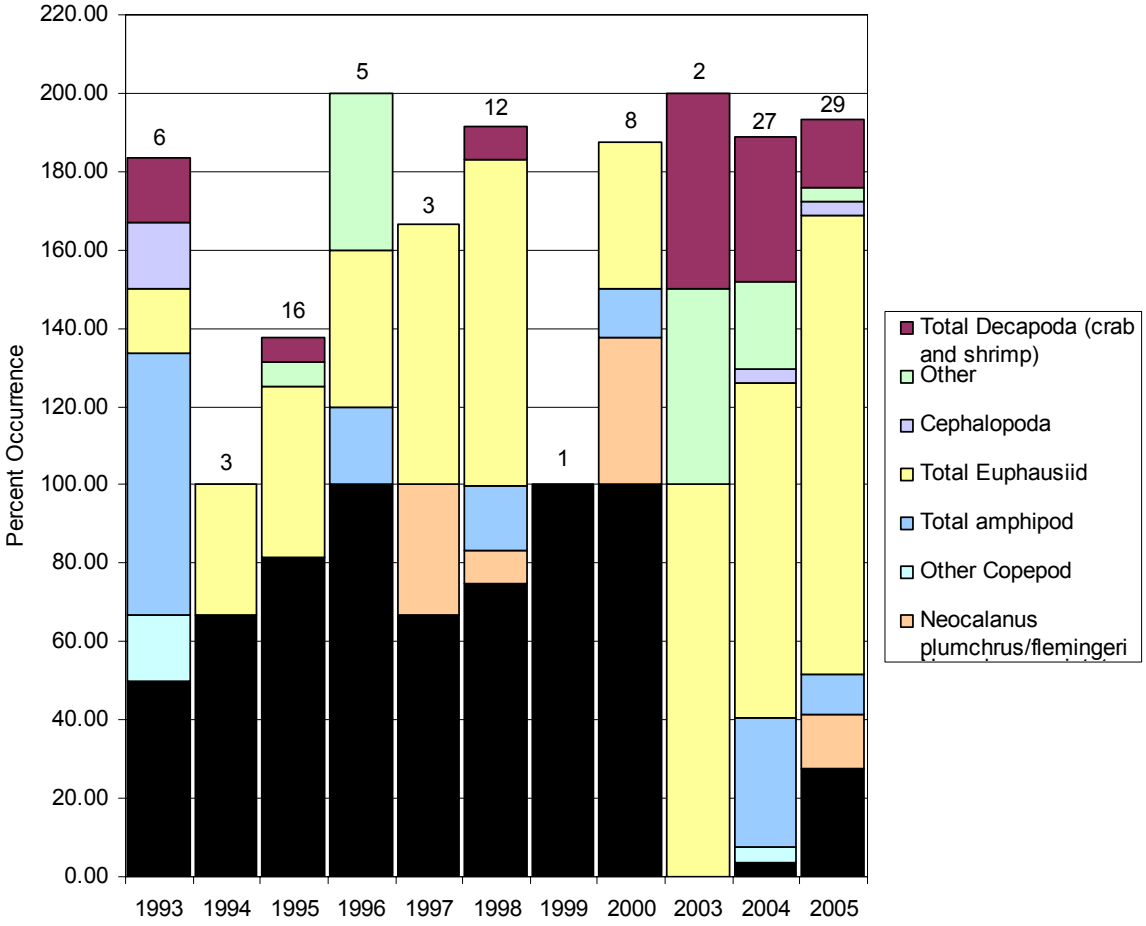

Figure 48. Frequency of prey occurrence in diets of parakeet auklets at Buldir Island, Alaska.

Table 71. Relative biomass of prey in diets of parakeet auklets at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species. Biomass data 2000-2005 not presently available.

	1993	1994	1995	1996	1997	1998	1999	2000	2003	2004	2005
No. samples	6	3	16	5	3	12	1	8	2	27	29
Total mass (g)	14.2	8.6	174.3	24.6	36.8	91.1	0.7	--	--	--	--
Pteropoda	--	--	<0.1	1.3	--	--	--	--	--	--	--
Periostracum	--	--	--	--	--	--	--	--	--	--	--
Cephalopoda - squid	28.2	--	--	--	--	--	--	--	--	--	--
Gonatidae	--	--	--	--	--	--	--	--	--	--	--
Worm	--	--	--	--	--	--	--	--	--	--	--
Copepoda											
Neocalanus cristatus	30.3	62.8	57.4	89.2	49.6	43.0	100.0	--	--	--	--
N. plumchrus/flemingeri	--	--	--	--	1.1	<0.1	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	--	--	--	--
Unid. Copepoda	6.2	--	--	--	--	--	--	--	--	--	--
Amphipoda											
Hyperiidea											
Parathemisto pacifica	32.8	--	--	<0.1	--	--	--	--	--	--	--
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	--
Primno macropa	1.1	--	--	--	--	--	--	--	--	--	--
Hyperoche medusarum	--	--	--	--	--	0.1	--	--	--	--	--
Gammaridea											
Lysianassidae	--	--	--	--	--	0.1	--	--	--	--	--
Euphausiacea											
Thysanoessa spp.	0.1	37.2	42.5	9.5	49.2	--	--	--	--	--	--
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--
Unid. Euphausiid	--	--	--	--	--	47.8	--	--	--	--	--
Decapoda											
Pandalid shrimp	--	--	--	--	--	--	--	--	--	--	--
Larval shrimp	--	--	--	--	--	--	--	--	--	--	--
Crab zoea	--	--	0.1	--	--	--	--	--	--	--	--
Oregoninae	1.4	--	--	--	--	--	--	--	--	--	--
Atelecyclidae megalopa	--	--	--	--	--	<0.1	--	--	--	--	--
Unid mollusk	--	--	--	--	--	--	--	--	--	--	--
Insect	--	--	--	--	--	--	--	--	--	--	--

Table 72. Frequency of occurrence of prey in diets of parakeet auklets at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1993	1994	1995	1996	1997	1998	1999	2000	2003	2004	2005
No. samples	6	3	16	5	3	12	1	8	2	27	29
Pteropoda	--	--	6.3	40.0	--	--	--	--	--	--	--
Periostracum	--	--	--	--	--	--	--	--	--	14.8	--
Cephalopoda - squid	16.7	--	--	--	--	--	--	--	--	3.7	--
Gonatidae	--	--	--	--	--	--	--	--	--	--	3.5
Worm	--	--	--	--	--	--	--	--	--	--	3.5
Copepoda											
Neocalanus cristatus	50.0	66.7	81.3	100.0	66.7	75.0	100.0	100.0	--	3.7	27.6
N. plumchrus/flemingeri	--	--	--	--	33.3	8.3	--	37.5	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	--	--	3.7	13.8
Unid. Copepoda	16.7	--	--	--	--	--	--	--	--	3.7	--
Amphipoda											
Hyperiidea											
Parathemisto pacifica	50.0	--	--	20.0	--	--	--	12.5	--	33.3	--
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	10.3
Primno macropa	16.7	--	--	--	--	--	--	--	--	--	--
Hyperoche medusarum	--	--	--	--	--	8.3	--	--	--	--	--
Gammaridea											
Lysianassidae	--	--	--	--	--	8.3	--	--	--	--	--
Euphausiacea											
Thysanoessa spp.	16.7	33.3	43.8	40.0	66.7	--	--	--	50.0	18.5	31.0
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	6.9
Unid. Euphausiid	--	--	--	--	--	83.3	--	37.5	50.0	66.7	79.3
Decapoda											
Pandalid shrimp	--	--	--	--	--	--	--	--	50.0	--	--
Larval shrimp	--	--	--	--	--	--	--	--	--	3.7	10.3
Crab zoea	--	--	6.3	--	--	--	--	--	--	3.7	3.5
Crab megalopa	--	--	--	--	--	--	--	--	--	--	3.5
Oregoninae	16.7	--	--	--	--	--	--	--	--	--	--
Atelecyclidae megalopa	--	--	--	--	--	8.3	--	--	--	29.6	--
Unid mollusk	--	--	--	--	--	--	--	--	50.0	--	--
Insect	--	--	--	--	--	--	--	--	--	7.4	--

Table 73. Breeding chronology dates for tufted puffins at Buldir Island, Alaska.

Year	mean hatch	SD	n[a]	median hatch	no. nests monitored[b]	first hatch	last hatch	first fledge
1988	19 Jul	3.9	8	18 Jul	17	14 Jul	24 Jul	30 Aug
1990	11 Jul	9.2	15	11 Jul	29	2 Jul	2 Aug	12 Aug
1991	23 Jul	5.9	26	21 Jul	32	12 Jul	6 Aug	>14 Aug[c]
1992	8 Jul	7.2	35	8 Jul	37	26 Jun	26 Jul	>10 Aug
1993	15 Jul	4.0	33	15 Jul	39	8 Jul	23 Jul	24 Aug
1994	10 Jul	6.3	13	9 Jul	24	2 Jul	25 Jul	18 Aug
1995	19 Jul	5.7	33	15 Jul	42	15 Jul	2 Aug	>18 Aug
1996	7 Jul	5.8	7	5 Jul	40	4 Jul	20 Jul	14 Aug
1997	16 Jul	4.8	27	15 Jul	29	9 Jul	24 Jul	>17 Aug
1998	8 Jul	8.9	21	9 Jul	52	25 Jun	23 Jul	>26 Aug
1999	25 Jul	6.7	10	23 Jul	24	13 Jul	4 Aug	24 Aug
2000	4 Jul	7.9	12	2 Jul	30	26 Jun	27 Jul	19 Aug
2001	20 Jul	0.0	1	20 Jul	30	5 Jul	25 Jul	14 Aug
2002	10 Jul	9.9	12	10 Jul	35	25 Jul	4 Aug	6 Aug
2003	23 Jul	6.9	3	27 Jul	13	10 Jul	27 Jul	18 Aug
2004	8 Jul	6.4	11	11 Jul	30	20 Jun	17 Jul	10 Aug
2005	25 Jul	4.6	5	25 Jul	11	21 Jul	1 Aug	>24 Aug
2006	6 Jul	5.1	7	4 Jul	38	1 Jul	11 Jul	22 Aug

[a] Sample size for calculation of mean and median hatch date estimates only.
[b] The total used for estimating the remaining parameters.
[c] No chicks had fledged (disappeared after reaching min. fledge age) by the time of the last visit in years with a “>” symbol.

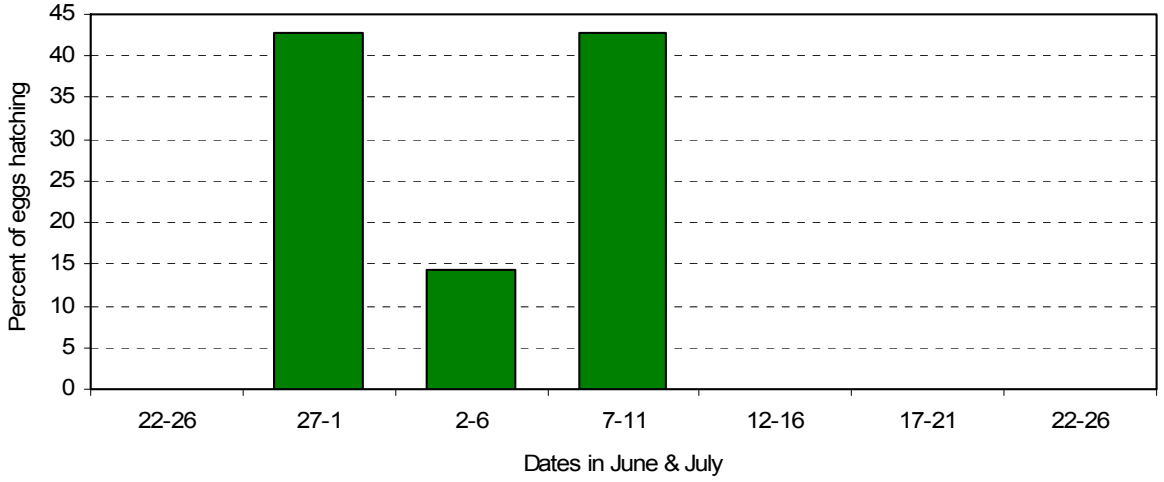

Figure 49. Hatching chronology of tufted puffins at Buldir Island, Alaska in 2006 (n=7).

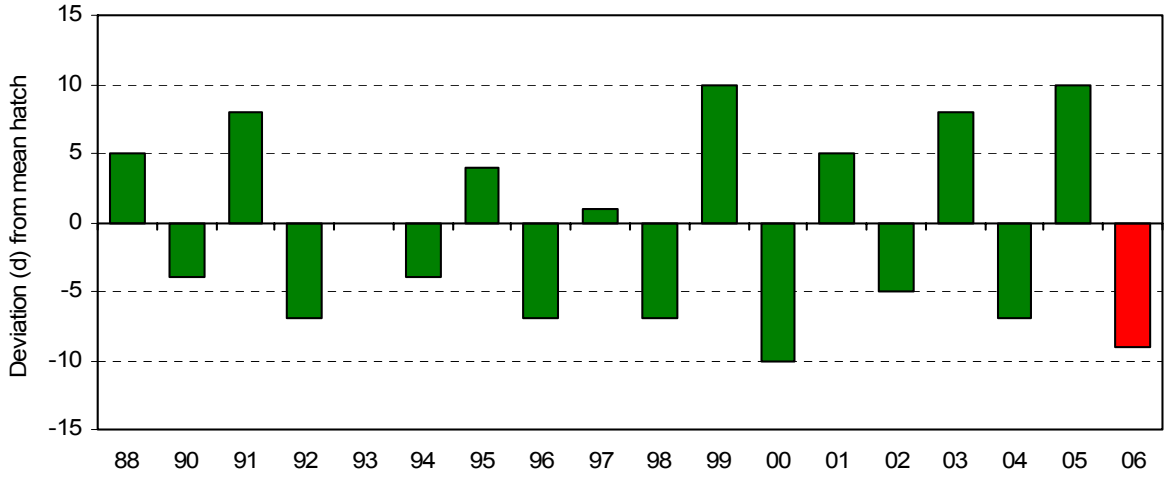

Figure 50. Yearly hatch date deviation (from the 1988-2005 average of 15 July) of tufted puffins at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

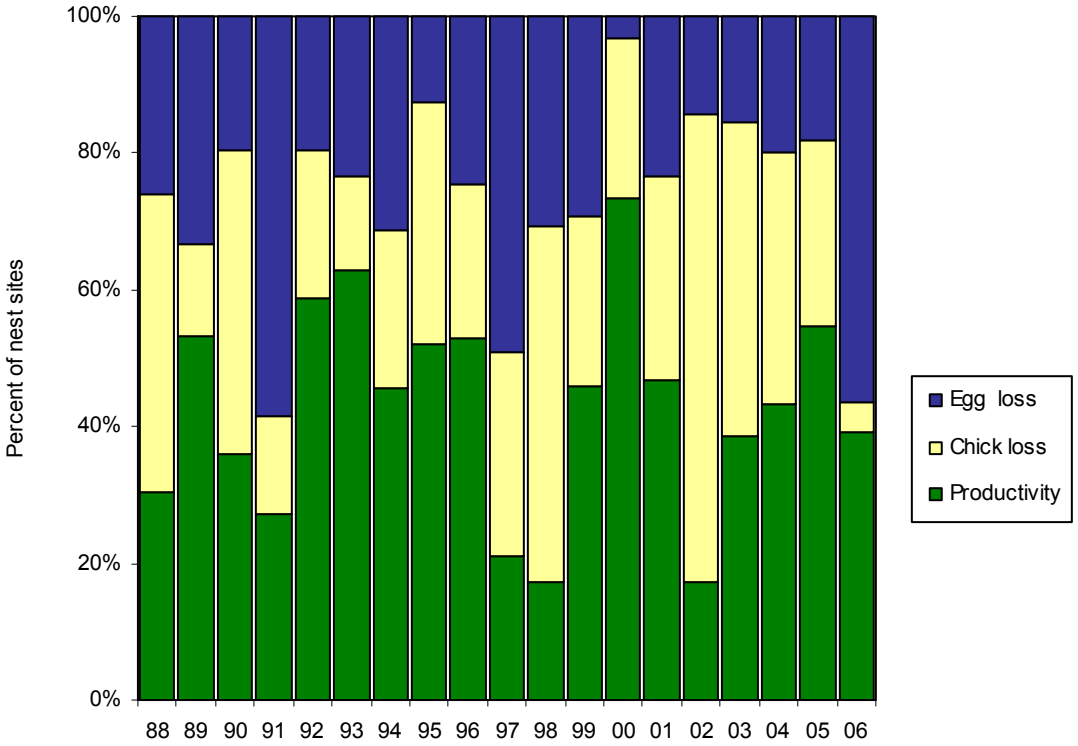

Figure 51. Reproductive performance of tufted puffins at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick.

Table 74. Reproductive performance of tufted puffins at Buldir Island, Alaska.

Parameter[a]	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. eggs found[b] (A)	23	30	36	77	46	51	35	48	53	57	52	24	30	30	35	13	30	11	23
No. eggs lost to:																			
disappearance	2	5	5	23	4	11	7	2	6	18	10	2	0	3	4	2	5	1	1
abandonment	3	4	2	18	5	1	3	0	1	2	6	5	1	4	0	0	1	1	4
breakage	1	1	0	4	0	0	1	4	6	8	0	0	0	0	1	0	0	0	8
No. eggs hatched (B)	17	20	29	32	37	39	24	42	40	29	36	17	29	23	30	11	24	9	10
No. chicks lost to:																			
disappearance	2	0	14	9	7	6	6	13	6	11	15	6	7	6	14	4	6	3	0
death	8	4	2	2	3	1	2	4	6	6	12	2	0	3	10	2	5	0	1
No. "successful" chicks (C_{1+2})	7	16	13	21	27	32	16	25	28	12	9	11	22	14	6	5	13	6	9
fledged[c] (C_1)	6	6	7	2	9	30	15	8	25	8	0	1	2	2	2	3	2	0	3
still present (C_2)	1	10	6	19	18	2	1	17	3	4	9	10	20	12	4	2	11	6	6
Hatching success (B/A)	0.74	0.67	0.81	0.42	0.80	0.76	0.69	0.88	0.75	0.51	0.69	0.71	0.97	0.77	0.86	0.85	0.80	0.82	0.44
Fledging success (C_{1+2}/B)	0.41	0.80	0.45	0.66	0.73	0.82	0.67	0.60	0.70	0.41	0.25	0.65	0.76	0.61	0.20	0.46	0.55	0.67	0.90
Reproductive success (C_{1+2}/A)	0.30	0.53	0.36	0.27	0.59	0.63	0.46	0.52	0.53	0.21	0.17	0.45	0.73	0.47	0.17	0.38	0.43	0.55	0.39
Productivity (hs x fs)	0.30	0.54	0.36	0.28	0.58	0.62	0.46	0.53	0.53	0.21	0.17	0.46	0.74	0.47	0.17	0.39	0.44	0.55	0.39

[a] Nest sites included in productivity estimates were visited at intervals of < 10 days at hatch and fledge/disappearance, but sites with larger intervals were included when the fate was known (dead chick observed, chick still alive at last visit, chick disappeared so early or so late that its fate would be the same even at ±half the visit interval).
[b] Sites at which an apparently incubating bird was observed on 2 consecutive visits were assumed to have an egg, regardless of whether or not a chick was later observed at that site.
[c] For chicks to be considered fledged, they had to be at least 38 days old before disappearing or 33 days old at the time of the last visit, if still present.

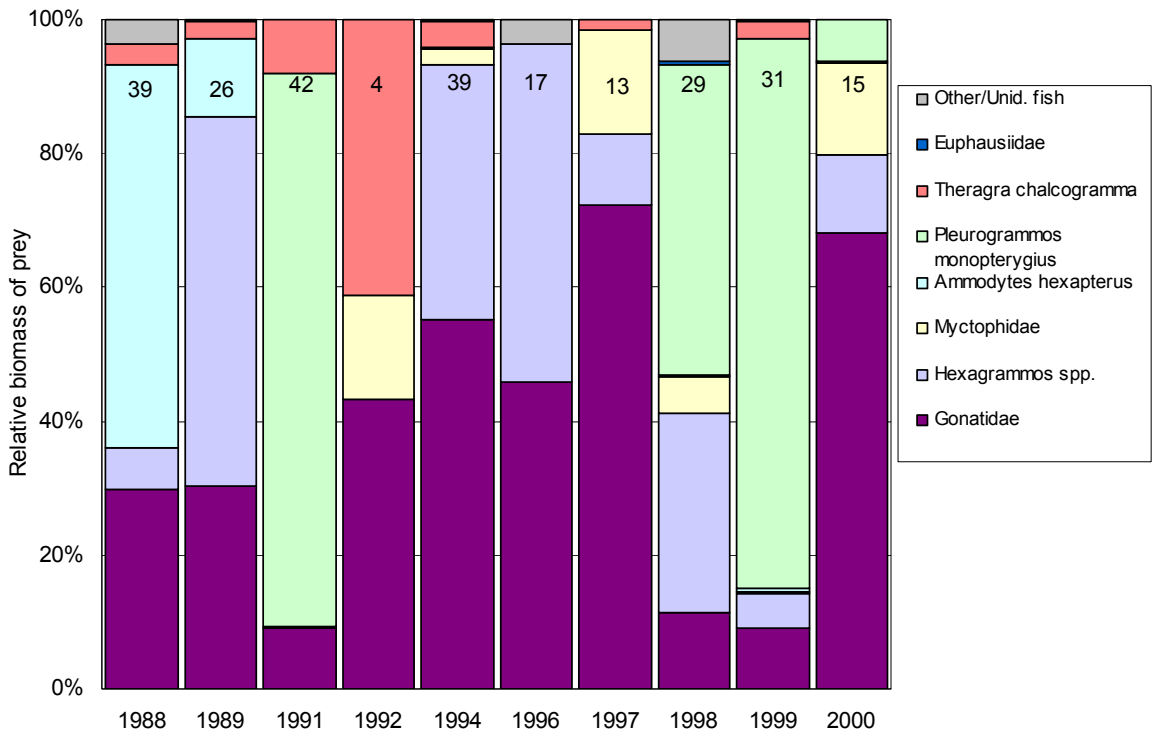

Figure 52. Relative biomass of prey in diets of tufted puffins at Buldir Island, Alaska.

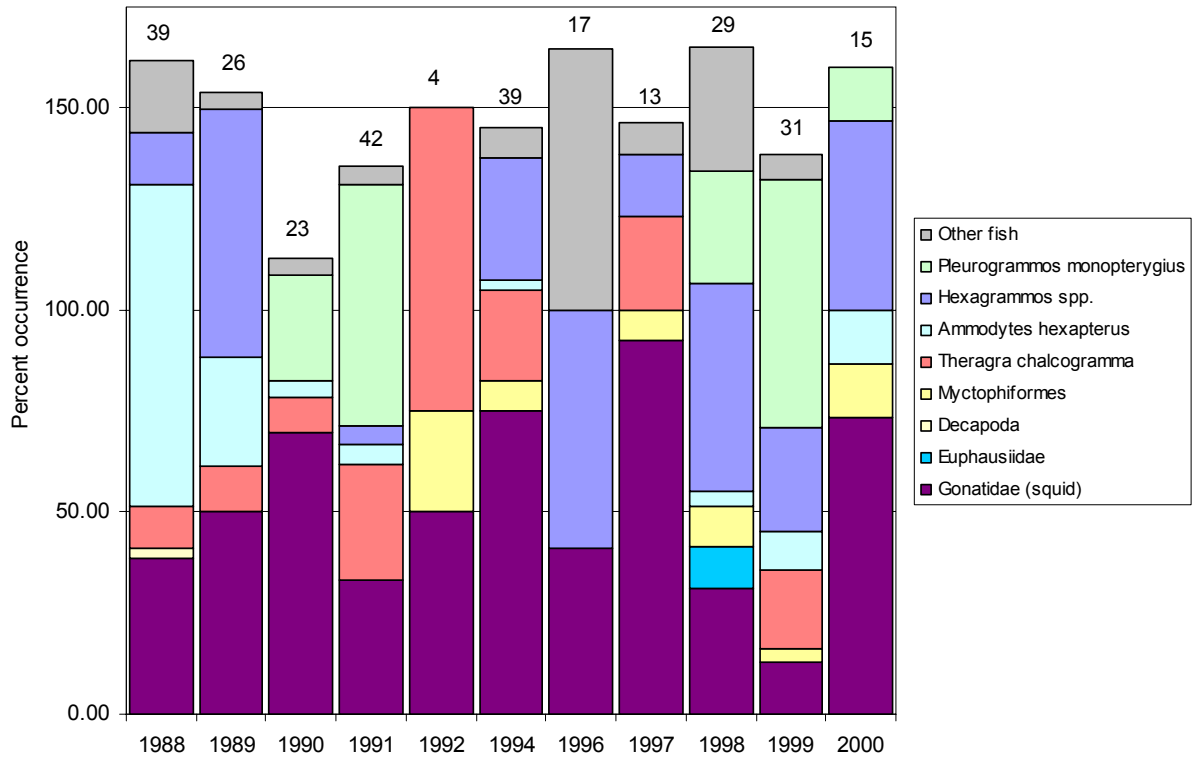

Figure 53. Frequency of prey occurrence in diets of tufted puffins at Buldir Island, Alaska.

Table 75. Relative biomass of prey in diets of tufted puffins at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

	1988	1989	1991	1992	1994	1996	1997	1998	1999	2000
Date: begin	12 Aug	25 Jul	9 Aug	11 Aug	6 Aug	31 Jul	12 Aug	9 Aug	10 Aug	26 Jul
end	5 Sep	15 Aug	12 Aug	11 Aug	18 Aug	17 Aug	17 Aug	15 Aug	21 Aug	12 Aug
No. samples	39	26	36	4	39	17	13	29	31	16
Total mass (g)	279.2	376.5	608.2	48.7	649.7	196.2	227.1	371.0	464.2	129.8
Gonatidae (squid)										
Gonatus middendorffi	--	--	--	--	--	32.5	71.8	--	--	--
Berryteuthis magister	--	--	--	--	--	6.7	--	--	--	--
Gonatopsis makko	--	--	--	--	--	--	0.4	--	--	--
Unid. squid	29.9	30.2	9.0	43.3	55.1	6.6	--	11.4	9.2	68.0
Euphausiidae										
Thysanoessa longipes	--	--	--	--	--	--	--	0.4	--	--
Thysanoessa spp.	--	--	--	--	--	--	--	0.2	--	--
Fish										
Myctophidae										
Stenobrachius leucopsarus	--	--	--	--	--	--	15.6	1.8	--	--
Unid. Myctophidae	--	--	--	15.4	2.4	--	--	3.8	0.3	13.7
Gadidae										
Theragra chalcogramma	3.2	2.7	7.8	41.3	4.1	--	1.5	--	--	--
Ptilichthyidae										
Ptilichthys goodei	--	0.1	--	--	--	--	--	0.1	--	--
Zaproridae										
Zaprora silenus	--	--	--	--	--	--	--	--	0.1	--
Ammodytidae										
Ammodytes hexapterus	57.3	11.7	0.1	--	0.2	--	--	0.2	0.5	0.4
Scorpaenidae	--	--	--	--	--	1.4	--	0.1	--	--
Anoplopomatidae										
Anoplopoma fimbria	--	--	--	--	--	0.4	--	--	--	--
Hexagrammidae										
Hexagrammos decagrammus	--	--	--	--	38.1	49.8	10.6	29.7	23.8	9.2
Hexagrammos spp.	6.2	55.3	0.2	--	--	0.8	--	--	--	2.5
Pleurogrammos monopterygius	--	--	82.8	--	--	--	--	46.4	82.1	6.2
Cottidae										
Hemilepidotus spp.	--	--	--	--	--	0.6	--	--	--	--
Blepsias bilobus	--	--	--	--	--	--	--	0.4	1.3	--
Pleuronectidae	--	--	--	--	0.1	0.4	--	0.2	--	--
Unid. fish	3.5	--	0.1	--	--	0.8	--	5.5	--	--

Table 76. Frequency of occurrence of prey in diets of tufted puffins at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1988	1989	1990	1991	1992	1994	1996	1997	1998	1999	2000
Date: begin	12 Aug	25 Jul	25 Jul	11 Jul	11 Aug	6 Aug	31 Jul	12 Aug	9 Aug	10 Aug	26 Jul
end	5 Sep	15 Aug	10 Aug	12 Aug	11 Aug	18 Aug	17 Aug	17 Aug	15 Aug	21 Aug	12 Aug
No. samples	39	26	23	42	4	39	17	13	29	31	16
Gonatidae (squid)											
Gonatus middendorffi	--	--	--	--	--	--	29.4	84.6	--	--	--
Berryteuthis magister	--	--	--	--	--	--	5.9	--	--	--	--
Gonatopsis makko	--	--	--	--	--	--	--	7.7	--	--	--
Unid. squid	38.5	50.0	69.6	33.3	50.0	75.0	5.9	--	31.0	12.9	73.3
Euphausiidae											
Thysanoessa longipes	--	--	--	--	--	--	--	--	3.4	--	--
Thysanoessa spp.	--	--	--	--	--	--	--	--	6.9	--	--
Decapoda - shrimp	2.6	--	--	--	--	--	--	--	--	--	--
Fish											
Myctophidae											
Stenobrachius leucopsarus	--	--	--	--	--	--	--	7.7	3.4	--	--
Unid. Myctophidae	--	--	--	--	25.0	7.5	--	--	6.9	3.2	13.3
Gadidae											
Theragra chalcogramma	10.3	11.5	8.7	28.6	75.0	22.5	--	23.1	--	19.4	--
Ptilichthyidae											
Ptilichthys goodei	--	3.8	--	--	--	--	--	--	3.4	--	--
Zaproridae											
Zaprora silenus	--	--	--	--	--	--	--	--	--	3.2	--
Ammodytidae											
Ammodytes hexapterus	79.5	26.9	4.3	4.8	--	2.5	--	--	3.4	9.7	13.3
Scorpaenidae	--	--	--	--	--	--	17.6	--	3.4	--	--
Anoplopomatidae											
Anoplopoma fimbria	--	--	--	--	--	--	5.9	--	--	--	--
Hexagrammidae											
Hexagrammos decagrammus	--	--	--	--	--	30.0	47.1	15.4	51.7	25.8	13.3
Hexagrammos spp.	12.8	61.5	--	4.8	--	--	11.8	--	--	--	33.3
Pleurogrammos monopterygius	--	--	26.1	59.5	--	--	--	--	27.6	61.3	13.3
Cottidae											
Hemilepidotus spp.	--	--	--	--	--	--	11.8	--	--	--	
Blepsias bilobus	--	--	--	--	--	--	--	--	3.4	3.2	--
Pleuronectidae	--	--	--	--	--	7.5	5.9	--	3.4	--	--
Unid. fish	17.9	--	4.3	4.8	--	--	23.5	7.7	17.2	--	--

Table 77. Species composition of prey in diets of tufted puffins at Buldir Island, Alaska. Values are expressed as the percentage of total number of individual prey items comprised by each species for each year.

	1988	1989	1990	1991	1992	1994	1996	1997	1998	1999	2000
Date: begin	12 Aug	25 Jul	25 Jul	11 Jul	11 Aug	6 Aug	31 Jul	12 Aug	9 Aug	10 Aug	26 Jul
end	5 Sep	15 Aug	10 Aug	12 Aug	11 Aug	18 Aug	17 Aug	17 Aug	15 Aug	21 Aug	12 Aug
No. samples	39	26	23	42	4	39	17	13	29	31	16
No. individual prey items	258	163	117	166	22	129	66	45	88	87	68
Gonatidae (squid)											
Gonatus middendorffi	--	--	--	--	--	--	22.7	75.6	--	--	--
Berryteuthis magister	--	--	--	--	--	--	1.5		--	--	--
Gonatopsis makko	--	--	--	--	--	--	--	2.2	--	--	--
Unid. squid	10.5	23.3	82.9	31.9	27.3	58.1	3.0	--	23.9	19.5	79.6
Euphausiidae											
Thysanoessa longipes	--	--	--	--	--	--	--	--	13.6	--	--
Thysanoessa spp.	--	--	--	--	--	--	--	--	10.2	--	--
Decapoda - shrimp	0.4	--	--	--	--	--	--	--	--	--	--
Fish											
Myctophidae											
Stenobrachius leucopsarus	--	--	--	--	--	--	--	6.7	1.1	--	--
Unid. Myctophidae	--	--	--	--	4.5	2.3	--	--	2.3	1.1	3.0
Gadidae											
Theragra chalcogramma	3.9	6.7	7.7	39.8	68.2	20.2	--	8.9	--	25.3	--
Ptilichthyidae											
Ptilichthys goodei	--	0.6	--	--	--	--	--	--	1.1	--	--
Zaproridae											
Zaprora silenus	--	--	--	--	--	--	--	--	--	1.1	--
Ammodytidae											
Ammodytes hexapterus	76.0	42.3	2.6	1.2	--	1.6	--	--	1.1	3.4	5.9
Scorpaenidae	--	--	--	--	--	--	18.2	--	1.1	--	--
Anoplopomatidae											
Anoplopoma fimbria	--	--	--	--	--	--	1.5	--	--	--	--
Hexagrammidae											
Hexagrammos decagrammus	--	--	--	--	--	15.5	27.3	4.4	22.7	10.3	3.0
Hexagrammos spp.	4.3	27.0	--	1.2	--	--	4.5	--	--	--	14.7
Pleurogrammos monopterygius	--	--	6.0	22.3	--	--	--	--	12.5	37.9	3.0
Cottidae											
Hemilepidotus spp.	--	--	--	--	--	--	6.1	--	--	--	--
Blepsias bilobus	--	--	--	--	--	--	--	--	1.1	1.1	--
Pleuronectidae	--	--	--	--	--	2.3	4.5	--	2.3	--	--
Unid. fish	5.0	--	0.9	3.6	--	--	10.6	2.2	6.8	--	--

Table 78. Breeding chronology dates for horned puffins at Buldir Island, Alaska.

Year	mean hatch	SD	n[a]	median hatch	no. nests monitored[b]	first hatch	last hatch	first fledge
1988	22 Jul	6.8	18	23 Jul	38	30 Jun	14 Aug	3 Sep
1989	25 Jul	6.1	7	23 Jul	39	9 Jul	8 Aug	>22 Aug[c]
1990	24 Jul	7.9	19	19 Jul	52	9 Jul	10 Aug	12 Aug
1991	26 Jul	4.7	15	27 Jul	71	15 Jul	6 Aug	>14 Aug
1992	21 Jul	4.8	8	20 Jul	27	11 Jul	5 Aug	>12 Aug
1993	23 Jul	4.5	12	25 Jul	19	15 Jul	3 Aug	28 Aug
1994	22 Jul	3.6	15	23 Jul	36	9 Jul	1 Aug	28 Aug
1995	25 Jul	6.0	10	24 Jul	38	15 Jul	4 Aug	>18 Aug
1996	20 Jul	2.7	13	20 Jul	51	10 Jul	7 Aug	>18 Aug
1997	25 Jul	4.7	21	24 Jul	52	15 Jul	6 Aug	>19 Aug
1998	20 Jul	7.4	16	23 Jul	39	5 Jul	2 Aug	>27 Aug
1999	28 Jul	5.9	13	25 Jul	25	22 Jul	8 Aug	>26 Aug
2000	19 Jul	8.3	21	18 Jul	62	2 Jul	2 Aug	>28 Aug
2001	27 Jul	8.0	13	25 Jul	60	16 Jul	12 Aug	25 Aug
2002	20 Jul	5.1	42	19 Jul	91	21 Jun	7 Aug	>4 Sep
2003	23 Jul	8.4	10	19 Jul	26	9 Jul	12 Aug	24 Aug
2004	24 Jul	5.5	15	23 Jul	53	29 Jun	2 Aug	>24 Aug
2005	26 Jul	3.0	8	25 Jul	24	19 Jul	6 Aug	>24 Aug
2006	26 Jul	9.9	24	25 Jul	60	1 Jul	16 Aug	16 Aug

[a] Sample size is for calculation of mean and median hatch date estimates only. Nest sites used to determine hatch dates had observations < 8 days apart from egg to chick except in 1989: ≤ 8 days; 1990: ≤10 days; 1993: ≤ 9 days.
[b] The total used for estimating the remaining parameters.
[c] No chicks had fledged (disappeared after reaching min fledging age) by the time of the last visit in years with a “>”.

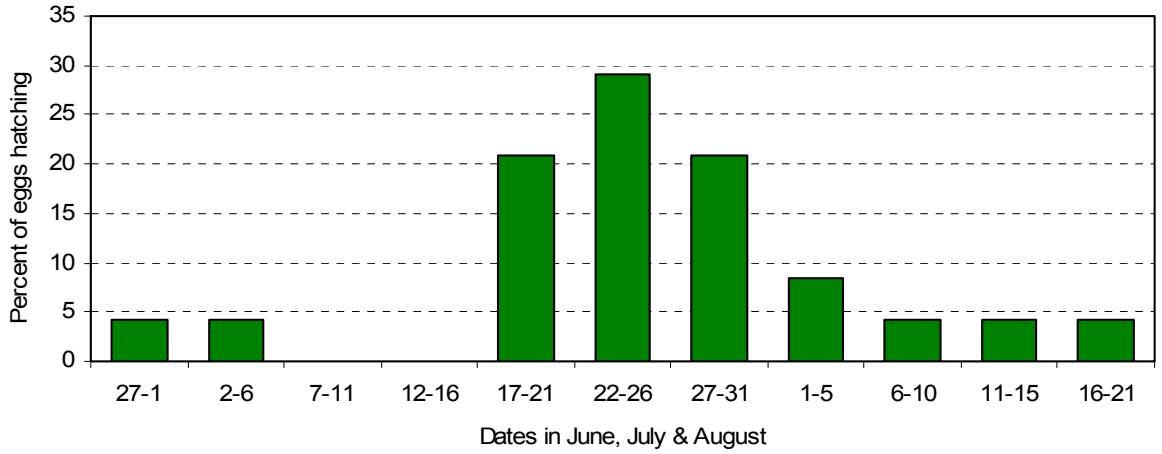

Figure 54. Hatching chronology of horned puffins at Buldir Island, Alaska in 2006 (n=24).

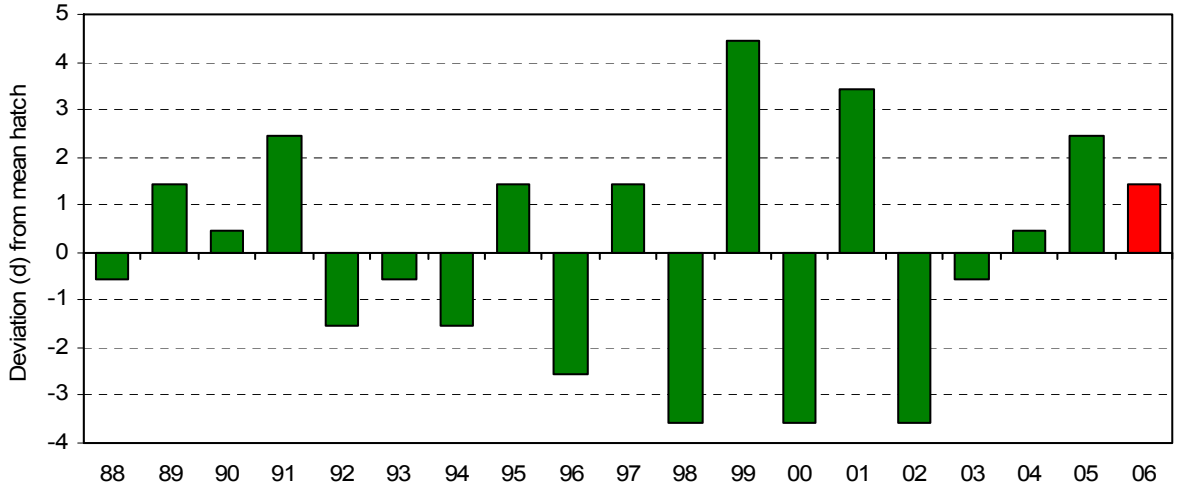

Figure 55. Yearly hatch date deviation (from the 1988-2005 average of 24 July) of horned puffins at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

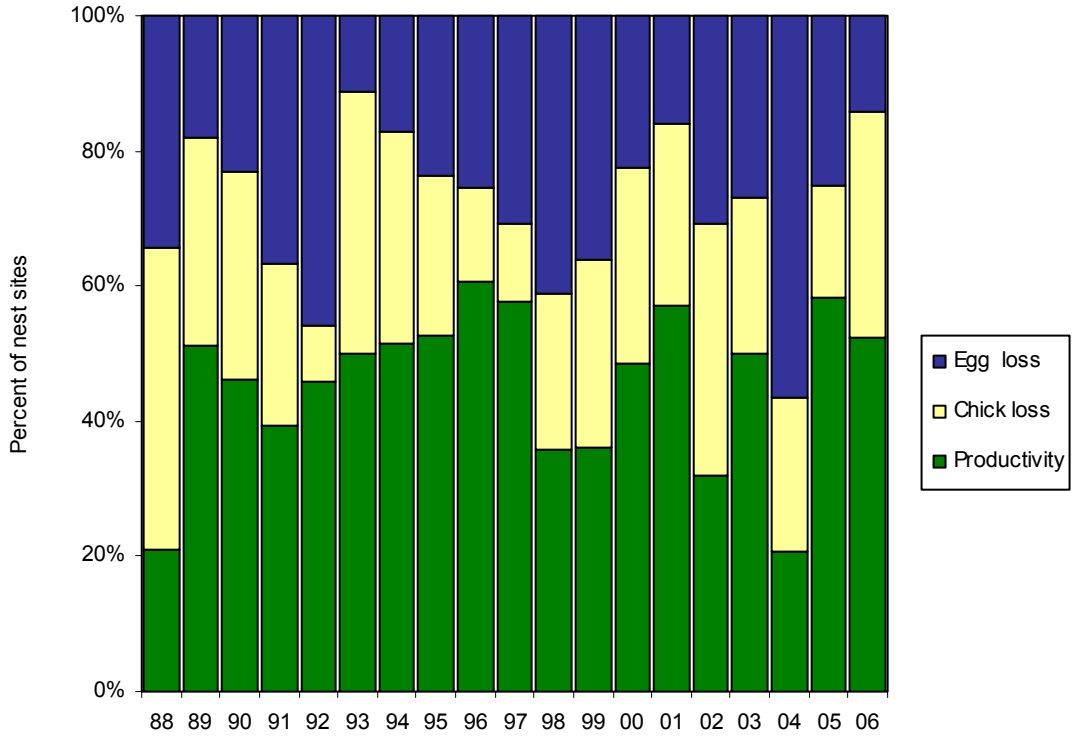

Figure 56. Reproductive performance of horned puffins at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick.

Table 79. Reproductive performance of horned puffins at Buldir Island, Alaska.

Parameter[a]	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. eggs found (A)	38	39	52	71	24	18	35	38	51	52	39	25	62	56	91	26	53	24	42
No. eggs lost to:																			
disappearance	11	4	12	11	9	2	5	6	8	11	8	7	14	5	14	5	14	2	5
abandonment	2	2	0	11	1	0	0	1	1	2	7	0	0	4	3	1	12	3	0
breakage	0	1	0	4	1	0	1	2	4	3	1	2	0	0	11	1	3	1	1
No. eggs hatched (B)	25	32	40	45	13	16	29	29	38	36	23	16	48	47	63	19	23	18	36
No. chicks lost to:																			
disappearance	12	9	13	9	0	5	7	5	3	5	5	6	16	4	21	3	8	3	0
death	5	3	3	8	2	2	4	4	4	1	4	1	2	11	13	3	4	1	13
No. "successful" chicks (C_{1+2})	8	20	24	28	11	9	18	20	31	30	14	9	30	32	29	13	11	14	22
fledged[b] (C_1)	8	2	1	0	0	9	18	0	9	2	0	0	2	9	0	2	0	0	10
still present (C_2)	0	18	23	28	11	0	0	20	22	28	14	9	28	23	29	11	11	14	12
Hatching success (B/A)	0.66	0.82	0.77	0.63	0.54	0.89	0.83	0.76	0.75	0.69	0.59	0.64	0.77	0.84	0.69	0.73	0.43	0.75	0.86
Fledging success (C_{1+2}/B)	0.32	0.63	0.60	0.62	0.85	0.56	0.62	0.69	0.82	0.83	0.61	0.56	0.63	0.68	0.46	0.68	0.48	0.78	0.61
Reproductive success (C_{1+2}/A)	0.21	0.51	0.46	0.39	0.46	0.50	0.51	0.53	0.61	0.58	0.36	0.36	0.48	0.57	0.32	0.50	0.21	0.58	0.52
Productivity (hs x fs)	0.21	0.51	0.46	0.39	0.46	0.50	0.52	0.53	0.61	0.58	0.36	0.36	0.49	0.57	0.32	0.50	0.21	0.59	0.52

[a] Data are from nest sites for which visit intervals at hatching and fledging were ≤ 12 days.
[b] For chicks to be considered fledged, they had to be 34 days old before disappearing or 30 days old at the time of the last.

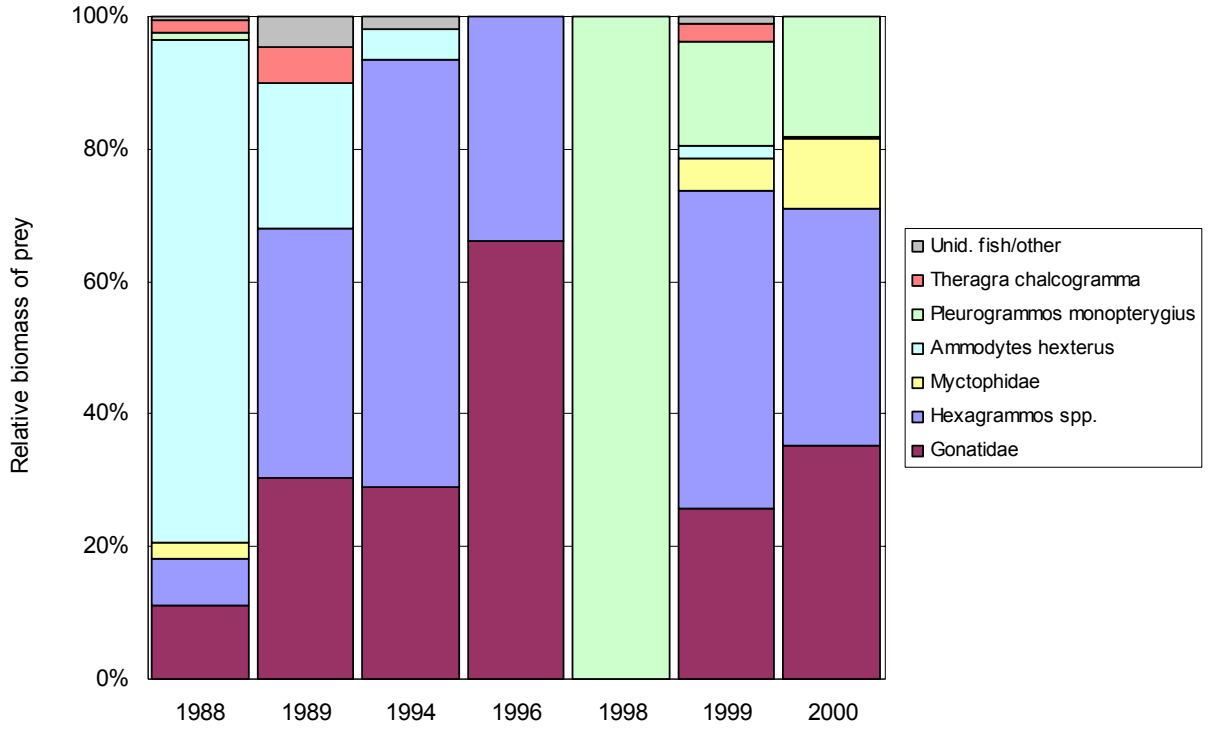

Figure 57. Relative biomass of prey in diets of horned puffins at Buldir Island, Alaska.

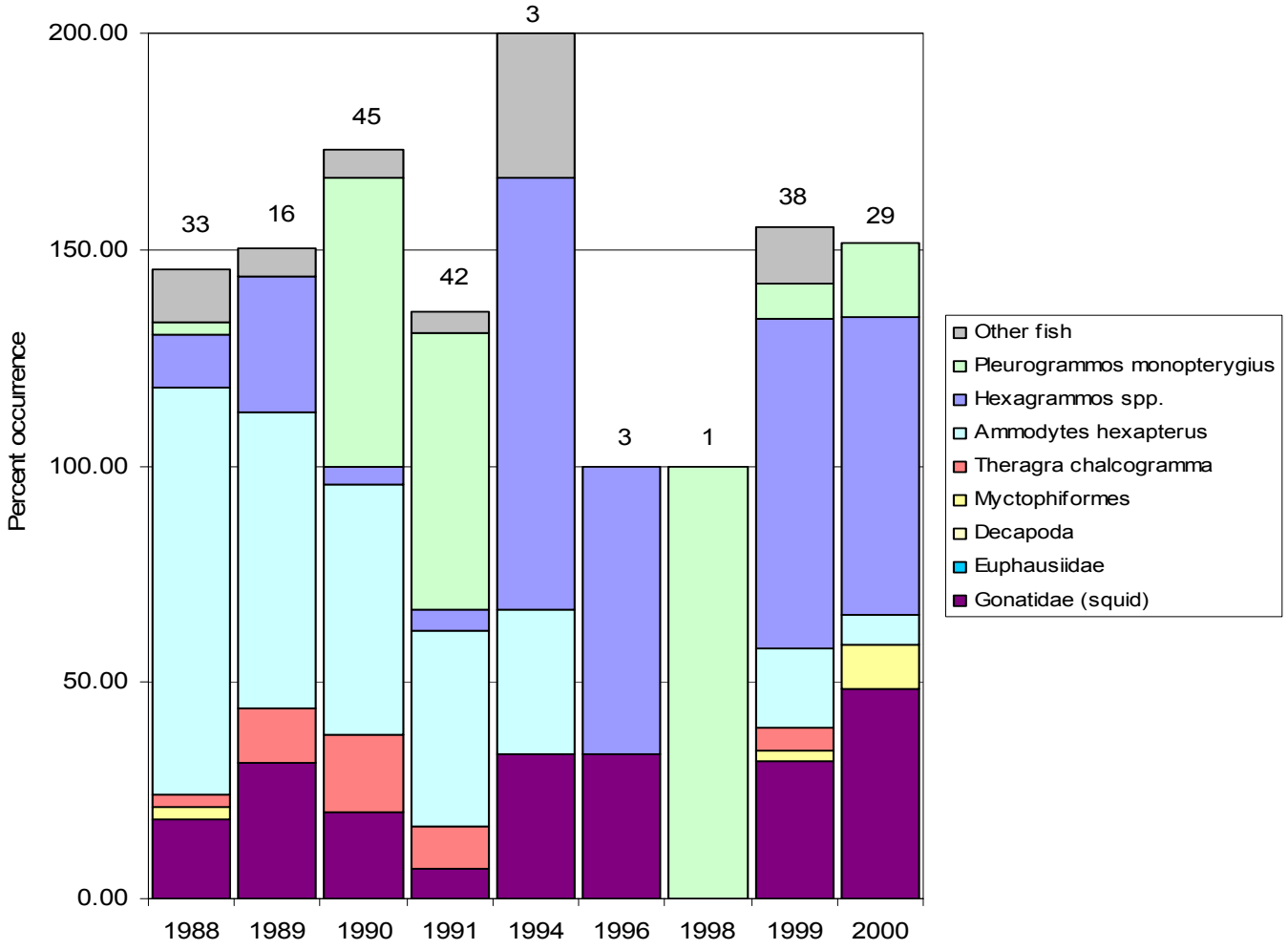

Figure 58. Frequency of prey occurrence in diets of horned puffins at Buldir Island, Alaska.

Table 80. Relative biomass of prey in diets of horned puffins at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

	1988	1989	1994	1996	1998	1999	2000
Date begin	16 Aug	2 Aug	7 Aug	3 Aug	13 Aug	22 Jul	26 Jul
end	5 Sep	15 Aug	14 Aug	17 Aug	13 Aug	21 Aug	12 Aug
No. samples	33	16	3	3	1	28	29
Total mass (g)	399.2	92.1	20.4	36.5	5.8	348.9	205.8
Gonatidae (squid)							
Gonatus middendorffi	--	--	--	66.0	--	--	--
Unid. squid	11.0	30.4	28.9	--	--	25.7	35.3
Fish							
Myctophidae							
Stenobrachius leucopsarus	2.5	--	--	--	--	4.8	--
Unid. Myctophidae	--	--	--	--	--	--	10.4
Gadidae							
Theragra chalcogramma	1.9	5.4	--	--	--	2.6	--
Ammodytidae							
Ammodytes hexapterus	75.7	22.1	4.4	--	--	1.9	0.5
Hexagrammidae							
Hexagrammos decagrammus	--	--	64.7	34.0	--	42.8	32.8
Hexagrammos spp.	7.2	37.5	--	--	--	5.2	2.9
Pleurogrammos monopterygius	1.1	--	--	--	100.0	15.8	18.1
Agonidae	0.1	--	--	--	--	--	--
Pleuronectidae	--	--	2.0	--	--	--	--
Unid. fish	0.5	4.6	--	--	--	1.2	--

Table 81. Frequency of occurrence of prey in diets of horned puffins at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1988	1989	1990	1991	1994	1996	1998	1999	2000
Date begin	16 Aug	2 Aug	27 Jul	22 Jul	7 Aug	3 Aug	13 Aug	22 Jul	26 Jul
end	5 Sep	15 Aug	10 Aug	11 Aug	14 Aug	17 Aug	13 Aug	21 Aug	12 Aug
No. samples	33	16	45	42	3	3	1	28	29
Gonatidae (squid)									
Gonatus middendorffi	--	--	--	--	--	33.3	--	--	--
Unid. squid	18.2	31.3	20.0	7.1	33.3	--	--	31.6	48.3
Fish									
Myctophidae									
Stenobrachius leucopsarus	3.0	--	--	--	--	--	--	2.6	--
Unid. Myctophidae	--	--	--	--	--	--	--	--	10.3
Gadidae									
Gadus macrocephalus	--	--	2.2	--	--	--	--	--	--
Theragra chalcogramma	3.0	12.5	17.8	9.5	--	--	--	5.3	--
Ammodytidae									
Ammodytes hexapterus	93.9	68.8	57.8	45.2	33.3	--	--	18.4	6.9
Hexagrammidae									
Hexagrammos decagrammus	--	--	--	--	100.0	66.7	--	52.6	51.7
Hexagrammos spp.	12.1	31.3	4.4	4.8	--	--	--	23.7	17.2
Pleurogrammos monopterygius	3.0	--	66.7	64.3	--	--	100.0	7.9	17.2
Agonidae	3.0	--	--	--	--	--	--	--	--
Pleuronectidae	--	--	2.2	2.4	33.3	--	--	--	--
Unid. fish	9.1	6.3	2.2	2.4	--	--	--	13.2	--

Table 82. Species composition of prey in diets of horned puffins at Buldir Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each species.

	1988	1989	1990	1991	1994	1996	1998	1999	2000
Date begin	16 Aug	2 Aug	27 Jul	22 Jul	7 Aug	3 Aug	13 Aug	22 Jul	26 Jul
end	5 Sep	15 Aug	10 Aug	11 Aug	14 Aug	17 Aug	13 Aug	21 Aug	12 Aug
No. samples	33	16	45	42	3	3	1	28	29
No. individual prey items	273	70	261	196	14	7	1	189	90
Gonatidae (squid)									
Gonatus middendorffi	--	--	--	--	--	57.1	--	--	--
Unid. squid	4.0	32.9	7.7	6.6	28.6	--	--	20.1	44.4
Fish									
Myctophidae									
Stenobrachius leucopsarus	0.4	--	--	--	--	--	--	2.6	--
Unid. Myctophidae	--	--	--	--	--	--	--	--	3.3
Gadidae									
Gadus macrocephalus	--	--	0.4	--	--	--	--	--	--
Theragra chalcogramma	4.0	5.7	11.1	2.6	--	--	--	3.2	--
Ammodytidae									
Ammodytes hexapterus	85.3	50.0	61.3	60.2	35.7	--	--	8.5	3.3
Hexagrammidae									
Hexagrammos decagrammus	--	--	--	--	21.4	42.9	--	24.9	17.8
Hexagrammos spp.	1.8	8.6	1.1	7.1	--	--	--	31.2	24.4
Pleurogrammos monopterygius	0.4	--	17.6	21.9	--	--	100.0	4.2	6.7
Agonidae	0.7	--	--	--	--	--	--	--	--
Pleuronectidae	--	--	0.4	0.5	14.3	--	--	--	--
Unid. fish	3.3	2.9	0.4	1.0	--	--	--	5.3	--

Table 83. Numbers of birds detected on off-road point count route number 315, Buldir Island, Alaska.

Species[a]	1995[b]	1996	1997	1998	2000[c]	2001	2002	2003	2005[d]	2006	Mean
Date	8 Jun	9 Jun	12 Jun	18 Jun	--	12 Jun	17 Jun	14 Jun	15 Jun	15 Jun	
Fork-tailed storm-petrel*	6	0	1	1	--	0	0	0	0	--	1
Leach's storm-petrel	0	1	0	0	--	0	0	0	0	--	--
Aleutian Canada goose*	133	112	85	22	--	70	2	76	-	31	66
Parasitic jaeger	2	2	8	5	--	1	2	1	0	8	3
Glaucous-winged gull*	60	142	161	66	--	18	20	34	-	54	69
Parakeet auklet	1	3	12	0	--	1	0	0	0	--	2
Tufted puffin	0	0	0	1	--	0	0	0	0	--	--
Bald eagle	1	0	0	0	--	0	0	0	0	0	--
Peregrine Falcon	0	0	0	0	--	0	0	0	0	1	--
Winter wren*	1	6	9	1	--	5	4	7	3	3	4
Song sparrow*	10	10	8	3	--	2	1	2	9	5	6
Lapland longspur* - total	30	26	22	14	--	18	31	18	22	30	23
male	24	22	17	11	--	--	--	13	17	--	17
female	5	3	3	0	--	--	--	0	5	--	3
unknown	1	1	2	3	--	18	31	5	0	--	8
Snow bunting*	9	6	14	1	--	2	8	0	11	11	7
Rosy finch*	2	4	1	9	--	1	5	0	7	4	4
Common rosefinch	0	0	1	0	--	0	0	0	0	0	--
Brambling	0	0	0	0	--	0	0	0	0	1	--

[a] For those species marked with an asterisk, we observed pairs, nests, and/or territorial males.
[b] Total number of individuals detected on survey.
[c] Data missing for the point count conducted in 2000. No point count was conducted in 2004.
[d] In 2005 the count at point 5 was missed and points 6-12 were conducted in conditions which made detection difficult.

Table 84. Numbers of resident passerine birds detected on off-road point count route number 315, Buldir Island, Alaska, on 15 June 2006.

Species	Point no. 1	2	3	4	5	6	7	8	9	10	11	12	Total[a]	% of total[b]	% of points[c]
Winter wren	2	0	0	1	0	0	0	0	0	0	0	0	3	5.6	16.6
Song sparrow	2	0	1	1	1	0	0	0	0	0	0	0	5	9.4	33.3
Lapland longspur - total	3	6	4	5	4	3	0	1	1	1	1	1	30	56.6	91.6
male	3	4	2	3	4	2	0	0	0	0	0	1	19	-	-
female	0	0	0	1	0	0	0	0	0	0	0	0	1	-	-
unknown	0	2	2	1	0	1	0	1	1	1	1	0	10	-	-
Snow bunting	0	0	0	0	0	0	2	1	2	2	2	2	11	20.8	50.0
Gray-crowned rosy-finch	2	0	0	2	0	0	0	0	0	0	0	0	4	7.5	16.6

[a]Total number of individuals detected on survey.
[b]Relative abundance of species: percent of total number of individual birds of all species detected on survey.
[c] Percent of points at which species was detected.

Table 85. Counts of sea otters at Buldir Island, Alaska.

Year	Date	A-B	B-C	C-D	D-E	E-F	F-A	Total	Survey type	Source
1959[a]	19 May	0	0	0	0	0	0	0	aerial	
1962[b]	25-28 June	--	--	--	--	--	--	7	boat	Jones 1963
1963[c]	7-19 July	14		--	--	--	--	14	boat	Kenyon 1969
1965	2 May	--	--	--	--	--	--	15	aerial	Kenyon 1969
1972[d]	7 July	--	--	--	--	--	--	>27	boat	Byrd 1972
1974[e]	18 July	--	--	--	--	--	20	>20	boat	G. Vernon Byrd, unpubl. Data
1979	23-24 June	4	2	0	4	11	15	36	boat	Day et al. 1979
1988[f]	26 June	--	--	--	--	--	--	95	boat	
1989[g]	13 June	11	14	3	13	14	3	58	boat	U.S. Fish and Wildl. Serv. Unpubl. data
1992	April	--	--	--	--	--	--	11	aerial	Evans et al. 1997
1995	28 June	0	0	2	0	0	0	2	boat	U.S. Fish and Wildl. Serv. Unpubl. data
1997	3 June	--	--	--	--	--	--	4	boat	U.S. Fish and Wildl. Serv. Unpubl. data
1998	13 June	0	1	5	3	1	0	10	boat	U.S. Fish and Wildl. Serv. Unpubl. data
1999	1 July	0	0	0	0	2	2	4	boat	U.S. Fish and Wildl. Serv. Unpubl. data
2000	20 June	0	0	0	0	5	0	5	boat	U.S. Fish and Wildl. Serv. Unpubl. data
2001	5 June	0	0	0	0	0	0	0	boat	U.S. Fish and Wildl. Serv. Unpubl. data
2002	2 July	0	0	0	6	0	1	7	boat	U.S. Fish and Wildl. Serv. Unpubl. data
2005	10 June	0	0	--	--	--	0[h]	0	boat	U.S. Fish and Wildl. Serv. Unpubl. data
2006	7 June	0	0	0	0	0	0	0	boat	U.S. Fish and Wildl. Serv. Unpubl. data

[a] Aerial count was conducted in less than ideal conditions.
[b] Includes 1 male and 3 females with pups.
[c] Includes 5 females with young and 4 lone adults along the north coast of the island (A-B and B-C).
[d] Partial boat survey around Northwest Point.
[e] Partial boat count.
[f] Partial boat counts, East Cape - Peregrine Point, approximately C-D and D-E (75 adults, 20 pups).
[g] Includes 2 pups.
[h] Surveyed only from A to Bull Point

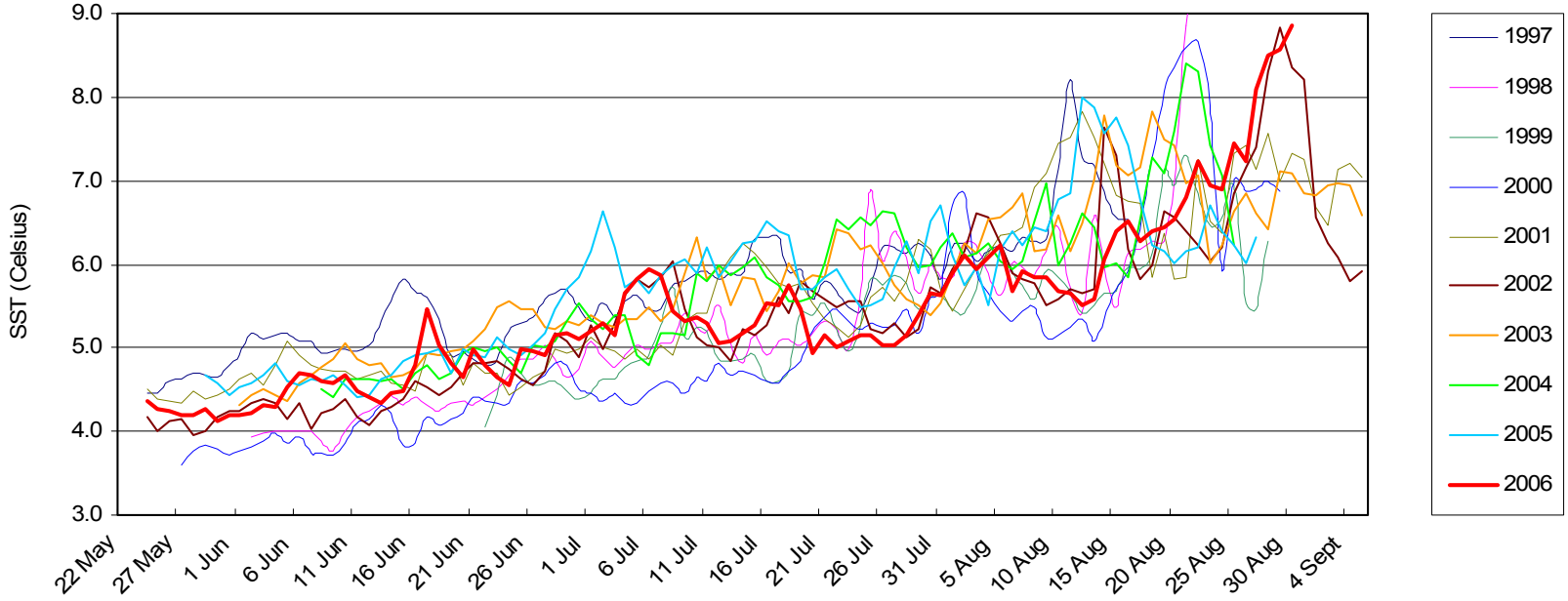

Figure 59. Daily mean sea surface temperature (ºC) at Buldir Island, Alaska.

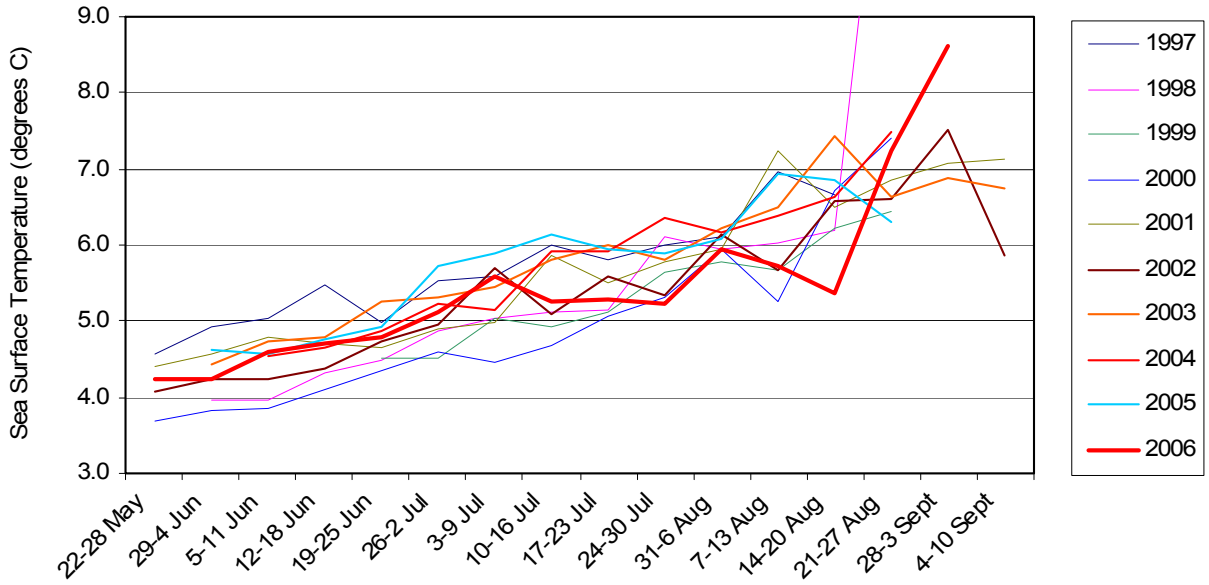

Figure 60. Weekly Sea Surface Temperature (ºC) at Buldir Island, Alaska.

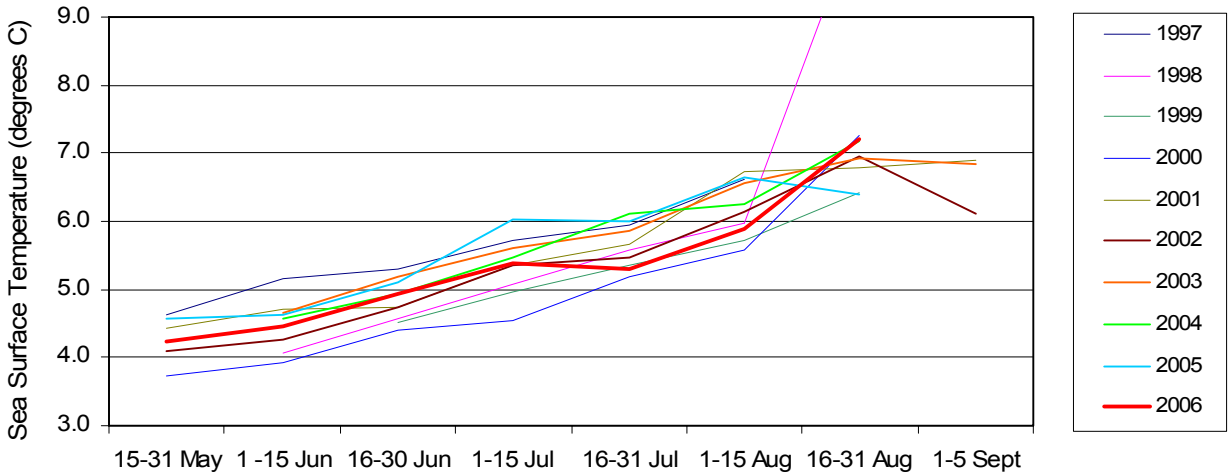

Figure 61. Biweekly Sea Surface Temperature (ºC) at Buldir Island, Alaska.

Table 86. Biweekly mean SST (ºC) at Buldir Island, Alaska. Composite of mean daily temperatures.

Date	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
15-31 May	4.6	--	--	3.7	4.4	4.1	--	--	4.6	4.2
1-5 Jun	5.2	4.1	--	3.9	4.7	4.3	4.7	4.6	4.6	4.5
16-30 Jun	5.3	4.6	4.5	4.4	4.7	4.7	5.2	4.9	5.1	4.9
1-15 Jul	5.7	5.1	5.0	4.5	5.3	5.4	5.6	5.5	6.0	5.4
16-31 Jul	5.9	5.6	5.4	5.2	5.7	5.5	5.8	6.1	6.0	5.3
1-15 Aug	6.6	6.0	5.7	5.6	6.7	6.1	6.6	6.2	6.7	5.9
16-31 Aug	--	10.5	6.4	7.3	6.8	7.0	6.9	7.2	6.4	7.2
1-5 Sept	--	--	--	--	6.9	6.1	6.8	--	--	--

Table 87. Weekly mean SST (ºC) at Buldir Island, Alaska. Composite of mean daily temperatures.

Date	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
22-28 May	4.6	--	--	3.7	4.4	4.1	--	--	--	4.2
29-4 Jun	4.9	4.0	--	3.8	4.6	4.2	4.4	--	4.61	4.2
5-11 Jun	5.0	4.0	--	3.8	4.8	4.2	4.7	4.5	4.57	4.6
12-18 Jun	5.5	4.3	--	4.1	4.7	4.4	4.8	4.6	4.77	4.7
19-25 Jun	5.0	4.5	4.5	4.3	4.7	4.7	5.3	4.9	4.93	4.8
26-2 Jul	5.5	4.9	4.5	4.6	4.9	5.0	5.3	5.2	5.71	5.1
3-9 Jul	5.6	5.0	5.0	4.5	5.0	5.7	5.4	5.1	5.90	5.6
10-16 Jul	6.0	5.1	4.9	4.7	5.9	5.1	5.8	5.9	6.14	5.3
17-23 Jul	5.8	5.1	5.1	5.1	5.5	5.6	6.0	5.9	5.95	5.3
24-30 Jul	6.0	6.1	5.7	5.3	5.8	5.3	5.8	6.3	5.89	5.2
31-6 Aug	6.1	6.0	5.8	5.9	6.0	6.2	6.2	6.2	6.09	5.9
7-13 Aug	7.0	6.0	5.7	5.3	7.2	5.7	6.5	6.4	6.94	5.7
14-20 Aug	6.7	6.2	6.2	6.7	6.5	6.6	7.4	6.6	6.84	5.4
21-27 Aug	--	12.7	6.4	7.4	6.8	6.6	6.6	7.5	6.29	7.2
28-3 Sep	--	--	--	--	7.1	7.5	6.9	--	--	8.6
4-10 Sep	--	--	--	--	7.1	5.9	6.8	--	--	--

Annotated list of species observed at Buldir Island, Alaska, 24 May through 30 August, 2006.

Abundance categories were defined as follows:
Abundant: >50 individuals per day or 6 per hour
Common: 10-49 individuals per day or 2-5 per hour
Fairly Common: 5-9 individuals per day or 1 per hour
Uncommon: 2-4 individuals per day or <1 per hour
Rare: 1 individual per day
Very Rare: <1 individual per day; sightings throughout summer
Casual: Irregular numbers of birds outside their expected range. Usually 1-5 sightings total.
Accidental: Only a few records for the species in the Aleutian Islands

Birds

Horned Grebe (*Podiceps auritus*) – Casual. A single bird was observed daily off of North Bight Beach from 24 May through 30 May.

Black-footed Albatross (*Diomedea nigripes*) – Uncommon offshore. One bird was seen from North Bight Beach.

Laysan Albatross (*Phoebastria immutabilis*) – Common offshore. Birds were seen from North Bight Beach and Main Talus when looked for, especially during strong south winds and most likely are often visible from land in small numbers.

Northern Fulmar (*Fulmarus glacialis*) – Common breeder. Nests in small colonies at East Cape, Kittiwake Lane, and Spike Camp. Almost all birds are dark morphs, but at least one light morph individual was seen at Kittiwake Lane.

Short-tailed Shearwater (*Puffinus tenuirostris*) – Common Offshore. Seen from shore occasionally.

Leach's Storm-Petrel (*Oceanodroma leucorhoa*) – Abundant breeder. Nests in burrows and crevices over most of the island.

Fork-tailed Storm-Petrel (*Oceanodroma furcata*) – Abundant breeder. Nests sympatrically with Leach's Storm-Petrel.

Pelagic Cormorant (*Phalacrocorax pelagicus*) – Common breeder. Nests on sea facing cliffs around the island.

Red-faced Cormorant (*Phalacrocorax urile*) – Uncommon Breeder. Nests in low numbers on sea facing cliffs. Two nests were monitored near Kittiwake Lane and several additional nests were observed at East Cape.

Black-crowned Night-Heron (*Nycticorax nycticorax*) – Casual. A total of four carcasses were collected, one on 25 May in South Marsh and three on 7 June in North Marsh and near Glissade Valley. All four carcasses were either in or near streams.

Great Egret (*Ardea alba*) – Accidental. Two carcasses were found, one on 25 May near Whale Pond in South Marsh and one on 28 May in the creek draining South Marsh. Both specimens belonged to the old world form based on the all-dark bill.

Intermediate Egret (*Egretta intermedia*) – Accidental. One carcass was found on a grassy hill near South Marsh on 30 May. The specimen was in excellent shape and represents the first North American record of the species. The specimen was sent to the University of Alaska Fairbanks, where it was prepared as a study skin by Dan Gibson; it was catalogued as UAM 22603.

Greater White-fronted Goose (*Anser albifrons*) – Accidental. First found on 3 June in North Marsh and seen again the following day. A week later it was seen briefly flying over South Marsh. Small size of the bird suggested Lesser White-fronted Goose, but overall appearance of bill and head more characteristic of the Greater. This is the first record of the species for Buldir Island.

Bean Goose (*Anser fabalis*) – Casual. One individual observed on 3 June and again on 4 June in North Marsh. On 8 June, three individuals were present in North Marsh and stayed at least until 11 June. A single bird was seen flying over North Marsh on 8 August.

Cackling Goose (*Branta hutchinsii leucopareia*) – Abundant breeder. Eggs were floated from 33 nests and 24 June was determined to be the mean hatch date. Goslings were first observed on 10 June. Peak flight feather molt occurred in late July. The following color banded geese were re-sighted, including date and location: Blue 55C, 9 June, North Marsh; Green -74, 18 June, behind Spike Camp cabin; Blue 370, 11 August, Main Talus; Blue 888, 23 August, Bean Goose Pond.

Mallard (*Anas platyrhynchos*) – Very rare. Up to two drakes were observed throughout the end of May and into the middle of June. Birds were found in North and South Marsh.

Green-winged Teal (*Anas crecca*) – Rare. Birds were present throughout the season with a maximum of two pairs. Birds were mainly found in North Marsh, South Marsh and Bean Goose Lake. No nest or broods were observed in 2006 and the species was nearly absent during the middle and end of summer.

American Wigeon (*Anas americana*) – Very rare migrant. Up to two drakes were present in North Marsh and Bean Goose Lake from the end of May to the middle of June.

Eurasian Wigeon (*Anas penelope*) – Rare migrant. Birds were present from 24 May into the middle of June, mainly dabbling in North Marsh, Bean Goose Lake and off of North Bight Beach. The maximum count for the season was six.

Northern Pintail (*Anas acuta*) – Rare migrant. Present from 24 May until the middle of June, with a high count of two pairs.

Northern Shoveler (*Anas clypeata*) – Rare migrant. One male and one female were present from 24 May until the middle of July; occasionally the pair was seen together. Both birds frequented North Marsh, Bean Goose Lake, and the waters off of North Bight Beach.

Tufted Duck (*Aythya fuligula*) – Rare migrant. Present from 24 May until the end of June. Most often seen off of North Bight Beach and occasionally at Bean Goose Lake. The high count was three males and one female.

Greater Scaup (*Aythya marila*) – Rare migrant. A pair was observed from the end of May until the middle of July, frequenting the waters off of North Bight Beach.

Common Eider (*Somateria mollissima*) – Fairly common breeder. Nest found with three eggs along West Gull Slide. On 16 June saw first ducklings. Additionally, two COEI counts were conducted from N. Bight Beach to Kittiwake Lane on 12 July and 22 July; 29 and 23 total individuals were tallied, respectively, including ducklings, females and males. During circumnavigation on 7 June, 57 individuals (males and females) were tallied.

White-winged Scoter (*Melanitta fusca*) – Very rare. A pair was seen flying from North West Ridge on 10 June. Another female was seen from Spike Camp on 1 July. A single male flew past the lower blind at Main Talus on 27 July. A dead bird was found on Pinnacle Beach near Kittiwake Lane on 9 August.

Harlequin Duck (*Histrionicus histrionicus*) – Fairly common. Seen in large groups from the end of May until the middle of June with up to twenty birds. After two weeks of absence, groups were noted again by the end of July with up to fifteen birds.

Common Goldeneye (*Bucephala clangula*) – Casual. On 14 June one female noted diving off of North Bight Beach.

Common Merganser (*Mergus merganser*) – Casual. Several dead birds were found in North Marsh during the end of May with approximately ten individuals.

Red-breasted Merganser (*Mergus serrator*) – Rare migrant. Seen in low numbers throughout the end of May and middle of June, mainly off of North Bight Beach.

Bald Eagle (*Haliaeetus leucocephalus*) – Rare breeder. Nested up along the canyon from South Marsh. The nest contained two young on 12 June. Adults and at least one sub-adult were seen throughout the island.

Peregrine Falcon (*Falco peregrinus*) – Fairly common breeder. Up to three birds were present around Camp Valley and Main Talus throughout the end of July. A pair was also observed at Peregrine Point throughout the summer.

Sandhill Crane (*Grus canadensis*) – Casual. One individual was observed at the top of the pass between Glissade and Gentle Valleys on 27 and 28 July.

Semipalmated Plover (*Charadrius semipalmatus*) – Casual. First seen on 15 June and present for about a week on North Bight Beach and along Northwest Ridge Beach.

Lesser Sand Plover (*Charadrius mongolus*) – Casual. Two birds observed at Northwest Ridge Beach on 21 June and 25 June and one was seen in the same location on 29 June.

Common Sandpiper (*Actitis hypoleucos*) – Very rare migrant. Single individuals observed on 2 June along North Bight Beach and on 12 June at Spike Camp Beach. One bird observed on 19 August at North Bight Beach. Two birds were present on North Bight Beach from 21 August through 30 August.

Gray-tailed Tattler (*Tringa brevipes*) – Very rare migrant. One bird was observed on 24 and 25 May with Wandering Tattlers along Tattler Creek. One bird was seen with Wandering Tattlers on 8 August at North Bight Beach.

Wandering Tattler (*Tringa incana*) – Rare migrant. Up to four individuals were present at Tattler Creek on 25 May. Pairs and individuals were observed from 24 May through the middle of June along North Bight Beach and Tattler Creek. Up to three individuals were observed along North Bight Beach from the end of July until the end of August.

Wood Sandpiper (*Tringa glareola*) – Rare migrant. Seen from 24 May until the middle of June with a high count of ten birds in South Marsh. Lower numbers were found in June in North and South Marsh. One bird was found at Spike Camp on 15 July and seen again at Spike Camp on 18 July and 23 July. One bird was seen in South Marsh on 21 August.

Whimbrel (*Numenius phaeopus*) – Casual. One present at North Bight Beach from 10 June until at least 15 June, belonging to the Asiatic race *variegates*.

Ruddy Turnstone (*Arenaria interpres*) – Rare migrant. Individuals sporadically present at North Bight Beach from 25 May until 16 June. One bird seen on North Bight Beach on 19 July. A single bird was seen on 29 July along North Bight Beach. Several were noted along North Bight Beach at the beginning of August with a high count of three individuals.

Dunlin (Calidris alpina) – Casual. On 25 August one individual was seen scooping up worms along Tattler Creek near North Bight Beach.

Long-toed Stint (*Calidris subminuta*) – Very rare. One individual seen in South Marsh on 24 May. Another individual was seen on 13 July until 17 July at Tattler Creek. One bird in South Marsh on 21 August. Two birds were seen at Spike Camp on 22 August.

Red-necked Stint (*Calidris ruficollis*) – Casual. One individual seen near Crested Point on 10 June.

Little Stint (*Calidris minuta*) – Casual. One juvenile was seen along North Bight Beach on 24 July.

Temminck's Stint (*Calidris temminckii*) – Casual. One individual on North Bight Beach on 20 and 21 August.

Ruff (*Philomachus pugnax*) – Casual. A juvenile was seen in South Marsh on 21 August.

Common Snipe (*Gallinago gallinago*) – Very rare. Up to three birds were found in South Marsh at the beginning of June. Individuals were present at the same location from the end of May into the middle of June.

Black-headed Gull (*Larus ridibundus*) – Casual. One individual was seen on 26 May near Kittiwake Lane. Up to two birds were observed from the end of May until the middle of June along North Bight Beach.

Glaucous-winged Gull (*Larus glaucescens*) – Abundant breeder. On 16 June noted first chicks. On 28 July the first flying fledge of the season was noted at Spike Camp. Fledges were abundant this year with groups of 10-15 birds from North Bight Beach to KWL.

Slaty-backed Gull (*Larus schistisagus*) – Casual. A second year bird was present at North Bight Beach and Camp Valley throughout the end of May and into the middle of June. Another probable first year bird was seen one day at the end of May. An adult plumaged bird bred near Crested Point and was paired with a Glaucous-winged Gull.

Black-legged Kittiwake (*Rissa tridactyla*) – Abundant breeder. Black-legged kittiwakes nested in large colonies at East Cape, Kittiwake Lane, Spike Camp, Peregrine Point, and Middle and Outer Rocks. Many cases of siblicide observed with larger chicks actively seen pecking at smaller chicks.

Red-legged Kittiwake (*Rissa brevirostris*) – Abundant breeder. This kittiwake, the less abundant of the two species, nested in large colonies sympatrically with Black-legged Kittiwakes.

Parasitic Jaeger (*Stercorarius parasiticus*) – Common breeder. Mostly dark phase individuals were observed with an occasional light morph early in the summer, probably being migrants. A nest containing two eggs was found on extra plateau on 21 June. The first juvenile of the year was seen flying with two adults on 6 August along North Bight Beach.

Common Murre (*Uria aalge*) – Abundant breeder. Common Murres nested sympatrically with Thick-billed Murres, but in much smaller numbers.

Thick-billed Murre (*Uria lomvia*) – Abundant breeder. This species nested in large colonies at East Cape, Kittiwake Lane, Spike Camp and on Middle and Outer Rocks. On 2 August, a 25-day old chick stole a squid from the adult delivering it to a nearby nest sight of a 21-day old chick. The pair realized that the chick was not theirs and pecked at it, but it managed to eat the squid and run back to its nest. Also, on 2 August, a 5-day old chick was fed a large squid that it could not eat and as the parents tried to feed the squid to the chick they knocked it off of the cliff.

Pigeon Guillemot (*Cepphus columba*) – Common breeder. Pigeon Guillemots were regularly seen just offshore around the island. Juvenile birds were first noted on 9 August. In addition to circumnavigation counts, two PIGU counts were conducted from N. Bight Beach to Kittiwake Lane on 12 July and 22 July; a total of 12 individuals and 21 individuals were tallied, respectively.

Ancient Murrelet (*Synthliboramphus antiquus*) – Abundant breeder. Although seen only occasionally during the day, this species nested on Buldir in large numbers. Many chicks seen on 13 July between Main Talus and Crested Point. Chicks were also noted at Spike Camp on 15 July. During the circumnavigation on 7 June, tallied 32 individuals.

Cassin's Auklet (*Ptychoramphus aleuticus*) – Common breeder. Cassin's Auklet was encountered only during nighttime hours; a few were captured by mist net at Crested Point. Two food loads were collected while collecting whiskered auklet food at Crested Point.

Parakeet Auklet (*Aethia psittacula*) – Abundant breeder. Parakeet Auklets nested in talus at Northwest Ridge, Spike Camp Valley, and in smaller numbers at Main Talus and Crested Point.

Least Auklet (*Aethia pusilla*) – Abundant breeder. This auklet, the second most abundant on Buldir, seems to be most common on Main Talus and near Spike Camp.

Whiskered Auklet (*Aethia pygmaea*) – Abundant breeder. This nocturnal auklet was found nesting at monitoring sites at Northwest Ridge, Main Talus, and Crested Point. A few individuals were also captured while mist-netting for parakeet auklets at Spike Camp.

Crested Auklet (*Aethia cristatella*) – Abundant breeder. Two aggregations were observed of nesting birds: one at Main Talus and the other above Spike Camp.

Tufted Puffin (*Fratercula cirrhata*) – Abundant breeder. This species nested on grassy and rocky slopes around the island.

Horned Puffin (*Fratercula corniculata*) – Abundant breeder. Horned Puffins nested most commonly in crevices at Main Talus and the Spike Camp area.

Common Cuckoo (*Cuculus canorus*) – Casual. One individual seen on 6 June along the beach near Crested Point.

Short-eared Owl (*Asio flammeus*) – Casual. One individual was seen in North Marsh on 6 and 7 June.

Tree Swallow (*Tachycineta bicolor*) – Casual. One individual observed on 28 May in Camp Valley; was most likely this species, even though only seen briefly; no white rump was noted.

Bank Swallow (*Riparia riparia*) – Accidental. One observed in Camp Valley and around the cabin on 30 June.

Winter Wren (*Troglodytes troglodytes*) – Abundant breeder. This species was most common along coastal areas. Fledglings first appeared on 31 June.

Eyebrowed Thrush (*Turdus obscurus*) – Casual. Two males observed in South Marsh on 24 May and stayed until at least 26 May. A single male was observed in Glissade Valley on 30 May. Another single male was seen in South Marsh on 10 June.

Red-flanked Bluetail (*Tarsiger cyanurus*) – Casual. One female seen in Glissade Valley on 8 June.

Yellow Wagtail (*Motacilla flava*) – Very rare migrant. Four birds seen at North Bight Beach on 24 May and a single bird seen in North Marsh on 30 May, all belonging to the Asiatic race *simillima*.

On 2 June an individual male was seen in North Marsh belonging to the Alaskan race *tschutschensis*.

Gray Wagtail (*Motacilla cinerea*) – Casual. One individual seen along North Bight Beach on 24 May.

American “Buff-bellied” Pipit (*Anthus rubescens japonicus*) – Casual. One individual flew over Camp several times in late May.

Song Sparrow (*Melospiza melodia*) – Abundant breeder. On 29 May, a nest was found with three eggs.

Lapland Longspur (*Calcarius lapponicus*) – Abundant breeder. Fledges were first noted on 20 July.

Snow Bunting (*Plectrophenax nivalis*) – Common Breeder. Mostly found along higher elevations. Fledges seen on 2 August.

Gray-crowned Rosy Finch (*Leucosticte arctoa*) – Abundant breeder. Fledges were first seen during the middle of July.

Common Redpoll (*Carduelis flammea*) – Casual. Seven birds seen in Glissade Valley on 31 May.

Brambling (*Fringilla montifringilla*) – Very rare migrant. Seen from the end of May through the end of June with a maximum of two birds present at different locations; seen as noted here: one at Camp Valley on 30 May, a singing male at Spike Camp on 8 June, two in Glissade Valley on 8 June, two singing males at Spike Camp on 11 June, and two singing males in Glissade Valley on 15 June.

Marine Mammals

Sea Otter (*Enhydra lutris*) – On 17 August, one individual swam by Spike Camp Beach eating a large fish.

Orca (*Orcinus Orca*) – Four (one male and three females) seen off of Kittiwake Lane on 5 June and four (one male and three females) seen from Main Talus on 10 June. A baby orca washed up on North Bight Beach on 4 July. It was 289cm in length and its maximum girth was 178cm. On 1 August two females with two calves were observed diving off of North Bight Beach around 1000 hours for about 15 minutes. A group of four (two females & two calves) were seen off of Northwest Ridge on 31 July in the afternoon and in the evening (around 2230 hours) six were seen off of Main Talus. The whales were scattered and appeared to be feeding. At least one male and three females were seen. Two females and two calves were again seen off of North Rocks on 3 August.

Sperm Whale (*Physeter macrocephalus*) – Two individuals were seen from Main Talus on both 10 June and 15 June.

Steller Sea Lion (*Eumetopias Jubatus*) – Thirty individuals were counted hauled out at the rookery on the SE side of Buldir on 7 June. One female was seen off of Main Talus on 10 June and on 15 June. Six individuals were seen and heard off of the beach at Spike Camp around dusk on 9 July. Sub-adult male seen near the shore at Kittiwake Lane on 12 July. One individual was observed surfing the large swells off of Spike Camp Beach on 14 July. Four individuals were seen close to shore along Spike Camp Beach on the evening of 17 July. One individual was seen off of Main Talus on 17 July. Approximately fifteen individuals were seen and heard off of Spike Camp Beach during the evening of 27 July. A female swam along North Bight Beach on 8 August.

Harbor Seal (*Phoca vitulina*) – Four adults and two pups were seen hauled-out along the beach between Petrel Valley Creek and North Rocks on 12 July. Single individuals were seen along the north side beaches throughout the summer. A group of six was seen in the evening east of North Rocks on 3 August.