

BIOLOGICAL MONITORING AT BULDIR ISLAND, ALASKA IN 2005: SUMMARY APPENDICES



Eric M. Andersen and Meredith A. Barrett

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

U.S. Fish and Wildlife Service
Aleutian Islands Unit
Alaska Maritime National Wildlife Refuge
95 Sterling Highway
Homer, Alaska
99603

October 2006

Cite as: Andersen, E. M. and M. A. Barrett. 2005. Biological monitoring at Buldir Island, Alaska in 2005: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 06/12. Homer, Alaska. 135 pp.



Photo: Slade Saporra

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.....	1
STUDY AREA	1
METHODS	3
ACKNOWLEDGMENTS.....	3
LITERATURE CITED and SELECTED REFERENCES	3
Leach's storm-petrels	
Reproductive performance	5-8
Food habits	9-11
Fork-tailed storm-petrels	
Reproductive performance	12-15
Food habits	16-18
Unspecified storm-petrels	
Reproductive performance	19-22
Pelagic cormorant	
Reproductive performance	23-24, 26
Red-faced cormorant	
Reproductive performance	25-26
Glaucous-winged gull	
Reproductive performance	27-28
Clutch size	28
Food habits	29-32
Black-legged kittiwake	
Breeding chronology.....	33-34
Reproductive performance	35-38
Populations	39-46
Food habits	47-49
Red-legged kittiwake	
Breeding chronology.....	50-51
Reproductive performance	52-53
Populations	54-60
Food habits	61-63
Thick-billed murre	
Breeding chronology.....	64-66
Reproductive performance	67-69
Populations	70-75
Common murres	
Breeding chronology.....	76
Reproductive performance	77
Pigeon guillemot	
Populations	77
Least auklet	
Breeding chronology.....	78-79
Reproductive performance	80-81
Food habits	82-84
Crested auklet	
Breeding chronology.....	85-86
Reproductive performance	87-88
Food habits	89-91
Whiskered auklet	
Breeding chronology.....	92-93
Reproductive performance	94-96
Food habits	97-99

Parakeet auklet	
Breeding chronology.....	100-101
Reproductive performance	102-104
Food habits	105-107
Tufted puffin	
Breeding chronology.....	108-109
Reproductive performance	110-111
Food habits	112-115
Horned puffin	
Breeding chronology.....	116-117
Reproductive performance	118-119
Food habits	120-123
Terrestrial birds	
Off-Road Point Count	124-125
Sea otters.....	126
Sea Surface Temperature.....	127-129
Annotated list of species observed in 2005	130-135

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 murre (*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 AMNWR's nine monitoring sites, have been studied annually since 1988 when intensive season-long monitoring began. However, historical data exist from as early as 1974, particularly for storm-petrels and auklets, and these are used for comparison purposes. Buldir is 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 2005 were to estimate: 1) reproductive success indices for 15 seabird species, 2) breeding chronology for kittiwakes, puffins, auklets and murre, 3) population indices for storm-petrels, kittiwakes and murre, 4) food habits data for storm-petrels, kittiwakes, auklets, and puffins, and 5) survival data for adult red-legged kittiwakes.

Detailed results of the 2005 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 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°C in the summer and 3.7°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 *Elymus-umbel*, *Elymus-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, a 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: Four USFWS observers were present on Buldir from 29 May through 27 August 2005. Erik Andersen served as camp leader and was assisted by Trevor Joyce, Meredith Barrett, and Aaron Stoertz. Paul Regular conducted research on auklet biology and was present for most of the season. Dr. Ian Jones, Sampath Seneviratne, and Chris and Cari Eggleston worked on various auklet-related projects during the first 10 days of the season.

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

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. Corey Van Stratt worked on producing the report by patiently adding revised figures. Finally, we would like to thank the crew of the M/V *Tiglax* for safe transport to and from the island.

LITERATURE CITED AND SELECTED REFERENCES

- Bailey, E.P. 1993. Introduction of foxes to Alaskan islands- history, effects on avifauna, and eradication. U.S. Fish and Wildl. Serv Resource Publ. 193. Washington D.C. 53 pp.
- Byrd, G.V. 1972. Notes of the Buldir Island expedition - 30 June thru 08 July 1972. U.S. Fish and Wildl. Serv. Rep. Adak, Alas. 12 pp.
- Byrd, G.V. 1978. Birds of Buldir Island, Alaska with notes on abundance and nesting chronology. U.S. Fish and Wildl. Serv. Rep. Adak, Alas. 132 pp.
- Byrd, G.V. 1984. Vascular vegetation of Buldir Island, Aleutian Islands, Alaska compared to another Aleutian Island. *Arctic* 37:37-48.
- Byrd, G.V., and L.A. Climo. 1988. The status of ledge-nesting seabirds in the western Aleutian Islands, Alaska in summer 1988. U.S. Fish and Wildl. Serv. Rep. Adak, Alas. 63 pp.
- Byrd, G. V., and R.H. Day. 1986. The avifauna of Buldir Island, Aleutian Islands, Alaska. *Arctic* 39:109-118.
- Byrd, G.V., and H.D. Douglas. 1989. The status of ledge-nesting seabirds at monitoring sites in the Aleutian Islands, Alaska in 1989. U.S. Fish and Wildl. Serv. Rep. Adak, Alas. 62 pp.
- Byrd, G.V., and J.C. Williams. 1994. Buldir Island, Alaska: a major monitoring site for seabirds. *Beringian Seabird Bulletin* 2:29
- Coats R.R., 1953. Geology of Buldir Island, Aleutian Islands, Alaska. Geological Survey Bull. 989-A. Washington, D.C.
- Corbett, D.G., C. Lefevre, T. J. Corbett, D. West, and D. Siegel-Causey. 1997. Excavations at KIS-008, Buldir Island: evaluations and potential. *Arctic Anthropology* 34:100-117.

- Cooney, R.T. 1981. Bering sea zooplankton and micronecton communities with emphasis on annual production. In: Hood, D.W., Calder, J.A. (eds) the eastern Bering Sea shelf: oceanography and resources, Vol. 1. Office of Marine Pollution Assessment, NOAA, Juneau, pp 947-974.
- Day, R.H., B.E. Lawhead, T.J. Early, and E.B. Rhode. 1980. Results of bird and mammal surveys of the western Aleutians - Summer 1979. U.S. Fish and Wildl. Serv. Rep. Adak, Alas. 140 pp.
- Dragoo, D.E., and G.V. Byrd. 1999. Seabird, Marine Mammal, and oceanography Coordinated Investigations at Buldir Island, Aleutian Islands, Alaska, July 1988 (SMMOCI-98-3). U.S. Fish and Wildl. Serv. Rep. AMNWR 99/05. Homer Alas. 72 pp.
- Dragoo, D.E., G.V. Byrd, and D.B. Irons. 2000. Breeding success and population trends of selected seabirds in Alaska in 1999. U.S. Fish and Wildl. Serv. Rep. AMNWR 00/02 61 pp.
- Evans, T.J., D.M. Burn, A.R. Degange. 1997. Distribution and relative abundance of sea otters in the Aleutian Archipelago. U.S. Fish and Wildl. Serv. Tech. Rep. MMM 97-5. Anch, Alas.
- Hipfner, J.M., J.C. Williams, and G.V. Byrd. 1991. The status of kittiwakes and murrelets at Agattu and Buldir Islands 1988-1990. U.S. Fish and Wildl. Serv. Rep. Adak, Alas. 69 pp.
- Jones, R.D. 1963. Buldir Islands, site of a remnant breeding population of Aleutian Canada geese. Wildfowl Trust 14th Ann. Rep. 1961-62, pp80-84
- Kenyon, K.W. 1969. The sea otter in the eastern Pacific ocean. No. Am. Fauna, No. 68. U.S. Fish and Wildl. Serv. Washington, D.C. 352 pp.
- Knudtson, E.P., and G.V. Byrd. 1982. Breeding biology of crested, least, and whiskered auklets on Buldir Island, Alaska. Condor 84:197-202.
- Lefevre, C., and D. Siegel-Causey. 1993. First report of bird remains from Buldir Island, Aleutian Islands, Alaska. Archaeofauna 2:83-96.
- Lefevre, C. D.G. Corbett, D. Siegel-Causey. 1997. A zooarchaeological study at Buldir Island, Western Aleutians, Alaska. Arctic Anthropology 34:118-131.
- Moore, H, P. Kappes, and M. Grinnell. Biological monitoring at Buldir Island, Alaska in 2001: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 01/11 Adak, Alas. 36 pp.
- Springer, A.M, J.F. Piatt, and G. Van Vliet. 1996. Seabirds as proxies of marine habitats and food webs in the western Aleutian Arc. Fish. Oceanogr. 5:45-55.
- Trapp, J.L. 1979. Variation in summer diet of Glaucous-winged gulls in the western Aleutian Islands: an ecological interpretation. Wilson Bulletin 91:412-419.
- Williams, J.C., and G.V. Byrd. 1992. The status of kittiwakes and murrelets at Agattu and Buldir Islands 1988-1991. U.S. Fish and Wildl. Serv. Rep. Adak, Alas. 68 pp.
- Williams, J.C., J.B. Fischer, L.J. Meehan, and M.A. Ortwerth. 1997. The status of kittiwakes and murrelets at Buldir Island, Alaska in 1995. U.S. Fish and Wildl. Serv. Rep. AMNWR 97/04. Adak, Alas. 55 pp.
- Williams, J.C., L.J. Meehan, J.B. Fischer, and L.M. Scharf. 1997. Seabird monitoring at Buldir Island, Alaska in 1996: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 97/08. 73 pp
- Williams, J.C., M. Ortwerth, and N. Rojek. 1998. Biological monitoring at Buldir Island, Alaska in 1997: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 98/05 Adak, Alas. 184 pp.
- Williams, J.C., J. Fischer, A. Palmer. 2001. Biological monitoring at Buldir Island, Alaska in 1998: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 99/03. Adak, Alas. 132 pp.
- Williams, J.C., and J. Daniels. 2001. Biological monitoring at Buldir Island, Alaska in 1999: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 01/15. Adak, Alaska. 103pp.
- Williams, J.C., L. Scharf, and G.V. Byrd. 2002. Ecological monitoring methods of the Aleutian Islands Unit, Alaska Maritime National Wildlife Refuge. U.S. Fish and Wildl. Serv. Rep. AMNWR 00/01v.2. Adak Alas. 351 pp

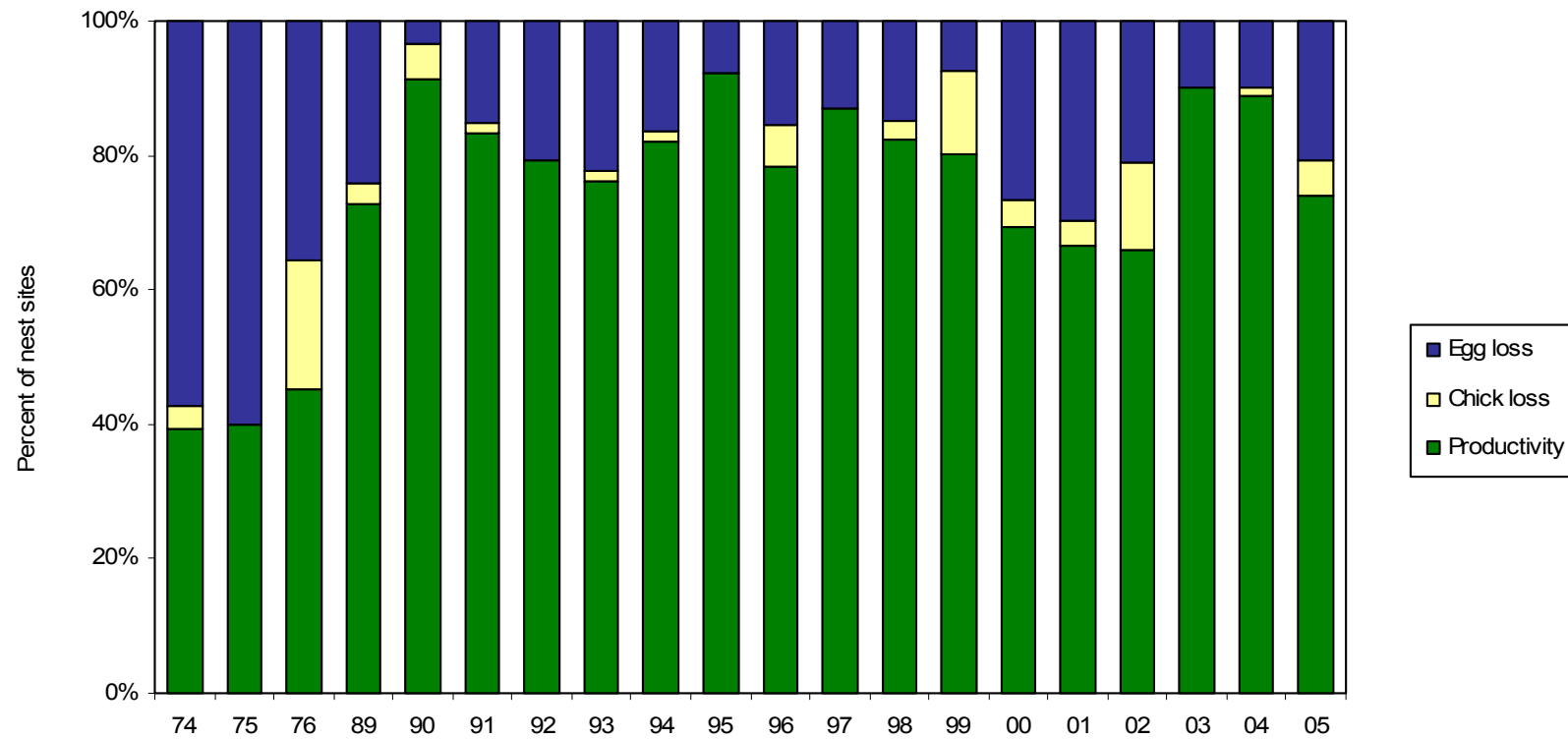


Figure 1. Reproductive performance of Leach's storm-petrels at Buldir Island, Alaska. These values represent the maximal reproductive potential. Actual values were undoubtedly lower. $\text{Egg loss} = (C - D) / C$; $\text{Chick loss} = (D - E) / C$; $\text{Productivity} = E / C$, where C = number of 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
Burrows with known contents (A)	308	277	282	265	304	189	285	116	283	222
Occupied burrows (B)	89	90	52	91	75	56	85	45	93	81
Eggs with known fate (C)	78	77	40	66	75	54	85	40	81	77
Eggs lost to disappearance	12	6	2	1	7	14	7	2	6	10
Eggs lost to abandonment	0	2	1	4	4	0	9	0	0	3
Eggs lost to breakage	0	2	0	0	2	2	0	2	2	1
Eggs remaining at last visit (unknown fate) ^a	10	7	14	17	7	1	2	0	4	2
Chicks (D)	66	67	34	61	55	38	67	36	73	61
Chicks lost to disappearance ^b	4	0	0	2	3	2	8	0	1	4
Chicks lost to death	1	0	1	6	0	0	3	0	0	2
Chicks potentially successful (E)	61	67	33	53	52	36	56	36	72	57
Chicks disappeared at unknown age or >55d	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
Occupancy rate (B/A)	0.29	0.32	0.18	0.34	0.25	0.30	0.30	0.39	0.33	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
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
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

^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, 2005.

Parameter	Plot					All Plots	SD
	1	2	3	4	7		
Burrows with known contents (A)	31	58	31	48	54	222	
Occupied burrows (B)	6	22	7	18	28	81	
Eggs with known fate (C)	5	21	6	18	27	77	
Eggs lost to disappearance	0	2	1	2	5	10	
Eggs lost to abandonment	0	0	0	0	3	3	
Eggs lost to breakage	1	0	0	0	0	1	
Eggs remaining at last visit (unknown fate) ^a	1	1	0	0	0	2	
Chicks (D)	4	17	5	16	19	61	
Chicks lost to disappearance ^b	0	1	1	1	1	4	
Chicks lost to death	0	0	0	0	2	2	
Chicks potentially successful (E)	4	17	4	15	17	57	
Chicks disappeared at unknown age or >55d	0	0	0	0	0	0	
Chicks still present at last visit	4	17	4	15	16	57	
Occupancy rate (B/A)	0.19	0.38	0.27	0.38	0.52	0.37	0.05
Hatching success (D/C)	0.80	0.81	0.83	0.89	0.70	0.79	0.04
Fledging success (E/D) ^c	1.00	1.00	0.80	0.94	0.90	0.93	0.03
Reproductive success (E/C) ^c	0.80	0.81	0.67	0.83	0.63	0.74	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.

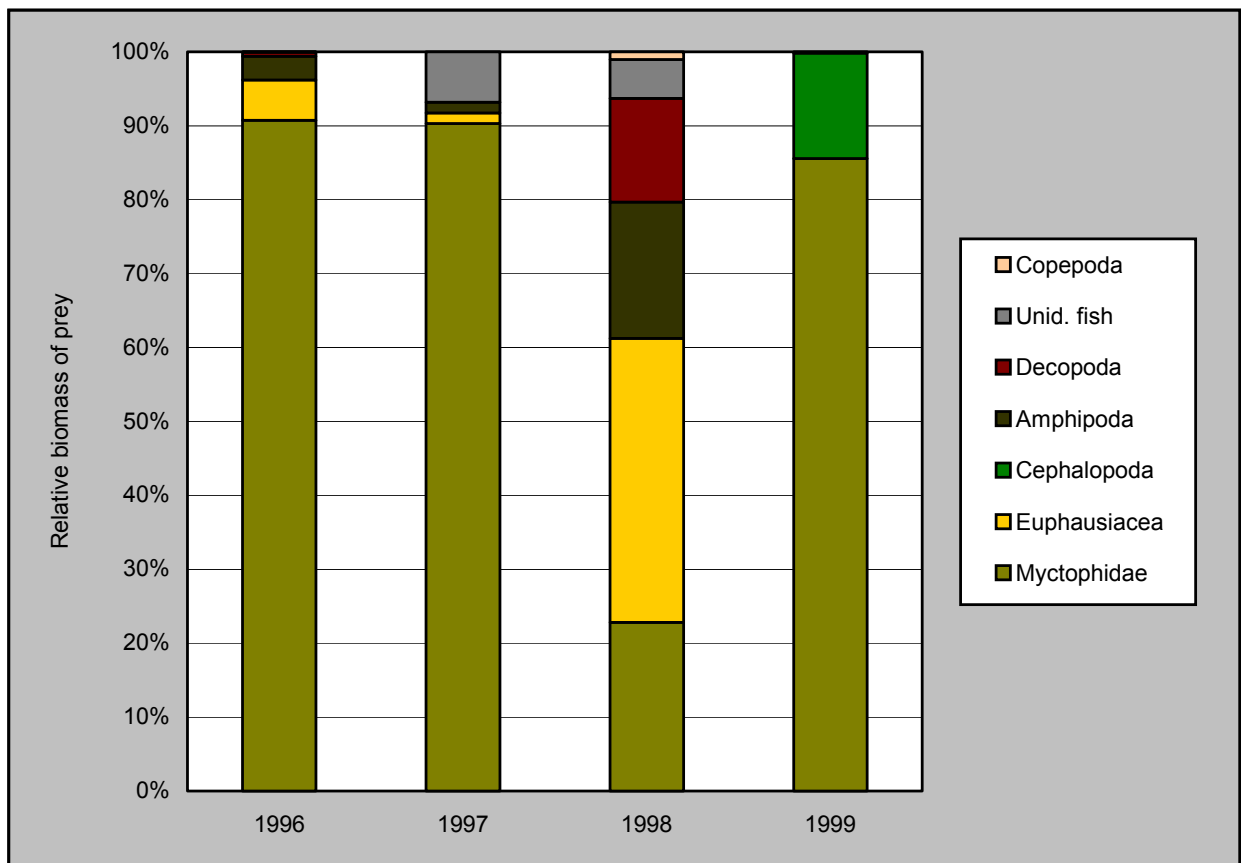


Figure 2. Relative biomass of prey in diets of Leach's storm-petrels at Buldir Island, Alaska.

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
No. samples	15	16	5	1
Total mass (g)	55.1	146.8	5.7	10.5
Cephalopoda				
Gonatidae				14.3
Copepoda				
<i>Neocalanus cristatus</i>	<0.1		1.1	
Amphipoda				
Unid Amphipod				0.2
Hyperiidea				
<i>Hyperoche medusarum</i>	0.2			
<i>Parathemisto pacifica</i>	0.1			
Gammaridea				
Lysianassidae	2.9	1.5	17.5	
Unid. Gammarid			0.9	
Euphausiacea				
<i>Thysanoessa</i> 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				
<i>Stenobrachius leucopsarus</i>		33.7	22.8	
Myctophid, not <i>S. leucopsarus</i>		15.7		
Unid. Myctophidae ^a	90.7	40.9		85.6
Unid. fish		6.8	5.3	

^aMost, if not all, of the unidentified myctophids are probably *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
No. samples	15	16	5	1
Cephalopoda				
Gonatidae				100.0
Copepoda				
<i>Neocalanus cristatus</i>	6.7		20.0	
Amphipoda				
Unid. Amphipod				100.0
Hyperiidea				
<i>Hyperoche medusarum</i>	20.0			
<i>Parathemisto pacifica</i>	20.0			
Gammaridea				
Lysianassidae	20.0	43.8	60.0	
Euphausiacea				
<i>Thysanoessa</i> 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				
<i>Stenobrachius leucopsarus</i>		25.0	20.0	
Myctophid, not <i>S. leucopsarus</i>		6.3		
Unid. Myctophidae ^a	73.3	56.3		100.0
Unid. fish		6.3	20.0	

^aMost, if not all, of the unidentified myctophids are probably *Stenobrachius leucopsarus*.

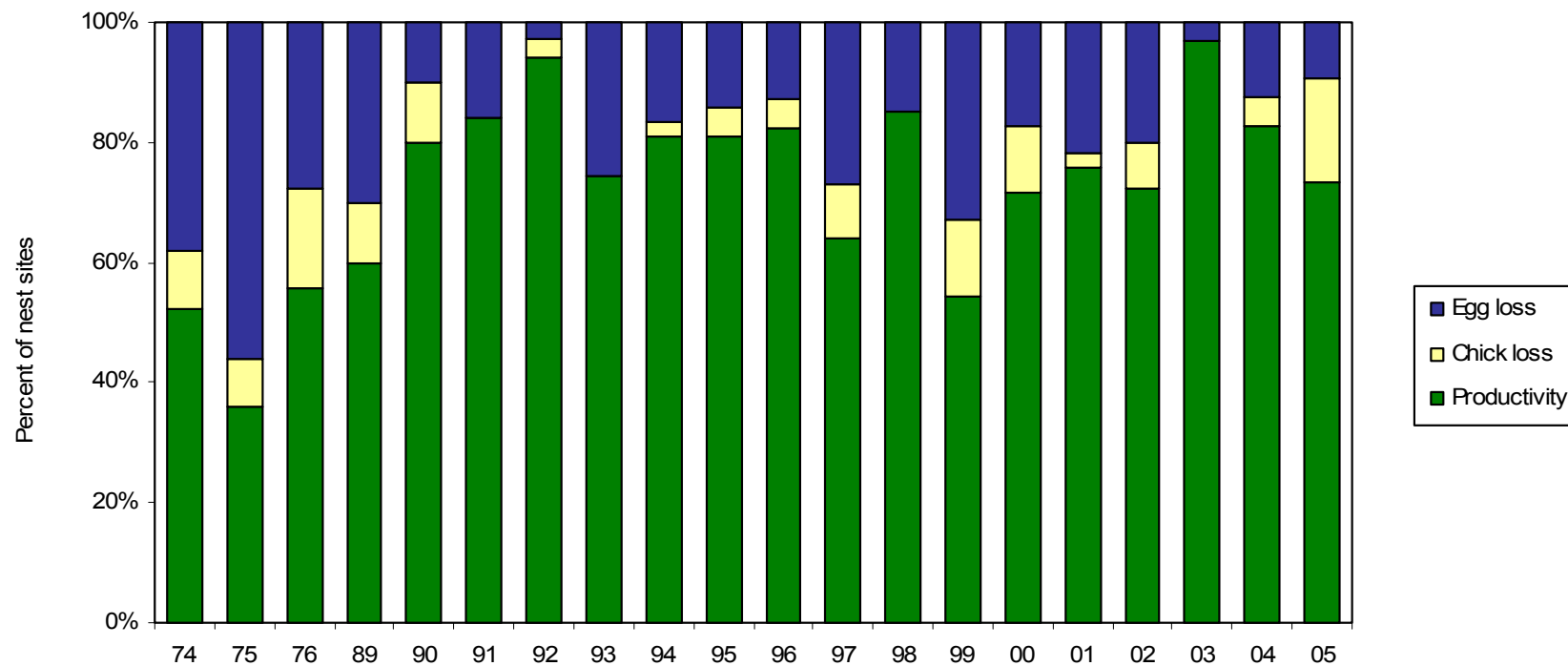


Figure 3. Reproductive performance of fork-tailed storm-petrels at Buldir Island, Alaska. These values represent the maximal reproductive potential. Actual values were undoubtedly lower. Egg loss= $(C-D)/C$; Chick loss= $(D-E)/C$; Productivity= E/C , where C=number of eggs, D=number of eggs hatched, 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
Burrows with known contents (A)	308	277	282	265	304	189	285	116	283	222
Occupied burrows (B)	90	69	81	75	81	42	78	38	69	66
Eggs with known fate (C)	85	67	74	70	81	41	65	31	64	64
Eggs lost to disappearance	2	1	2	17	0	0	5	0	6	4
Eggs lost to abandonment	0	3	0	0	5	3	2	1	0	1
Eggs lost to breakage	9	14	9	6	8	5	6	0	2	0
Eggs remaining at last visit (unknown fate) ^a	5	2	4	1	1	0	0	0	0	0
Chicks (D)	74	49	63	47	67	32	52	30	56	58
Chicks lost to disappearance	3	1	0	5	7	1	3	0	0	8
Chicks lost to death	1	5	0	4	2	0	2	0	3	4
Chicks potentially successful (E)	70	43	63	38	58	31	47	30	53	47
Chicks disappeared at unknown age or >55d	65	42	58	38	48	31	40	20	9	4
Chicks still present at last visit	5	1	5	0	10	0	7	8	44	43
Occupancy rate (B/A)	0.29	0.25	0.21	0.28	0.27	0.22	0.27	0.33	0.24	0.30
Hatching success (D/C)	0.87	0.73	0.85	0.67	0.83	0.78	0.80	0.97	0.88	0.91
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
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

^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, 2005.

Parameter	Plot					All Plots	SD
	1	2	3	4	7		
Burrows with known contents (A)	31	58	31	48	54	222	
Occupied burrows (B)	12	12	13	17	12	66	
Eggs with known fate (C)	11	12	12	17	12	64	
Eggs lost to disappearance	1	0	0	2	1	4	
Eggs lost to abandonment	1	0	0	0	0	1	
Eggs lost to breakage	0	0	0	0	0	0	
Eggs remaining at last visit (unknown fate) ^a	0	0	0	0	0	0	
Chicks (D)	9	12	12	15	10	58	
Chicks lost to disappearance ^b	0	0	3	4	1	8	
Chicks lost to death	0	2	0	0	2	4	
Chicks potentially successful (E)	9	10	9	11	8	47	
Chicks disappeared at unknown age or >55d	0	0	2	1	1	4	
Chicks still present at last visit	9	10	7	10	7	43	
Occupancy rate (B/A)	0.39	0.21	0.42	0.35	0.22	0.30	0.04
Hatching success (D/C)	0.82	1.00	1.00	0.88	0.83	0.91	0.04
Fledging success (E/D) ^c	1.00	0.83	0.75	0.73	0.80	0.81	0.04
Reproductive success (E/C) ^c	0.82	0.83	0.75	0.65	0.67	0.73	0.04

^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.

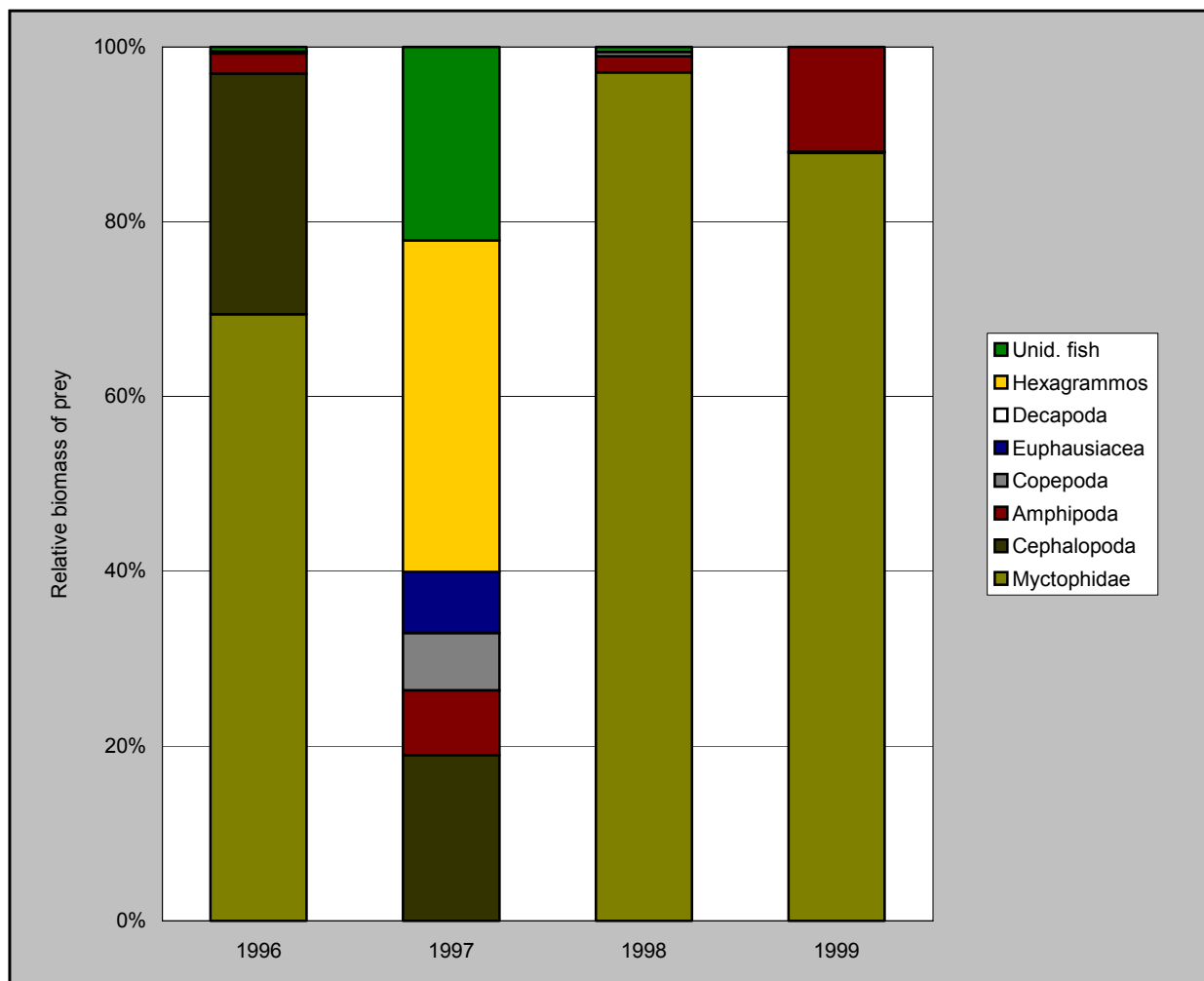


Figure 4. Relative biomass of prey in diets of fork-tailed storm-petrels at Buldir Island, Alaska.

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				
<i>Neocalanus plumchrus</i>	0.2	4.2	0.5	
Amphipoda				
Unid. Amphipod				12.0
Hyperiidea				
<i>Hyperoche medusarum</i>	<0.1			
<i>Parathemisto pacifica</i>	0.1			
Gammaridea				
Lysianassidae	2.3	4.7	1.9	
Euphausiacea				
<i>Thysanoessa</i> spp.		4.4		
Decapoda				
Shrimp zoea	<0.1			
Fish				
Myctophidae				
<i>Stenobrachius leucopsarus</i>		8.1	97.1	
Unid. Myctophidae ^a	69.4	28.2		87.9
<i>Hexagrammos</i> spp.		24.2		
Unid. fish	0.5	14.1	0.6	

^aMost, if not all, of the unidentified myctophids are probably *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				
<i>Neocalanus plumchrus</i>	15.4	28.6	16.7	
Amphipoda				
Unid. Amphipod				50.0
Hyperiidea				
<i>Hyperoche medusarum</i>	7.7			
<i>Parathemisto pacifica</i>	15.4			
Gammaridea				
Lysianassidae	46.2	57.1	50.0	
Euphausiacea				
<i>Thysanoessa</i> spp.		14.3		
Decapoda				
Shrimp zoea	7.7			
Unid. Crustacea		14.3		
Fish				
Myctophidae				
<i>Stenobrachius leucopsarus</i>		14.3	100.0	
Unid. Myctophidae ^a	76.9	42.9		100.0
<i>Hexagrammos</i> spp.		14.3		
Unid. fish	7.7	28.6		
(Plastic - not prey)		14.3	33.3	

^aMost, if not all, of the unidentified myctophids are probably *Stenobrachius leucopsarus*.

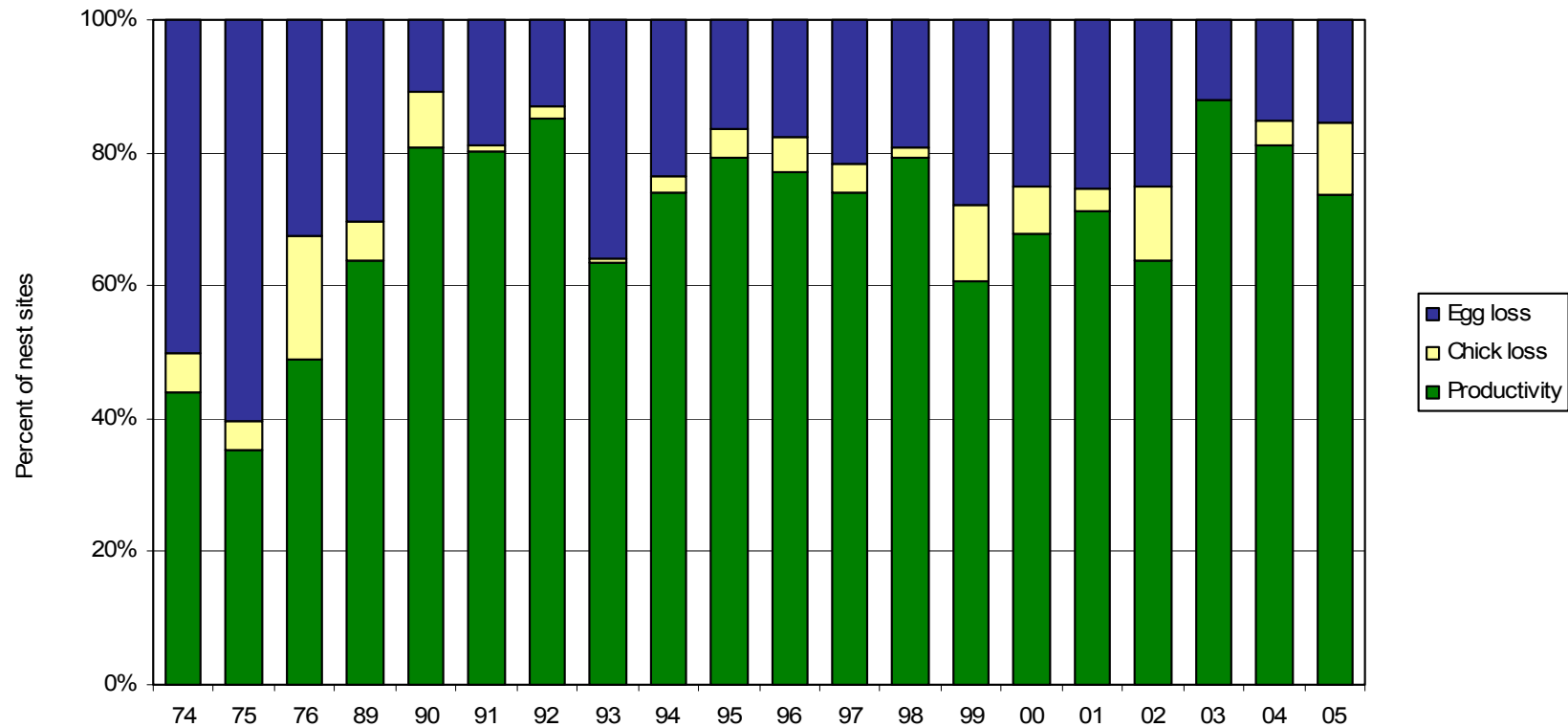


Figure 5. Reproductive performance of storm-petrels (Leach's, fork-tailed and unknown species) at Buldir Island, Alaska. These values represent the maximal reproductive potential. Actual values were undoubtedly lower. Egg loss= $(C-D)/C$; Chick loss= $(D-E)/C$; Productivity= E/C , where C=number of eggs, 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)	0.50	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
Burrows with known contents (A)	308	277	282	265	304	189	285	116	283	222
Occupied burrows (B)	190	168	149	182	164	103	191	94	185	147
Eggs with known fate (C)	170	153	125	150	164	94	179	75	158	141
Eggs lost to disappearance	26	25	14	11	18	19	19	3	15	14
Eggs lost to abandonment	4	3	10	31	5	0	19	1	0	5
Eggs lost to breakage	0	5	0	0	10	5	4	5	9	1
Eggs remaining at last visit (unknown fate) ^a	17	9	20	16	8	1	3	0	5	2
Chicks (D)	140	120	101	108	123	70	134	66	134	119
Chicks lost to disappearance ^b	7	1	0	7	10	3	12	0	1	12
Chicks lost to death	2	6	2	13	2	0	8	0	5	6
Chicks potentially successful (E)	126	111	91	91	101	67	107	58	128	104
Chicks disappeared at unknown age or >55d	5	2	5	0	10	0	7	8	9	4
Chicks still present at last visit	131	113	99	91	111	67	114	66	119	99
Occupancy rate (B/A)	0.62	0.61	0.53	0.69	0.54	0.54	0.67	0.81	0.65	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
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
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

^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, 2005.

Parameter	Plot					All Plots	SD
	1	2	3	4	7		
Burrows with known contents (A)	31	58	31	48	54	222	
Occupied burrows (B)	18	34	20	35	40	147	
Eggs with known fate (C)	16	33	18	35	39	141	
Eggs lost to disappearance	1	2	1	4	6	14	
Eggs lost to abandonment	1	0	0	0	4	5	
Eggs lost to breakage	1	0	0	0	0	1	
Eggs remaining at last visit (unknown fate) ^a	1	1	0	0	0	2	
Chicks (D)	13	29	17	31	29	119	
Chicks lost to disappearance ^b	0	1	4	5	2	12	
Chicks lost to death	0	2	0	0	4	6	
Chicks potentially successful (E)	13	27	13	26	25	104	
Chicks disappeared at unknown age or >55d	0	0	2	1	1	4	
Chicks still present at last visit	13	27	11	25	23	99	
Occupancy rate (B/A)	0.58	0.59	0.65	0.73	0.74	0.66	0.04
Hatching success (D/C)	0.81	0.88	0.94	0.89	0.74	0.84	0.04
Fledging success (E/D) ^c	1.00	0.93	0.77	0.84	0.86	0.87	0.03
Reproductive success (E/C) ^c	0.81	0.82	0.72	0.74	0.64	0.74	0.04

^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
Total number of nests (A)	53	37	34	35	21	28	14	17
Date of maximum nest count	5 Jun	16 Jun	13 Aug	11 Jun	12 Jun	15 Jun	13 Jun	1 Aug
Total number of chicks (B)	23	-	61	25	13	36	17	13
Date of maximum chick count	19 Aug	-	13 Aug	2 Aug	19 Aug	9 Aug	10 Aug	5 Aug
Number of large chicks in nest:								
0	-	-	7	25	14	10	5	9
1	-	-	4	0	3	6	3	3
2	-	-	12	5	2	6	4	5
3	-	-	11	5	2	6	2	0
4	-	-	0	0	0	0	0	0
Number of nests with chicks (C)	-	-	27	10	7	18	9	8
Mean brood size (B/C)	-	-	2.3	2.5	1.9	2.0	1.9	1.6
SD	-	-	0.7	0.5	0.9	0.8	0.8	0.5
% of nests w/ chicks ((C/A)X100)	68.8 ^b	-	79.4	28.6	33.3	64.3	64.3	47.1
Productivity ^c (B/A)	1.4 ^b	-	1.8	0.9	0.6	1.3	1.2	0.8

^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 From a subsample of 16 nests.

^c Number of chicks present per nest, including empty nests.

Table 11 continued. Pelagic cormorant productivity at Buldir Island, Alaska.

Parameter		1997	1998	1999	2000	2001	2002	2003	2004	2005
Total number of nests (A)		22	29	24	48	64	66	73	79	63
Date of maximum nest count		25 May	22 Jun	24 Jun	6 June	10 Jun	16 Jun	13 Jun	27 Jun	8 Jun
Total number of chicks (B)		24	18	31	52	55	59	39	72	51
Date of maximum chick count		10 Aug	7 Aug	12 Aug	4 Aug	29 Jul	5 Aug	1 Aug	3 Aug	7 Aug
Number of chicks in nest ^a :	0	13	14	7	3	18	0	26	17	20
	1	0	0	2	8	9	9	8	2	4
	2	3	6	8	10	18	19	11	15	10
	3	6	2	5	0	3	4	3	12	4
	4	0	0	0	0	0	0	0	1	0
Number of nests with chicks (C)		9	8	15	25	33	32	22	30	23
Mean brood size (B/C)		2.7	2.3	2.2	2.1	1.8	1.8	1.7	2.4	2.2
SD		0.5	0.5	0.7	0.9	0.6	0.6	0.7	0.4	0.7
% of nests w/ chicks ((C/A)X100)		40.9	27.6	62.5	52.1	51.6	48.5	45.2	40.0	36.5
Productivity ^b (B/A)		1.1	0.6	1.3	1.1	0.9	0.9	0.5	0.9	0.37

^a On date of maximum chick count.

^b Number of chicks present per nest, including empty nests.

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

Parameter		2003	2004	2005
Total number of nests (A)		4	9	6
Date of maximum nest count		19 Jun	17 Jun	8 Jun
Total number of chicks (B)		5	11	7
Date of maximum chick count		25 Jun	3 Aug	2 Aug
Max. count of large chicks in nest ^a :	0	1	2	1
	1	1	1	1
	2	2	2	1
	3	0	2	1
Number of nests with chicks (C)		3	5	3
Mean brood size (B/C)		1.67	2.2	2.33
SD		0.60	0.8	0.57
% of nests with chicks ((C/AX100))		75.0	55.6	50.0
Productivity ^a (B/A)		1.25	1.22	0.50

^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 2005.

Date	No. nests	No. nests containing $\geq X$ chicks					No. nests	
		0	1+	2+	3+	4+	w/ chick	no. chicks
28 Jun	50	50	-	-	-	-	-	-
4 Jul ^a	57	55	2	-	-	-	2	2
15 Jul	41	35	2	4	-	-	6	10
25 Jul	40	30	1	7	2	-	10	21
2 Aug	39	22	5	7	5	-	17	34
7 Aug	39	20	4	10	4	-	19	37
15 Aug	36	17	6	10	4	-	19	37
23 Aug	36	21	4	9	2	-	15	28

^a Inactive nests were not monitored after 4 Jul.

Table 14. Red-faced cormorant productivity at Buldir Island, Alaska in 2005.

Date	No. nests	No. nests containing $\geq X$ chicks					No. nests	
		0	1+	2+	3+	4+	w/ chick	no. chicks
9 Jul	4	4	-	-	-	-	-	-
15 Jul	4	3	-	1	-	-	1	2
25 Jul	4	3	1	-	-	-	1	1
2 Aug	4	1	-	2	1	-	3	7
7 Aug	4	1	1	1	1	-	3	6
15 Aug	4	1	-	3	-	-	3	6
23 Aug	4	1	1	2	-	-	3	5

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

Parameter	1979 ^a	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total no. nests (A)	--	209	199	180	133	175	88	75	20	54	40	38	23	31	39
No. eggs in nest:															
0	0	49	66	49	82	40	63	18	17	11	6	9	0	5	15
1	1	28	26	15	5	15	6	8	0	3	3	2	2	3	4
2	10	48	35	40	20	35	10	26	2	10	12	4	1	4	4
3	56	84	72	75	26	85	9	22	1	30	19	23	13	15	16
4	0	0	0	1	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
n (B)	67	160	133	131	51	135	25	56	3	43	34	29	16	16	24
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
Max. no. eggs (C) ^b	--	376	312	324	123	340	53	126	7	113	84	81	53	69	60
Maximum no. chicks seen (D)	--	122	35	49	34	83	28	28	2	17	12	33	22	23	17
Chicks seen on last visit before fledging (E)	--	89	8	48	14	34	15	9	0	12	8	15	19	22	9
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
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
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
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
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

^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.

Parameter	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. nests (A) ^a	47	30	20	28	--	37	23	34	39
No. nests w/ ≥ 1 egg (B)	10	26	3	24	--	31	22	27	24
No. eggs (C)	22	58	7	63	--	89	56	78	60
No. nests ≥ 1 chick (D)	8	13	1	10	--	26	20	18	14
No. chicks (E)	14	21	2	18	--	57	38	38	17
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
Hatching success (E/C)	0.64	0.36	0.29	0.29	--	0.64	0.68	0.49	0.28
Mean hatch date	11 July	2 July	23 Jun	23 Jun	--	21 Jun	-- ^b	15 Jun	17 Jun
n	5	13	1	7	--	14	--	18	20
SD	2.2	3.4	--	6.2	--	6.4	--	7.4	4.7

^a Number of nests represents maximum number of nests during the season.

^b Hatch dates not calculated; chicks were present on the first visit.

Table 17. Clutch size of glaucous-winged gulls at Buldir Island, Alaska in 2005.

Date	No. nests	No. nests containing X eggs				Total No. eggs	No. chicks
		0	1	2	3		
1 Jun	34	13	3	3	15	54	0
4 Jun	36	15	4	4	13	51	0
8 Jun	37	16	4	3	14	52	0
13 Jun	39	23	1	5	10	41	4
19 Jun	37	25	5	3	5	23	10
28 Jun	36	31	2	1	1	7	9
4 Jul	33	30	2	1	0	4	6
15 Jul ^a	-	-	-	-	-	-	9

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

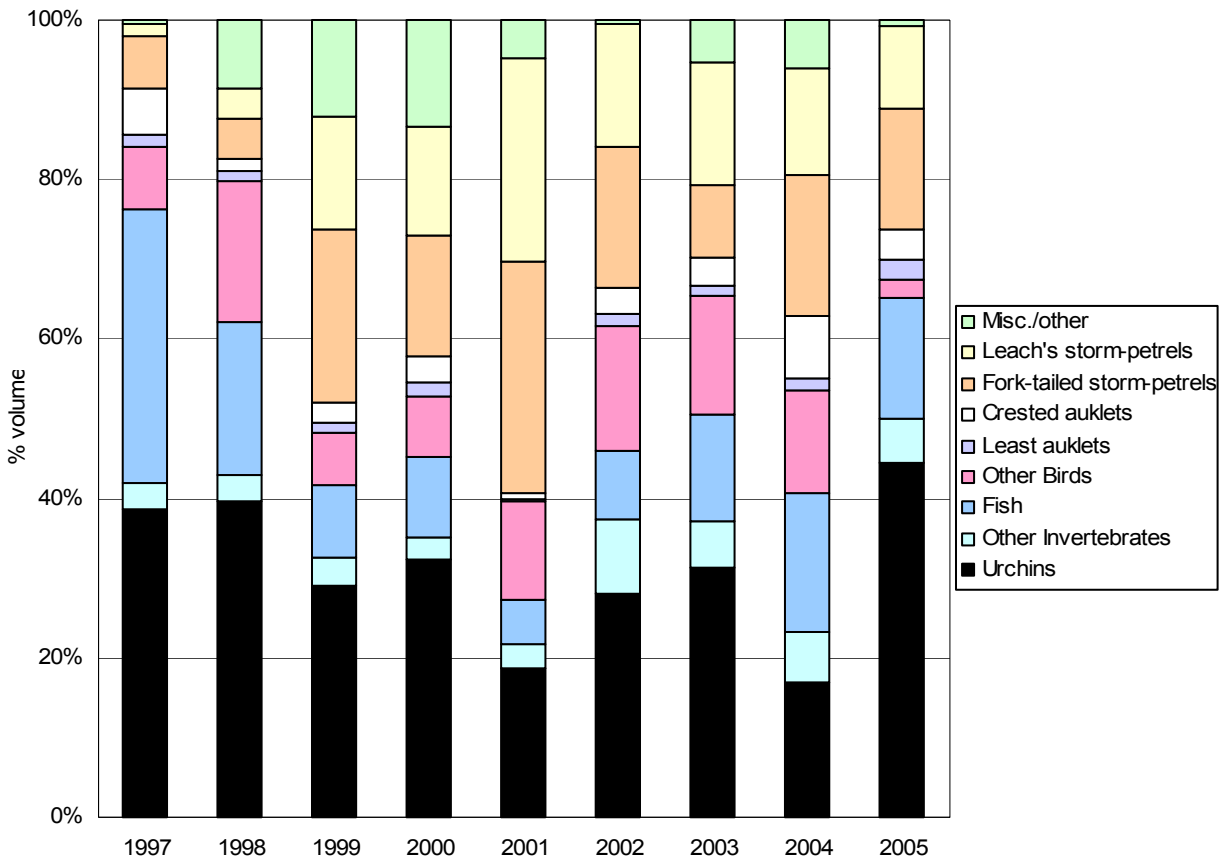


Figure 6. Percent volume of food items in regurgitated pellets of glaucous-winged gulls at Buldir Island, Alaska. Composite value for invertebrates does not include urchins. Composite value for birds is inclusive of all species except crested auklet, least auklet, fork-tailed storm-petrel, and Leach's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

Table 18. Occurrence of food items (%) in regurgitated pellets of glaucous-winged gulls at Buldir Island, Alaska in various years.

Food item sample size	1974-76 ^a 655	1997 158	1998 210	1999 505	2000 279	2001 281	2002 247	2003 660	2004 301	2005 552
Invertebrates^b	1.9	46.2	49.5	38.4	42.3	28.1	46.6	47.4	31.2	50.9
sea urchin	1.1	39.9	42.8	33.5	37.3	22.4	31.6	35.9	22.3	44.9
blue mussel	--	3.2	2.4	2.4	2.9	2.1	3.2	2.4	3.7	2.0
snail	--	0.6	1.0	0.2	1.1	0.4	4.0	0.5	--	--
limpet	--	1.3	--	1.0	0.4	1.8	4.5	6.7	1.3	4.0
chiton	--	--	1.9	0.2	0.4	--	0.8	--	3.7	--
crab	--	0.6	0.5	0.2	0.4	0.4	--	0.3	--	--
unid. bivalve	--	0.6	0.5	0.4	--	0.7	--	--	0.3	--
unid. shellfish	--	--	--	0.2	--	0.4	1.2	1.7	--	--
amphipod	--	--	--	0.2	--	--	0.4	--	--	--
beetle	--	--	--	0.2	--	--	--	--	--	--
unid. kelp fly	0.08	--	--	--	--	--	--	--	--	--
Euphausiid	--	--	--	--	--	--	0.8	--	--	--
Fish	19.5	36.1	21.4	11.3	12.2	6.4	13.8	18.3	25.2	15.4
<10 cm	--	8.9	10.0	6.5	2.5	1.8	6.1	12.1	9.3	0.7
10-20 cm	--	12.0	9.5	4.2	6.1	3.9	6.1	0.2	14.6	14.5
>20 cm	--	15.2	1.9	0.6	3.6	0.7	1.6	1.5	0.3	0.2
unknown size	--	--	--	--	--	--	--	4.5	0.7	--
Birds	79.2	24.1	31.9	48.5	44.8	70.1	60.7	48.9	59.5	34.4
crested auklet	2.9	6.3	1.0	2.4	3.6	0.7	4.0	3.8	8.6	4.0
least auklet	1.4	1.3	1.4	1.4	1.8	0.4	1.6	1.2	1.7	2.4
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
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	2.0	1.0	--
unid. sm. auklet	--	1.3	--	--	0.7	--	--	0.2	--	0.2
unid med. auklet	--	1.3	--	0.4	--	--	--	--	0.7	--
unid. auklet	1.4	3.8	0.5	0.4	0.7	0.7	3.6	--	1.0	--
fork-tailed storm-petrel	40.0	7.0	5.7	22.2	16.1	29.5	18.2	9.1	18.6	15.0
Leach's storm-petrel	20.0	1.3	3.8	15.4	14.3	26.3	16.2	16.1	14.3	10.3
unid. storm-petrel	0.8	1.9	4.8	2.2	--	--	2.0	1.5	--	--
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	--	--
Aleutian Cackling gosling	--	--	--	0.2	0.4	--	0.8	--	--	--
Aleutian Cackling eggs	--	--	--	--	--	--	--	1.2	--	--
unid. sm. bird	0.3	0.6	13.3	1.4	1.1	5.3	0.8	6.4	1.0	1.8
unid. bird eggs	1.7	--	--	2.0	--	1.4	4.0	1.2	4.0	0.4
glaucous-winged gull	--	--	--	--	--	0.4	--	--	--	--
gull eggs	--	--	--	--	--	--	--	1.4	--	--
Miscellaneous	6.8	1.3	10.0	18.0	21.5	1.4	1.6	8.3	15.9	1.1
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	2.0	7.4	13.0	0.9
pebbles	0.8	--	4.3	1.8	1.4	1.9	0.8	0.3	2.3	--
sea lion hair	3.5	--	--	--	--	--	--	--	--	--
plastic	--	--	--	--	2.9	--	2.0	0.2	0.3	--

^a From Trapp 1979

^b All values represent percent occurrence in total sample. Values in bold are composite totals for invertebrates, fish, birds, and miscellaneous.

Table 19. Percent volume of food in regurgitated pellets of glaucous-winged gulls along the north shore of Buldir Island, Alaska in various years.

Food item sample size	1997 158	1998 210	1999 505	2000 279	2001 281	2002 247	2003 660	2004 301	2005 552
Invertebrates^a	42.0	42.9	32.6	35.1	21.7	37.3	37.1	23.1	50.0
sea urchin	38.7	39.6	29.1	32.3	18.6	28.2	31.2	16.8	44.5
blue mussel	2.3	1.8	1.9	1.5	1.0	2.2	0.8	2.5	1.9
snail	<0.1	<0.1	0.2	1.1	<0.1	1.9	0.2	--	--
limpet	0.8	--	0.8	0.2	1.3	3.2	3.9	0.9	3.6
chiton	--	<0.1	0.2	0.1	--	0.6	--	2.9	--
crab	<0.1	<0.1	<0.1	<0.1	0.3	--	--	--	--
unid. bivalve	0.1	--	0.2	--	0.4	--	--	--	--
unid. shellfish	--	<0.1	<0.1	--	<0.1	0.4	0.9	--	--
amphipod	--	--	--	--	--	<0.1	--	--	--
beetle	--	--	<0.1	--	--	--	--	--	--
unid. kelp fly	--	--	--	--	--	--	--	--	--
euphausiid	--	--	--	--	--	0.8	--	--	--
Fish^b	34.3	19.3	9.0	10.0	5.6	8.8	13.3	17.5	15.1
<10 cm	7.4	9.9	4.8	1.6	1.0	4.8	9.4	5.4	0.5
10-20 cm	11.7	5.1	3.8	5.2	3.9	3.4	0.1	11.5	14.5
>20 cm	15.2	4.3	0.4	3.2	0.7	0.6	1.3	0.3	0.2
unidentified	--	--	--	--	--	--	2.4	0.4	--
Birds	23.1	29.2	46.2	41.5	67.9	53.6	44.4	53.1	34.1
crested auklet	6.0	1.4	2.4	3.3	0.7	3.5	3.6	8.0	4.0
least auklet	1.3	1.4	1.4	1.8	0.4	1.4	1.2	1.4	2.4
whiskered auklet	--	--	0.2	0.4	0.4	--	--	--	--
parakeet auklet	--	0.5	0.2	2.5	1.1	1.4	2.6	0.7	0.4
Cassin's auklet	--	0.5	--	0.4	--	--	0.8	--	--
ancient murrelet	--	0.5	0.2	2.7	4.0	6.2	2.0	0.9	--
unid. sm. auklet ^c	0.3	--	--	<0.1	--	--	--	--	0.2
unid. med. auklet ^c	0.6	--	0.4	--	--	--	--	0.6	--
unid. auklet	4.4	0.5	0.4	0.7	0.7	3.6	--	1.0	--
fork-tailed storm-petrel	6.7	5.2	21.7	15.1	29.0	17.5	9.0	17.4	15.0
Leach's storm-petrel	1.3	3.8	14.2	13.6	25.5	15.6	15.5	13.5	10.3
unid. storm-petrel	1.9	3.8	2.0	--	--	1.3	1.4	--	--
black-legged kittiwake	--	--	--	--	--	0.4	--	--	--
unidentified kittiwake	--	--	--	--	--	--	1.1	7.5	--
murre chick	--	--	--	--	--	--	--	0.3	--
tufted puffin	--	--	--	--	--	1.0	--	--	--
unidentified puffin	--	--	--	--	--	--	0.1	--	--
Aleutian Cackling gosling	--	--	0.2	0.4	--	0.5	--	--	--
glaucous-winged gull	--	--	--	--	<0.1	--	--	--	--
unid. sm. bird	0.6	11.0	1.3	0.7	5.0	0.1	4.3	0.4	1.6
gull egg	--	--	--	--	--	--	1.4	--	--
goose egg	--	--	--	--	--	--	1.0	--	--
unid. bird eggs	--	0.8	1.6	--	1.2	0.5	0.4	1.4	0.2
Miscellaneous	0.6	8.5	12.0	13.4	4.9	0.4	5.2	5.9	0.9
terrestrial vegetation	--	--	0.2	1.1	--	--	0.1	0.3	--
unid. marine algae	0.6	4.9	11.1	11.6	2.2	0.2	5.0	5.2	0.8
pebbles	--	3.6	0.7	0.6	2.7	<0.1	0.1	0.5	--
sea lion hair	--	--	--	--	--	--	--	--	--
plastic	--	--	--	0.2	--	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 552 regurgitated pellets of glaucous-winged gulls at Buldir Island, Alaska, 7 June-25 Aug 2005.

Food item	no. samples	min. no. birds/orgs.	% occurrence ^a
Invertebrates	281	418	50.9
sea urchin	248	248	44.9
blue mussel	11	80	2.0
snail	-	-	-
limpet	22	90	4.0
chiton	-	-	-
crab	-	-	-
unid. shellfish	-	-	-
unid. bivalve	-	-	-
Fish^b	85	85	15.4
<10 cm	4	4	0.7
10-20 cm	80	80	14.5
>20 cm	1	1	0.2
unk. size	-	-	-
Birds	190	190	34.4
crested auklet	22	22	4.0
least auklet	13	13	2.4
parakeet auklet	2	2	0.4
Cassin's auklet	-	-	-
ancient murrelet	-	-	-
unid. alcid	1	1	0.2
unid med. alcid	-	-	-
unid. kittiwake	-	-	-
murre chick	-	-	-
fork-tailed storm-petrel	83	83	15.0
Leach's storm-petrel	57	57	10.3
unid. sm. bird	10	10	1.8
unid. puffin	-	-	-
murre egg	2	2	0.4
goose egg	-	-	-
unid. egg	-	-	-
Miscellaneous	6	6	1.1
terr. plant material	1	1	0.2
kelp/sea weed	5	5	0.9
pebbles	-	-	-
plastic	-	-	-

^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 Regurgitated fish masses were not identifiable to species without sending samples to a lab. Most fish were large and were possibly Atka mackerel or Pacific cod.

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

^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).

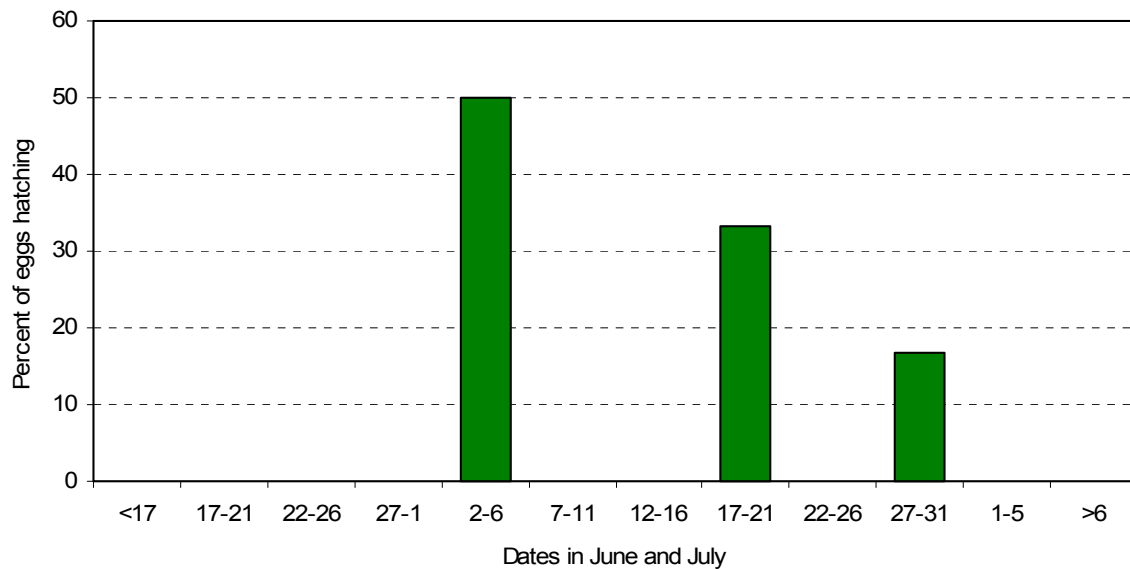


Figure 7. Hatching chronology of black-legged kittiwakes at Buldir Island, Alaska in 2005.

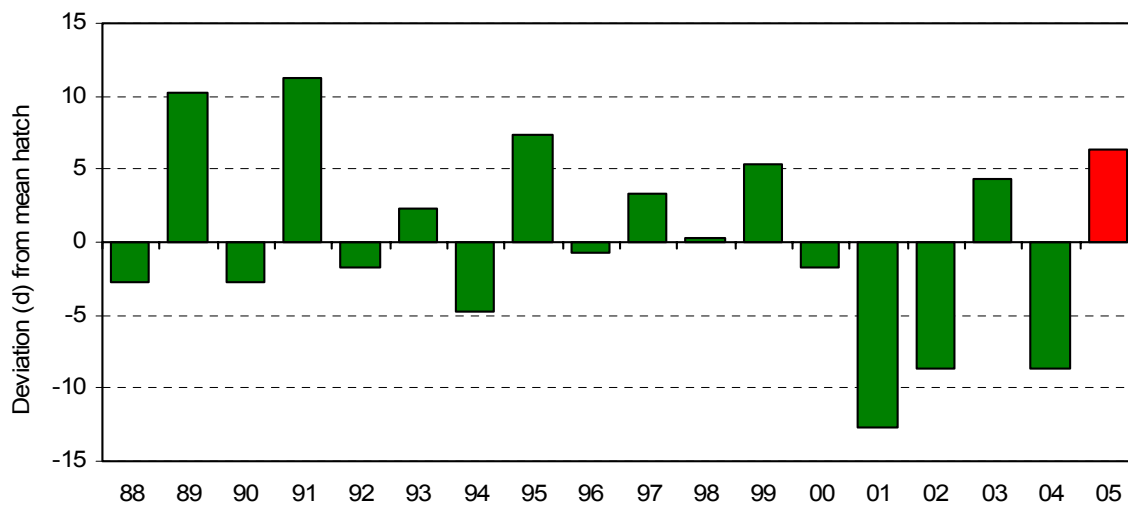


Figure 8. Yearly hatch date deviation (from the 1988-2004 average of 6 July) for black-legged kittiwakes at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

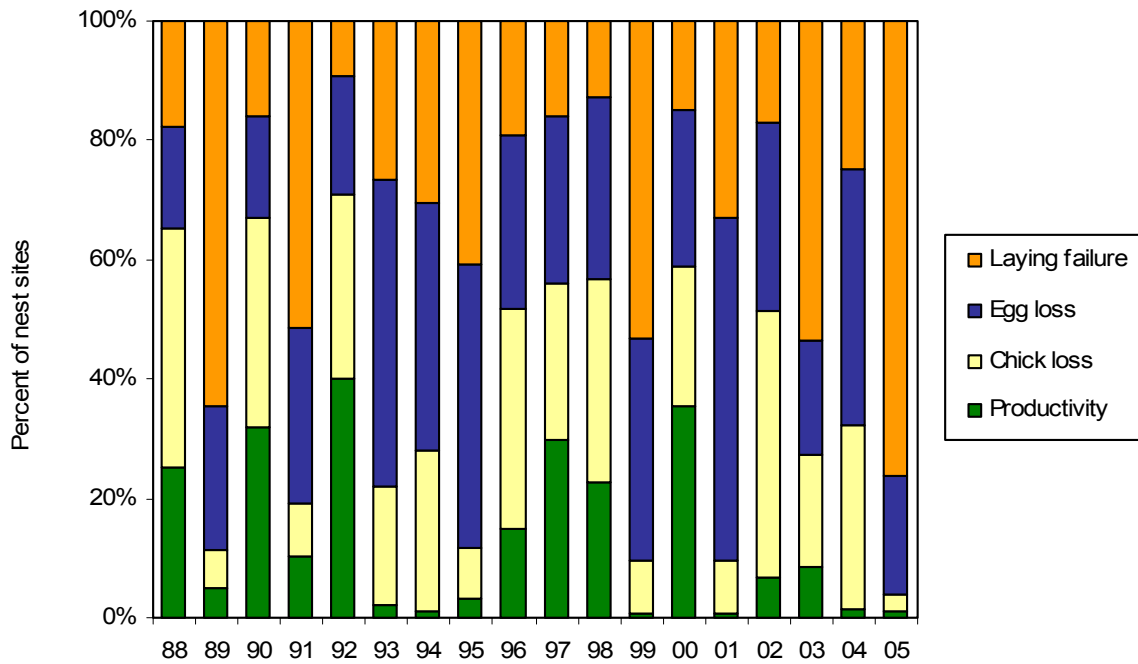


Figure 9. Reproductive performance of black-legged kittiwakes at Buldir Island, Alaska. Laying Failure= $(A-B)/A$; Egg Loss= $(B-D)/A$; Chick Loss= $(D-F)/A$; Productivity= F/A , where A=total number of nests; B=number of nests with ≥ 1 egg; D=number of nests with ≥ 1 chick; F=number of nests with ≥ 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 ^a	412	1.11	98	16	4	0.24	0.16	0.25	0.04	0.01

^a Two "Boom or Bust" plots were monitored at KWL in 2005. 60 nests were counted in two plots on 23 June. These nests were revisited on 7 Aug where a total of 5 chicks were counted. The number of chicks per nest (maximum possible productivity) for the two plots were 0.04 and 0.11.

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

	1976 ^a	1988	1989	1990	1991	1992	1993	1994	1995
mean	1.61	1.78	1.22	1.76	1.35	1.79	1.58	1.66	1.41
n ^b	74	462	220	761	350	462	391	323	213
0	-	-	-	-	-	-	-	-	145
1	-	-	-	-	-	-	-	-	126
2	-	-	-	-	-	-	-	-	87
3	-	-	-	-	-	-	-	-	0

^a Data from Byrd and Day (1986).

^b Nest sites used as sample units.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
mean	1.69	1.73	1.75	1.49	1.79	-	1.79	1.51	1.11	1.11
n ^b	344	415	244	237	324	-	299	99	239	412
0	82	78	36	126	48	-	51	114	69	360
1	107	111	64	57	59	-	54	49	75	40
2	236	304	178	54	216	-	193	50	95	12
3	1	0	2	0	1	-	1	0	0	0

^a Data from Byrd and Day (1986).

^b Nest sites used as sample units.

Table 24. Reproductive performance of black-legged kittiwakes on index plot at Buldir Island, Alaska, in 2005.

Parameter	Spike Camp Plots									total	n	mean	SD
	36	37A	37B	39D	40	41	42	45	46				
total nests (A)	23	51	21	59	39	37	70	71	41	412			
no. of nests with ≥ 1 egg (B)	8	11	3	11	5	19	0	30	11	98			
total eggs (C) ^a	9	12	4	11	5	21	0	33	14	109			
no. of nests with ≥ 1 chick (D)	1	0	0	0	0	2	0	11	2	16			
total chicks (E)	1	0	0	0	0	2	0	11	2	16			
no. of nests where ≥ 1 chick fledged (F)	0	0	0	0	0	0	0	4	0	4			
total chicks fledged (G)	0	0	0	0	0	0	0	4	0	4			
nests with 1 egg	6	0	2	8	5	15	0	3	1	40			
nests with 2 eggs	1	1	1	0	0	4	0	2	3	12			
nests with 3 eggs	0	0	0	0	0	0	0	0	0	0			
laying succ. (B/A)	0.35	0.22	0.14	0.19	0.13	0.51	0.00	0.42	0.27		9	0.24	0.06
clutch size (C/B)	1.13	1.09	1.33	1.00	1.00	1.11	0.00	1.10	1.27		9	1.11	0.03
nesting succ. (D/B)	0.13	0.00	0.00	0.00	0.00	0.11	0.00	0.37	0.18		9	0.16	0.07
hatching success (E/C)	0.11	0.00	0.00	0.00	0.00	0.10	0.00	0.33	0.14		9	0.15	0.07
chick succ. (G/E)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00		9	0.25	0.10
egg success (G/C)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00		9	0.04	0.03
fledging success (F/D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00		9	0.25	0.10
reproductive success (F/B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00		9	0.04	0.03
overall productivity (F/A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00		9	0.01	0.01

^aAll egg counts refer to minimum number of eggs possible.

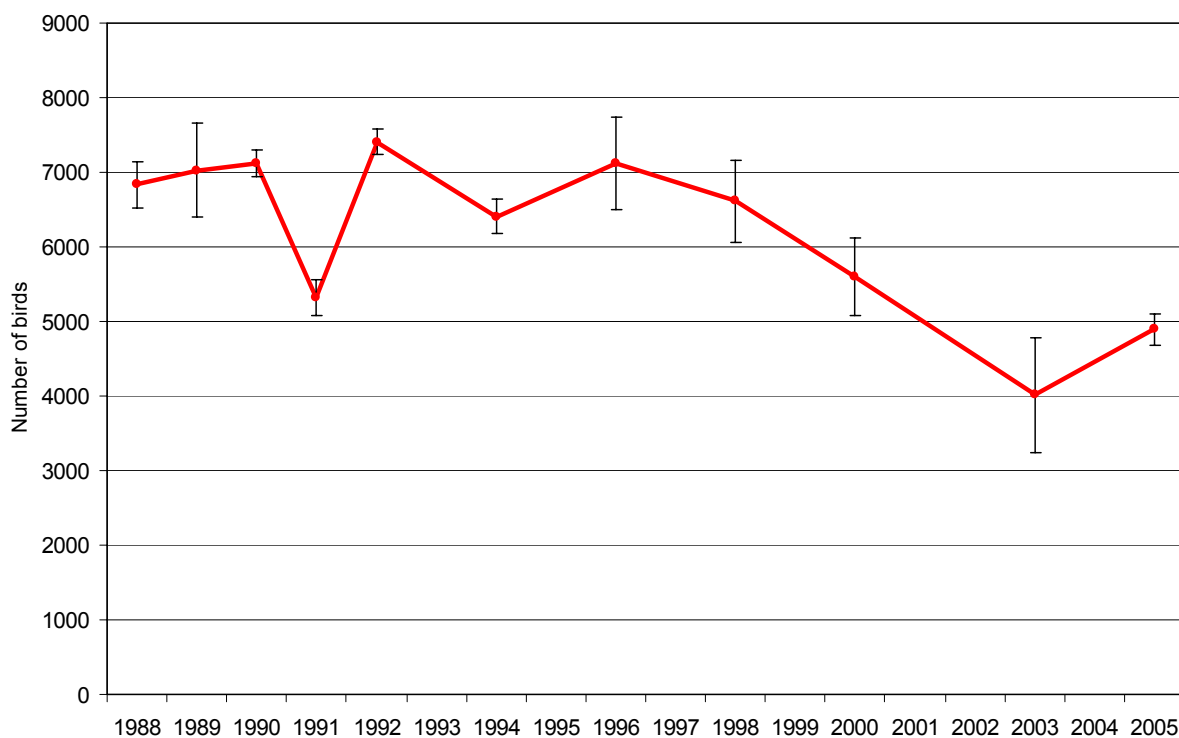


Figure 10. Counts of black-legged kittiwakes on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year.

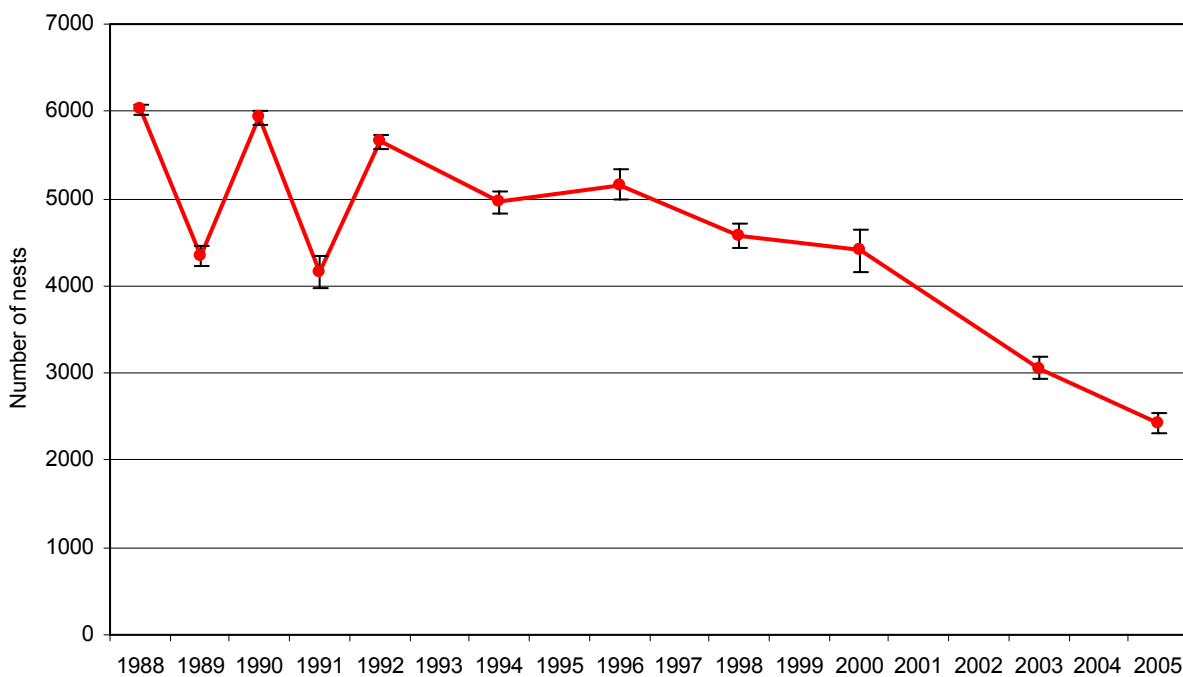


Figure 11. Counts of black-legged kittiwake nests on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year.

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					mean	SD	max.
	1	2	3	4	5			
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 (plots 15-18), 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					mean	SD	max.
	1	2	3	4	5			
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 (plots 15-18), KWLW is Kittiwake Lane West (plots 19-29).

^b Consists of all plots at The Dip and Kittiwake Lane combined.

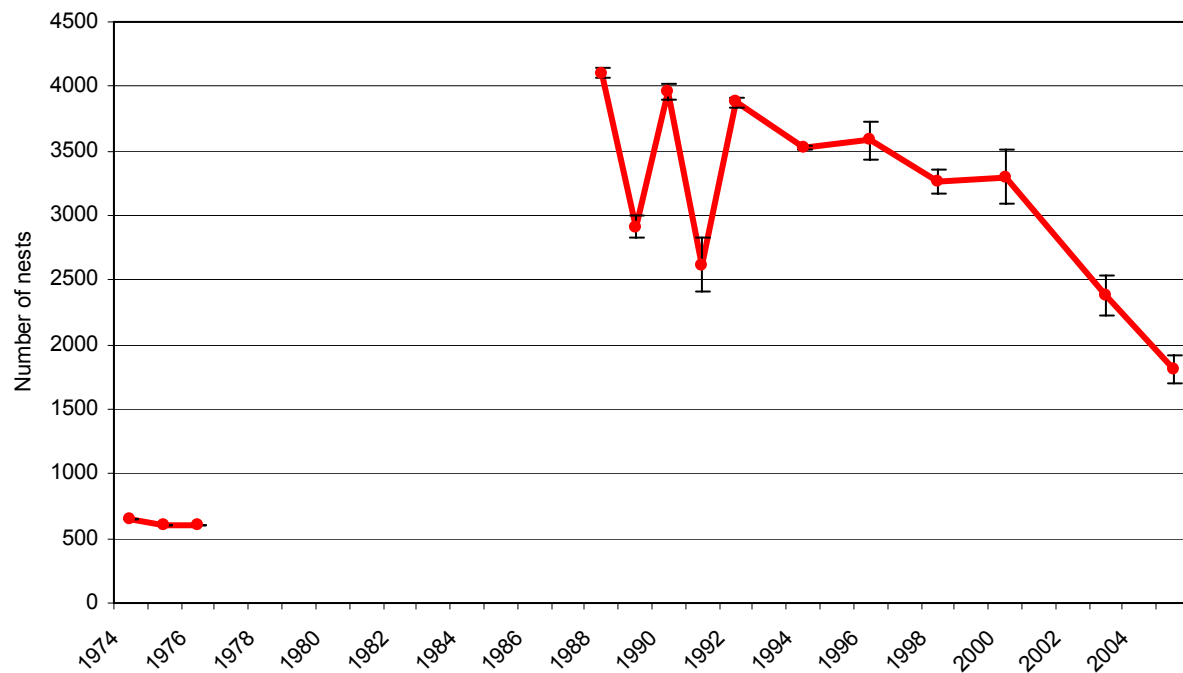


Figure 12. Counts of black-legged kittiwake nests at Kittiwake Lane, Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year. Note that the general trend at Kittiwake Lane from 1988 on mirrors that of the island counts in Fig. 11.

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.

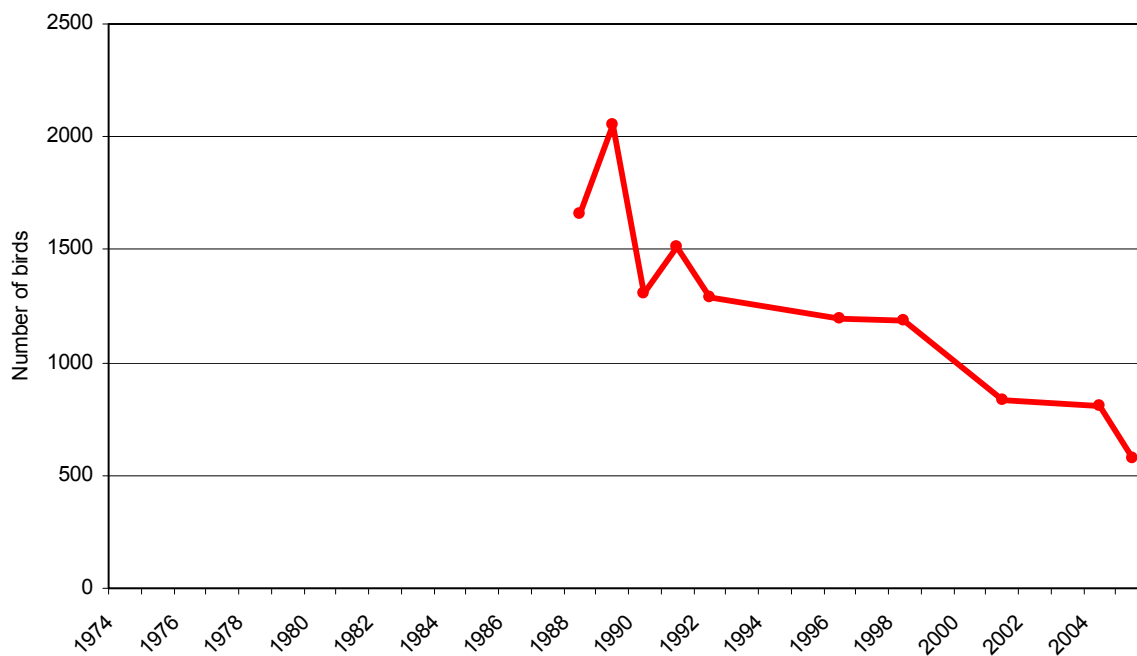


Figure 13. Counts of black-legged kittiwakes at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

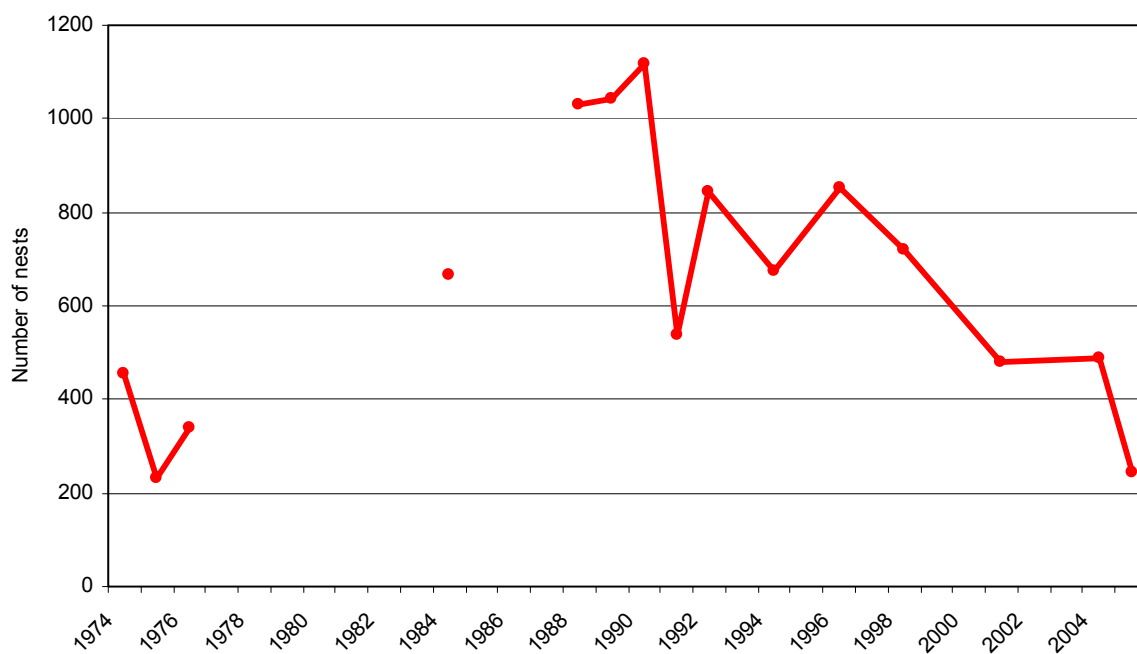


Figure 14. Counts of black-legged kittiwake nests at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

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

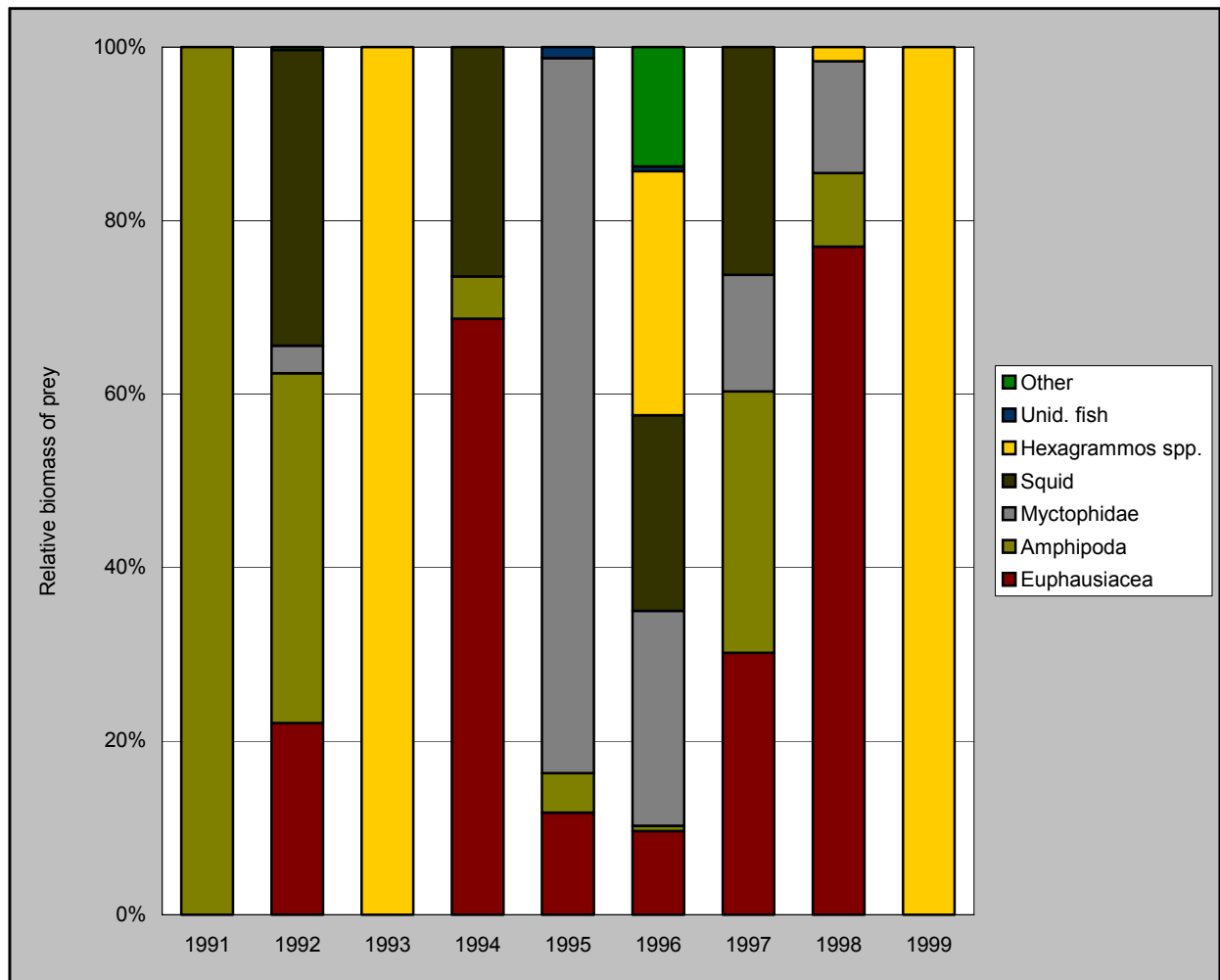


Figure 15. Relative biomass of prey in diets of black-legged kittiwakes at Buldir Island, Alaska.

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
No. samples	3	23	14	6	4	7	3	11	1
Total mass (g)	0.9	158.4	249.0	104.1	118.9	181.7	30.5	309.5	49.0
Cephalopoda - squid		34.1		26.4		22.6	26.2		
Copepoda									
<i>Neocalanus plumchrus</i>					2.3				
<i>N. cristatus</i>		2.4						8.2	
Amphipoda									
Hyperiidea									
<i>Parathemisto pacifica</i>		23.3		4.9	2.3	0.6	30.2	0.2	
<i>Parathemisto</i> spp.	43.2	13.0							
Gammaridea									
Lysianassidae	56.8	0.3				0.1		0.1	
Unid. Amphipoda		1.3							
Euphausiacea									
<i>Thysanoessa</i> spp.		22.1		68.7	11.8	9.6	30.2		
Unid. Euphausiid								77.0	
Decapoda - shrimp		0.3							
Fish									
Myctophidae									
<i>Stenobrachius leucopsarus</i>							13.4	12.9	
Unid. Myctophidae		3.2			82.4	24.8			
<i>Hexagrammos</i> 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
No. samples	3	23	14	6	4	7	3	11	1
Cephalopoda - squid		17.4		50.0		28.6	33.3		
Copepoda									
<i>Neocalanus plumchrus</i>					25.0				
<i>N. cristatus</i>		13.0						18.2	
Unid. Copepoda		4.3							
Amphipoda									
Hyperiidea									
<i>Parathemisto pacifica</i>		13.0		50.0	25.0	14.3	33.3	18.2	
<i>Parathemisto</i> spp.	33.3	17.4							
Gammaridea									
Lysianassidae	33.3	4.3				14.3		9.1	
Unid. Amphipoda		8.7							
Euphausiacea									
<i>Thysanoessa</i> spp.		47.8		83.3	25.0	14.3	33.3		
Unid. Euphausiid								81.8	
Decapoda - shrimp		4.3							
Fish									
Myctophidae									
<i>Stenobrachius leucopsarus</i>							66.7	27.3	
Unid. Myctophidae		43.5			75.0	28.6			
<i>Ammodytes hexapterus</i>	33.3	8.7							
<i>Hexagrammos</i> 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

^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 kittiwake nests by plot at Buldir Island, Alaska, 2005.

Plot	July																														
	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																				1					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

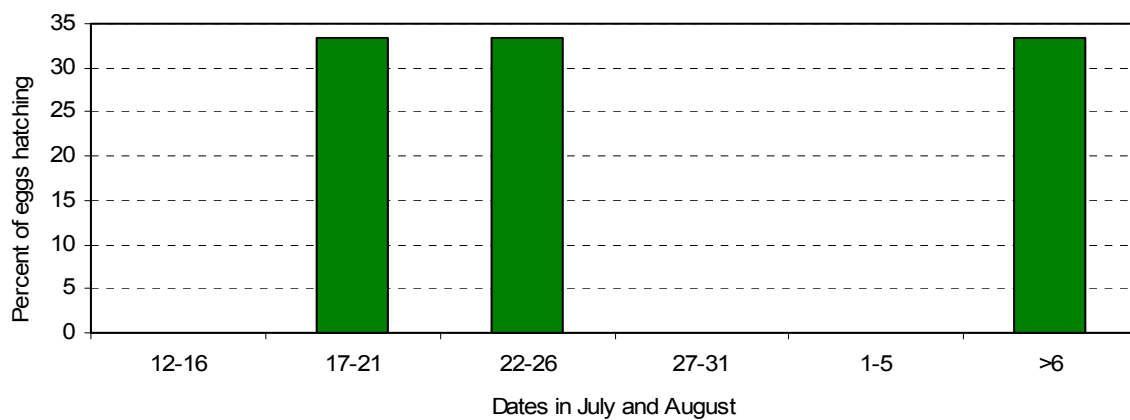


Figure 16. Hatching chronology of red-legged kittiwakes at Buldir Island, Alaska in 2005.

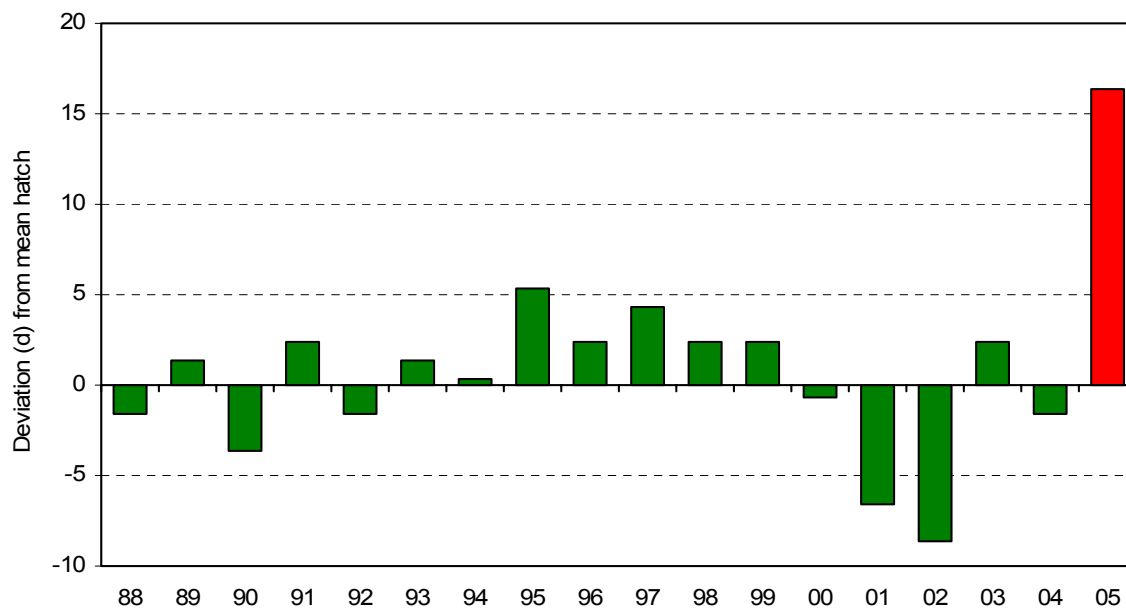


Figure 17. Yearly hatch date deviation (from the 1988-2004 average of 11 July) for red-legged kittiwakes at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

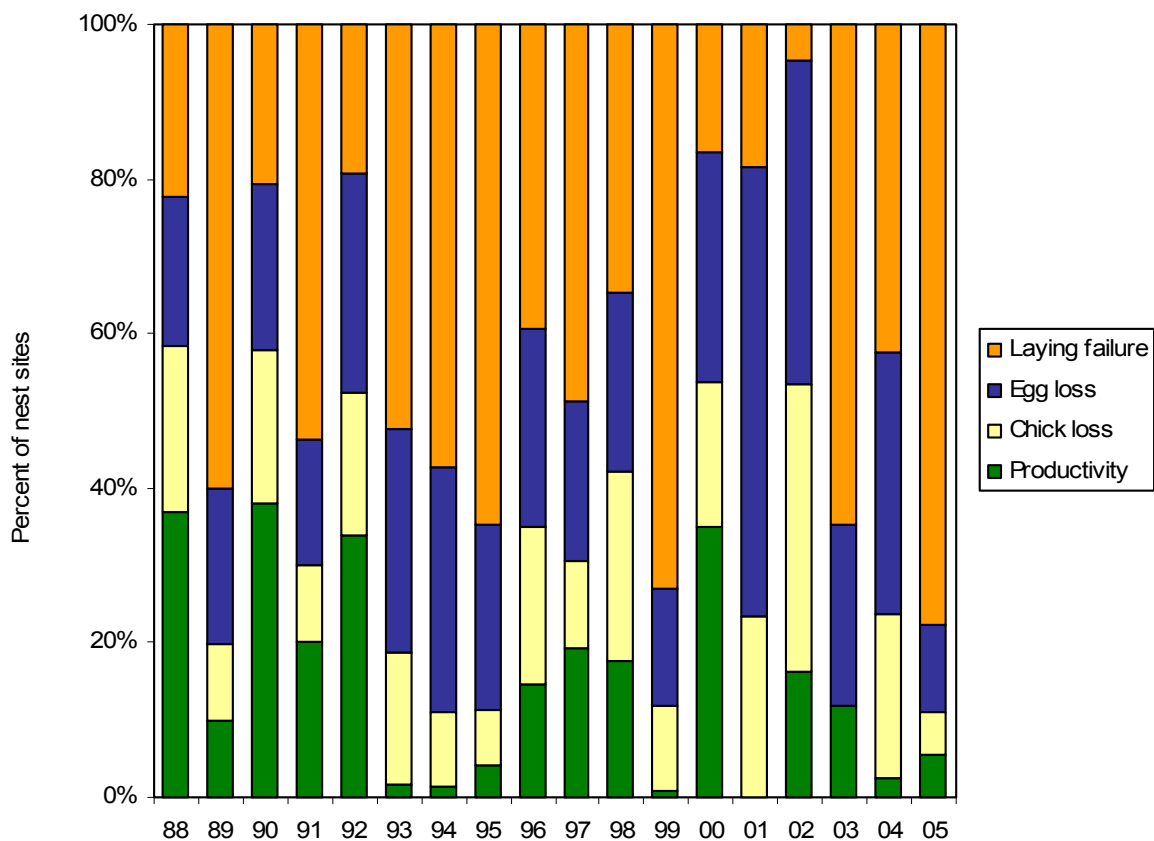


Figure 18. Reproductive performance of red-legged kittiwakes at Buldir Island, Alaska. Laying Failure=(A-B)/A; Egg Loss=(B-C)/A; Chick Loss=(C-D)/A; Productivity=D/A, where A=total number of nests; B=number of nests with ≥ 1 egg; C=number of nests with ≥ 1 chick; D= number of nests with ≥ 1 fledged chick.

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 ^a B/A	nesting success ^b C/B	fledging success ^c D/C	reproductive success ^d D/B	productivity ^e 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 ^f	36	8	4	2	0.22	0.50	0.50	0.25	0.06

^a Two "Boom or Bust" plots were monitored at KWL in 2005. 49 nests were counted in two plots on 23 June. These nests were revisited on 7 Aug where a total of 10 chicks were counted. The number of chicks per nest (maximum possible productivity) for the two plots were 0.28 and 0.13.

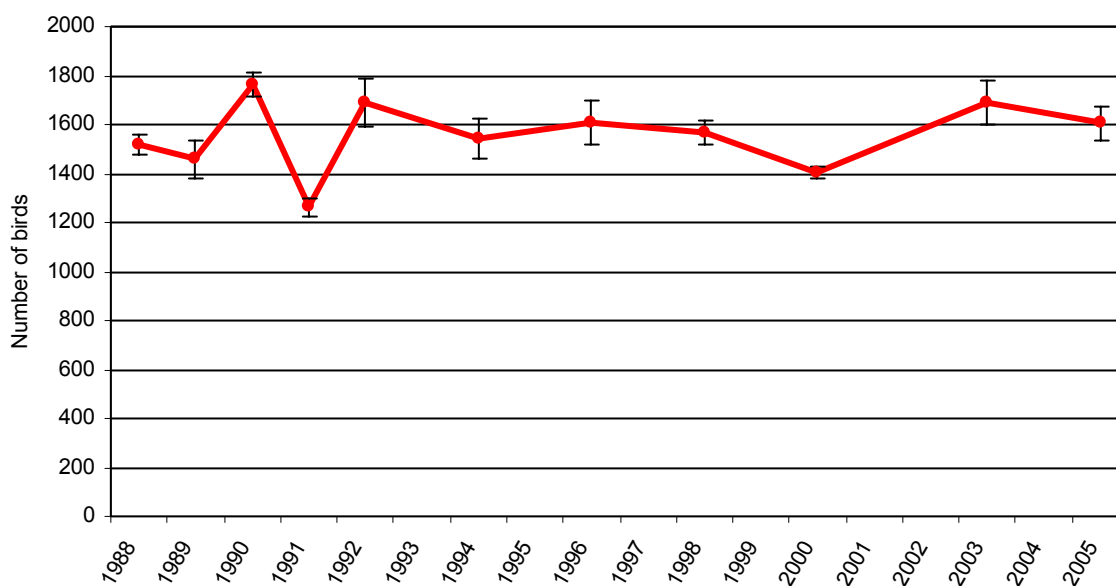


Figure 19. Counts of red-legged kittiwakes on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

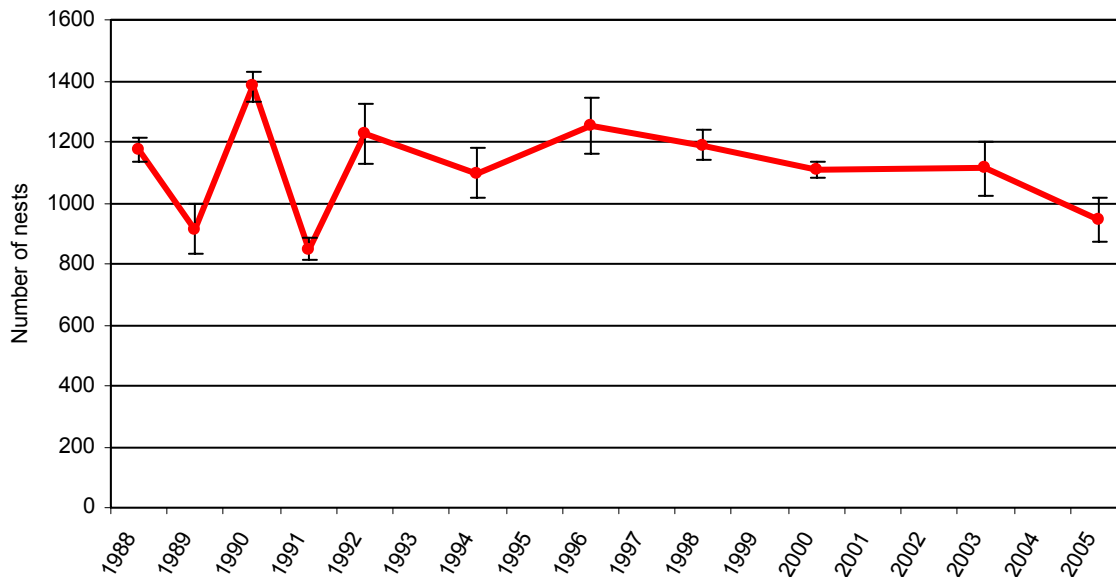


Figure 20. Counts of red-legged kittiwake nests on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

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					mean	SD	max.
	1	2	3	4	5			
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 (plots 15-18), 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					0	SD	max.
	1	2	3	4	5			
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 (plots 15-18), KWLW is KWL West (plots 19-28).

^b Consists of all plots at The Dip and Kittiwake Lane combined.

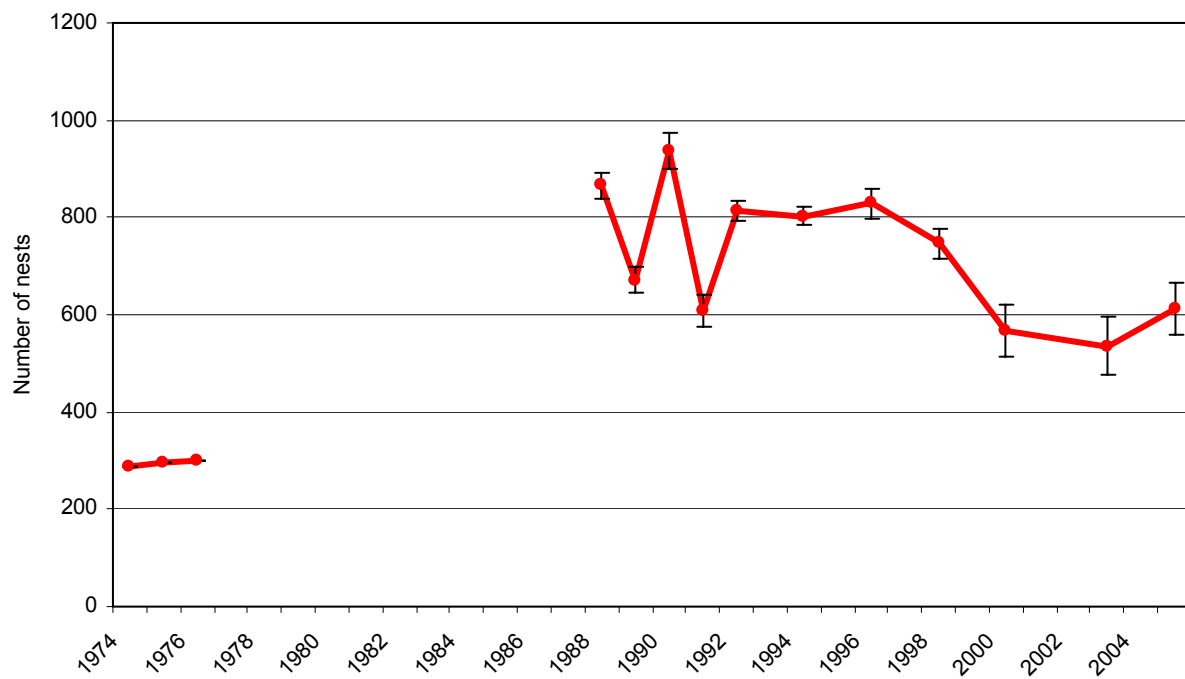


Figure 21. Counts of red-legged kittiwake nests at Kittiwake Lane, Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year. Note that the general trend at Kittiwake Lane does not mirror that of the island counts in Fig. 20.

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	45.6
2 (16)	--	89	--	110	83	108	75	98	95	68	70	37	33	30.6
3 (17)	--	46	--	149	125	129	63	87	80	79	56	57	53	87.8
4 (18)	--	49	--	167	75	114	85	123	137	171	135	93	81	141.4
5 (19)	--	12	--	52	51	75	34	62	66	59	49	46	43	52.0
6 (20)	--	20	--	109	72	117	44	95	94	81	81	83	38	45.4
7 (21)	--	0	--	49	49	76	73	70	86	95	95	70	63	68.2
8 (22)	--	0	--	56	56	78	79	88	82	66	69	31	48	44.8
9 (23)	--	0	--	46	63	87	80	90	57	44	37	27	31	59.0
10 (24)	--	0	--	1	1	6	2	4	7	17	26	24	12	3.6
11 (25)	--	0	--	0	0	0	0	0	5	11	10	11	22	24.4
12 (26)	--	0	--	0	0	0	0	0	2	12	14	18	28	7.8
13 (27)	--	0	--	0	0	0	0	0	1	10	8	13	10	2.6
14 (28)	--	0	--	0	1	3	0	0	9	28	15	12	3	0.2
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 July	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

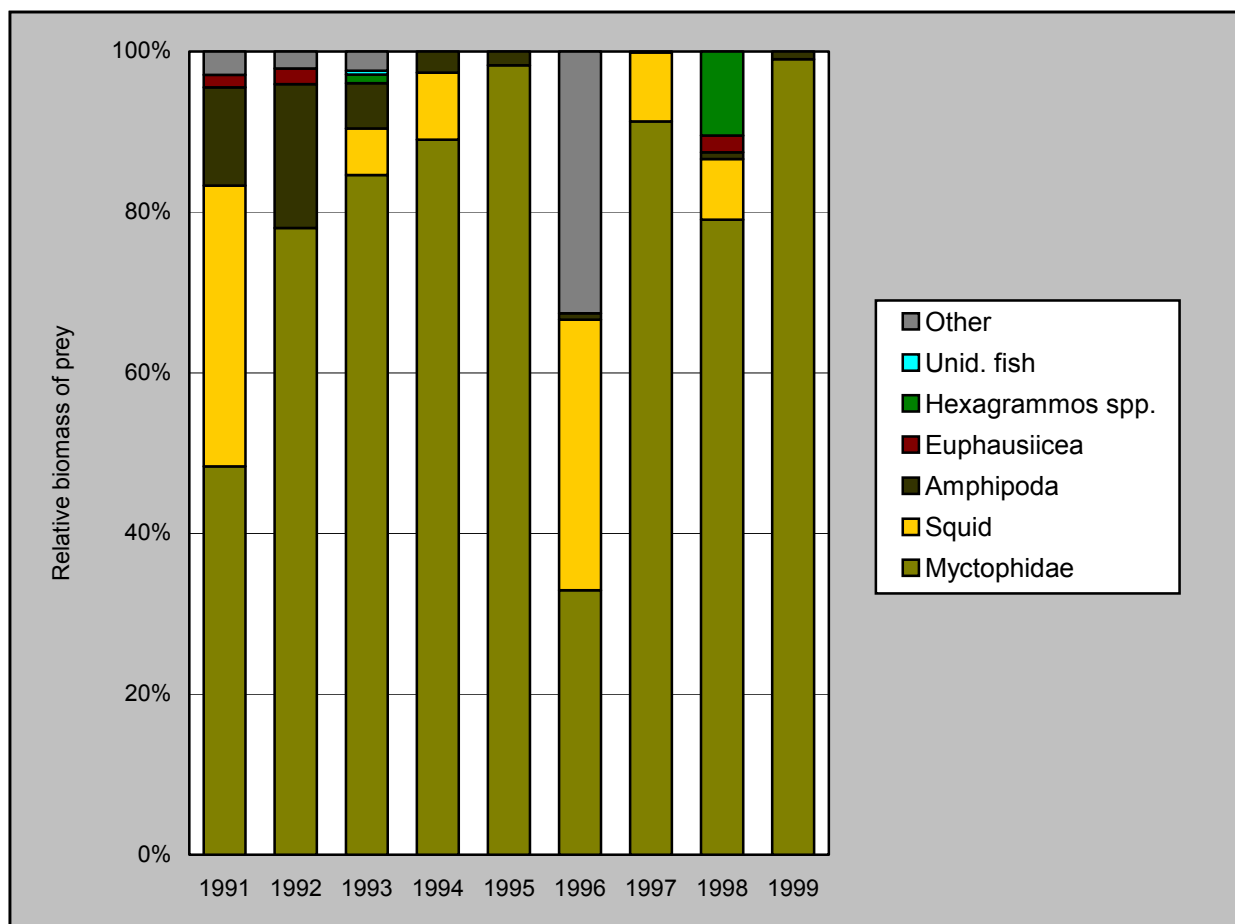


Figure 22. Relative biomass of prey in diets of red-legged kittiwakes at Buldir Island, Alaska.

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
No. samples	18	26	39	27	13	6	8	9	2
Total mass (g)	171.5	47.9	189.8	389.3	145.5	136.6	174.4	238.9	57.0
Cephalopoda - squid	35.0		5.8	8.3		33.7	8.6	7.5	
Amphipoda									
Hyperiidea									
<i>Parathemisto pacifica</i>				0.2					
<i>Parathemisto</i> 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
Unid. Amphipoda	2.6	4.2							
Euphausiacea									
<i>Thysanoessa</i> spp.	1.5	2.0							
Unid Euphausiid								2.1	
Decapoda - shrimp	2.9	2.1	1.1						
Fish									
Osmeridae			1.3						
Myctophidae									
<i>Stenobrachius leucopsarus</i>			84.6				91.3	69.0	
Unid. Myctophidae	48.3	78.0		89.0	98.3	32.9		10.0	99.1
<i>Hexagrammos</i> 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
No. samples	18	26	39	27	13	6	8	9	2
Cephalopoda - squid	11.1		10.3	14.8		33.3	12.5	11.1	
Amphipoda									
Hyperiidea									
<i>Parathemisto pacifica</i>				7.4					
<i>Parathemisto</i> 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
Unid. Amphipoda	16.7	3.8							
Euphausiacea									
<i>Thysanoessa</i> spp.	16.7	7.7							
Unid Euphausiid								11.1	
Decapoda - shrimp	33.3	7.7	10.3						
Fish									
Osmeridae			2.6						
Myctophidae									
<i>Stenobrachius leucopsarus</i>			82.1				87.5	88.9	
Myctophidae - not <i>S. leuco.</i>			2.6					22.2	
Unid. Myctophidae	55.6	84.6		100.0	100.0	33.3			100.0
<i>Ammodytes hexapterus</i>	5.6								
<i>Hexagrammos</i> 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 murre 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	<Jun 15	28 Jul	8 Jul	16 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, 2005^a.

Plot	July																																
	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										2					1						1												
38A															3						2												1
38B																6		1			6					2	4						
39A																					1						1						
39B/C																					3												
40											1						1					11					3						1
43													1			1																	
44																																	
45											2					3						10					4						

^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).

Plot	August																																
	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						2															
39A																																	
39B/C																																	
40																																	
43																																	
44																																	
45																																	

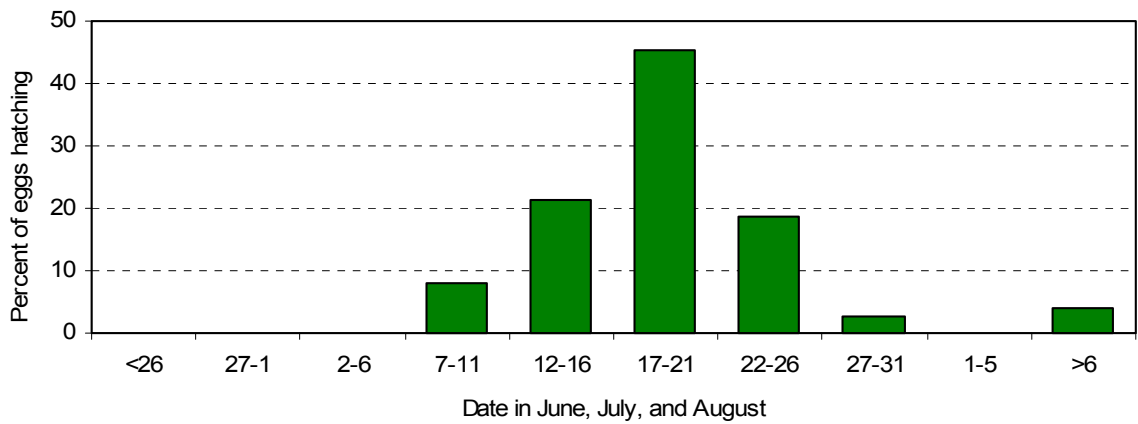


Figure 23. Hatching chronology of thick-billed murres at Buldir Island, Alaska in 2005.

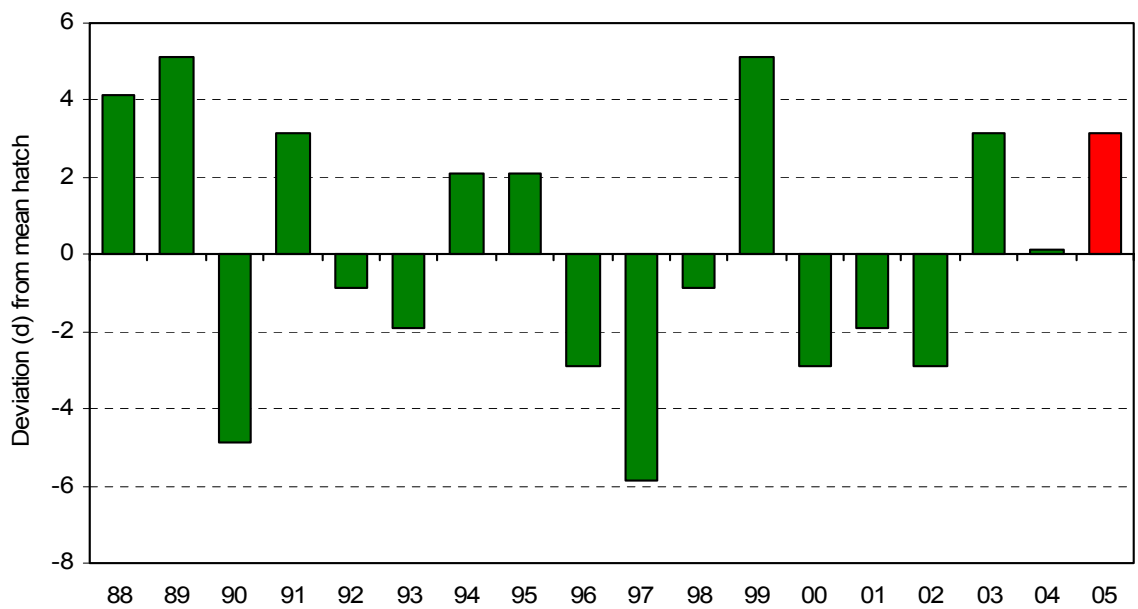


Figure 24. Yearly hatch date deviation (from the 1988-2004 average of 17 July) for thick-billed murres at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

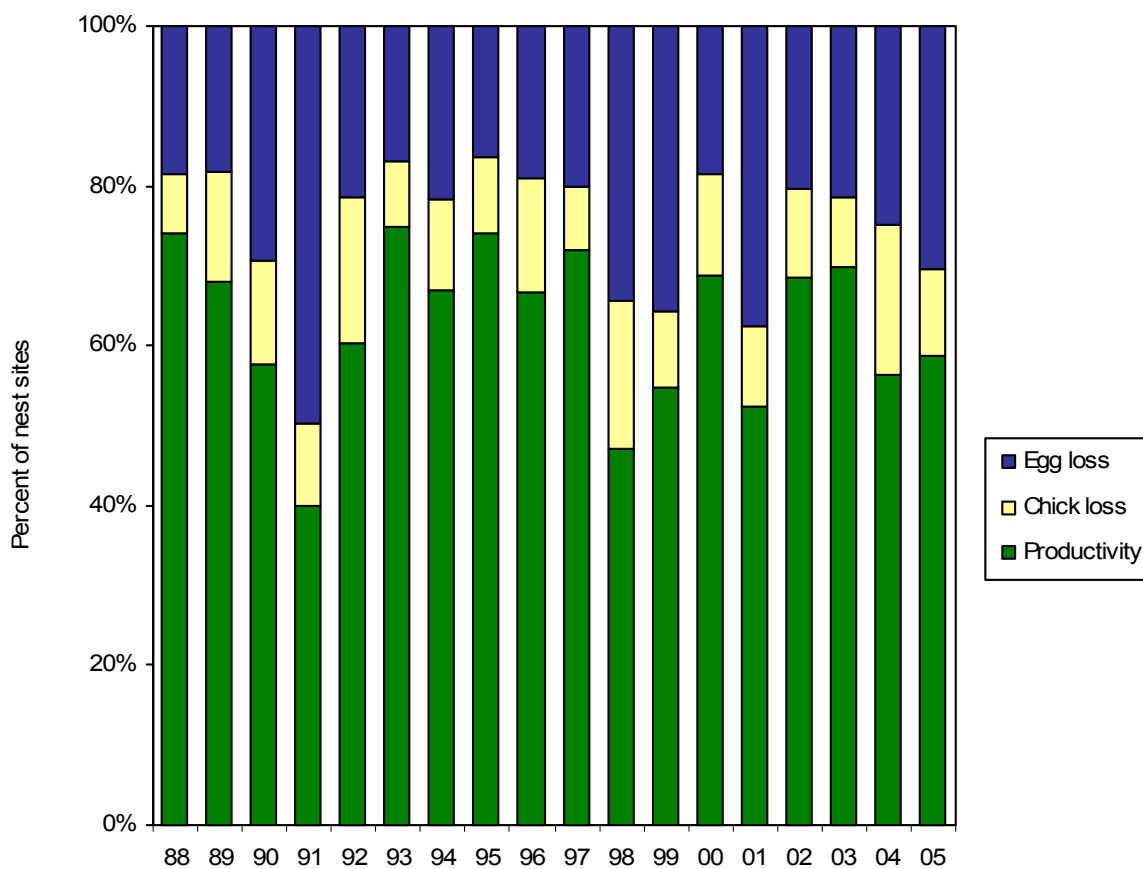


Figure 25. Reproductive performance of thick-billed murrelets at Buldir Island, Alaska. $\text{Egg Loss} = (A-B)/A$; $\text{Chick Loss} = (B-C)/A$; $\text{Productivity} = C/A$, where A =number nest sites, B =number of nest sites with a chick; C =number of nest sites with fledged chick.

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

Table 49. Reproductive performance of thick-billed murres on index plots at Buldir Island, Alaska, in 2005.

Parameter	<u>Plot</u>										<u>Statistics</u>		
	36	38A	38B	39A	39B/C	40	43	44	45	Total	n	mean	SD
no. of sites with an egg (A)	16	39	51	14	20	43	23	13	67	286			
no. of sites with chick (B)	15	19	36	11	13	36	9	5	55	199			
no. of sites where chick fledged (C)	11	15	31	8	12	33	6	5	47	168			
hatching success (B/A)	0.94	0.49	0.71	0.79	0.65	0.84	0.39	0.38	0.82		9	0.70	0.06
fledging success (C/B)	0.73	0.79	0.86	0.73	0.92	0.92	0.67	1.00	0.85		9	0.84	0.02
reproductive success (C/A)	0.69	0.38	0.61	0.57	0.60	0.77	0.26	0.39	0.70		9	0.59	0.06

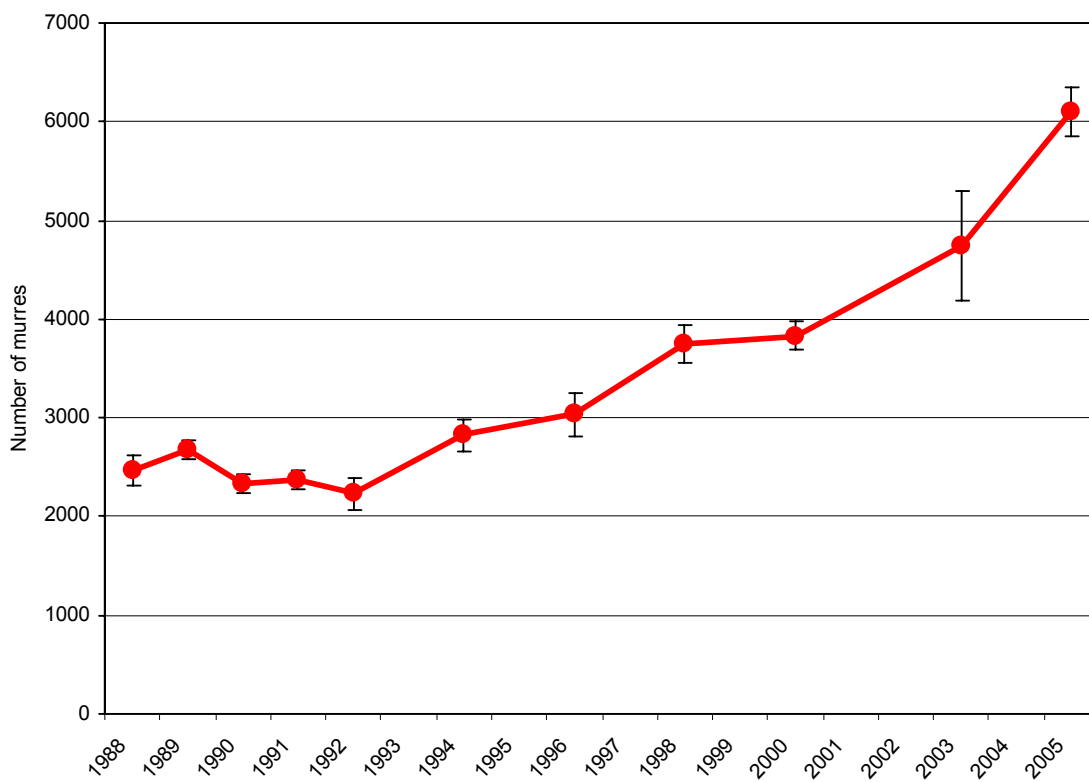


Figure 26. Counts of thick-billed murres on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

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					mean	SD	max.
	1	2	3	4	5			
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.

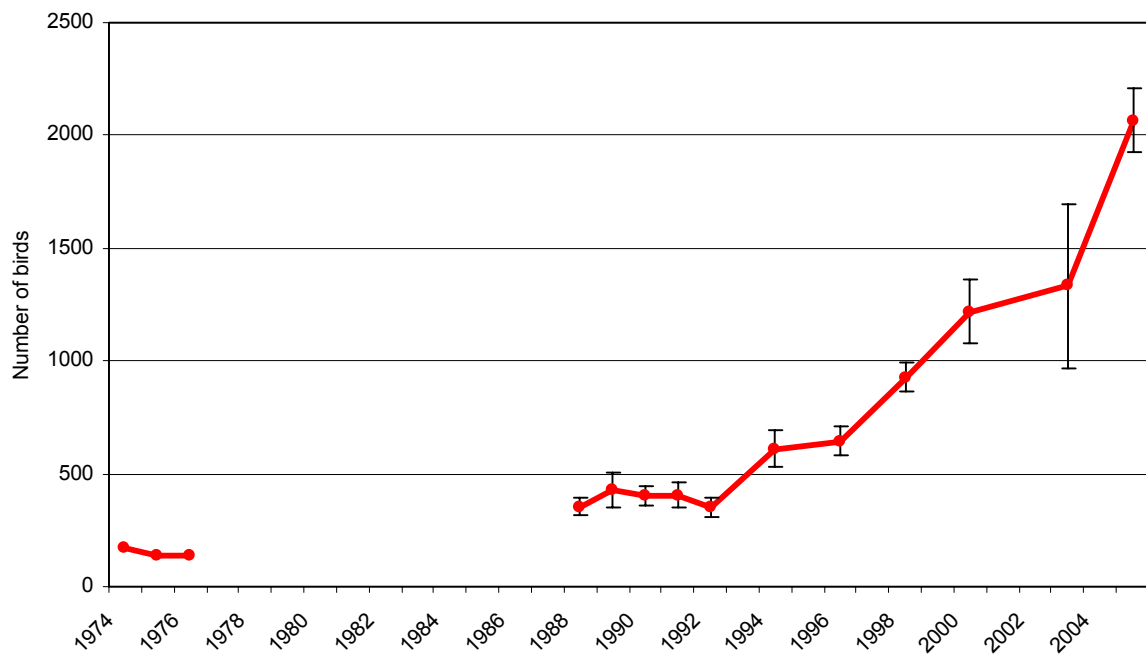


Figure 27. Counts of thick-billed murres at Kittiwake lane, Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

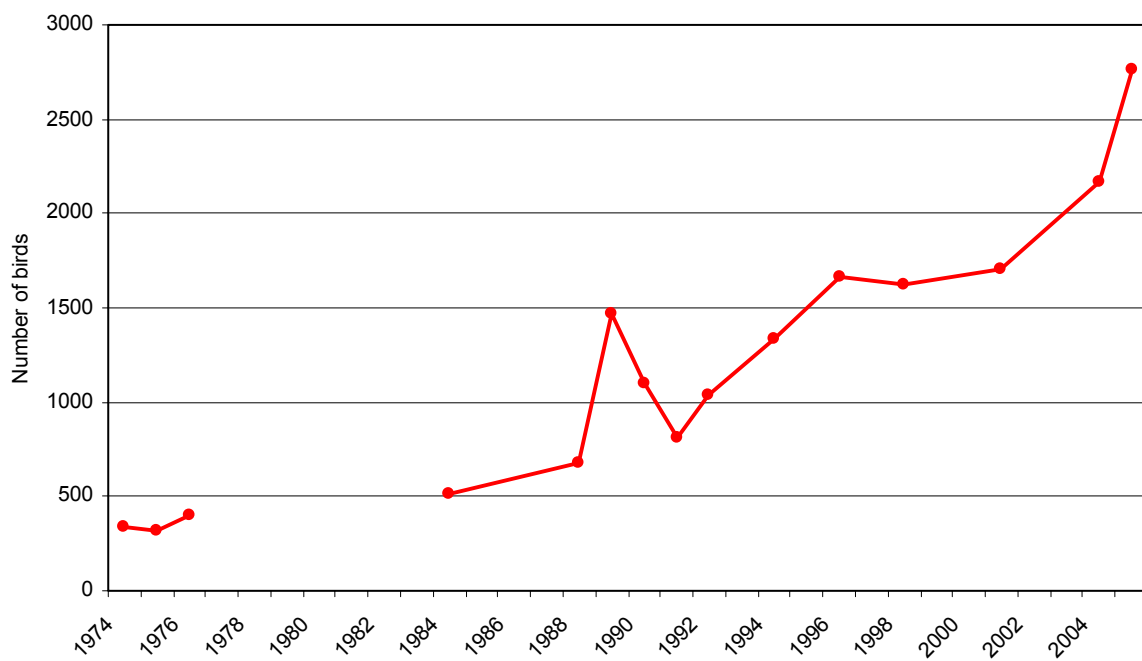


Figure 28. Counts of thick-billed murres at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

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 murre were observed.

^b In addition, 28 common murre were observed.

^c In addition 31 common murre observed in segment I.

^d In addition 35 common murre observed in segment.

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

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

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

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

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

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

^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).

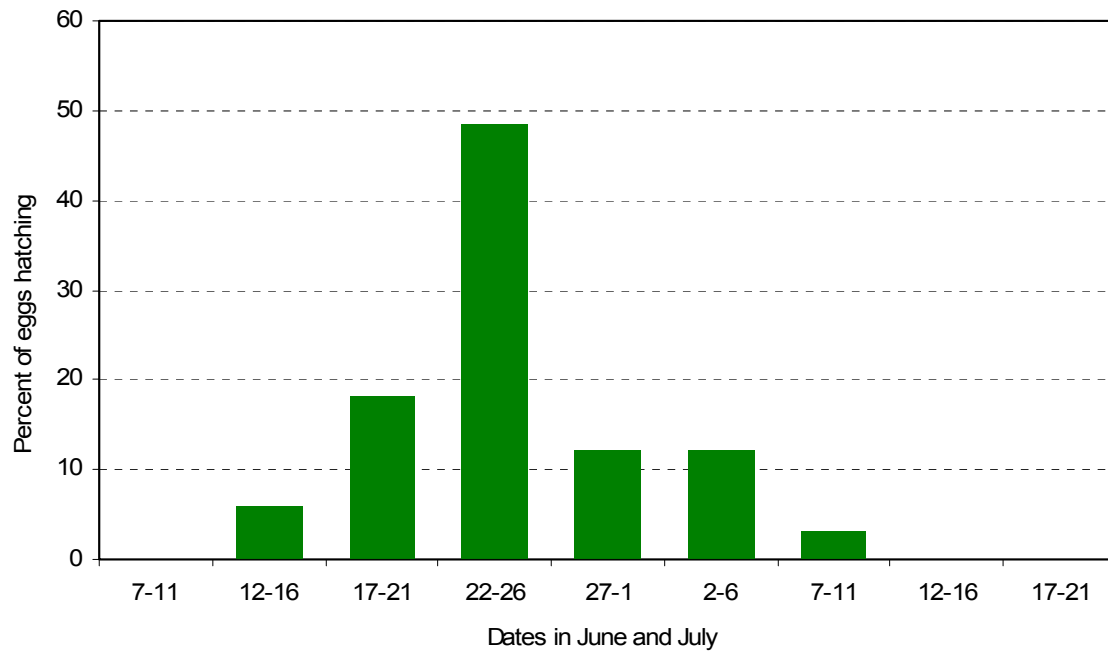


Figure 29. Hatching chronology of least auklets at Buldir Island, Alaska in 2005.

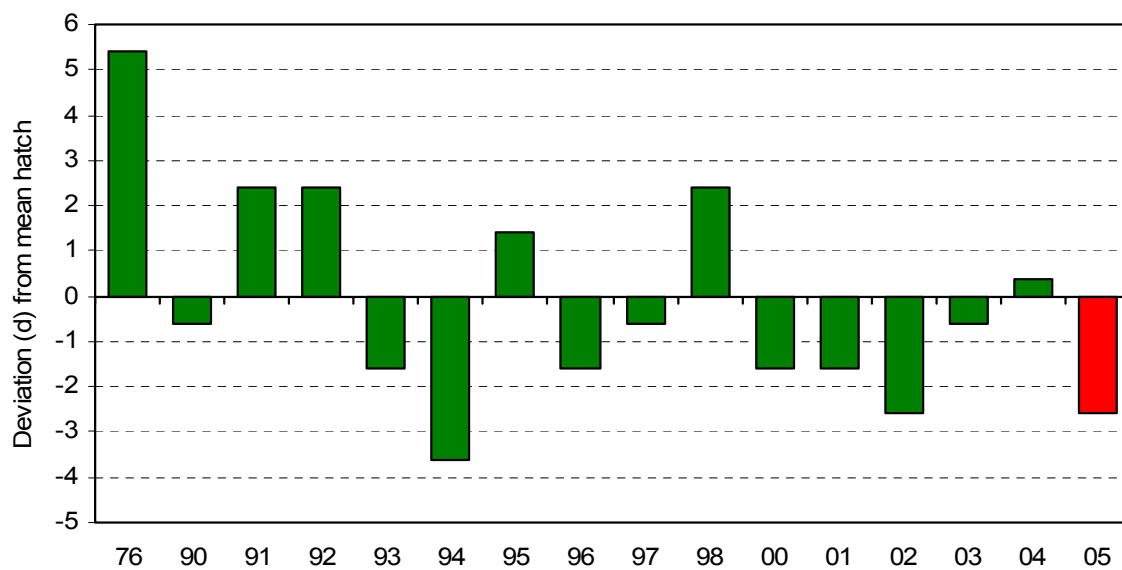


Figure 30. Yearly hatch date deviation (from the 1988-2004 average of 28 June) for least auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

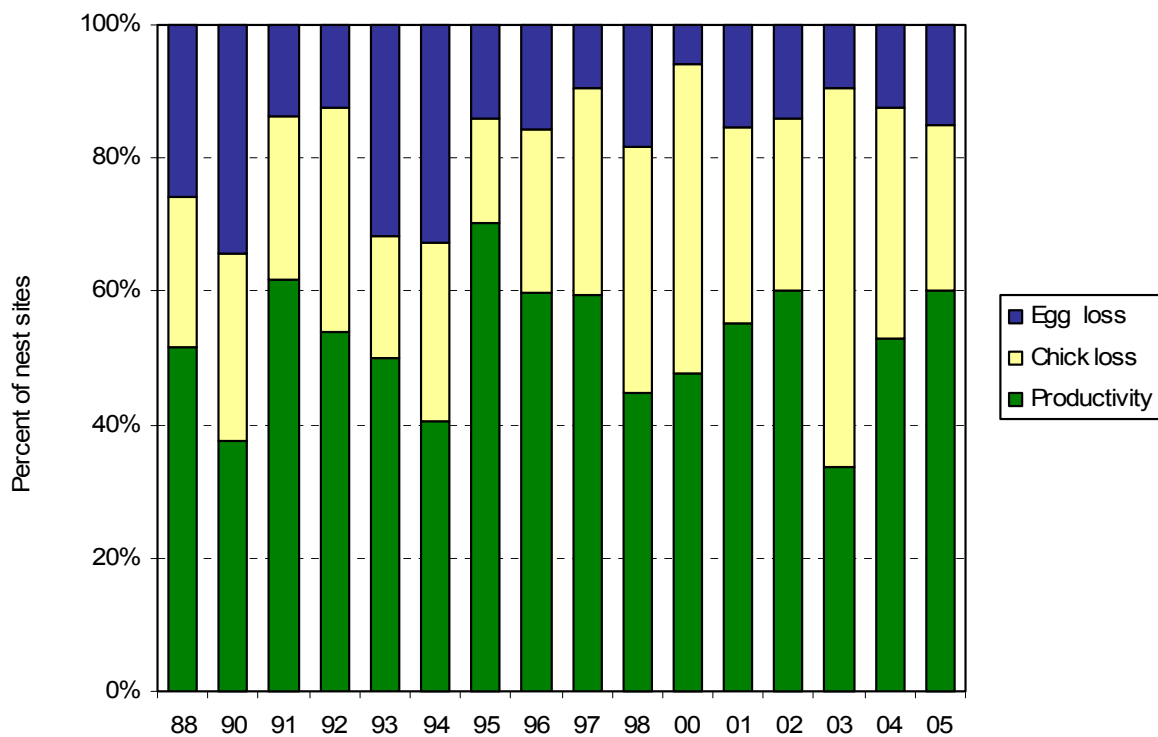


Figure 31. Reproductive performance of least auklets at Buldir Island, Alaska. Egg loss= $(A-B)/A$; Chick loss= $(B-C)/A$; Productivity= C/A , where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick.

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
No. eggs found (A)	28	31	60	61	81	89	44	64	64	57	84	76	0	69	65	50	83	81	73
No. eggs lost to:																			
disappearance	--	6	18	18	9	9	9	14	3	6	7	8	--	4	5	4	2	3	4
abandonment	--	0	2	2	0	1	3	6	3	1	0	6	--	0	5	3	4	4	7
breakage	--	2	3	1	2	1	2	1	3	2	1	0	--	0	0	0	2	3	0
No. eggs hatched (B)	19	23	37	40	70	78	30	43	55	48	76	62	--	65	55	43	75	71	62
No. chicks lost to:																			
disappearance	--	5	--	16	14	26	4	10	9	7	22	24	--	26	15	10	39	19	15
death	--	2	--	1	6	4	4	7	1	7	3	4	--	6	4	3	8	9	3
No. chicks fledged (C)	--	16	--	23	50	48	22	26	45	34	50	34	--	33	36	30	28	43	44
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
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
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
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

^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.

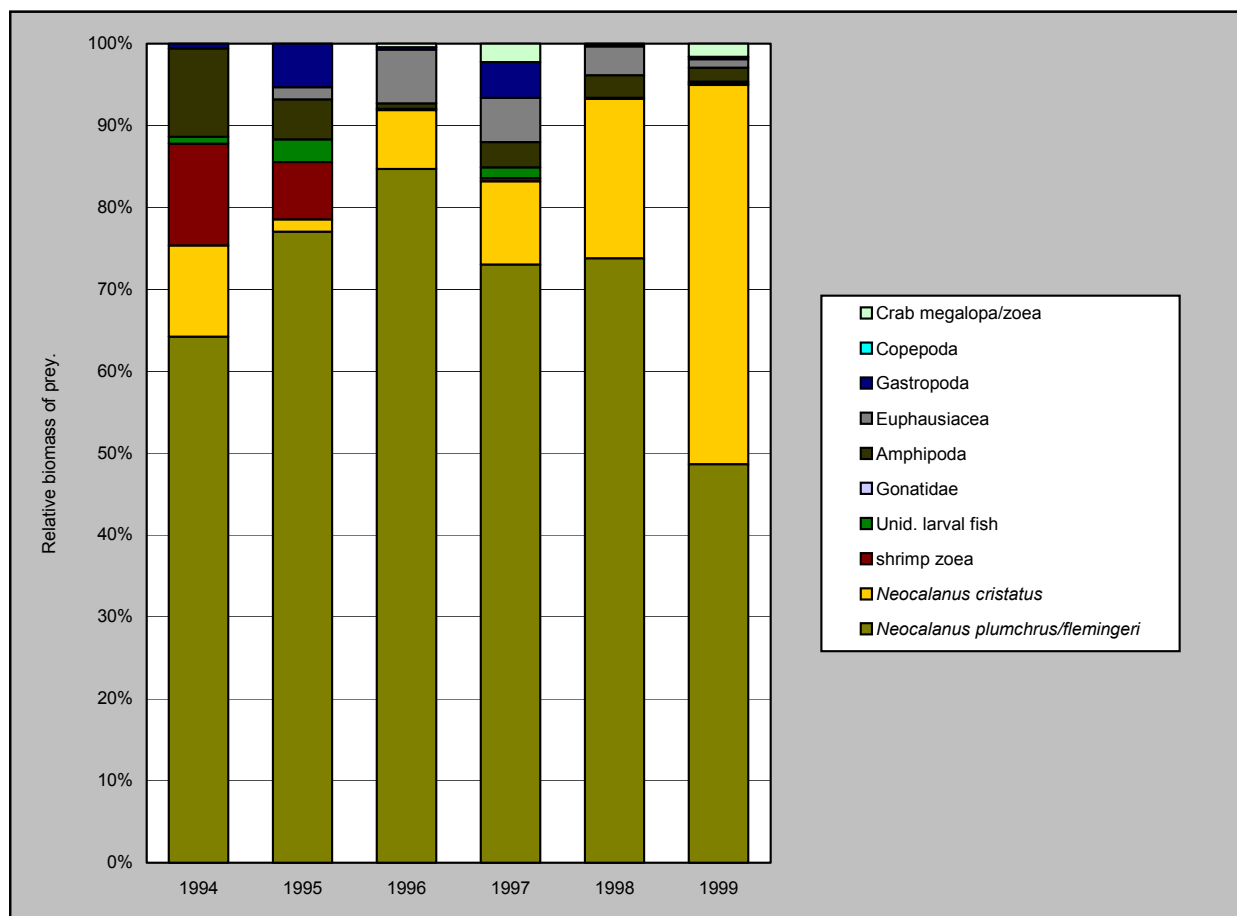


Figure 32. Relative biomass of prey in diets of least auklets at Buldir Island, Alaska.

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.

	1994	1995	1996	1997	1998	1999
No. samples	4	8	16	31	26	32
Total mass (g)	12.1	18.2	46.3	97.6	87.1	146.1
Gonatidae						0.1
Gastropoda						
Unid. snail	0.6					
<i>Limacina helicina</i>					0.2	
Pteropoda		5.3	0.3	4.4		0.3
Copepoda						
<i>Neocalanus plumchrus/flemingeri</i>	64.2	77.1	84.5	73.0	73.9	48.7
<i>N. cristatus</i>	11.1	1.5	7.2	10.2	19.5	46.3
<i>Calanus marshallae</i>					<0.1	
<i>Pachyptilus pacificus</i>						<0.1
<i>Pareuchaeta birostrata</i>						<0.1
Amphipoda						
Hyperiidea						
<i>Hyperoche medusarum</i>		3.6	0.1			
<i>Parathemisto pacifica</i>	7.5	1.3	0.6	1.2	<0.1	0.6
<i>Primno macropa</i>	3.3			1.8		1.1
Gammaridea						
<i>Erichtonius</i> spp.					2.7	
Euphausiacea						
<i>Thysanoessa</i> spp.		1.5	6.7	5.4		
Euphausiid furcilla					1.0	0.3
Unid. Euphausiid					2.5	0.7
Decapoda						
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
No. samples	4	8	16	31	26	32
Gonatidae						3.1
Gastropoda						
Unid. snail	50.0					
<i>Limacina helicina</i>					34.6	
Pteropoda		75.0	18.8	54.8		40.6
Copepoda						
<i>Neocalanus plumchrus/flemingeri</i>	100.0	100.0	100.0	100.0	100.0	93.8
<i>N. cristatus</i>	75.0	37.5	12.5	58.1	69.2	81.3
<i>Calanus marshallae</i>					7.7	
<i>Pachyptilus pacificus</i>						3.1
<i>Pareuchaeta birostrata</i>						3.1
Amphipoda						
Hyperiidea						
<i>Hyperoche medusarum</i>		50.0	12.5			
<i>Parathemisto pacifica</i>	75.0	50.0	31.3	19.4	11.5	31.3
<i>Primno macropa</i>	25.0			25.8		18.8
Gammaridea						
<i>Erichitonius</i> spp.					34.6	
Euphausiacea						
<i>Thysanoessa</i> spp.		25.0	75.0	35.5		
Euphausiid furcilla					61.5	6.3
Unid. Euphausiid					26.9	21.9
Decapoda						
Shrimp zoea	50.0	25.0	6.3	19.4	19.2	15.6
Crab zoea				3.2		3.1
Crab megalopa			6.3	22.6		
Hippolytidae megalopa						37.5
Atelecyclidae megalopa					3.8	6.3
Paguridae megalopa						6.3
Fish		25.0	12.5		6.5	3.1

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 July	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

^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).

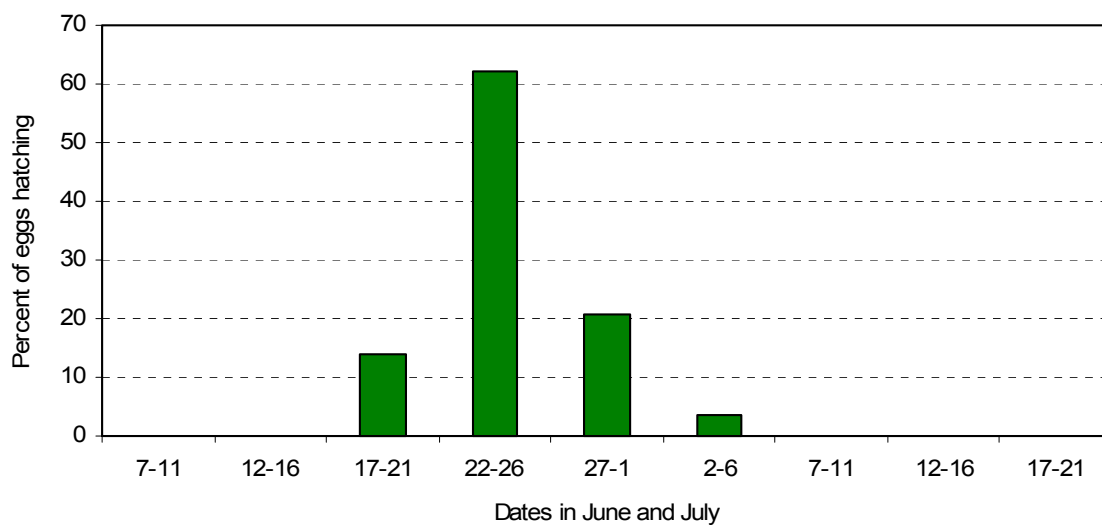


Figure 33. Hatching chronology of crested auklets at Buldir Island, Alaska in 2005.

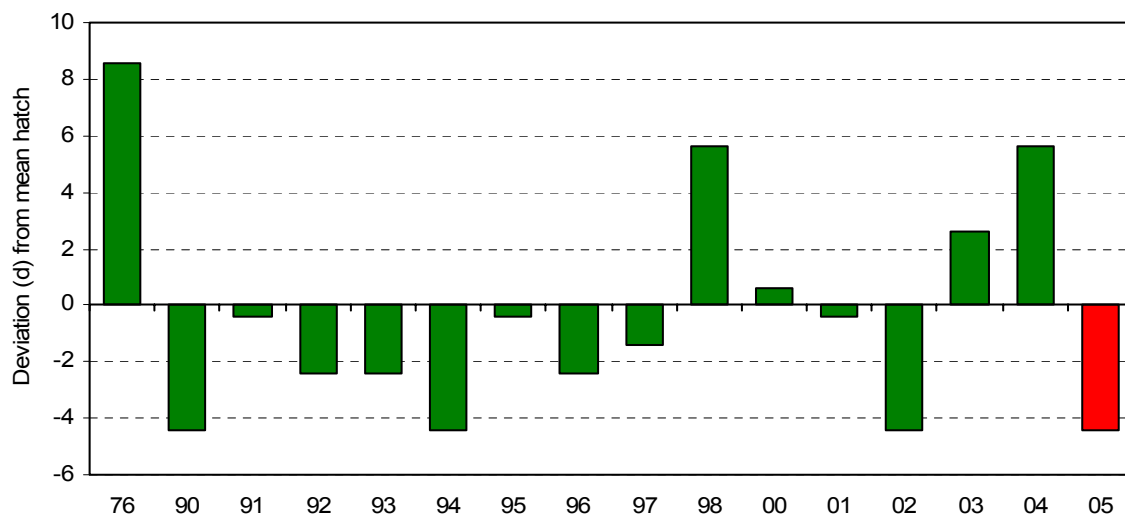


Figure 34. Yearly hatch date deviation (from the 1988-2004 average of 29 June) of crested auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

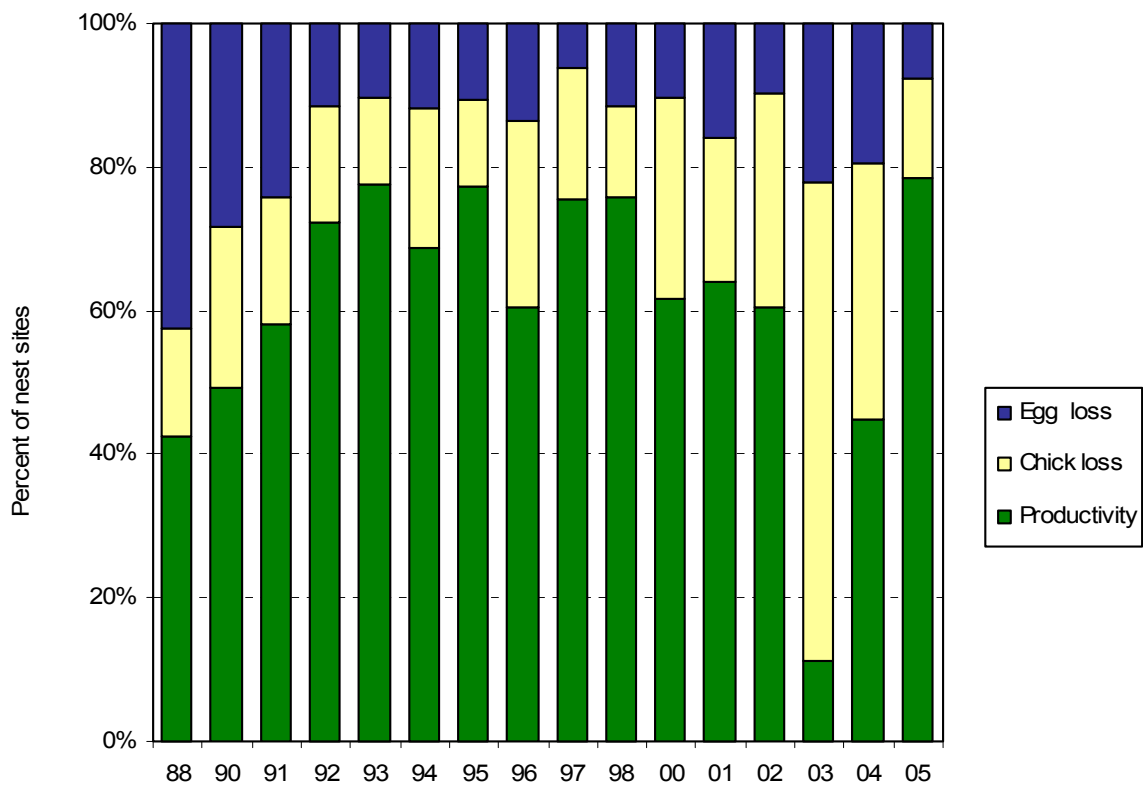


Figure 35. Reproductive performance of crested auklets at Buldir Island, Alaska. Egg loss= $(A-B)/A$; Chick loss= $(B-C)/A$; Productivity= C/A , where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick.

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
No. eggs found (A)	59	33	83	67	74	79	49	67	66	66	82	70	0	78	75	81	45	67	79
No. eggs lost to:																			
disappearance	--	4	23	15	13	7	3	4	5	7	2	4	--	6	6	3	4	6	4
abandonment	--	9	4	3	3	2	2	2	1	2	2	4	--	1	6	5	6	5	2
breakage	--	1	3	1	2	0	0	2	1	0	1	0	--	1	0	0	0	2	0
No. eggs hatched (B)	45	19	53	48	56	70	44	59	59	57	77	62	--	70	63	73	35	54	73
No. chicks lost to:																			
disappearance	--	1	--	13	12	12	6	9	7	9	14	9	--	17	8	16	14	13	5
death	--	4	--	2	1	1	0	4	1	8	1	0	--	5	7	8	16	11	6
No. chicks fledged (C)	--	14	--	33	43	57	38	46	51	40	62	53	--	48	48	49	5	30	62
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
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
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
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

^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.

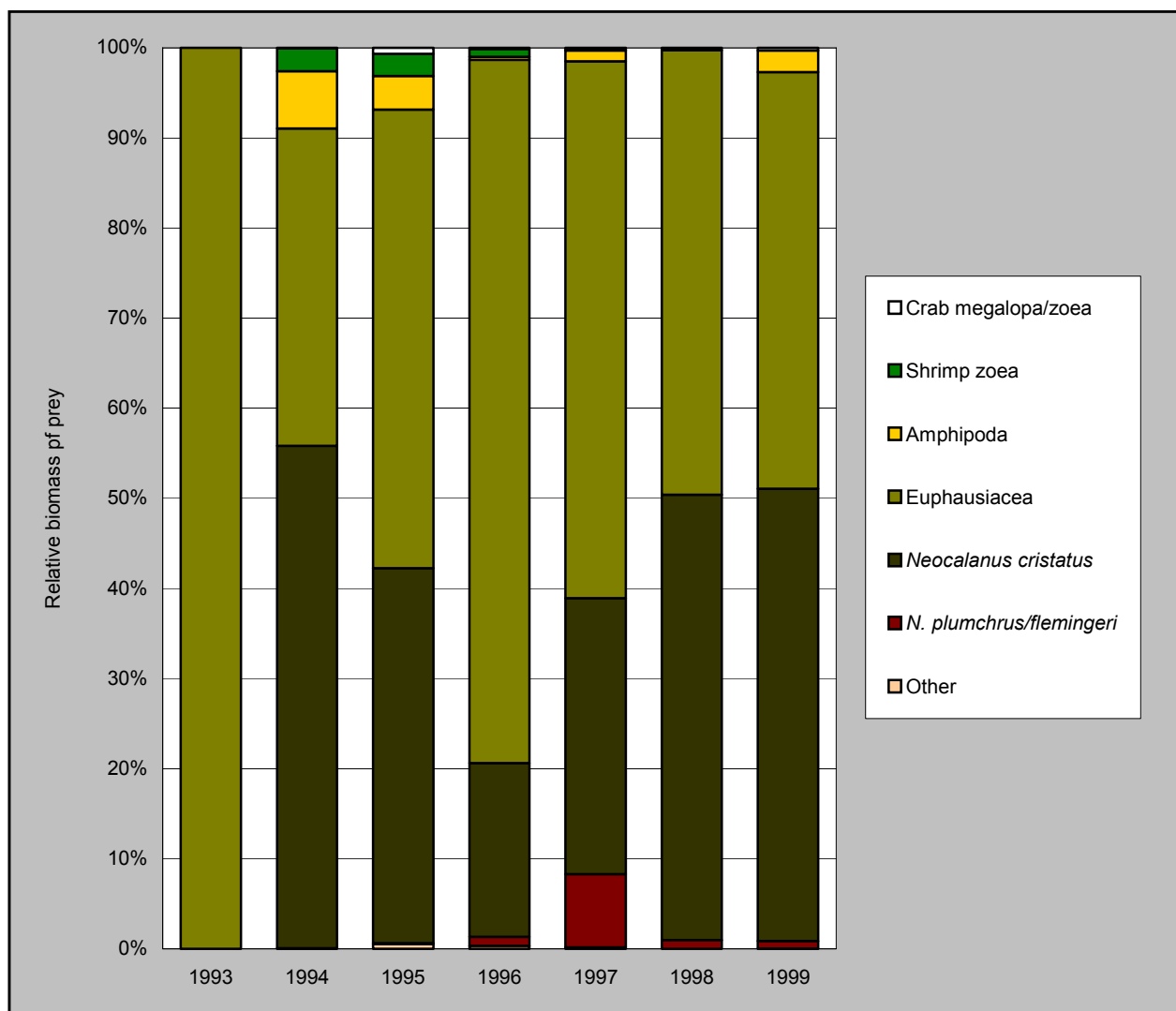


Figure 36. Relative biomass of prey in diets of crested auklets at Buldir Island, Alaska.

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.

	1993	1994	1995	1996	1997	1998	1999
No. samples	1	37	47	78	82	103	88
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							
<i>Neocalanus plumchrus/flemingeri</i>		0.1	0.1	1.0	8.1	1.0	7.5
<i>N. cristatus</i>		55.8	41.6	19.3	30.7	49.5	50.2
Amphipoda							
Hyperiidea							
<i>Hyperoche medusarum</i>				<0.1			
<i>Parathemisto pacifica</i>		5.6	3.7	0.3	1.2	0.3	2.3
<i>Primno macropa</i>		0.7					0.1
Euphausiacea							
<i>Thysanoessa</i> spp.	100.0	35.2	50.9	78.1	59.6		
Unid. Euphausiid						49.3	46.2
Euphausiid furcilla							<0.1
Decapoda							
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.

	1993	1994	1995	1996	1997	1998	1999
No. samples	1	37	47	78	82	103	88
Pteropoda				1.3			
Cephalopoda - squid			4.3	1.3	2.2	1.0	
Copepoda							
<i>Neocalanus plumchrus/flemingeri</i>		16.2	6.4	17.9	39.6	45.6	15.9
<i>N. cristatus</i>		91.9	78.7	34.6	63.0	94.2	92.0
Amphipoda							
Hyperiidea							
<i>Hyperoche medusarum</i>				2.6			
<i>Parathemisto pacifica</i>		43.2	51.1	32.1	50.3	36.9	37.5
<i>Primno macropa</i>		21.6					1.1
Euphausiacea							
<i>Thysanoessa</i> spp.	100.0	89.2	72.3	94.9	77.6		
Unid. Euphausiid						90.3	97.7
Euphausiid furcilla							1.1
Decapoda							
Shrimp zoea		13.5	25.5	25.6	6.9	5.8	
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

^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 , but less than 10 days apart or estimated event dates (e.g. "bird Incubating" on first visit followed by "chick" on the next visit).

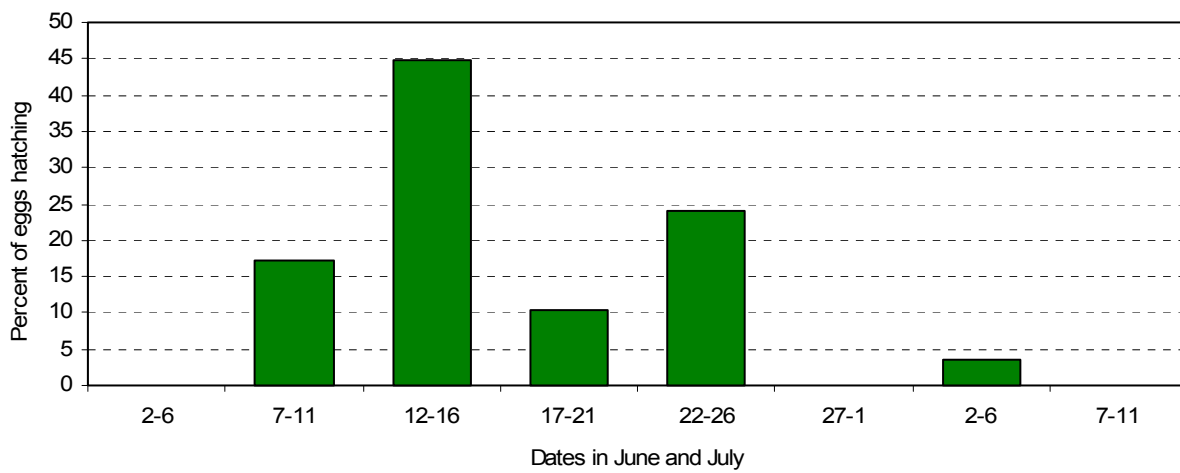


Figure 37. Hatching chronology of whiskered auklets at Buldir Island, Alaska in 2005.

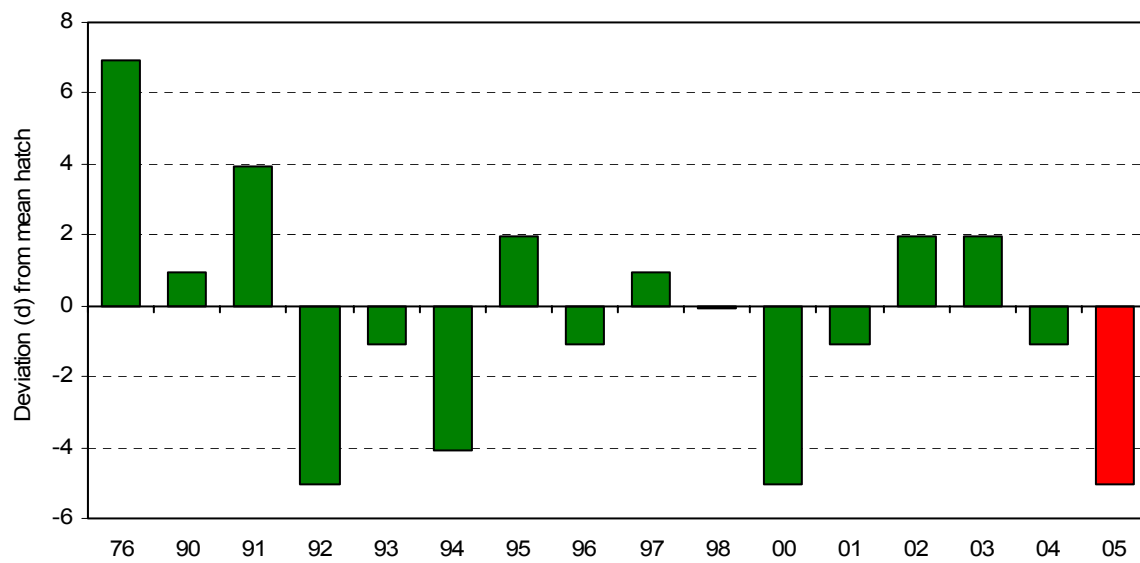


Figure 38. Yearly hatch date deviation (from the 1988-2004 average of 23 June) of whiskered auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

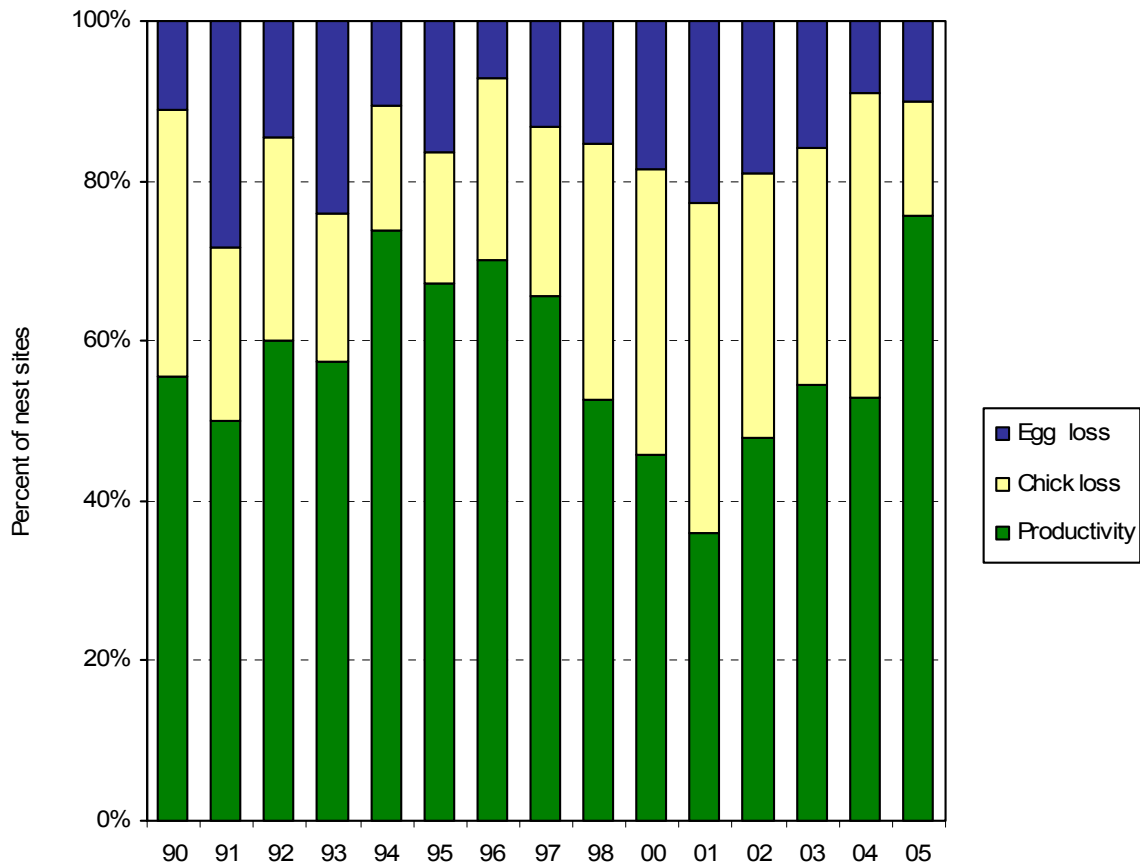


Figure 39. Reproductive performance of whiskered auklets at Buldir Island, Alaska. $\text{Egg loss} = (A-B)/A$; $\text{Chick loss} = (B-C)/A$; $\text{Productivity} = C/A$, where A =number of nest sites, B =number of nest sites with a chick, C =number of sites with fledged chick.

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

Parameter ^a	1976	1988	1989	1990	1991	1992	1993	1994	1995
No. eggs found (A)	7	7	16	9	46	55	54	57	67
No. eggs lost to:									
disappearance	-	0	1	1	5	5	8	4	2
abandonment	-	0	2	0	4	3	4 ^b	2	9
breakage	-	0	2	0	4	0	1	0	0
No. eggs hatched (B)	6	7	11	8	33	47	41	51	56
No. chicks lost to:									
disappearance	-	-	-	2	7	9	6	6	10
death	-	-	-	1	3	5	4	3	1
No. chicks fledged (C)	-	-	-	5	23	33	31	42	45
Hatching success (B/A)	0.86	1.00	0.69	0.89	0.72	0.85	0.76	0.89	0.84
Fledging success (C/B) ^b	-	-	-	0.63	0.70	0.70	0.76	0.82	0.80
Reproductive success (C/A)	-	-	-	0.56	0.50	0.60	0.57	0.74	0.67
Productivity (hs x fs)	-	-	-	0.56	0.50	0.60	0.58	0.73	0.67

^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 32 days before disappearing or 29 days at time of last visit, if chicks were still present.

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

Parameter ^a		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. eggs found (A)		57	90	78	0	70	75	100	44	66	70
No. eggs lost to:	disappearance	1	8	9	-	4	5	6	3	3	3
	abandonment	3	3	2	-	9	12	10	4	2	2
	breakage	0	1	1	-	0	0	3	0	1	2
No. eggs hatched (B)		53	78	66	-	57	58	81	37	60	63
No. chicks lost to:	disappearance	6	17	20	-	20	5	21	9	12	7
	death	7	2	5	-	5	26	12	4	13	3
No. chicks fledged (C)		40	59	41	-	32	27	48	24	35	53
Hatching success (B/A)		0.93	0.87	0.85	-	0.81	0.77	0.81	0.84	0.91	0.90
Fledging success (C/B) ^b		0.75	0.76	0.62	-	0.56	0.47	0.59	0.65	0.58	0.84
Reproductive success (C/A)		0.70	0.66	0.53	-	0.46	0.36	0.48	0.55	0.53	0.76
Productivity (hs x fs)		0.70	0.66	0.53	-	0.46	0.36	0.48	0.55	0.53	0.76

^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 32 days before disappearing or 29 days at time of last visit, if chicks were still present.

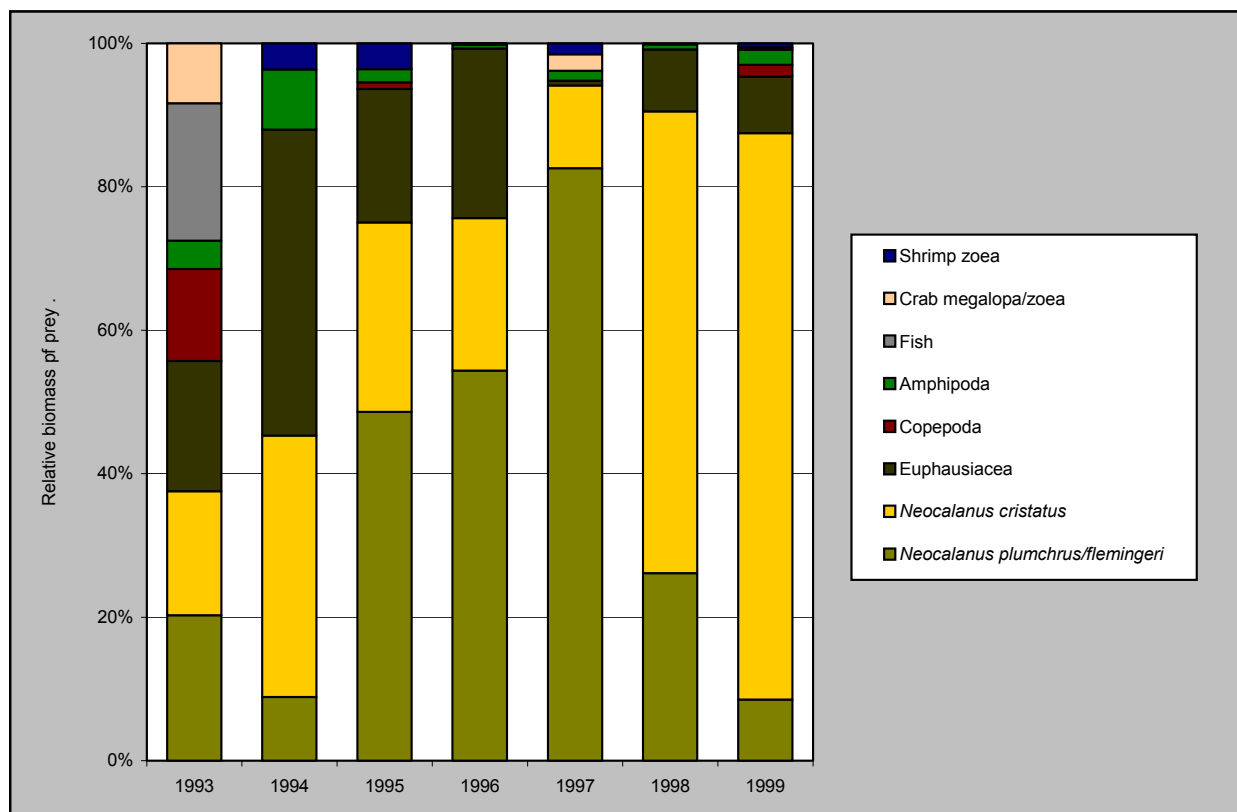


Figure 40. Relative biomass of prey in diets of whiskered auklets at Buldir Island, Alaska.

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.

	1993	1994	1995	1996	1997	1998	1999
No. samples	24	16	48	71	36	26	43
Total mass (g)	53.4	93.9	387.5	481.3	300.2	214.1	434.1
Gastropoda							
Unid. snail		0.2					
Pteropoda – (prob. <i>Limacina helicina</i>)	1.5		0.7	0.3	2.1	0.2	0.2
Copepoda							
<i>Neocalanus plumchrus/flemingeri</i>	21.8	8.9	48.3	54.2	80.9	26.1	8.5
<i>N. cristatus</i>	18.6	36.4	26.2	21.2	11.3	64.3	78.8
<i>Calanus pacifica</i>			0.1				
<i>Pachyptilus pacificus</i>							1.0
<i>Pareuchta birostrata</i>							0.7
<i>Lophotrix frontalis</i>							<0.1
Unid. Copepoda	13.8		0.9				
Amphipoda							
Hyperideia							
<i>Hyperoche medusarum</i>			1.7	0.5			
<i>Parathemisto pacifica</i>	3.9	0.5	0.1	<0.1	<0.1		
<i>Primno macropa</i>	0.3	7.9			1.3	0.7	2.1
Gammaridea							
Talitridae				0.1			
Euphausiacea							
<i>Thysanoessa</i> spp.	19.5	42.5	18.5	23.6	0.6		
Unid. Euphausiid						8.4	7.9
Euphausiid furcilla						0.2	
Decapoda							
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 - <i>Hexagrammos</i> 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.

Sample	1993	1994	1995	1996	1997	1998	1999
Number	24	16	48	71	36	26	43
Scyphozoa				1.4			
Gastropoda							
Unid. snail		25.0					
Pteropoda – (prob. <i>Limacina helicina</i>)	4.2		39.6	50.7	66.7	34.6	44.2
Copepoda							
<i>Neocalanus plumchrus/flemingeri</i>	62.5	93.8	93.8	97.2	100.0	88.5	83.7
<i>N. cristatus</i>	45.8	100.0	93.8	74.6	75.0	96.2	97.7
<i>Calanus pacifica</i>			4.2				
<i>Pachyptilus pacifica</i>							14.0
<i>Pareuchta birostrata</i>							18.6
<i>Lophotrix frontinalis</i>							2.3
Unid. Copepoda	20.8		2.1				
Amphipoda							
Hyperiidea							
<i>Hyperoche medusarum</i>			31.3	62.0			
<i>Parathemisto pacifica</i>	16.7	12.5	6.3	2.8	2.8		
<i>Primno macropa</i>	4.2	68.8			36.1	15.4	41.9
Gammaridea							
Talitridae				4.2			
Euphausiacea							
<i>Thysanoessa</i> spp.	91.7	68.8	66.7	87.3	8.3		
Unid. Euphausiid						92.3	90.7
Euphausiid furcilla						19.2	
Decapoda							
Shrimp zoea		25.0	29.2	12.7	58.3	34.6	60.5
Crab zoea				9.9	16.7		
Crab megalopa				5.6	22.2		
Hippolytidae juvenile							16.3
Fish							
<i>Hexagrammos</i> 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

^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).

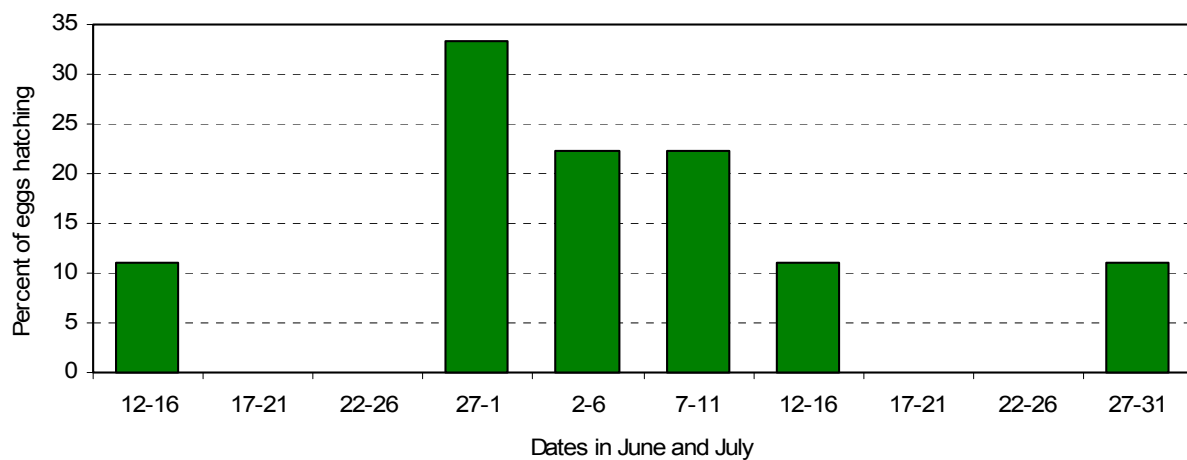


Figure 41. Hatching chronology of parakeet auklets at Buldir Island, Alaska in 2005.

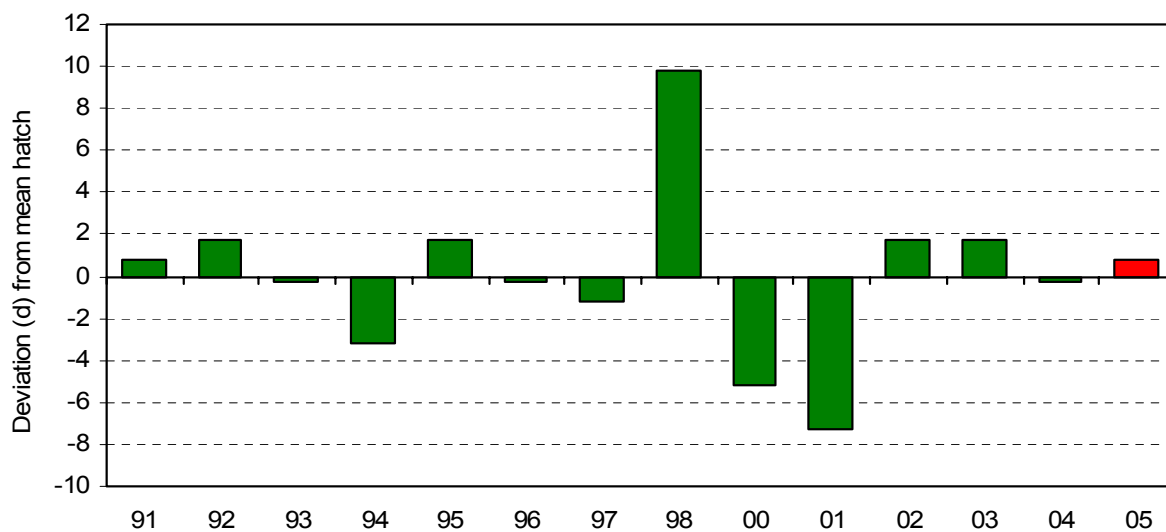


Figure 42. Yearly hatch date deviation (from the 1988-2004 average of 4 July) of parakeet auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

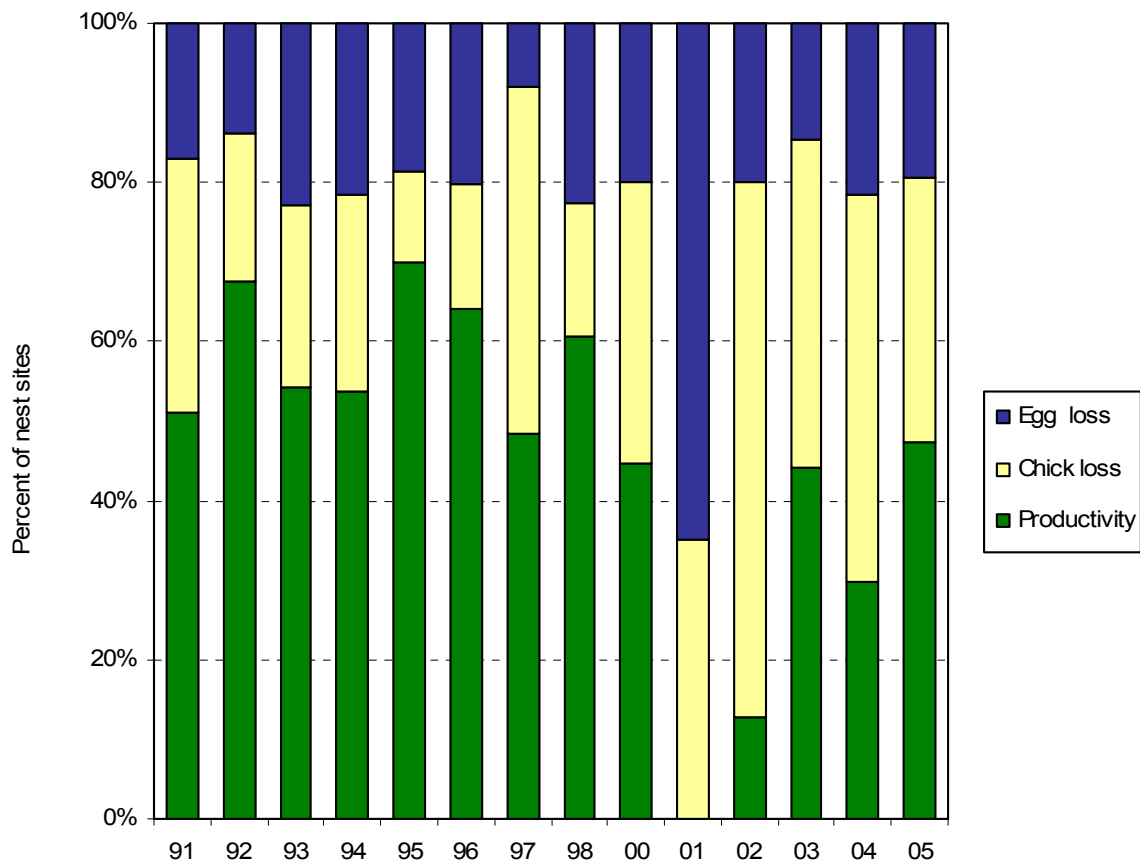


Figure 43. Reproductive performance of parakeet auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick.

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

Parameter ^a	1991	1992	1993	1994	1995	1996	1997
No. eggs found (A)	53	43	35	65	70	64	62
No. eggs lost to:							
disappearance	2	3	4	6	5	9	1
abandonment	3	3	3	6	6	3 ^b	2
breakage	4	0	1	2	2	1	2
No. eggs hatched (B)	44	37	27	51	57	51	57
No. chicks lost to:							
disappearance	8	6	7	12	8	2	9
death	9	2	1	4	0	8	18
No. chicks fledged (C)	27	29	19	35	49	41	30
Hatching success (B/A)	0.83	0.86	0.77	0.78	0.81	0.80	0.92
Fledging success (C/B) ^c	0.61	0.78	0.70	0.69	0.86	0.80	0.53
Reproductive success (C/A)	0.51	0.67	0.54	0.54	0.70	0.64	0.48
Productivity (hs x fs)	0.51	0.67	0.54	0.54	0.70	0.64	0.49

^a Data are from nest sites for which visit intervals at hatching and fledging were ≤ 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.

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

Parameter ^a		1998	1999	2000	2001	2002	2003	2004	2005
No. eggs found (A)		71	0	65	40	55	34	37	36
No. eggs lost to:	disappearance	11	-	10	8	6	0	3	2
	abandonment	5	-	3	18	5	5	3	5
	breakage	0	-	0	0	0	0	2	0
No. eggs hatched (B)		55	-	52	14	44	29	29	29
No. chicks lost to:	disappearance	0	-	22	3	6	10	6	5
	death	12	-	1	11	27	4	12	7
No. chicks fledged (C)		43	-	29	0	7	15	11	17
Hatching success (B/A)		0.77	-	0.80	0.35	0.80	0.85	0.78	0.81
Fledging success (C/B) ^c		0.78	-	0.56	0.00	0.16	0.52	0.38	0.59
Reproductive success (C/A)		0.61	-	0.45	0.00	0.13	0.44	0.30	0.47
Productivity (hs x fs)		0.60	-	0.45	0.00	0.13	0.44	0.30	0.48

^a Data are from nest sites for which visit intervals at hatching and fledging were ≤ 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.

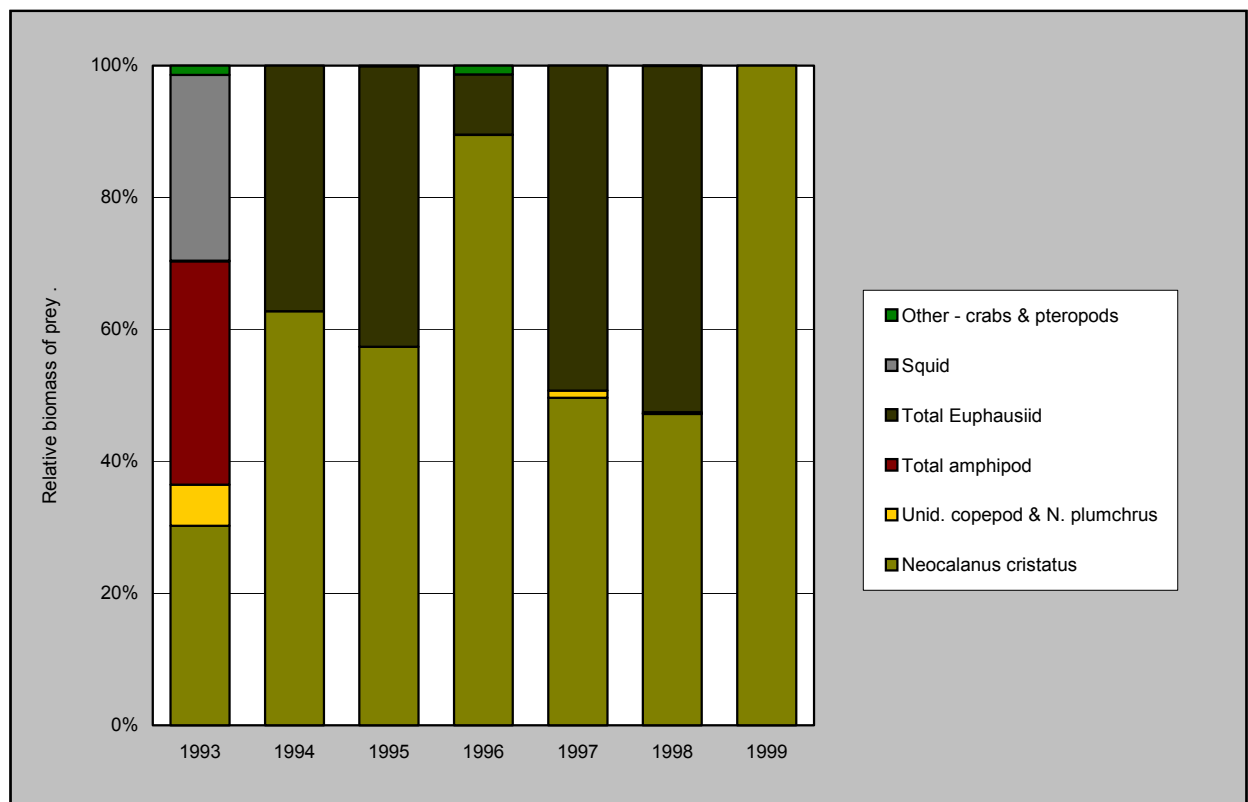


Figure 44. Relative biomass of prey in diets of parakeet auklets at Buldir Island, Alaska.

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.

	1993	1994	1995	1996	1997	1998	1999
No. samples	6	3	16	5	3	12	1
Total mass (g)	14.2	8.6	174.3	24.6	36.8	91.1	0.7
Pteropoda			<0.1	1.3			
Cephalopoda - squid	28.2						
Copepoda							
<i>Neocalanus plumchrus/flemingeri</i>					1.1	<0.1	
<i>N. cristatus</i>	30.3	62.8	57.4	89.2	49.6	43.0	100.0
Unid. Copepoda	6.2						
Amphipoda							
Hyperiidea							
<i>Parathemisto pacifica</i>	32.8			<0.1			
<i>Primno macropa</i>	1.1						
<i>Hyperoche medusarum</i>						0.1	
Gamaridea							
Lysianassidae						0.1	
Euphausiacea							
<i>Thysanoessa</i> spp.	0.1	37.2	42.5	9.5	49.2		
Unid. Euphausiid						47.8	
Decapoda							
Crab zoea			0.1				
Oregoninae	1.4						
Atelecyclidae megalopa						<0.1	

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
No. samples	6	3	16	5	3	12	
Pteropoda			6.3	40.0			
Cephalopoda - squid	16.7						
Copepoda							
<i>Neocalanus plumchrus/flemingeri</i>					33.3	8.3	
<i>N. cristatus</i>	50.0	66.7	81.3	100.0	66.7	75.0	100.0
Unid. Copepoda	16.7						
Amphipoda							
Hyperiidea							
<i>Parathemisto pacifica</i>	50.0			20.0			
<i>Primno macropa</i>	16.7						
<i>Hyperoche medusarum</i>						8.3	
Gamaridea							
Lysianassidae						8.3	
Euphausiacea							
<i>Thysanoessa</i> spp.	16.7	33.3	43.8	40.0	66.7		
Unid. Euphausiid						83.3	
Decapoda							
Crab zoea			6.3				
Oregoninae	16.7						
Atelecyclidae megalopa						8.3	

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

^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.

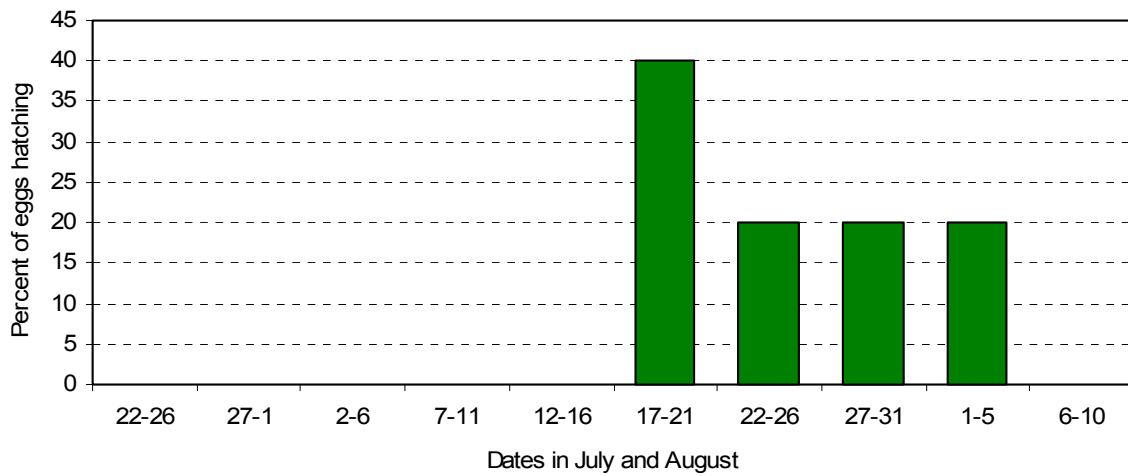


Figure 45. Hatching chronology of tufted puffins at Buldir Island, Alaska in 2005.

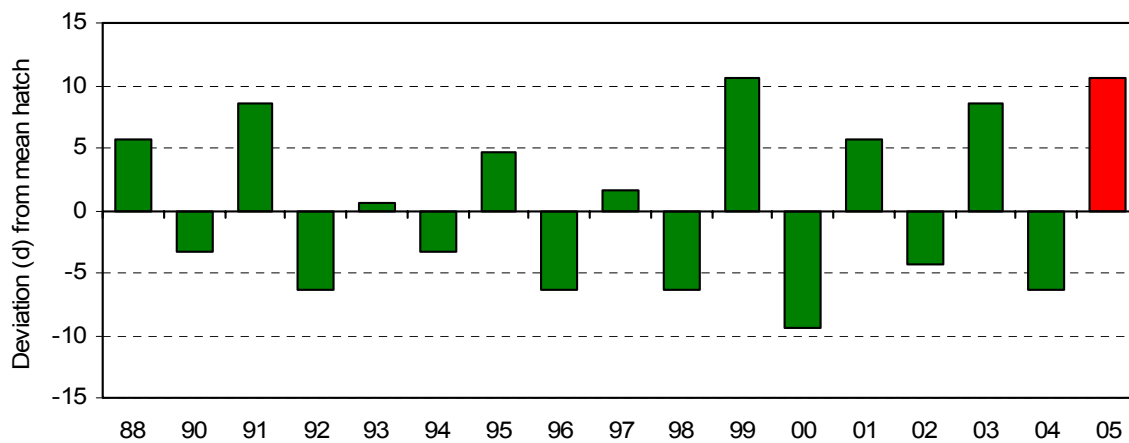


Figure 46. Yearly hatch date deviation (from the 1988-2004 average of 14 July) of tufted puffins at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

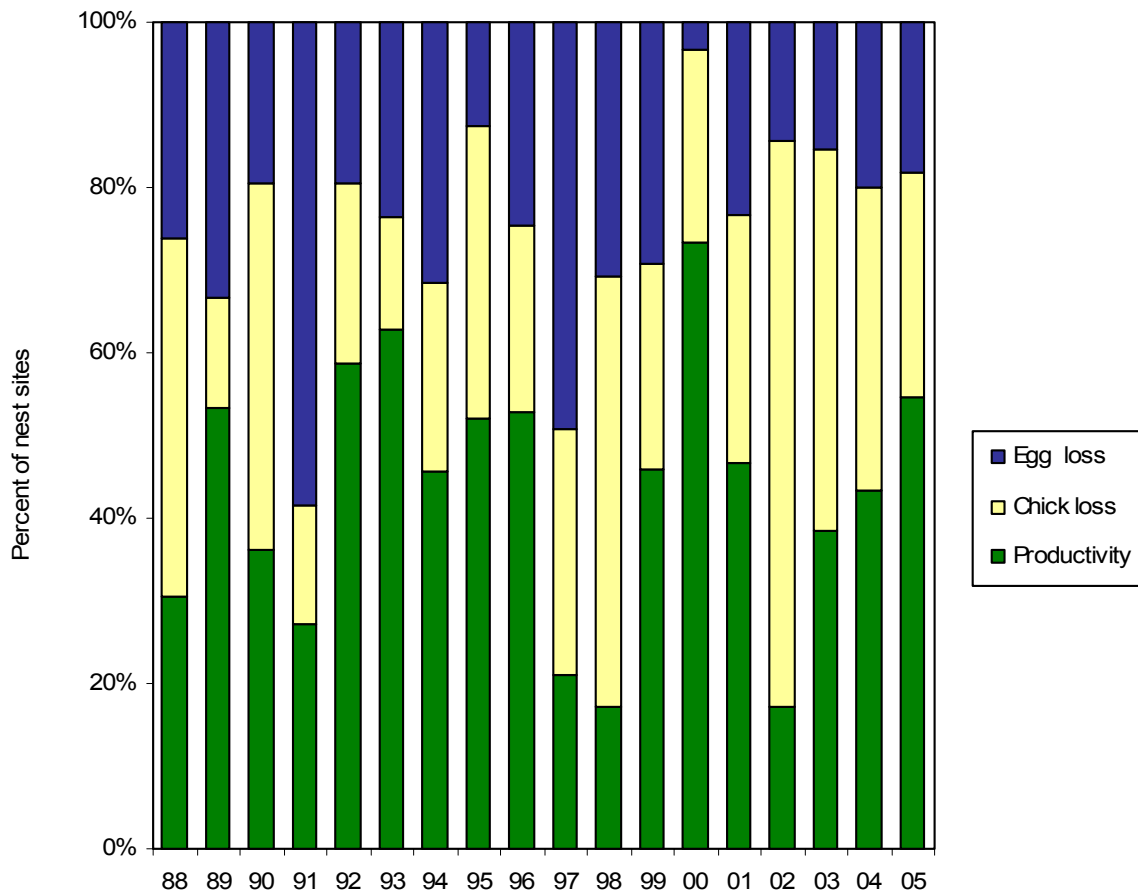


Figure 47. Reproductive performance of tufted puffins at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick.

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
No. eggs found ^b (A)	23	30	36	77	46	51	35	48	53	57	52	24	30	30	35	13	30	11
No. eggs lost to:																		
disappearance	2	5	5	23	4	11	7	2	6	18	10	2	0	3	4	2	5	1
abandonment	3	4	2	18	5	1	3	0	1	2	6	5	1	4	0	0	1	1
breakage	1	1	0	4	0	0	1	4	6	8	0	0	0	0	1	0	0	0
No. eggs hatched (B)	17	20	29	32	37	39	24	42	40	29	36	17	29	23	30	11	24	9
No. chicks lost to:																		
disappearance	2	0	14	9	7	6	6	13	6	11	15	6	7	6	14	4	6	3
death	8	4	2	2	3	1	2	4	6	6	12	2	0	3	10	2	5	0
No. "successful" chicks (C_{1+2})	7	16	13	21	27	32	16	25	28	12	9	11	22	14	6	5	13	6
fledged ^c (C_1)	6	6	7	2	9	30	15	8	25	8	0	1	2	2	2	3	2	0
still present (C_2)	1	10	6	19	18	2	1	17	3	4	9	10	20	12	4	2	11	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
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
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
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

^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 \pm 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.

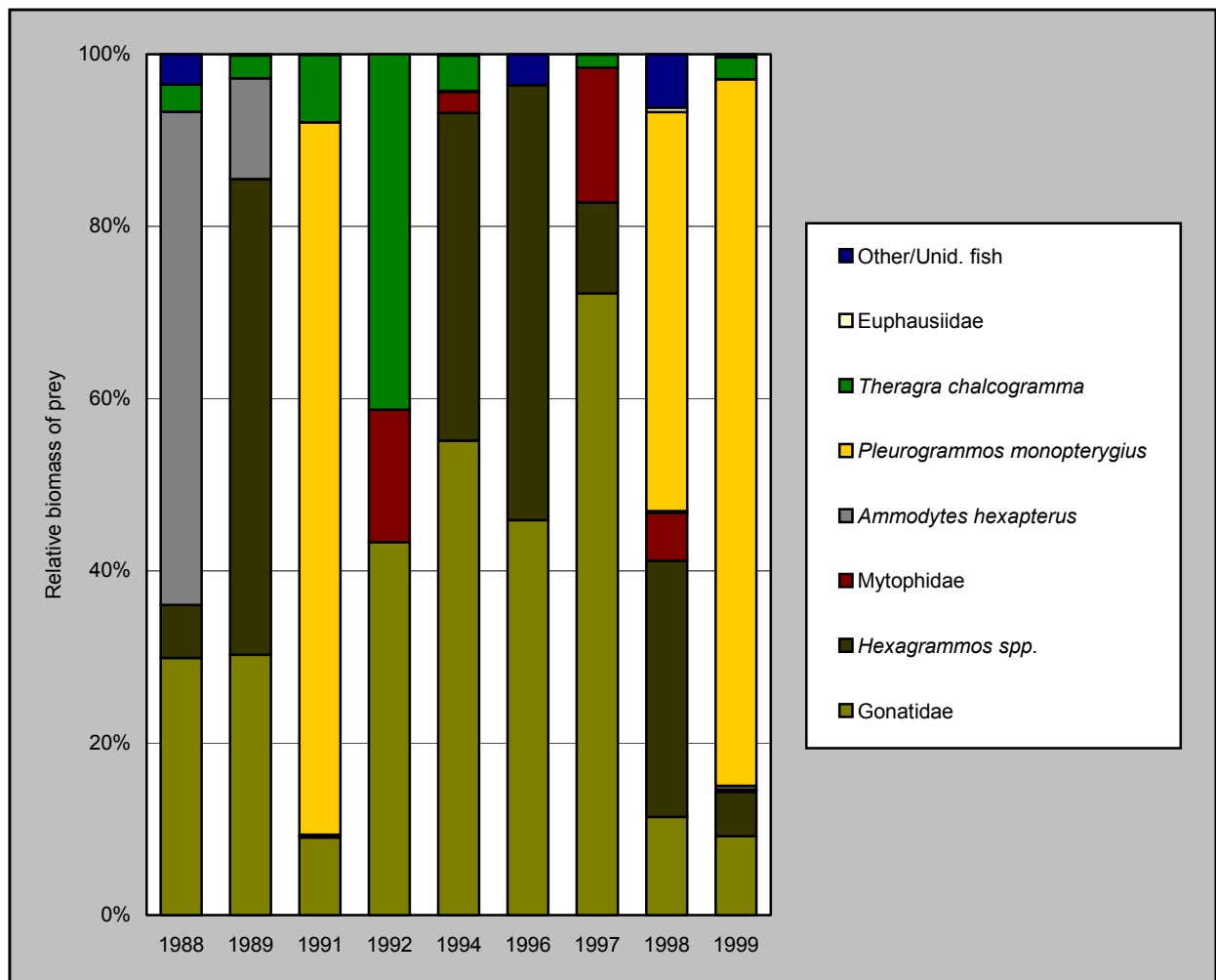


Figure 48. Relative biomass of prey in diets of tufted puffins at Buldir Island, Alaska.

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
Date: begin end	12 Aug 5 Sep	25 Jul 15 Aug	9 Aug 12 Aug	11 Aug 11 Aug	6 Aug 18 Aug	31 Jul 17 Aug	12 Aug 17 Aug	9 Aug 15 Aug	10 Aug 21 Aug
No. samples	39	26	36	4	39	17	13	29	31
Total mass (g)	279.2	376.5	608.2	48.7	649.7	196.2	227.1	371.0	464.2
Gonatidae (squid)									
<i>Gonatus middendorffi</i>						32.5	71.8		
<i>Beryteuthis magister</i>						6.7			
<i>Gonatopsis makko</i>							0.4		
Unid. squid	29.9	30.2	9.0	43.3	55.1	6.6		11.4	9.2
Euphausiidae									
<i>Thysanoessa longipes</i>								0.4	
<i>Thysanoessa</i> spp.								0.2	
Fish									
Myctophidae									
<i>Stenobrachius leucopsarus</i>							15.6	1.8	
Unid. Myctophidae				15.4	2.4			3.8	0.3
Gadidae									
<i>Theragra chalcogramma</i>	3.2	2.7	7.8	41.3	4.1		1.5		
Ptilichthyidae									
<i>Ptilichthys goodei</i>		0.1						0.1	
Zaproridae									
<i>Zaprora silenus</i>									0.1
Ammodytidae									
<i>Ammodytes hexapterus</i>	57.3	11.7	0.1		0.2			0.2	0.5
Scorpaenidae						1.4		0.1	
Anoplopomatidae									
<i>Anoplopoma fimbria</i>						0.4			
Hexagrammidae									
<i>Hexagrammos decagrammus</i>					38.1	49.8	10.6	29.7	23.8
<i>Hexagrammos</i> spp.	6.2	55.3	0.2			0.8			
<i>Pleurogrammos monopterygius</i>			82.8					46.4	82.1
Cottidae									
<i>Hemilepidotus</i> spp.						0.6			
<i>Blepsias bilobus</i>								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
Date: begin end	12 Aug 5 Sep	25 Jul 15 Aug	25 Jul 10 Aug	11 Jul 12 Aug	11 Aug 11 Aug	6 Aug 18 Aug	31 Jul 17 Aug	12 Aug 17 Aug	9 Aug 15 Aug	10 Aug 21 Aug
No. samples	39	26	23	42	4	39	17	13	29	31
Gonatidae (squid)										
<i>Gonatus middendorffi</i>							29.4	84.6		
<i>Beryteuthis magister</i>							5.9			
<i>Gonatopsis makko</i>								7.7		
Unid. squid	38.5	50.0	69.6	33.3	50.0	75.0	5.9		31.0	12.9
Euphausiidae										
<i>Thysanoessa longipes</i>									3.4	
<i>Thysanoessa</i> spp.									6.9	
Decapoda - shrimp	2.6									
Fish										
Myctophidae										
<i>Stenobrachius leucopsarus</i>								7.7	3.4	
Unid. Myctophidae					25.0	7.5			6.9	3.2
Gadidae										
<i>Theragra chalcogramma</i>	10.3	11.5	8.7	28.6	75.0	22.5		23.1		19.4
Ptilichthyidae										
<i>Ptilichthys goodei</i>		3.8							3.4	
Zaproridae										
<i>Zaprora silenus</i>										3.2
Ammodytidae										
<i>Ammodytes hexapterus</i>	79.5	26.9	4.3	4.8		2.5			3.4	9.7
Scorpaenidae							17.6		3.4	
Anoplopomatidae										
<i>Anoplopoma fimbria</i>							5.9			
Hexagrammidae										
<i>Hexagrammos decagrammus</i>						30.0	47.1	15.4	51.7	25.8
<i>Hexagrammos</i> spp.	12.8	61.5		4.8			11.8			
<i>Pleurogrammos monopterygius</i>			26.1	59.5					27.6	61.3
Cottidae										
<i>Hemilepidotus</i> spp.							11.8			
<i>Blepsias bilobus</i>									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
Date: begin	12 Aug	25 Jul	25 Jul	11 Jul	11 Aug	6 Aug	31 Jul	12 Aug	9 Aug	10 Aug
end	5 Sep	15 Aug	10 Aug	12 Aug	11 Aug	18 Aug	17 Aug	17 Aug	15 Aug	21 Aug
No. samples	39	26	23	42	4	39	17	13	29	31
No. individual prey items	258	163	117	166	22	129	66	45	88	87
Gonatidae (squid)										
<i>Gonatus middendorffi</i>							22.7	75.6		
<i>Berryteuthis magister</i>							1.5			
<i>Gonatopsis makko</i>								2.2		
Unid. squid	10.5	23.3	82.9	31.9	27.3	58.1	3.0		23.9	19.5
Euphausiidae										
<i>Thysanoessa longipes</i>									13.6	
<i>Thysanoessa</i> spp.									10.2	
Decapoda - shrimp	0.4									
Fish										
Myctophidae										
<i>Stenobrachius leucopsarus</i>								6.7	1.1	
Unid. Myctophidae					4.5	2.3			2.3	1.1
Gadidae										
<i>Theragra chalcogramma</i>	3.9	6.7	7.7	39.8	68.2	20.2		8.9		25.3
Ptilichthyidae										
<i>Ptilichthys goodei</i>		0.6							1.1	
Zaproridae										
<i>Zaprora silenus</i>										1.1
Ammodytidae										
<i>Ammodytes hexapterus</i>	76.0	42.3	2.6	1.2		1.6			1.1	3.4
Scorpaenidae							18.2		1.1	
Anoplopomatidae										
<i>Anoplopoma fimbria</i>							1.5			
Hexagrammidae										
<i>Hexagrammos decagrammus</i>						15.5	27.3	4.4	22.7	10.3
<i>Hexagrammos</i> spp.	4.3	27.0		1.2			4.5			
<i>Pleurogrammos monopterygius</i>			6.0	22.3					12.5	37.9
Cottidae										
<i>Hemilepidotus</i> spp.							6.1			
<i>Blepsias bilobus</i>									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

^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 ">".

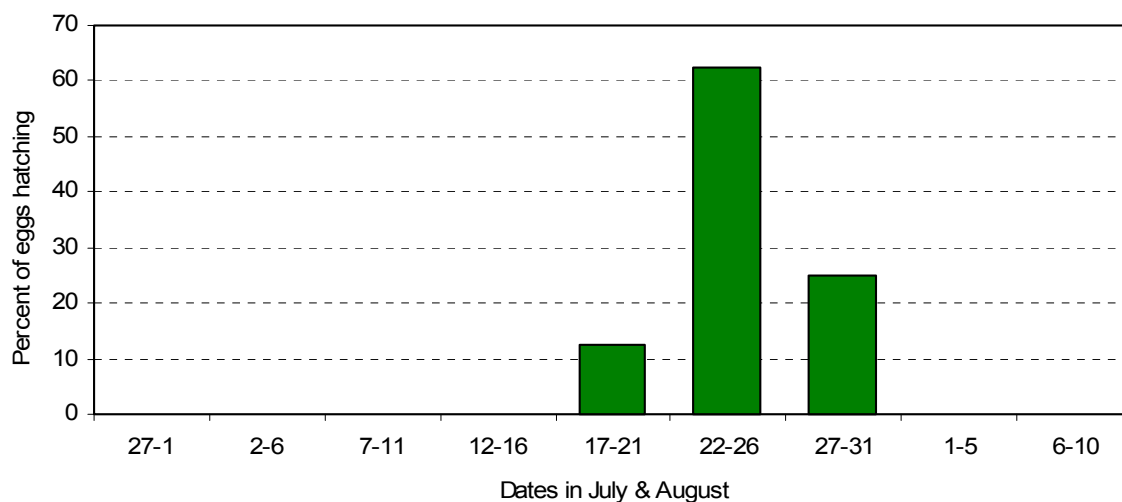


Figure 49. Hatching chronology of horned puffins at Buldir Island, Alaska in 2005.

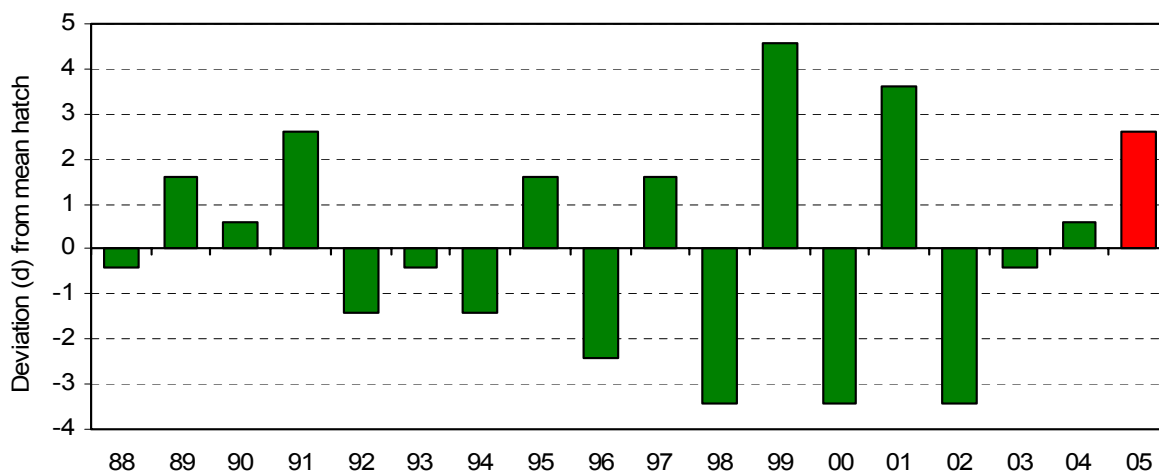


Figure 50. Yearly hatch date deviation (from the 1988-2004 average of 23 July) of horned puffins at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

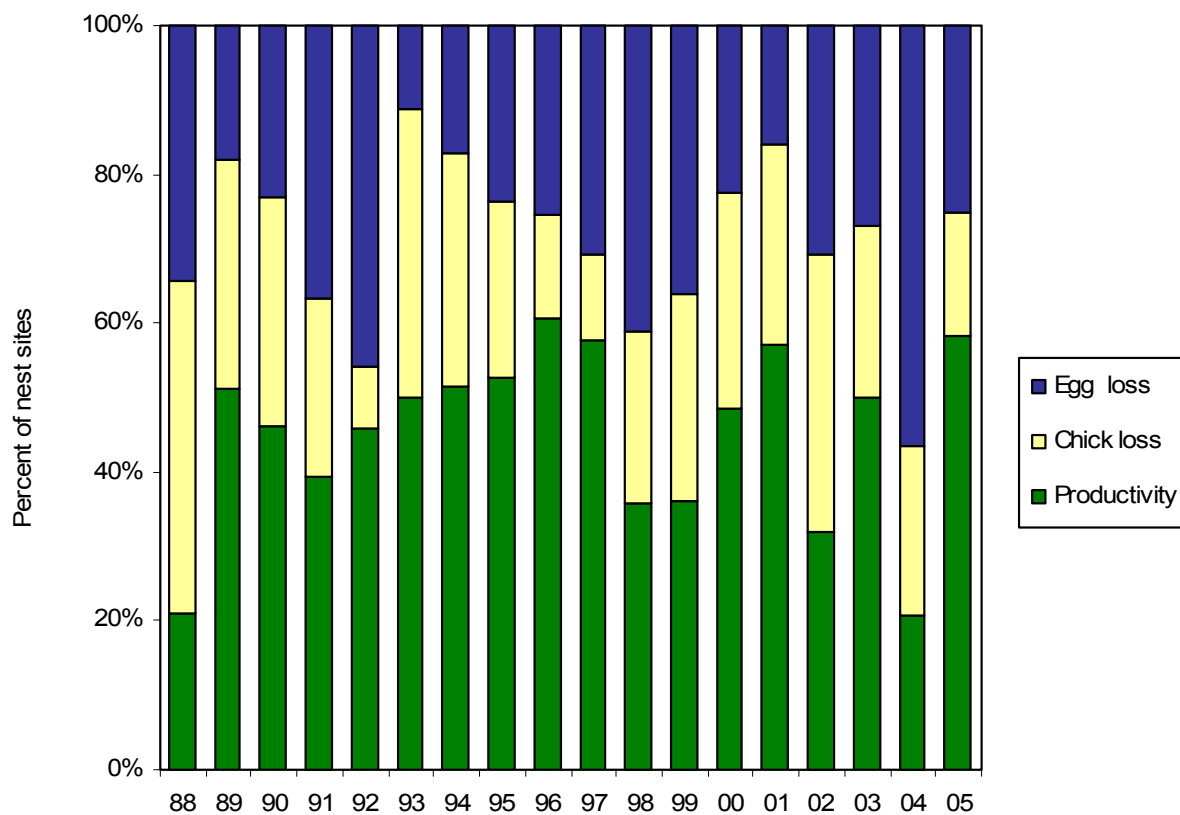


Figure 51. Reproductive performance of horned puffins at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick.

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
No. eggs found (A)	38	39	52	71	24	18	35	38	51	52	39	25	62	56	91	26	53	24
No. eggs lost to:																		
disappearance	11	4	12	11	9	2	5	6	8	11	8	7	14	5	14	5	14	2
abandonment	2	2	0	11	1	0	0	1	1	2	7	0	0	4	3	1	12	3
breakage (%)	0	1	0	4	1	0	1	2	4	3	1	2	0	0	11	1	3	1
No. eggs hatched (B)	25	32	40	45	13	16	29	29	38	36	23	16	48	47	63	19	23	18
No. chicks lost to:																		
disappearance	12	9	13	9	0	5	7	5	3	5	5	6	16	4	21	3	8	3
death	5	3	3	8	2	2	4	4	4	1	4	1	2	11	13	3	4	1
No. "successful" chicks (C_{1+2})	8	20	24	28	11	9	18	20	31	30	14	9	30	32	29	13	11	14
fledged ^b (C_1)	8	2	1	0	0	9	18	0	9	2	0	0	2	9	0	2	0	0
still present (C_2)	0	18	23	28	11	0	0	20	22	28	14	9	28	23	29	11	11	14
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
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
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
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

^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.

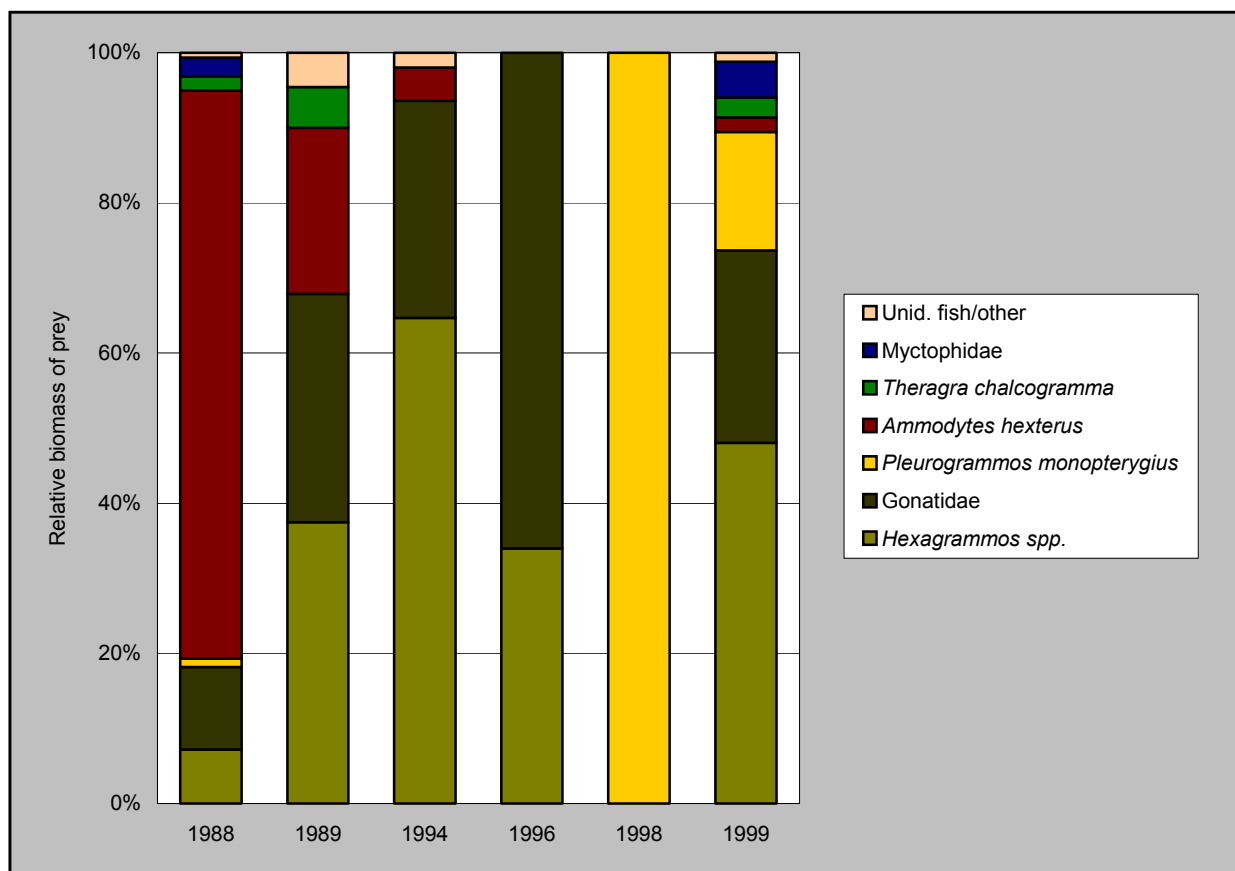


Figure 52. Relative biomass of prey in diets of horned puffins at Buldir Island, Alaska.

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
Date begin end	16 Aug 5 Sep	2 Aug 15 Aug	7 Aug 14 Aug	3 Aug 17 Aug	13 Aug 13 Aug	22 Jul 21 Aug
No. samples	33	16	3	3	1	28
Total mass (g)	399.2	92.1	20.4	36.5	5.8	348.9
Gonatidae (squid)						
<i>Gonatus middendorffi</i>				66.0		
Unid. squid	11.0	30.4	28.9			25.7
Fish						
Myctophidae						
<i>Stenobrachius leucopsarus</i>	2.5					4.8
Gadidae						
<i>Theragra chalcogramma</i>	1.9	5.4				2.6
Ammodytidae						
<i>Ammodytes hexapterus</i>	75.7	22.1	4.4			1.9
Hexagrammidae						
<i>Hexagrammos decagrammus</i>			64.7	34.0		42.8
<i>Hexagrammos</i> spp.	7.2	37.5				5.2
<i>Pleurogrammos monopterygius</i>	1.1				100.0	15.8
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
Date begin end	16 Aug 5 Sep	2 Aug 15 Aug	27 Jul 10 Aug	22 Jul 11 Aug	7 Aug 14 Aug	3 Aug 17 Aug	13 Aug 13 Aug	22 Jul 21 Aug
No. samples	33	16	45	42	3	3	1	28
Gonatidae (squid)								
<i>Gonatus middendorffi</i>						33.3		
Unid. squid	18.2	31.3	20.0	7.1	33.3			31.6
Fish								
Myctophidae								
<i>Stenobrachius leucopsarus</i>	3.0							2.6
Gadidae								
<i>Gadus macrocephalus</i>			2.2					
<i>Theragra chalcogramma</i>	3.0	12.5	17.8	9.5				5.3
Ammodytidae								
<i>Ammodytes hexapterus</i>	93.9	68.8	57.8	45.2	33.3			18.4
Hexagrammidae								
<i>Hexagrammos decagrammus</i>					100.0	66.7		52.6
<i>Hexagrammos</i> spp.	12.1	31.3	4.4	4.8				23.7
<i>Pleurogrammos monopterygius</i>	3.0		66.7	64.3			100.0	7.9
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
Date begin end	16 Aug 5 Sep	2 Aug 15 Aug	27 Jul 10 Aug	22 Jul 11 Aug	7 Aug 14 Aug	3 Aug 17 Aug	13 Aug 13 Aug	22 Jul 21 Aug
No. samples	33	16	45	42	3	3	1	28
No. individual prey items	273	70	261	196	14	7	1	189
Gonatidae (squid)								
<i>Gonatus middendorffi</i>						57.1		
Unid. squid	4.0	32.9	7.7	6.6	28.6			20.1
Fish								
Myctophidae								
<i>Stenobrachius leucopsarus</i>	0.4							2.6
Gadidae								
<i>Gadus macrocephalus</i>			0.4					
<i>Theragra chalcogramma</i>	4.0	5.7	11.1	2.6				3.2
Ammodytidae								
<i>Ammodytes hexapterus</i>	85.3	50.0	61.3	60.2	35.7			8.5
Hexagrammidae								
<i>Hexagrammos decagrammus</i>					21.4	42.9		24.9
<i>Hexagrammos</i> spp.	1.8	8.6	1.1	7.1				31.2
<i>Pleurogrammos monopterygius</i>	0.4		17.6	21.9			100.0	4.2
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. Surveys were conducted on 8 June 1995, 9 June 1996, and 12 June 1997, 18 June 1998, 12 June 2001, 17 June 2002, and 14 June 2003. No point count was conducted in 2004. For those species marked with an asterisk, we observed pairs, nests, and/or territorial males.

Species	1995 ^a	1996	1997	1998	2000	2001	2002	2003	2005	Mean
Fork-tailed storm-petrel*	6	0	1	1	-	0	0	0	0	1.0
Leach's storm-petrel	0	1	0	0	-	0	0	0	0	0.1
Aleutian Canada goose*	133	112	85	22	-	70	2	76	-	71.4
Parasitic jaeger	2	2	8	5	-	1	2	1	0	2.6
Glaucous-winged gull*	60	142	161	66	-	18	20	34	-	71.6
Parakeet auklet	1	3	12	0	-	1	0	0	0	2.1
Tufted puffin	0	0	0	1	-	0	0	0	0	0.1
Bald eagle	1	0	0	0	-	0	0	0	0	0.1
Winter wren*	1	6	9	1	-	5	4	7	3	4.5
Song sparrow*	10	10	8	3	-	2	1	2	9	5.6
Lapland longspur* - total	30	26	22	14	-	18	31	18	22	22.6
male	24	22	17	11	-	--	--	13	17	17.3
female	5	3	3	0	-	--	--	0	5	2.7
unknown	1	1	2	3	-	18	31	5	0	7.6
Snow bunting*	9	6	14	1	-	2	8	0	11	6.4
Rosy finch*	2	4	1	9	-	1	5	0	7	3.6
Common rosefinch	0	0	1	0	-	0	0	0	0	0.1

^a Total number of individuals detected on survey.

Table 84. Numbers of birds detected on off-road point count route number 315, Buldir Island, Alaska, on 15 June 2005. The count at point 5 was missed in 2005; points 6-12 were conducted in conditions which made detection difficult.

Species	Point no.												Total ^a	% of total ^b	% of points ^c
	1	2	3	4	5	6	7	8	9	10	11	12			
Winter wren	2	0	0	1	-	0	0	0	0	0	0	0	3	5.8	18.2
Song sparrow	2	4	0	2	-	1	0	0	0	0	0	0	9	17.3	36.4
Lapland longspur - total	3	5	6	7	-	1	0	0	0	0	0	0	22	42.3	45.5
male	2	4	5	5	-	1	0	0	0	0	0	0	17	32.7	45.5
female	1	1	1	2	-	0	0	0	0	0	0	0	5	9.6	36.4
unknown	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0
Snow bunting	0	0	0	0	-	0	4	2	1	0	2	2	11	21.2	45.5
Gray-crowned rosy-finch	3	0	0	1	-	0	2	1	0	0	0	0	7	13.5	36.4

^aTotal number of individuals detected on survey.

^bRelative abundance of species: percent of total number of individual birds of all species detected on survey.

^cPercent 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

^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

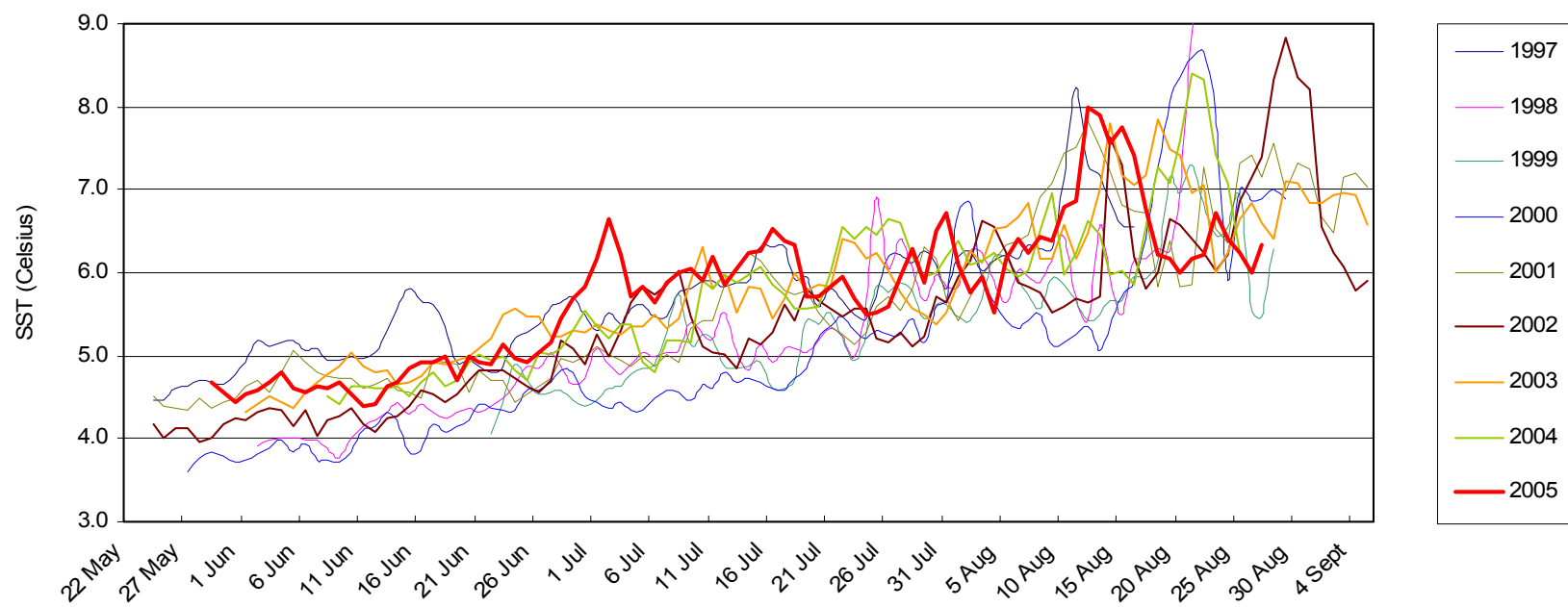


Figure 53. Sea surface temperature (°C) at Buldir Island, Alaska, 1997-2005. Values are the daily mean temperature.

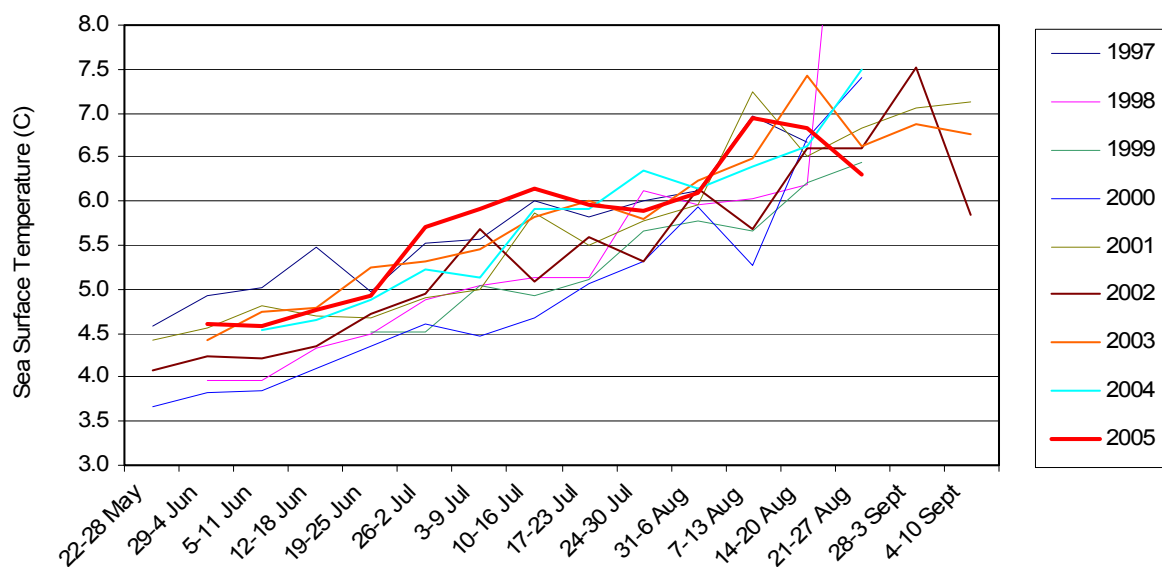


Figure 54. Weekly Sea Surface Temperature (°C) at Buldir Island, Alaska, 1997-2005.

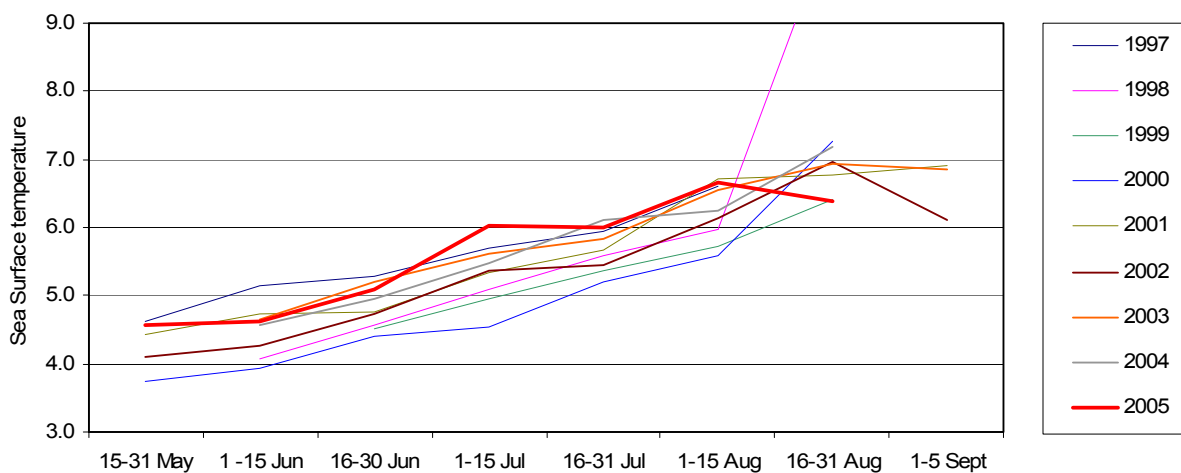


Figure 55. Biweekly Sea Surface Temperature (°C) at Buldir Island, Alaska, 1997-2005.

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

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

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

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

Annotated list of species observed at Buldir Island, Alaska, 29 May through 26 August, 2005.

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

Arctic Loon (*Gavia artica*) – Casual. A single bird was observed near Crested Point on 27 June.

Horned Grebe (*Podiceps auritus*) – Casual. A single bird was present off North Bight Beach from 6-9 June, and two individuals were observed near Gull Slide on 13 June.

Red-necked Grebe (*Podiceps grisegena*) – Casual. A single individual was present off North Bight Beach on 18 June.

Laysan Albatross (*Phoebastria immutabilis*) – Common offshore. Birds were regularly seen from the Tiglax, but this species was not observed from land.

Northern Fulmar (*Fulmarus glacialis*) – Common breeder. Nests in small colonies at East Cape, Kittiwake Lane, and Spike Camp. Most birds were dark morphs, but several light morph individuals nested near Spike Camp.

Short-tailed Shearwater (*Puffinus tenuirostris*) – Casual near shore. A single bird was observed swimming near Kittiwake Lane on 18 July. This species is more common in offshore waters.

Fork-tailed Storm-Petrel (*Oceanodroma furcata*) – Abundant breeder. Nests in burrows and crevices over most of the island. Productivity and density was monitored at 5 plots near camp and South Marsh.

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

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

Red-faced Cormorant (*Phalacrocorax urile*) – Fairly common breeder. Nests on sea-facing cliffs around the island.

Cackling Goose (*Branta hutchinsii*) – Abundant breeder. The Aleutian subspecies of what was previously the Canada Goose (*B. Canadensis leucopareia*) was suspected to be extinct until a remnant population was discovered on Buldir in the 1960s; because of intensive managing, the species is now abundant on many islands. Goslings were first observed on 8 June. Peak flight-feather molt occurred in late July; the first post-molt goose noted flying was on 1 August.

Brant (*Branta bernicula*) – Casual. A single Black Brant was observed at Bean Goose Pond from 16-22 August.

Mallard (*Anas platyrhynchos*) – Casual. A single male was observed at Bean Goose Pond on 30 May, and a single juvenile was present at Tattler Creek on 17 August.

Green-winged Teal (*Anas crecca*) – Uncommon breeder. Green-winged Teal numbers fluctuated throughout the season. Twelve birds, the highest number observed, were present at Bean Goose Pond on 29 May. A clutch of chicks was observed on 17 June in South Marsh.

American Wigeon (*Anas americana*) – Casual. A single male was present at Bean Goose Pond on 30 May.

Eurasian Wigeon (*Anas penelope*) – Uncommon migrant. Eurasian Wigeons were seen on Buldir from 29 May to 24 June. The largest number of birds observed was 14 on 30 May at Bean Goose Pond.

Northern Pintail (*Anas acuta*) – Uncommon migrant. Individuals were observed on several occasions from 29 May to 24 June. The largest number encountered was 6 on 29 May at Bean Goose Pond.

Northern Shoveler (*Anas clypeata*) – Uncommon migrant. Northern Shovelers (a maximum of four) were observed on several occasions from 31 May to 21 June. Additionally, three individuals were present at Kittiwake Pond on 16 July.

Greater Scaup (*Aythya marila*) – Rare migrant. A single bird was present off of North Bight Beach on 29 May; three birds were observed at Kittiwake Pond on 24-25 June and two were present there on 3 August.

Common Eider (*Somateria mollissima*) – Fairly common breeder. Groups of birds were seen regularly throughout the season. The first chicks were observed on 20 June.

Harlequin Duck (*Histrionicus histrionicus*) – Fairly common. This species was present in small numbers throughout the season, but was much more common early and late in the season.

Common Merganser (*Mergus merganser*) – Casual. A bird dead approximately one month was found on North Bight Beach on 8 June.

Red-breasted Merganser (*Mergus serrator*) – Casual. A single male was observed near Kittiwake Lane on 10 June, and a single female was present on North Bight Beach on 5 August.

Bald Eagle (*Haliaeetus leucocephalus*) – Rare breeder. Both adults and immature birds were occasionally seen throughout the season, but no nests were observed in 2005.

Peregrine Falcon (*Falco peregrinus*) – Fairly common breeder. This species was most common along the coast, but individuals were also occasionally observed in alpine areas.

Sandhill Crane (*Grus canadensis*) – Casual. A single bird was observed at Bean Goose Pond on 29-30 May and near Spike Camp on 15 June.

Lesser Sand Plover (*Charadrius mongolus*) – Casual. One individual was seen on North Bight Beach on 7 July.

Common Greenshank (*Tringa nebularia*) – Casual. A single bird was observed on Tattler Creek 12 August and at Bean Goose Pond on 16 August.

Wandering Tattler (*Heteroscelus incanus*) – Casual. As many as two birds were present along the northern coast from 1-18 June, and a single individual was observed at the mouth of Tattler Creek on 29 July.

Gray Tailed Tattler (*Heteroscelus brevipes*) – Casual. A single individual was observed near Tattler Creek on 5 August.

Wood Sandpiper (*Tringa glareola*) – Rare migrant. Wood Sandpipers were observed regularly from our arrival on 29 May until 13 June, and from 13 August until our departure. Most sightings occurred in the vicinity of South Marsh. The largest number of birds observed was four at Bean Goose Pond on 16 August.

Common Sandpiper (*Actitis hypoleucos*) – Casual. A single bird was present near the Main Talus on 13 June, and two birds were seen near Crested Point on 14 August.

Ruddy Turnstone (*Arenaria interpres*) – Rare migrant. Individuals (a maximum of three birds) were observed on several occasions in early June and late August. Additionally, three birds were present on 29 July.

Rock Sandpiper (*Calidris ptilocnemis*) – Casual. A single bird was observed in North Marsh on 13 August; two birds were present on 16 August in the same location.

Long-toed Stint (*Calidris subminuta*) – Casual. Three birds were observed in South Marsh on 29 May, two were seen the next day, and single birds were found on 13 June and 22 August.

Temminck's Stint (*Calidris temminckii*) – Casual. A lone bird was present in South Marsh on 30 May.

Red-necked Stint (*Calidris ruficollis*) – Casual. A single bird was present on North Bight Beach from 5-7 June, another was found near Crested Point on 6 August.

Common Snipe (*Gallinago gallinago*) – Casual. As many as two birds were present in South Marsh from 29 May through 1 June, and a single bird was flushed on the trail leading down to Spike Camp on 25 August.

Parasitic Jaeger (*Stercorarius parasiticus*) – Common breeder. Dark phase individuals were encountered regularly throughout the summer. A nest with two eggs was found near Kittiwake Pond on 24 June; one chick was present on 30 June and the second egg was pipped.

Common Black-headed Gull (*Larus ridibundus*) – Casual. A single individual was observed on North Bight Beach on several occasions from 29 May through 13 June.

Slaty-backed Gull (*Larus schistisagus*) – Upon our May 29 arrival, three birds—an adult, a first-year, and a second year bird—were present on North Bight Beach. The first year bird remained until its death in mid-July. The second year bird was last seen on 3 June. The adult bird was apparently paired with a Glaucous-winged Gull, and nest-defense behavior was noted on 7 June near Main Talus, but the nest was not discovered until 28 June. At this time one egg and two young chicks were present. An unhatched egg (determined to be non-viable) and one dead chick were present in the nest on a return visit on 1 July. The adults were no longer defending the nest and the second chick could not be located. The dead chick was collected and tissue samples were taken.

Glaucous Gull (*Larus hyperboreus*) – Casual after winter. An immature bird (possibly a Glaucous-winged Gull hybrid) was observed on North Bight beach in early June, and a dead immature bird—several weeks dead—was found on North Bight Beach on 8 June.

Glaucous-winged Gull (*Larus glaucescens*) – Abundant breeder. Glaucous-winged Gull nests were common in all lowland areas of the island. Hatchlings were observed on 8 June, and the first fledglings were noted on 16 July. Breeding success was relatively high in 2005—355 fledglings were counted between Crested Point and Main Camp on 19 August (256 on 12 August).

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.

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.

Least Tern (*Sterna antillarum*) – Accidental. A single bird was observed on North Bight Beach from 4-6 July. The presence of a light gray rump and uppertail coverts (not drastically lighter than the mantle) and a very short tail indicate that the bird was a Least Tern and not the very similar Little Tern (*Sterna albifrons*). However, we were unable to examine the bird in hand, and cannot declare the species with confidence. Least Tern would be a first record for Alaska, and Little Tern a first for North America outside of the Hawaiian Islands.

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.

Pigeon Guillemot (*Cepphus columba*) – Common breeder. Pigeon Guillemots were regularly seen just offshore around the island. Juvenile birds were first noted on 15 August.

Ancient Murrelet (*Synthliboramphus antiquus*) – Abundant breeder. Although seen only occasionally during the day, this species nested on Buldir in large numbers. The first chicks were noted on 2 July.

Cassin's Auklet (*Ptychoramphus aleuticus*) – Common breeder. Cassin's Auklet was encountered only during nighttime hours; the species was often captured by mist net at Crested Point.

Parakeet Auklet (*Cyclorhynchus psittacula*) – Abundant breeder. Parakeet Auklets nested in talus at Northwest Ridge, Spike Camp Valley, and in smaller numbers at Main Talus, and Crested Point. Chicks were first encountered on 24 June.

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. Chicks were first found on 18 June.

Whiskered Auklet (*Aethia pygmaea*) – Abundant breeder. This nocturnal auklet was found nesting at monitoring sites at Northwest Ridge, Main Talus, and Crested Point. Chicks were first found on 14 June.

Crested Auklet (*Aethia cristatella*) – Abundant breeder. The most abundant of auklets, Crested Auklets nested in talus slopes and rocky hillsides throughout the coastal areas of Buldir. Chicks were first discovered on 22 June.

Tufted Puffin (*Fratercula cirrhata*) – Abundant breeder. This species nested on grassy and rocky slopes around the island. The first chick was found on 13 July.

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

Common Cuckoo (*Cuculus canorus*) – Casual. A single gray-morph individual was observed at several locations along the north coast from 20 June to 4 July.

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. Birds were present from 1-12 June. Three females were present between South Marsh and Bean Goose Pond on 3 June and at least 1 male was seen on 5 and 6 June.

Red-breasted Flycatcher (*Ficedula parva*) – Casual. A single female was observed between South Marsh and Bean Goose Pond on 29 and 30 May; two females were present in that location on 1 June.

Asian Brown Flycatcher (*Muscicapa dauurica*) – Accidental. A single bird was found between South Marsh and Bean Goose Pond on 29 May.

Siberian Rubythroat (*Luscinia calliope*) – Casual. Individual males (at least two) were observed between South Marsh and Bean Goose Pond from 29 May to 1 June.

Red-flanked Bluetail (*Tarsiger cyanurus*) – Casual. A female was observed between South Marsh and Bean Goose Pond on 29 and 30 May.

Yellow Wagtail (*Motacilla flava*) – Casual. As many as two Individuals were observed in South Marsh during the first week of June.

Olive-backed Pipit (*Anthus hodgsoni*) – Casual. Two birds were present near camp on 29 May.

Red-throated Pipit (*Anthus cervinus*) – A single male was observed near Bean Goose Pond on 29 May.

Song Sparrow (*Melospiza melodia*) – Abundant breeder. Song Sparrows were commonly seen at lower altitudes, especially near the coast. Fledglings were first noted on 19 June.

Lapland Longspur (*Calcarius lapponicus*) – Abundant breeder. This species was commonly seen in all low and mid-elevation habitats on the island. The first fledgling was recorded on 11 July.

Snow Bunting (*Plectrophenax nivalis*) – Common breeder. Although individuals were occasionally encountered along the coast, this species was mostly restricted to higher elevations.

Reed Bunting (*Emberiza schoeniclus*) – Casual. Between two and four birds (one male and at least one female) were present near Main Camp upon our 29 May arrival. At least one bird was present until 9 June.

Rustic Bunting (*Emberiza rustica*) – Casual. A single male was observed 4 June and a possible female was reported on 1 and 4 June.

Gray-crowned Rosy Finch (*Leucosticte arctoa*) – Abundant breeder. This species was found throughout the island. Fledglings were noted on 2 July.

Oriental Greenfinch (*Carduelis sinica*) – Casual. A flock of five birds was encountered near South Marsh on 1 June.

Common Redpoll (*Carduelis flammea*) – Casual. Common Redpolls were first observed at Spike Camp on 5 July. On 12 June 4 birds were present at Spike Camp and over 10 birds were present at Main Camp. Individuals were encountered in smaller numbers throughout the remainder of the season.

Brambling (*Fringilla montifringilla*) – Casual. Flocks of Bramblings (9 and 22+ birds) were observed between 29 May and 1 June.

Hawfinch (*Coccothraustes coccothraustes*) – Casual. Two individuals were present around camp and North Marsh from 29 May to 19 June.

Marine Mammals

Sea Otter (*Enhydra lutris*) – Very rare. Occasionally seen in the nearshore waters off Kittiwake Lane, Northwest Point, and Spike Camp.

Harbor Seal (*Phoca vitulina*) – Fairly common. Individuals and groups of up to 5 animals were encountered throughout the season. A dead pup was found on the north coast in early August.

Steller Sea Lion (*Eumetopias jubatus*) – Fairly common. 105 sea lions, including 8 pups, were present at the rookery on 15 August. Lone individuals and small groups were observed at various locations throughout the summer.

Sperm Whale (*Physeter macrocephalus*) – Very rare nearshore. A single whale was seen off of Main Talus on 22 June.