AMNWR 08/16

BIOLOGICAL MONITORING AT BULDIR ISLAND, ALASKA IN 2008: SUMMARY APPENDICES

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

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September 2008

Cite as: Payne, K. J. 2008. Biological monitoring at Buldir Island, Alaska in 2008: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 08/16. Homer, Alaska. 160 pp.

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

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

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

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

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

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

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

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

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

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

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

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

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

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INTRODUCTION

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

Seabirds at Buldir Island, one of the nine monitoring sites, have been studied annually since 1988 when intensive season-long monitoring began. However, historical data exists from as early as 1974, particularly for storm-petrels and auklets, and these are used for comparison purposes. Buldir is almost unique among Aleutian Islands in that it escaped the widespread introduction of arctic foxes (Bailey 1993) and rats, both of which apply heavy predation pressure on breeding seabirds. The island's isolation and difficulty of access, as well as the absence of non-native predators, have made Buldir the most diverse (21 nesting species) and possibly largest seabird colony in Alaska (perhaps 4,000,000 individuals; Byrd 1978, Byrd and Day 1986, Byrd and Williams 1994).

The specific monitoring goals in 2008 were to estimate: 1) reproductive success indices for 15 seabird species, 2) breeding chronology and for kittiwakes, puffins, auklets and murres, 3) productivity indices for storm-petrels, kittiwakes, murres, auklets, puffins, and cormorants, 4) food habits data for storm-petrels, kittiwakes, auklets, and puffins, and 5) survival data for adult red-legged kittiwakes.

Detailed results of the 2008 monitoring program are contained in these appendices and archived at the Refuge headquarters in Homer, Alaska. Summary data were entered into the Pacific Seabird Monitoring Database and will be included in the annual Alaska Consolidated Seabird Monitoring report of the Alaska Maritime National Wildlife Refuge.

STUDY AREA

Buldir Island (52°21' N, 176°56' E) is the westernmost island in the Rat Islands group of the Aleutian chain. This 2000-ha island is approximately 6.4 km long and 3.2 km wide. Located about 110 km from both Shemya to the west and Kiska to the east, it is the most isolated island in the Aleutians, providing the only landfall in a 220 km-wide pass.

The weather is typical of a northern maritime climate, with moderate year-round temperatures and strong winds. Fog and rain are characteristic, and violent storms occur frequently. The average temperature at sea level is about 7.7°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 *Leymus*-umbel, *Leymus*-umbel-fern, and *Carex*-fescue meadow. The lowland short-plant complex is composed of four communities of which the moss-willow tundra is most widespread. Over 119 plants have been identified on the island – fewer than on most other Aleutian Islands. There are no erect trees or shrubs.

Buldir Island is surrounded by deep water and is representative of a pelagic seabird colony where prey is diverse and availability is variable among years (Springer et al. 1996). Most prey species taken by birds are members of the Oceanic and Outer-shelf Zooplankton community (Cooney 1981), or are deep-dwelling vertical migrants (e.g. squid and Myctophids). The shallow water surrounding Buldir, Middle and Tahoma reefs to the southeast and south serve as surrogate meso-scale continental shelf-like habitats for coastal marine fauna in this otherwise deep water environment. The three reefs are important feeding areas for many birds breeding on Buldir (Dragoo and Byrd 1999). In particular, the juxtaposition of the

Buldir reef escarpment (60-100m) to the Buldir Depression, an 18x55 km basin with depths to 2000 m, creates a physiographic structure conducive to foraging by a wide variety of seabirds. Sea surface temperatures measured in North Bight are normally 3-4^{o} C in late May and rise to 6-7^{o} C in late August. Occasionally, anomalous events occur such as in 1998 when sea surface temperature rose to an unusually high 12^{o} C.

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

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

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

METHODS

Personnel.--Three USFWS observers, Scott Freeman (Camp Leader), Kevin Payne (Technician), and Bob Keller (Volunteer) were present on Buldir Island from 26 May through 27 August 2008. Two students from Memorial University, Newfoundland were present from 26 May through 5 August to conduct auklet resightings.

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

- In addition to the intensive Type II productivity monitoring of kittiwakes at Spike Camp, nesting birds at Kittiwake Lane were monitored by a Type I "Boom or Bust" method. Nests were counted in June and chicks were counted in late July and the middle of August to estimate maximum productivity potential and allow a means of success rate comparison between the two colonies.

- A digital camera was used to take pictures inside puffin burrows that were difficult to see. If these pictures positively determined the contents of a burrow they were used to determine productivity. This method was not particularly successful.

INTERESTING OBSERVATIONS

- Productivity was lower than average for horned puffins (35%). This was primarily caused by a 35% chick loss. Crested and whiskered auklet productivity was very good this year with productivity rates at 83% and 85%, respectively

- Parakeet auklet productivity was average this year but they experienced a high chick loss rate of 39%

- Black-legged kittiwake productivity reached the second highest levels ever. This year 39% of nesting attempts resulted in the production of at least one fledgling. Productivity measured by the boom bust method was higher than all previous years. This method indicated a 79% productivity rate at the Kittiwake Lane plots.

- Red-legged kittiwake productivity reached the highest levels ever. This year 47% of nesting attempts resulted in the production of at least one fledgling. Productivity measured by the boom bust method was the second highest since data has been collected with this method. This method indicated a 66% productivity rate at the Kittiwake Lane plots.

ACKNOWLEDGMENTS

This monitoring program would not exist without the guiding influences and visions of Vernon Byrd and Jeff Williams who have tirelessly shaped and molded the program over the years. We would also like to thank all other staff members of Alaska Maritime NWR in both Homer and Adak—field camps would accomplish very little without their support. Finally, we would like to thank the crew of the M/V *Tiglax* for safe transport to and from the island.

LITERATURE CITED AND SELECTED REFERENCES

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.

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.

Barrett, M,A, E.M. Andersen, Murphy, M.A., and S.F. Sapora. 2005. Biological monitoring at Buldir Island, Alaska in 2004: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 05/19. Homer, Alaska. 126 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 summer1988. 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.

Gibson, D. D., G. V. Byrd, 2007. Birds of the Aleutian Islands, Alaska. The Nuttall Ornithological Club and The American Ornithologist's Union; 2007. 351 p.

Hipfner, J.M., J.C. Williams, and G.V. Byrd. 1991. The status of kittiwakes and murres at Agattu and Buldir Islands 1988-1990. U.S. Fish and Wildl. Serv. Rep. Adak, Alas. 69 pp.

Jones, N., M. Murphy, J.C. Williams, E. Andersen, and M. Barrett. 2005. Biological monitoring at Buldir Island, Alaska in 2003: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 05/17. Homer, Alaska. 125 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.

Orben, R.O., C. S. Van Stratt and S. Lorenz. 2006. Biological monitoring at Buldir Island, Alaska in 2006: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 06/14. Homer, Alaska. 135 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 murres 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 murres 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., E. Sommer, K. Brenneman, S. Syria, and H. Moore. 2002. Biological monitoring at Buldir Island, Alaska in 2000 and 2002: Summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 02/08. Adak, Alaska. 146 pp.

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.

FIGURES AND TABLES

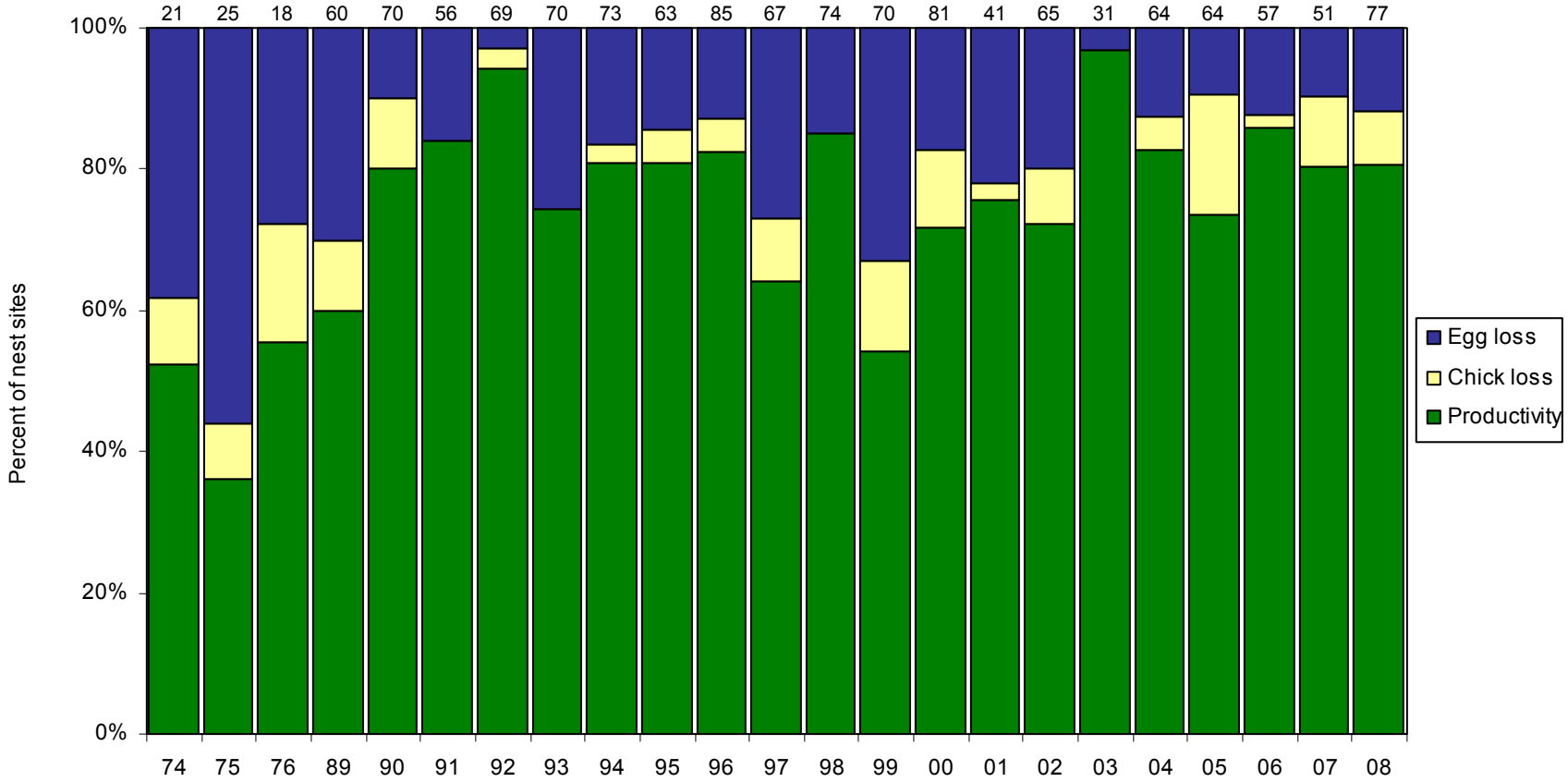

Figure 1. Reproductive performance of fork-tailed storm-petrels at Buldir Island, Alaska. Egg loss=(C-D)/C; Chick loss=(D-E)/C; Productivity=E/C, where C=number of eggs, D=number of eggs hatched, E=number of chicks fledged or still alive at last check. Productivity represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower. The number of eggs with known fates are given above each bar.

Table 1. 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	1996
Burrows with known contents (A)	69	71	113	232	285	287	294	249	297	280	308
Occupied burrows (B)	21	25	18	68	76	68	74	82	78	74	90
Eggs with known fate (C)	21	25	18	60	70	56	69	70	73	63	85
Eggs lost to disappearance	--	--	1	15	3	9	2	18	10	9	2
Eggs lost to abandonment	--	--	0	0	2	0	0	0	2	0	0
Eggs lost to breakage	--	--	4	3	2	0	0	0	0	0	9
Eggs remaining at last visit (unknown fate)[a]	--	--	--	7	4	11	4	11	5	11	5
Chicks (D)	13	11	13	42	63	47	67	52	61	54	74
Chicks lost to disappearance[b]	--	--	0	2	3	0	0	0	0	2	3
Chicks lost to death	--	--	3	4	4	0	2	0	2	1	1
Chicks potentially successful (E)	11	9	10	36	56	47	65	52	59	51	70
Chicks disappeared at unknown age or >50d	--	--	0	0	0	0	3	5	14	0	65
Chicks still present at last visit	11	9	10	36	56	47	62	47	45	51	5
Occupancy rate (B/A)	0.30	0.35	0.16	0.29	0.27	0.24	0.25	0.33	0.26	0.26	0.29
Hatching success (D/C)	0.62	0.44	0.72	0.70	0.90	0.84	0.97	0.74	0.84	0.86	0.87
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	0.95
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	0.83

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <50 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.

Table 1 continued. Productivity and burrow occupancy rates of fork-tailed storm-petrels at Buldir Island, Alaska.

Parameter	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Burrows with known contents (A)	277	282	265	304	189	285	116	283	222	195	181	225
Occupied burrows (B)	69	81	75	81	42	78	38	69	66	57	57	80
Eggs with known fate (C)	67	74	70	81	41	65	31	64	64	57	51	77
Eggs lost to disappearance	1	2	17	0	0	5	0	6	4	2	4	3
Eggs lost to abandonment	3	0	0	5	3	2	1	0	1	3	1	5
Eggs lost to breakage	14	9	6	8	5	6	0	2	0	1	0	0
Eggs remaining at last visit (unknown fate)[a]	2	4	1	1	0	0	0	0	0	1	4	0
Chicks (D)	49	63	47	67	32	52	30	56	58	50	46	68
Chicks lost to disappearance[b]	1	0	5	7	1	3	0	0	8	1	3	10
Chicks lost to death	5	0	4	2	0	2	0	3	4	0	2	4
Chicks potentially successful (E)	43	63	38	58	31	47	30	53	47	49	41	62
Chicks disappeared at unknown age or >50d	42	58	38	48	31	40	20	9	4	12	0	4
Chicks still present at last visit	1	5	0	10	0	7	8	44	43	37	41	58
Occupancy rate (B/A)	0.25	0.21	0.28	0.27	0.22	0.27	0.33	0.24	0.30	0.29	0.31	0.40
Hatching success (D/C)	0.73	0.85	0.67	0.83	0.78	0.80	0.97	0.88	0.91	0.88	0.90	0.93
Fledging success (E/D)[c]	0.88	1.00	0.81	0.87	0.97	0.90	1.00	0.95	0.81	0.98	0.89	0.86
Reproductive success (E/C)[c]	0.64	0.85	0.54	0.72	0.76	0.72	0.97	0.69	0.73	0.86	0.80	0.80

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <50d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.

Table 2. Productivity and burrow occupancy rates of fork-tailed storm-petrels at Buldir Island, Alaska, 2008.

Parameter	Plot 1	2	3	4	7	8[d]	Plots 1-7	Mean	SD[e]
Burrows with known contents (A)	25	58	30	51	61	--	225		
Occupied burrows (B)	15	14	14	22	15	--	80		
Eggs with known fate (C)	15	14	14	20	14	--	77		
Eggs lost to disappearance	0	0	0	2	1	--	3		
Eggs lost to abandonment	1	0	2	1	1	--	5		
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)	14	14	12	19	13	--	68		
Chicks lost to disappearance[b]	3	1	1	4	1	--	10		
Chicks lost to death	0	1	0	0	3	--	4		
Chicks potentially successful (E)	12	12	11	17	10	--	62		
Chicks disappeared at unknown age or >50 d	1	0	0	2	1	--	4		
Chicks still present at last visit	11	12	11	15	9	--	58		
Occupancy rate (B/A)	0.60	0.24	0.47	0.43	0.25	--	0.40	0.40	0.15
Hatching success (D/C)	0.93	1.00	0.86	0.95	0.93	--	0.93	0.93	0.05
Fledging success (E/D)[c]	0.86	0.86	0.92	0.89	0.77	--	0.86	0.86	0.06
Reproductive success (E/C)[c]	0.80	0.86	0.79	0.85	0.71	--	0.80	0.80	0.06

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <50d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.
[d] Unoccupied burrows were not quantified for Plot 8 and were not included in this summary.
[e] Standard deviations were calculated with ratio estimator software.

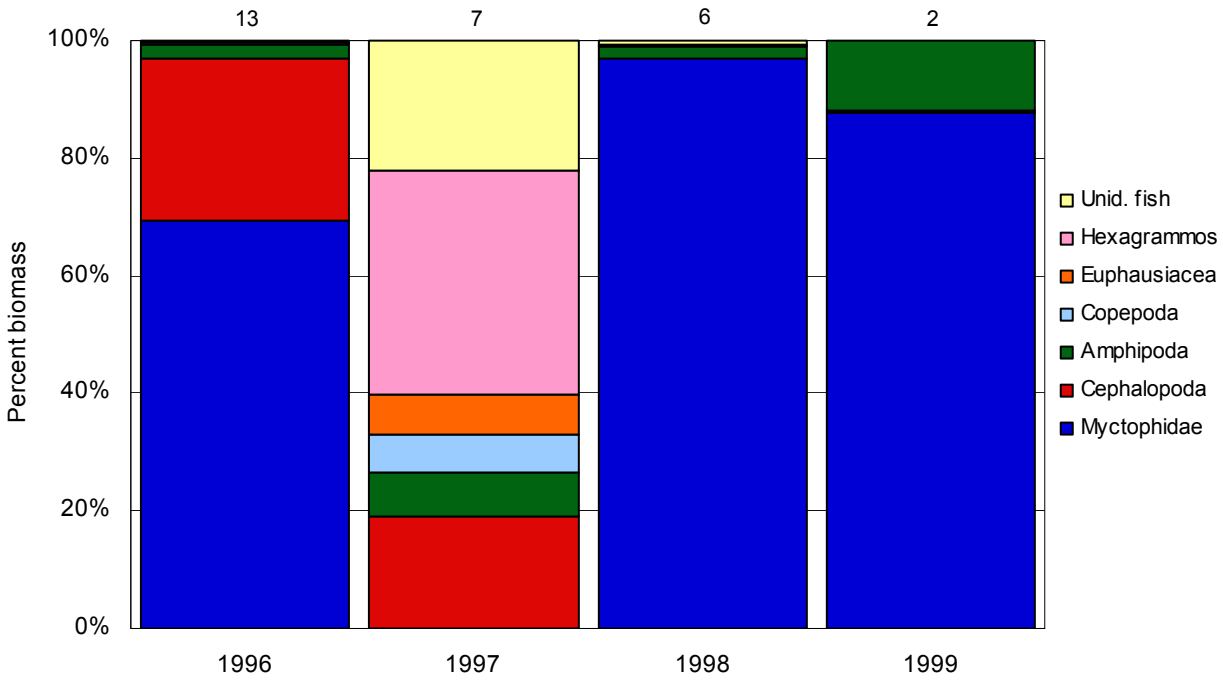

Figure 2. Relative biomass of prey in diets of fork-tailed storm-petrels at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

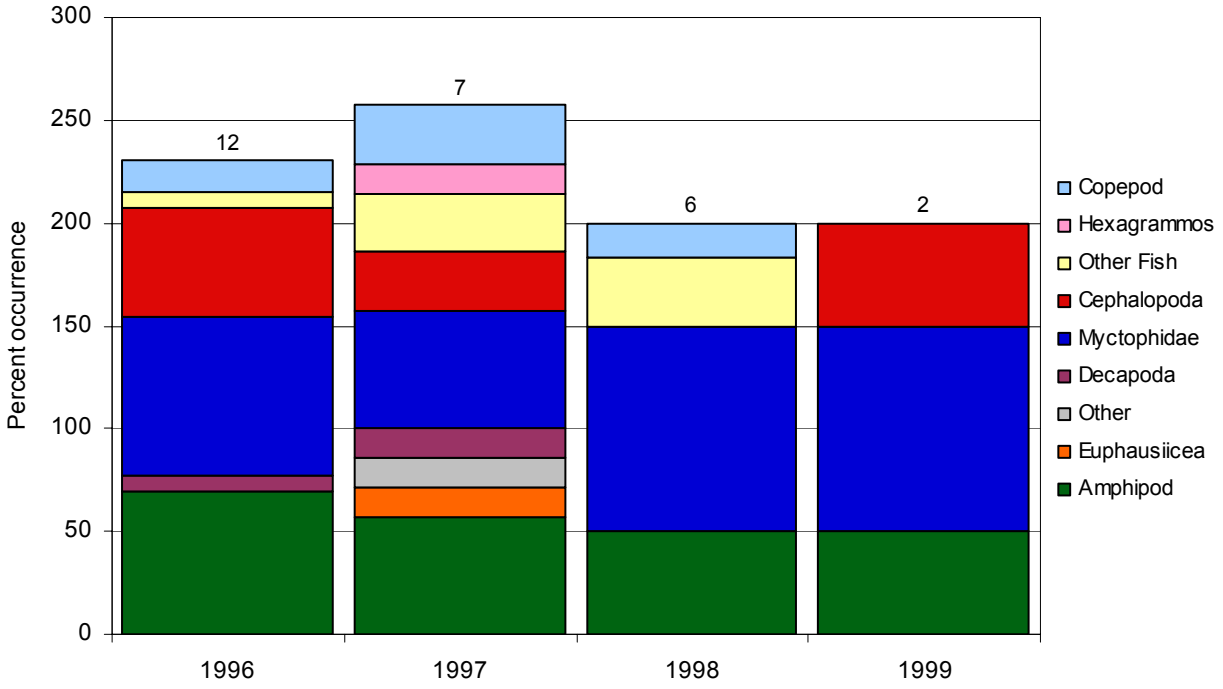

Figure 3. Frequency of occurrence of prey in diets of fork-tailed storm-petrels at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

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

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

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

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

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

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

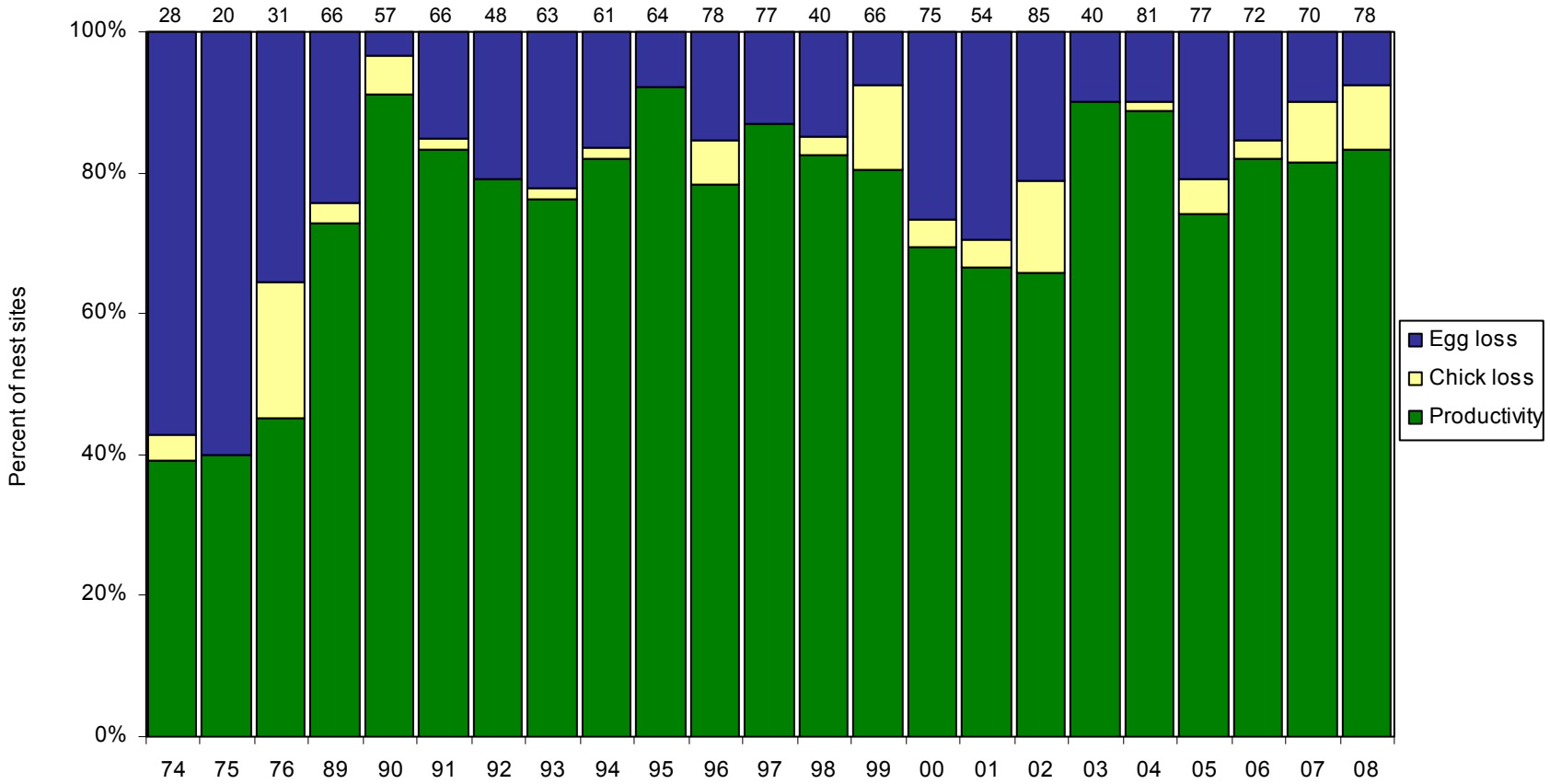

Figure 4. Reproductive performance of Leach's storm-petrels at Buldir Island, Alaska. Egg loss=(C-D)/C; Chick loss=(D-E)/C; Productivity=E/C, where C=number of eggs, D=number of eggs hatched, E=number of chicks fledged or still alive at last check. Productivity represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower. The number of eggs with known fates are given above each bar.

Table 5. 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 >50d	--	--	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 <50d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.

Table 5 continued. Productivity and burrow occupancy rates of Leach's storm-petrels at Buldir Island, Alaska.

Parameter	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Burrows with known contents (A)	308	277	282	265	304	189	285	116	283	222	195	181	225
Occupied burrows (B)	89	90	52	91	75	56	85	45	93	81	72	75	89
Eggs with known fate (C)	78	77	40	66	75	54	85	40	81	77	72	70	78
Eggs lost to disappearance	12	6	2	1	7	14	7	2	6	10	7	4	11
Eggs lost to abandonment	0	2	1	4	4	0	9	0	0	3	0	2	4
Eggs lost to breakage	0	2	0	0	2	2	0	2	2	1	0	1	2
Eggs remaining at last visit (unknown fate)[a]	10	7	14	17	7	1	2	0	4	2	4	2	0
Chicks (D)	66	67	34	61	55	38	67	36	73	61	61	63	72
Chicks lost to disappearance[b]	4	0	0	2	3	2	8	0	1	4	2	5	6
Chicks lost to death	1	0	1	6	0	0	3	0	0	2	0	1	1
Chicks potentially successful (E)	61	67	33	53	52	36	56	36	72	57	59	57	65
Chicks disappeared at unknown age or >50d	0	0	0	0	0	0	0	0	0	0	0	0	0
Chicks still present at last visit	61	67	30	53	52	36	56	36	72	57	59	57	65
Occupancy rate (B/A)	0.29	0.32	0.18	0.34	0.25	0.30	0.30	0.39	0.33	0.37	0.37	0.41	0.36
Hatching success (D/C)	0.85	0.87	0.85	0.92	0.73	0.70	0.79	0.90	0.90	0.79	0.85	0.90	0.96
Fledging success (E/D)[c]	0.92	1.00	0.97	0.87	0.95	0.95	0.84	1.00	0.99	0.93	0.97	0.90	0.85
Reproductive success (E/C)[c]	0.78	0.87	0.83	0.80	0.69	0.67	0.66	0.90	0.89	0.74	0.82	0.81	0.82

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <50 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.

Table 6. Productivity and burrow occupancy rates of Leach's storm-petrels at Buldir Island, Alaska, 2008.

Parameter	Plot 1	2	3	4	7	8[d]	Plots 1-7	Mean	SD[e]
Burrows with known contents (A)	25	58	30	51	61	--	225		
Occupied burrows (B)	6	29	7	17	30	--	89		
Eggs with known fate (C)	6	26	5	12	29	--	78		
Eggs lost to disappearance	0	3	2	5	1	--	11		
Eggs lost to abandonment	0	1	0	0	3	--	4		
Eggs lost to breakage	0	0	0	0	2	--	2		
Eggs remaining at last visit (unknown fate)[a]	0	0	0	0	0	--	0		
Chicks (D)	6	25	5	12	24	--	72		
Chicks lost to disappearance[b]	0	0	2	0	4	--	6		
Chicks lost to death	1	0	0	0	0	--	1		
Chicks potentially successful (E)	5	25	3	12	20	--	65		
Chicks disappeared at unknown age or >50d	0	0	0	0	0	--	0		
Chicks still present at last visit	5	25	3	12	20	--	65		
Occupancy rate (B/A)	0.24	0.50	0.23	0.33	0.49	--	0.36	0.36	0.13
Hatching success (D/C)	1.00	0.96	1.00	1.00	0.83	--	0.96	0.96	0.07
Fledging success (E/D)[c]	0.83	1.00	0.60	1.00	0.83	--	0.85	0.85	0.16
Reproductive success (E/C)[c]	0.83	0.96	0.60	1.00	0.69	--	0.82	0.82	0.17

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <50 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.
[d] Unoccupied burrows were not quantified for Plot 8 and were not included in this summary.
[e] Standard deviations were calculated with ratio estimator software.

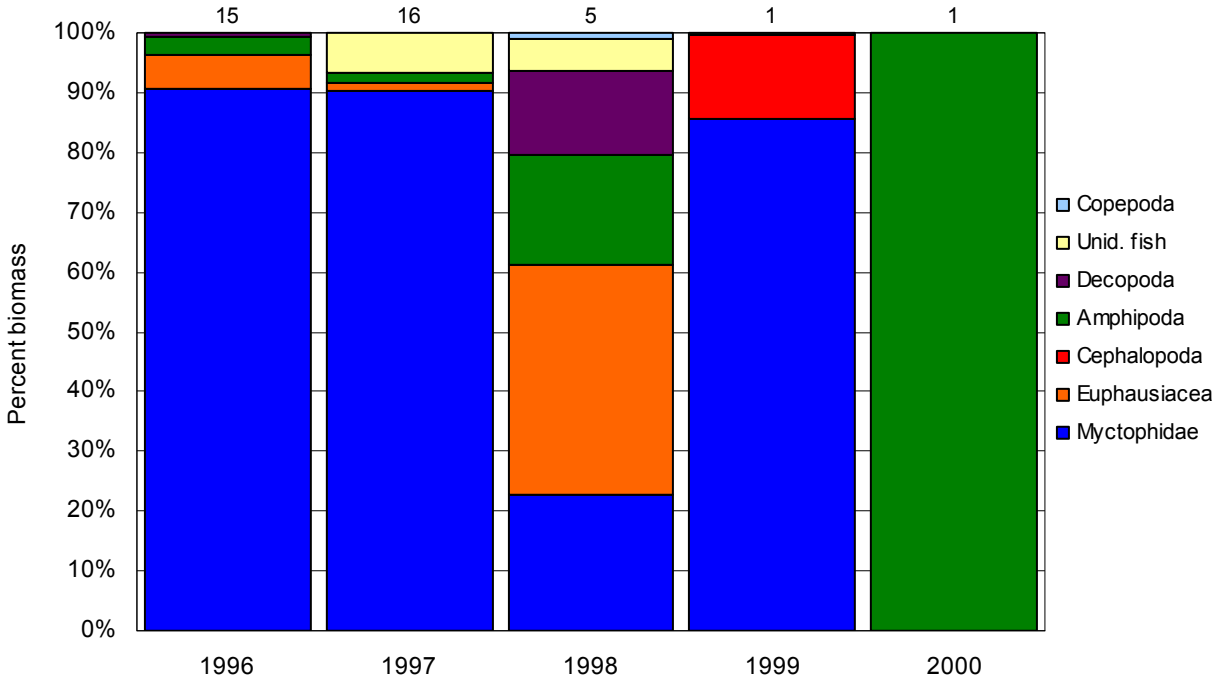

Figure 5. Relative biomass of prey in diets of Leach's storm-petrels at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

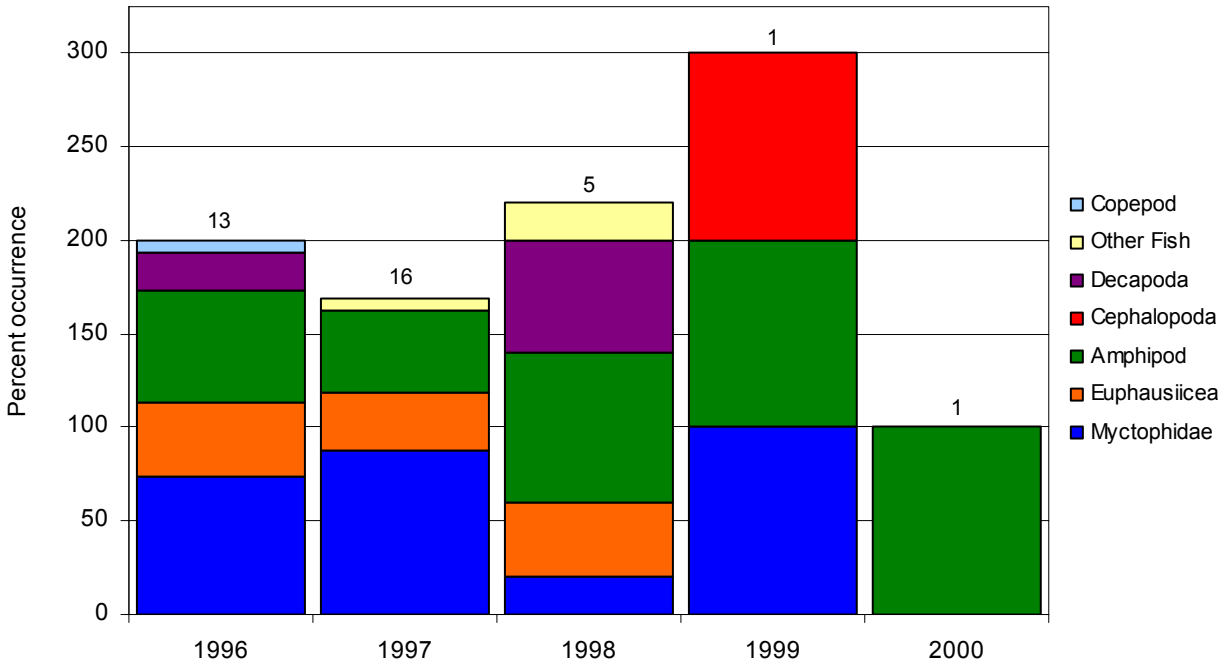

Figure 6. Frequency of occurrence of prey in diets of Leach's storm-petrels at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

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

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

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

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

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

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

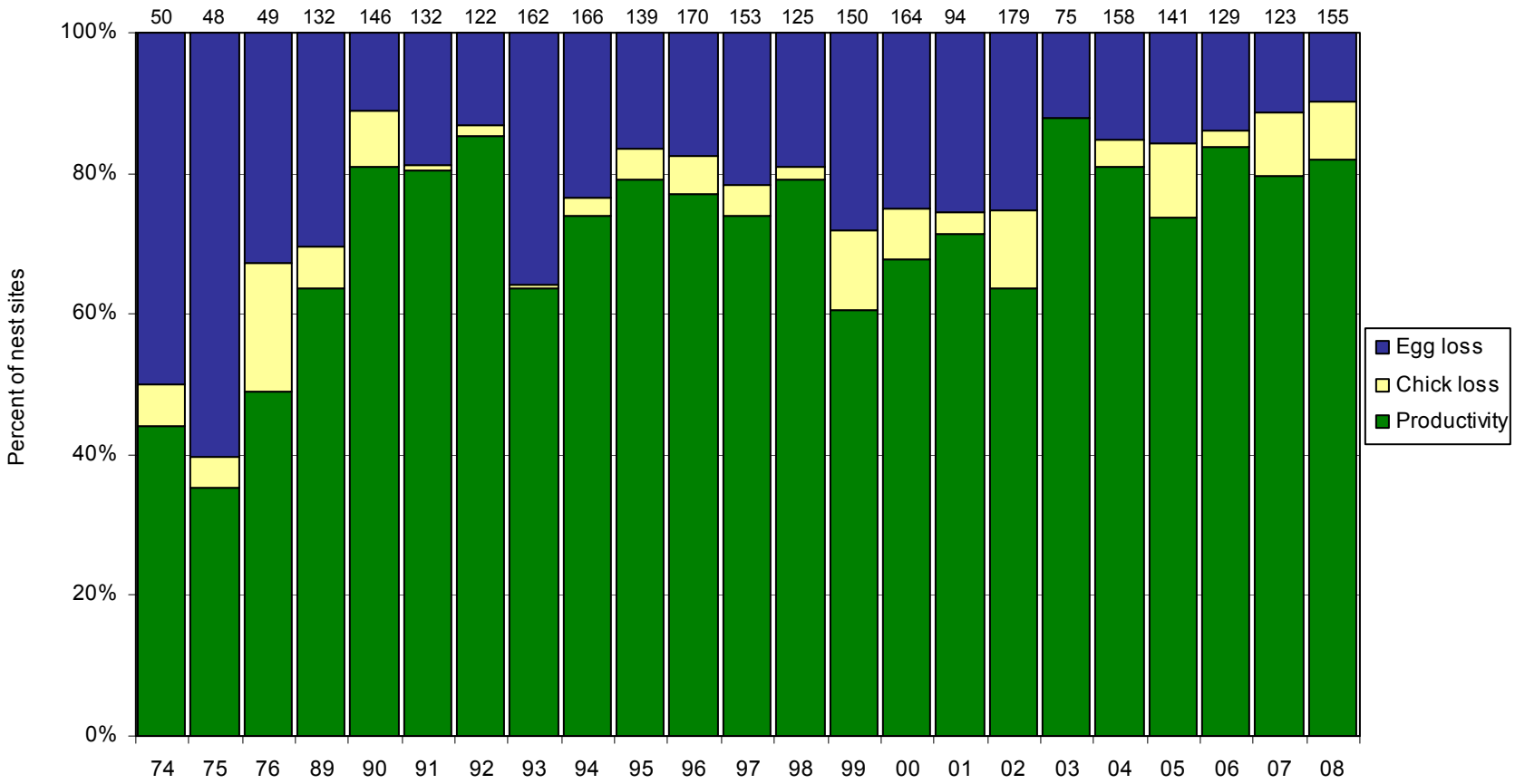

Figure 7. Reproductive performance of storm-petrels (Leach's, fork-tailed and unknown species) at Buldir Island, Alaska. Egg loss=(C-D)/C; Chick loss=(D-E)/C; Productivity=E/C, where C=number of eggs, D=number of eggs hatched, E=number of chicks fledged or still alive at last check. Productivity represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower. The number of eggs with known fates are given above each bar.

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	1996
Burrows with known contents (A)	69	71	113	232	285	287	294	249	297	280	308
Occupied burrows (B)	50	48	49	160	181	163	180	170	183	168	190
Eggs with known fate (C)	50	48	49	132	146	132	122	162	166	139	170
Eggs lost to disappearance	--	--	28	10	25	16	37	27	18	28	26
Eggs lost to abandonment	--	--	26	29	30	57	27	17	28	26	4
Eggs lost to breakage	--	--	5	2	0	0	0	12	5	5	0
Eggs remaining at last visit (unknown fate)[a]	--	--	7	4	0	0	1	0	0	7	17
Chicks (D)	25	19	33	92	130	107	106	104	127	116	140
Chicks lost to disappearance[b]	--	--	0	2	6	0	0	0	0	4	7
Chicks lost to death	--	--	9	6	8	1	2	1	4	2	2
Chicks potentially successful (E)	22	17	0	0	1	0	3	6	22	0	126
Chicks disappeared at unknown age or >50d	--	--	24	84	118	106	104	103	123	110	5
Chicks still present at last visit	22	17	24	84	117	106	101	97	101	110	131
Occupancy rate (B/A)	0.72	0.68	0.43	0.69	0.64	0.57	0.61	0.68	0.62	0.60	0.62
Hatching success (D/C)	0.50	0.40	0.67	0.70	0.89	0.81	0.87	0.64	0.77	0.83	0.82
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	0.77
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	0.94

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <50 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.

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

Parameter	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Burrows with known contents (A)	277	282	265	304	189	285	116	283	222	195	181	225
Occupied burrows (B)	168	149	182	164	103	191	94	185	147	129	136	169
Eggs with known fate (C)	153	125	150	164	94	179	75	158	141	129	123	155
Eggs lost to disappearance	25	14	11	18	19	19	3	15	14	9	9	14
Eggs lost to abandonment	3	10	31	5	0	19	1	0	5	3	3	9
Eggs lost to breakage	5	0	0	10	5	4	5	9	1	1	2	2
Eggs remaining at last visit (unknown fate)[a]	9	20	16	8	1	3	0	5	2	5	7	0
Chicks (D)	120	101	108	123	70	134	66	134	119	111	109	140
Chicks lost to disappearance[b]	1	0	7	10	3	12	0	1	12	3	8	16
Chicks lost to death	6	2	13	2	0	8	0	5	6	0	3	5
Chicks potentially successful (E)	111	91	91	101	67	107	58	128	104	108	98	127
Chicks disappeared at unknown age or >50d	2	5	0	10	0	7	8	9	4	12	0	4
Chicks still present at last visit	113	99	91	111	67	114	66	119	99	96	98	123
Occupancy rate (B/A)	0.61	0.53	0.69	0.54	0.54	0.67	0.81	0.65	0.66	0.66	0.75	0.75
Hatching success (D/C)	0.78	0.81	0.72	0.75	0.75	0.75	0.88	0.85	0.84	0.86	0.89	0.90
Fledging success (E/D)[c]	0.74	0.79	0.61	0.68	0.71	0.64	0.88	0.96	0.87	0.97	0.90	0.91
Reproductive success (E/C)[c]	0.94	0.98	0.84	0.90	0.96	0.85	0.77	0.81	0.74	0.84	0.80	0.82

[a] Eggs still present, apparently viable, regardless of age not included in analysis.
[b] Chicks known to be <50 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).
[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.

Table 10. Productivity and burrow occupancy rates of fork-tailed and Leach's storm-petrels (incl. unknown spp.) at Buldir Island, Alaska, 2008.

Parameter	Plot 1	2	3	4	7	8[d]	Plots 1-7	Mean	SD[e]
Burrows with known contents (A)	25	58	30	51	61	--	225		
Occupied burrows (B)	21	43	21	39	45	--	169		
Eggs with known fate (C)	21	40	19	32	43	--	155		
Eggs lost to disappearance	0	3	2	7	2	--	14		
Eggs lost to abandonment	1	1	2	1	4	--	9		
Eggs lost to breakage	0	0	0	0	2	--	2		
Eggs remaining at last visit (unknown fate)a	0	0	0	0	0	--	0		
Chicks (D)	20	39	17	31	37	--	140		
Chicks lost to disappearanceb	3	1	3	4	5	--	16		
Chicks lost to death	1	1	0	0	3	--	5		
Chicks potentially successful (E)	17	37	14	29	30	--	127		
Chicks disappeared at unknown age or >50d	1	0	0	2	1	--	4		
Chicks still present at last visit	16	27	14	27	29	--	123		
Occupancy rate (B/A)	0.84	0.74	0.70	0.76	0.74	--	0.75	0.75	0.05
Hatching success (D/C)	0.95	0.98	0.89	0.97	0.86	--	0.90	0.90	0.07
Fledging success (E/D)c	0.85	0.95	0.82	0.94	0.81	--	0.91	0.91	0.07
Reproductive success (E/C)c	0.81	0.93	0.74	0.91	0.70	--	0.82	0.82	0.10

[a] Eggs still present, apparently viable, regardless of age not included in analysis

[b] Chicks known to be <50 d when they disappeared or ones that disappeared before 1 Aug (earliest date we expected fledging).

[c] This value represents the maximum potential success, since it assumes all chicks still present at last check survived to fledging; actual values were likely lower.

[d] Unoccupied burrows were not quantified for Plot 8 and were not included in this summary.

[e] Standard deviations were calculated with ratio estimator software.

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

Parameter	1974[a]	1989	1990	1992	1993	1994	1995	1996	1997	1998
Total number of nests (A)	53	37	34	35	21	28	14	17	22	29
Date of maximum nest count	5	16 Jun	13 Aug	11 Jun	12 Jun	15 Jun	13 Jun	1 Aug	25 May	22 Jun
Total number of chicks (B)	23	--	61	25	13	36	17	13	24	18
Date of maximum chick count	19 Aug	--	13 Aug	2 Aug	19 Aug	9 Aug	10 Aug	5 Aug	10 Aug	7 Aug
Number of large chicks in nest[b]:										
0	--	--	7	25	14	10	5	9	13	14
1	--	--	4	0	3	6	3	3	0	0
2	--	--	12	5	2	6	4	5	3	6
3	--	--	11	5	2	6	2	0	6	2
4	--	--	0	0	0	0	0	0	--	--
Number of nests with chicks (C)	--	--	27	10	7	18	9	8	9	8
Brood size:										
Mean (B/C)	--	--	2.3	2.5	1.9	2	1.9	1.6	2.7	2.3
SD		--	0.7	0.5	0.9	0.8	0.8	0.5	0.5	0.5
% of nests w/ chicks ((C/A)X100)	68.8[c]	--	79.4	28.6	33.3	64.3	64.3	47.1	40.9	27.6
Productivity[d] (B/A)	1.4b	--	1.8	0.7	0.6	1.3	1.2	0.8	1.1	0.6

[a] Nest contents were not recorded in 1974 or 1989. Data from 1974 from Byrd (1978). In all years, observers counted cormorant nests from East Main Talus through Kittiwake Lane.

[b] In nests with adult attendance on date of maximum chick count.

[c] From a subsample of 16 nests.

[d] Number of chicks present per nest, including empty nests.

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

Parameter	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total number of nests (A)	24	48	64	66	73	79	63	92	67	82
Date of maximum nest count	24 Jun	6 Jun	10 Jun	16 Jun	13 Jun	27 Jun	8 Jun	17 Jun	25 May	10 Jun
Total number of chicks (B)	31	52	55	59	39	72	51	79	63	101
Date of maximum chick count	12 Aug	4 Aug	29 Aug	5 Jul	1 Aug	3 Aug	7 Aug	4 Aug	14 Aug	6 Aug
Number of large chicks in nest[b]:										
0	7	3	18	0	26	17	20	9	6	4
1	2	8	9	9	8	2	4	8	6	2
2	8	10	18	19	11	15	10	17	9	25
3	5	0	3	4	3	12	4	11	10	15
4	--	--	--	--	--	1	--	1	0	1
Number of nests with chicks (C)	15	25	33	32	22	30	23	37	25	47
Brood size:										
Mean (B/C)	2.1	2.1	1.7	1.8	1.8	2.4	2.2	2.1	2.3	2.1
SD	0.5	0.7	0.9	0.6	0.6	0.7	0.7	0.67	0.79	0.84
% of nests w/ chicks ((C/A)X100)	62.5	52.1	51.6	48.5	30.1	38	36.5	40.2	41.8	57.3
Productivity[d] (B/A)	1.3	1.1	0.9	0.9	0.5	0.9	0.8	0.9	0.9	1.2

[a] Nest contents were not recorded in 1974 or 1989. Data from 1974 from Byrd (1978). In all years, observers counted cormorant nests from East Main Talus through Kittiwake Lane.

[b] In nests with adult attendance on date of maximum chick count.

[c] From a subsample of 16 nests.

[d] Number of chicks present per nest, including empty nests.

Table 12. Pelagic cormorant productivity at Buldir Island, Alaska in 2008.

		No. nests containing ≥ *X* chicks					No. nests	
Date	No. nests	0	1+	2+	3+	4+	w/ chick	no. chicks
2 Jun	61	61	-	-	-	-	0	0
6 Jun	63	63	-	-	-	-	0	0
10 Jun	69	69	-	-	-	-	0	0
18 Jun	61	61	-	-	-	-	0	0
23 Jun	67	67	-	-	-	-	0	0
29 Jun	61	61	-	-	-	-	0	0
6 Jul	54	43	10	1	-	-	11	12
12 Jul	50	27	14	6	3	-	23	35
19 Jul	51	17	15	13	6	-	24	59
24 Jul	49	14	9	24	2	-	35	63
30 Jul	49	9	13	18	7	2	40	78
6 Aug	47	4	2	25	15	1	43	101
12 Aug	43	5	4	19	12	3	38	90
22 Aug	23	1	8	7	6	1	22	44

[a] Inactive nests were not counted after 6 Jul.

Table 13. Red-faced cormorant productivity at Buldir Island, Alaska.

Parameter	2003	2004	2005	2006	2007	2008
Total number of nests (A)	4	9	6	2	1	9
Date of maximum nest count	19-Jun	17-Jun	8-Jun	17-Jun	-	10-Jun
Total number of chicks (B)	5	11	7	6	0	14
Date of maximum chick count	25-Jun	3-Aug	2-Aug	4-Aug	-	22-Aug
Max. count of large chicks in nest[a]:						
0	1	2	1	0	1	4
1	1	1	1	0	0	0
2	2	2	1	0	0	1
3	0	2	1	2	0	4
Number of nests with chicks (C)	3	5	3	2	0	5
Brood size:						
Mean (B/C)	1.7	2.2	2.3	3	-	2.8
SD	.6	.8	.58	-	-	0.45
% of nests with chicks ((C/A)x100)	75	55.6	50	100	0	55.6
Productivity[b] (B/A)	1.3	1.2	1.2	3	0	1.6

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

Table 14. Red-faced cormorant productivity at Buldir Island, Alaska in 2008.

		No. nests containing ≥ *X* chicks					No. nests	
Date	No. nests	0	1+	2+	3+	4+	w/ chick	no. chicks
2 Jun	3	0	-	-	-	-	0	0
6 Jun	5	0	-	-	-	-	0	0
10 Jun	6	0	-	-	-	-	0	0
18 Jun	6	0	-	-	-	-	0	0
23 Jun	6	0	-	-	-	-	0	0
29 Jun	6	0	-	-	-	-	0	0
6 Jul	6	0	-	-	-	-	0	0
12 Jul	6	4	-	2	-	-	2	4
19 Jul	5	2	-	1	2	-	3	8
24 Jul	5	1	1	3	0	-	4	7
30 Jul	5	0	1	2	2	-	5	11
6 Aug	5	0	1	1	3	-	5	12
12 Aug	5	0	0	1	4	-	5	14
22 Aug	5	0	0	1	4	-	5	14

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

Parameter		1979[a]	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007[c]	2008
Total no. nests (A)		-	209	199	180	133	175	88	75	20	54	40	38	23	31	39	9	4	38
No. eggs in nest:																			
	0	0	49	66	49	82	40	63	18	17	11	6	8	0	3	13	1	1	13
	1	1	28	26	15	5	15	6	8	0	3	3	0	3	1	3	2	0	3
	2	10	48	35	40	20	35	10	26	2	10	12	6	4	5	3	0	0	11
	3	56	84	72	75	26	85	9	22	1	30	19	23	14	21	15	3	3	10
	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clutch size:	mean	2.8	2.4	2.4	2.5	2.4	2.5	2.1	2.3	2.3	2.8	2.5	2.8	2.5	2.7	2.6	2.2	3.0[d]	2.3
	n (B)	67	160	133	131	51	135	25	56	3	43	34	29	21	27	21	5	3	24
	SD	0.4	0.8	0.8	0.7	0.7	0.7	0.8	0.7	0.6	0.4	0.7	0.41	0.75	0.63	0.83	1.1	0.0	.69
Max. no. eggs (C)[b]		-	376	312	324	123	340	53	126	7	113	84	81	53	74	54	11	9	55
Maximum no. chicks seen (D)		-	122	35	49	34	83	28	28	2	17	12	33	22	23	17	5	-	33
Chicks seen on last visit before fledging (E)		-	89	8	48	14	34	15	9	0	12	8	15	19	22	9	5	-	33
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	0.91	0.87	0.54	0.56	-	.63
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	0.31	0.31	0.45	-	.60
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	0.96	0.53	1.00	-	1.00
Breeding success (E/C)		-	0.24	0.03	0.15	0.11	0.10	0.28	0.07	0.00	0.11	0.10	0.19	0.36	0.30	0.17	0.45	-	.60
Overall prod (E/A)		-	0.43	0.04	0.27	0.11	0.19	0.17	0.12	0.00	0.22	0.20	0.39	0.83	0.71	0.23	0.56	-	.87

[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.
[c] Only three active nests were present in 2007 between E. Main Talus and E. Kittiwake Lane. These nests were not monitored after 5 June and attention was redirected to the inland monitoring site where laying success was 0.71 and hatching success was 0.19.
[d] Clutch size for the inland monitoring site was 2.44 (*n*=50, SD=0.67).

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

Parameter	1997	1998	1999	2000	2002	2003	2004	2005	2006[c]	2007	2008
No. nests (A)[a]	47	30	20	28	37	23	34	39	--	69	50
No. nests ≥ 1 egg (B)	10	26	3	24	31	22	27	24	23	49	27
No. eggs (C)	22	58	7	63	89	56	78	60	56	120	64
No. nests ≥1 chick (D)	8	13	1	10	26	20	18	14	16	14	22
No. chicks (E)	14	21	2	18	57	38	38	17	37	23	41
Laying success (B/A)	0.21	0.87	0.15	0.86	0.84	0.96	0.79	0.62	--	0.71	0.54
Nesting success (D/B)	0.8	0.5	33.3	0.42	0.84	0.91	0.67	0.58	0.7	0.29	0.81
Hatching success (E/C)	0.64	0.36	0.29	0.29	0.64	0.68	0.49	0.28	0.66	0.19	0.64
Mean hatch date	11 Jul	2 Jul	23 Jun	23 Jun	21 Jun	--[b]	15 Jun	17 Jun	20 Jun	20 Jun	23 Jun
n	5	13	1	7	14	--	18	20	14	22	22
SD	2.2	3.4	--	6.2	6.4	--	7.4	4.7	4.6	5.5	8.5

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

Table 17. Clutch size of glaucous-winged gulls on Buldir Island, Alaska in 2008.

		No. nests containing *X* eggs				Total	
Date	No. nests	0	1	2	3	No. eggs	No. chicks
2 Jun	34	12	3	9	10	51	0
6 Jun	29	15	3	9	11	54	0
11 Jun	36	13	3	11	10	55	3
18 Jun	32	12	4	10	4	36	12
23 Jun	31	17	4	9	2	28	12
29 Jun	31	23	3	5	0	13	20
6 Jul	23	19	3	1	0	5	13
12 Jul	21	19	2	0	0	2	9

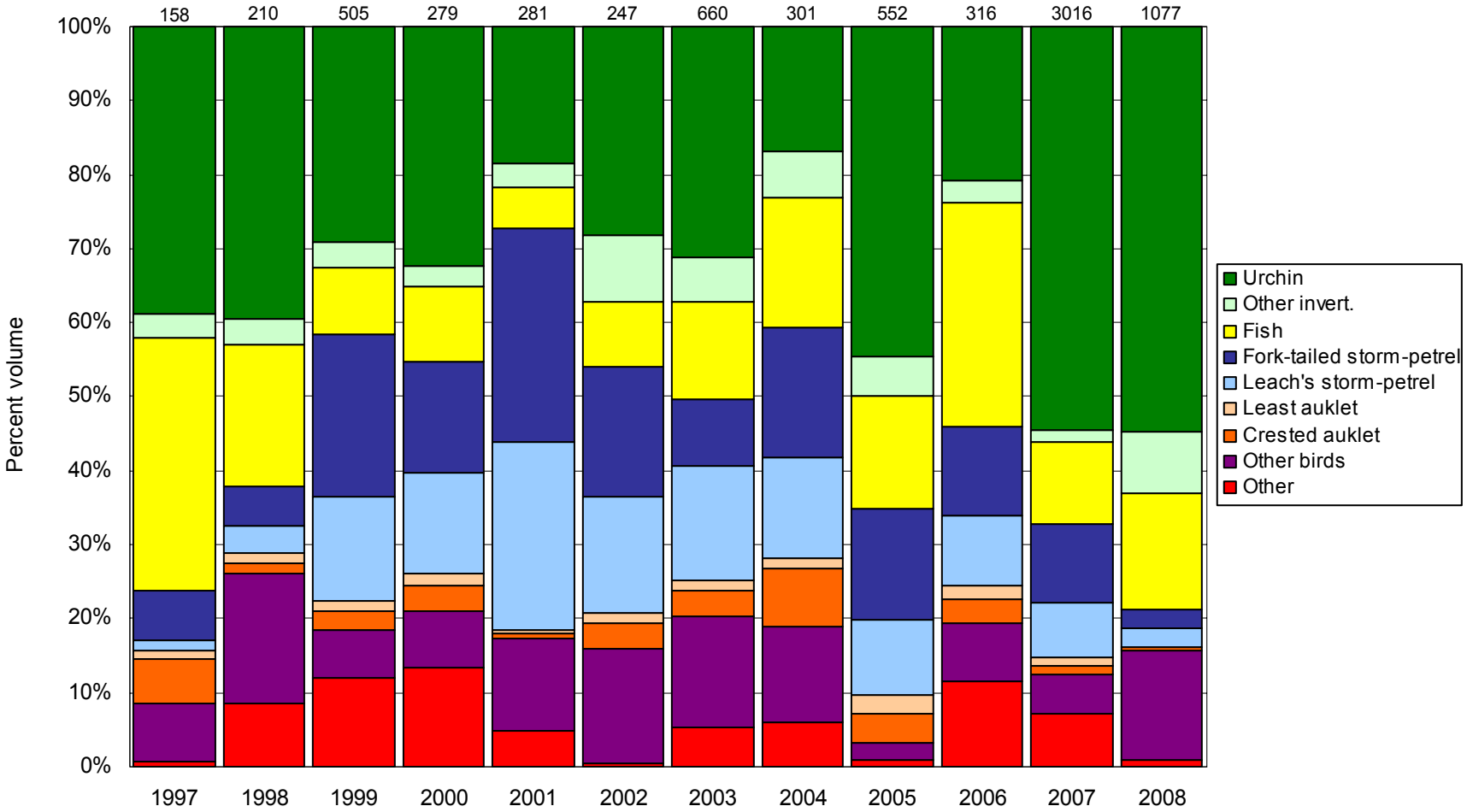

Figure 8. Percent volume of food items in regurgitated pellets of glaucous-winged gulls at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 18. Percent occurrence of food items in regurgitated pellets of glaucous-winged gulls of Buldir Island, Alaska.

Food item	1974-76[a]	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of pellets	655	158	210	505	279	281	247	660	301	552	316	3016	1077
Invertebrates[b]	**1.9**	**46.2**	**49.5**	**38.4**	**42.3**	**28.1**	**46.6**	**47.4**	**31.2**	**50.9**	**30.2**	**58.5**	**64.4**
sea urchin	1.1	39.9	42.8	33.5	37.3	22.4	31.6	35.9	22.3	44.9	23.8	55.9	55.7
blue mussel	--	3.2	2.4	2.4	2.9	2.1	3.2	2.4	3.7	2	1.9	1.8	0.8
snail	--	0.6	1	0.2	1.1	0.4	4	0.5	--	--	1.0	0.2	0.3
limpet	--	1.3	--	1	0.4	1.8	4.5	6.7	1.3	4	1.0	0.3	1.1
chiton	--	--	1.9	0.2	0.4	--	0.8	--	3.7	--	0.3	--	--
crab	--	0.6	0.5	0.2	0.4	0.4	--	0.3	--	--	--	0.1	0.1
unid. bivalve	--	0.6	0.5	0.4	--	0.7	--	--	0.3	--	0.3	0.1	0.3
unid. shellfish	--	--	--	0.2	--	0.4	1.2	1.7	--	--	1.0	--	0.6
amphipod	--	--	--	0.2	--	--	0.4	--	--	--	0.3	--	6
beetle	--	--	--	0.2	--	--	--	--	--	--	--	--	--
unid. kelp fly	0.08	--	--	--	--	--	--	--	--	--	--	--	--
Euphausiid	--	--	--	--	--	--	0.8	--	--	--	0.6	--	--
Fish	**19.5**	**36.1**	**21.4**	**11.3**	**12.2**	**6.4**	**13.8**	**18.3**	**25.2**	**15.4**	**36.2**	**11.4**	**16.2**
<10 cm	--	8.9	10	6.5	2.5	1.8	6.1	12.1	9.3	0.7	6.0	5.3	2.4
10-20 cm	--	12	9.5	4.2	6.1	3.9	6.1	0.2	14.6	14.5	28.3	4.4	11
>20 cm	--	15.2	1.9	0.6	3.6	0.7	1.6	1.5	0.3	0.2	1.6	1.1	2.8
unknown size	--	--	--	--	--	--	--	4.5	0.7	--	0.3	0.7	--
Birds	**79.2**	**24.1**	**31.9**	**48.5**	**44.8**	**70.1**	**60.7**	**48.9**	**59.5**	**34.4**	**38.4**	**26.5**	**22**
crested auklet	2.9	6.3	1	2.4	3.6	0.7	4	3.8	8.6	4	3.2	1.3	0.5
least auklet	1.4	1.3	1.4	1.4	1.8	0.4	1.6	1.2	1.7	2.4	1.9	1.1	--
whiskered auklet	--	--	--	0.2	0.4	0.4	--	--	--	--	--	--	--
parakeet auklet	--	--	0.5	0.2	2.5	1.1	1.6	2.7	0.7	0.4	0.3	0.3	1
Cassin's auklet	0.2	--	0.5	--	0.4	--	--	0.9	--	--	--	0.2	--
ancient murrelet	10.1	--	0.5	0.2	2.9	14.3	6.9	2	1	--	0.6	0.6	0.3
unid. sm. auklet	--	1.3	--	--	0.7	--	--	0.2	--	0.2	--	0.6	0.6
unid med. auklet	--	1.3	--	0.4	--	--	--	--	0.7	--	1.6	0.5	0.6
unid. auklet	1.4	3.8	0.5	0.4	0.7	0.7	3.6	--	1	--	4.8	1.5	0.1
fork-tailed storm-petrel	40	7	5.7	22.2	16.1	29.5	18.2	9.1	18.6	15	12.4	10.9	2.9
Leach's storm-petrel	20	1.3	3.8	15.4	14.3	26.3	16.2	16.1	14.3	10.3	9.8	7.6	2.5
unid. storm-petrel	0.8	1.9	4.8	2.2	--	--	2	1.5	--	--	1.6	0.2	0.2
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	1.8	1.9	0.7	--
unid. bird eggs	1.7	--	--	2	--	1.4	4	1.2	4	0.4	0.3	1.0	0.6
glaucous-winged gull	--	--	--	--	--	0.4	--	--	--	--	--	--	--
gull eggs	--	--	--	--	--	--	--	1.4	--	--	--	--	0.2
Murre egg	--	--	--	--	--	--	--	--	--	--	--	--	12.1
Miscellaneous	**6.8**	**1.3**	**10**	**18**	**21.5**	**1.4**	**1.6**	**8.3**	**15.9**	**1.1**	**17.5**	**9.4**	**1.1**
terrestrial vegetation	2.5	--	--	0.4	2.2	--	--	0.5	0.3	0.2	--	0.2	0.1
unid. marine algae	--	1.3	5.7	15.8	15.1	3.9	2	7.4	13	0.9	15.6	8.7	0.7
pebbles	0.8	--	4.3	1.8	1.4	1.9	0.8	0.3	2.3	--	1.6	0.5	0.3
sea lion hair	3.5	--	--	--	--	--	--	--	--	--	--	--	--
plastic	--	--	--	--	2.9	--	2	0.2	0.3	--	0.3	--	--

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

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

Food item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of pellets	158	210	505	279	281	247	660	301	552	316	3016	1077
Invertebrates[a]	**42**	**42.9**	**32.6**	**35.1**	**21.7**	**37.3**	**37.1**	**23.1**	**50**	**23.7**	**56.2**	**63.1**
sea urchin	38.7	39.6	29.1	32.3	18.6	28.2	31.2	16.8	44.5	20.8	54.5	54.8
blue mussel	2.3	1.8	1.9	1.5	1	2.2	0.8	2.5	1.9	1.1	1.3	0.7
snail	<0.1	<0.1	0.2	1.1	<0.1	1.9	0.2	--	--	0.4	--	0.3
limpet	0.8	--	0.8	0.2	1.3	3.2	3.9	0.9	3.6	0.3	0.2	1.1
chiton	--	<0.1	0.2	0.1	--	0.6	--	2.9	--	0.3	--	--
crab	<0.1	<0.1	<0.1	<0.1	0.3	--	--	--	--	--	0.1	0.1
unid. bivalve	0.1	--	0.2	--	0.4	--	--	--	--	<0.1	0.1	0.3
unid. shellfish	--	<0.1	<0.1	--	<0.1	0.4	0.9	--	--	0.1	--	0.4
amphipod	--	--	--	--	--	<0.1	--	--	--	--	--	5.6
beetle	--	--	<0.1	--	--	--	--	--	--	0.2	--	--
unid. kelp fly	--	--	--	--	--	--	--	--	--	--	--	--
euphausiid	--	--	--	--	--	0.8	--	--	--	0.6	--	--
Fish[b]	**34.3**	**19.3**	**9**	**10**	**5.6**	**8.8**	**13.3**	**17.5**	**15.1**	**36.1**	**10.9**	**15.6**
<10 cm	7.4	9.9	4.8	1.6	1	4.8	9.4	5.4	0.5	4.6	4.8	2.1
10-20 cm	11.7	5.1	3.8	5.2	3.9	3.4	0.1	11.5	14.5	24.2	4.3	10.8
>20 cm	15.2	4.3	0.4	3.2	0.7	0.6	1.3	0.3	0.2	1.6	1.1	2.7
unidentified	--	--	--	--	--	--	2.4	0.4	--	<0.1	0.6	--
Birds	**23.1**	**29.2**	**46.2**	**41.5**	**67.9**	**53.6**	**44.4**	**53.1**	**34.1**	**38.3**	**25.7**	**20.3**
crested auklet	6	1.4	2.4	3.3	0.7	3.5	3.6	8	4	3.1	1.2	0.5
least auklet	1.3	1.4	1.4	1.8	0.4	1.4	1.2	1.4	2.4	1.8	1.1	--
whiskered auklet	--	--	0.2	0.4	0.4	--	--	--	--	--	--	--
parakeet auklet	--	0.5	0.2	2.5	1.1	1.4	2.6	0.7	0.4	0.3	0.3	1.0
Cassin's auklet	--	0.5	--	0.4	--	--	0.8	--	--	--	0.2	--
ancient murrelet	--	0.5	0.2	2.7	4	6.2	2	0.9	--	0.6	0.6	0.3
unid. sm. auklet[c]	0.3	--	--	<0.1	--	--	--	--	0.2	--	0.6	0.6
unid. med. auklet[c]	0.6	--	0.4	--	--	--	--	0.6	--	1.6	0.5	0.6
unid. auklet	4.4	0.5	0.4	0.7	0.7	3.6	--	1	--	3.6	1.4	0.1
fork-tailed storm-petrel	6.7	5.2	21.7	15.1	29	17.5	9	17.4	15	11.9	10.7	2.7
Leach's storm-petrel	1.3	3.8	14.2	13.6	25.5	15.6	15.5	13.5	10.3	9.6	7.4	2.4
unid. storm-petrel	1.9	3.8	2	--	--	1.3	1.4	--	--	0.6	0.2	0.2
black-legged kittiwake	--	--	--	--	--	0.4	--	--	--	--	--	--
unidentified kittiwake	--	--	--	--	--	--	1.1	7.5	--	--	--	--
murre chick	--	--	--	--	--	--	--	0.3	--	--	--	--
tufted puffin	--	--	--	--	--	1	--	--	--	--	--	--
unidentified puffin	--	--	--	--	--	--	0.1	--	--	--	--	--
Aleutian Cackling gosling	--	--	0.2	0.4	--	0.5	--	--	--	--	--	--
glaucous-winged gull	--	--	--	--	<0.1	--	--	--	--	--	--	--
unid. sm. bird	0.6	11	1.3	0.7	5	0.1	4.3	0.4	1.6	1.2	0.6	--
gull egg	--	--	--	--	--	--	1.4	--	--	--	--	0.2
goose egg	--	--	--	--	--	--	1	--	--	--	--	--
unid. bird eggs	--	0.8	1.6	--	1.2	0.5	0.4	1.4	0.2	<0.1	0.8	0.5
murre egg	--	--	--	--	--	--	--	--	--	--	--	11.3
Miscellaneous	**0.6**	**8.5**	**12**	**13.4**	**4.9**	**0.4**	**5.2**	**5.9**	**0.9**	**17.4**	**7.1**	**0.8**
terrestrial vegetation	--	--	0.2	1.1	--	--	0.1	0.3	--	--	0.1	0.1
unid. marine algae	0.6	4.9	11.1	11.6	2.2	0.2	5	5.2	0.8	10.8	6.9	0.6
pebbles	--	3.6	0.7	0.6	2.7	<0.1	0.1	0.5	--	0.4	0.1	0.1
sea lion hair	--	--	--	--	--	--	--	--	--	--	--	--
plastic	--	--	--	0.2	--	0.1	--	--	--	<0.1	--	--

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

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

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

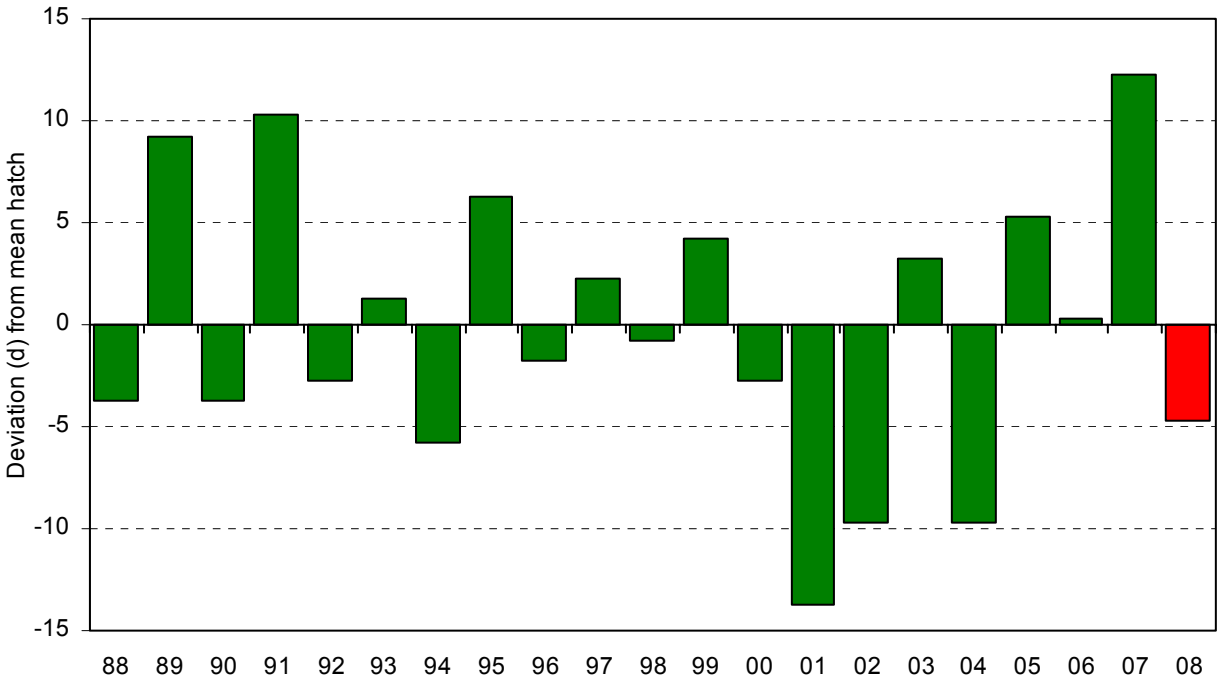

Figure 9. Yearly hatch date deviation (from the 1988-2007 average of 6 July) for black-legged kittiwakes at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

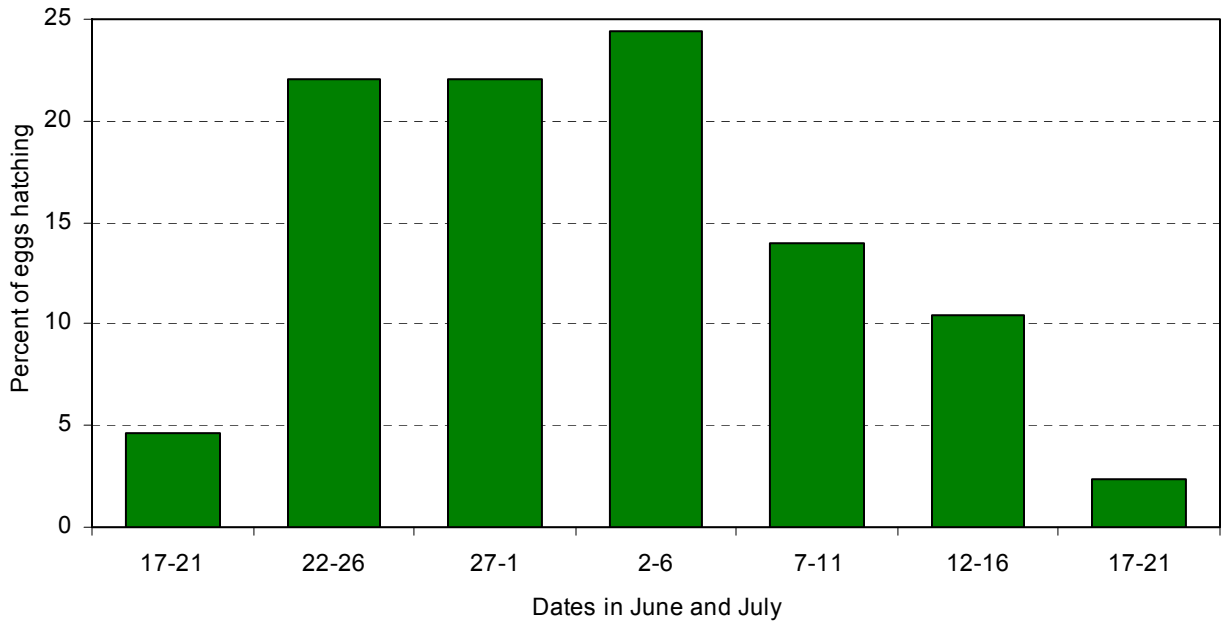

Figure 10. Hatching chronology of black-legged kittiwakes at Buldir Island, Alaska in 2008 (*n*=86).

Table 20. Breeding chronology dates for black-legged kittiwakes at Buldir Island, Alaska.

Year	mean hatch	SD	*n*[a]	median hatch	no. nests monitored[b]	first lay	last lay	first hatch	last hatch	first fledge
1988	3 Jul	--	246	--	--	--	--	--	--	--
1989	16 Jul	--	52	--	--	--	--	--	--	--
1990	3 Jul	--	474	--	--	--	--	--	--	--
1991	17 Jul	--	124	--	--	--	--	--	--	--
1992	3 Jul	7.8	389	30 Jun	--	--	--	--	--	--
1993	8 Jul	--	119	--	--	--	--	--	--	--
1994	1 Jul	--	165	--	--	--	--	--	--	--
1995	13 Jul	9.9	39	13 Jul	359	<15 Jun	13 Jul	28 Jun	8 Aug	3 Aug
1996	4 Jul	12.0	223	2 Jul	426	<14 Jun	23 Jul	<14 Jun	4 Aug	19 Jul
1997	9 Jul	8.1	276	9 Jul	493	<9 Jun	9 Jul	17 Jun	7 Aug	31 Jul
1998	6 Jul	8.1	160	5 Jul	280	<14 Jun	5 Jul	16 Jun	4 Aug	4 Aug
1999	11 Jul	7.6	27	9 Jul	237	<24 Jun	9 Jul	28 Jun	4 Aug	16 Aug
2000	3 Jul	8.6	184	3 Jul	324	<11 Jun	10 Jul	12 Jun	1 Aug	1 Aug
2001	23 Jun	4.0	17	26 Jun	178	<17 Jun	20 Jun	17 Jun	1 Jul	>22 Aug
2002	27 Jun	5.3	147	29 Jun	299	<12 Jun	29 Jun	15 Jun	11 Jul	28 Jul
2003	10 Jul	4.3	21	8 Jul	272	<17 Jun	3 Jul	<22 Jun	<23 Jul	11 Aug
2004	27 Jun	5.4	34	28 Jun	239	<15 Jun	1 Jul	18 Jun	11 Jul	14 Aug
2005	12 Jul	10.7	6	11 Jul	412	<15 Jun	28 Jul	<27 Jun	6 Aug	10 Aug
2006	7 Jul	6.7	88	7 Jul	248	<9 Jun	29 Jun	23 Jun	25 Jul	4 Aug
2007	19 Jul	14.6	5	21 Jul	176	<16 Jun	<17 Jul	13 Jul	10 Aug	10 Aug
2008	1-Jul	7.53	86	2 Jul	227	<15 Jun	2 Jul	<16 Jun	19 Jul	30 Jul

[a] Sample size is for the calculation of mean and median hatch dates. These data are a subsample for which we have observations $\leq$ 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 21. Frequency distribution of hatch dates for Black-legged Kittiwakes at Buldir Island, Alaska. Data for 1988-1991, 1993-1994, 1996, 2001, and 2004 not available.

Julian	No. nests hatching on Julian date											
Date	1992	1995	1997	1998	1999	2000	2002	2003	2005	2006	2007	2008
164	--	--	--	--	--	1	--	--	--	--	--	--
165	--	--	--	--	--	--	--	--	--	--	--	--
166	6	--	--	--	--	--	1	--	--	--	--	--
167	--	--	--	2	--	--	--	--	--	--	--	--
168	--	--	2	--	--	4	--	--	--	--	--	--
169	--	--	--	--	--	--	1	--	--	--	--	--
170	--	--	--	--	--	--	13	--	--	--	--	2
171	14	--	--	3	--	--	17	--	--	--	--	--
172	--	--	--	--	--	1	--	--	--	--	--	2
173	--	--	--	--	--	--	2	--	--	--	--	--
174	--	--	5	1	--	--	--	--	--	2	--	16
175	2	--	--	--	--	--	21	--	--	--	--	--
176	41	--	--	14	--	16	5	--	--	--	--	--
177	--	--	--	--	--	1	2	--	--	--	--	1
178	--	--	--	--	--	--	1	--	--	--	--	2
179	--	3	21	--	2	53	--	--	--	--	--	6
180	1	--	--	1	--	--	44	--	--	13	--	11
181	--	--	--	--	--	--	--	--	--	--	--	--
182	136	--	1	37	--	1	4	--	--	--	1	2
183	2	--	--	--	--	2	2	1	--	1	--	--
184	1	1	--	--	--	--	28	1	3	19	--	19
185	1	5	84	4	4	33	--	--	--	--	--	2
186	88	--	--	34	--	--	--	--	--	--	--	--
187	--	--	--	--	--	--	--	--	--	--	--	--
188	1	1	1	--	--	--	5	1	--	21	--	--
189	1	--	1	--	--	3	--	11	--	--	--	--
190	2	8	73	1	9	--	--	--	--	1	--	10
191	--	--	--	--	--	--	--	--	--	1	--	--
192	35	--	1	38	--	46	1	--	--	11	--	--
193	--	1	2	--	1	--	--	--	--	4	--	2
194	--	10	42	--	9	--	--	5	--	--	1	--
195	5	--	--	--	--	--	--	--	--	1	--	9
196	32	--	--	16	--	--	--	--	--	--	--	--
197	--	--	1	--	--	10	--	--	--	9	--	--
198	--	--	--	--	--	--	--	--	--	2	1	--
199	--	5	--	--	--	--	--	--	1	--	--	--
200	1	--	21	--	--	1	--	2	--	--	--	--
201	--	--	--	3	--	--	--	--	1	--	--	--
202	12	--	--	--	--	11	--	--	--	3	1	2
203	2	1	1	--	--	--	--	--	--	--	--	--
204	--	--	--	--	--	--	--	--	--	--	--	--
205	--	--	--	--	--	--	--	--	--	--	--	--
206	4	--	11	2	--	--	--	--	--	2	--	--
207	--	--	--	--	--	--	--	--	--	--	--	--
208	--	--	--	--	--	--	--	--	1	--	--	--
209	--	--	--	--	--	--	--	--	--	--	--	--
210	--	--	2	3	1	--	--	--	--	--	--	--
211	--	--	--	--	--	--	--	--	--	--	--	--
212	1	--	4	--	--	--	--	--	--	--	--	--
213	--	--	--	--	--	--	--	--	--	--	--	--
214	--	2	--	--	--	1	--	--	--	--	--	--
215	--	--	--	--	--	--	--	--	--	--	--	--
216	--	--	--	1	1	--	--	--	--	--	--	--
217	1	--	--	--	--	--	--	--	--	--	--	--
218	--	--	--	--	--	--	--	--	--	--	--	--
219	--	--	3	--	--	--	--	--	--	--	--	--
220	--	2	--	--	--	--	--	--	--	--	--	--
221	--	--	--	--	--	--	--	--	--	--	--	--
222	--	--	--	--	--	--	--	--	--	--	1	--
n	389	39	276	160	27	184	147	21	6	90	5	86

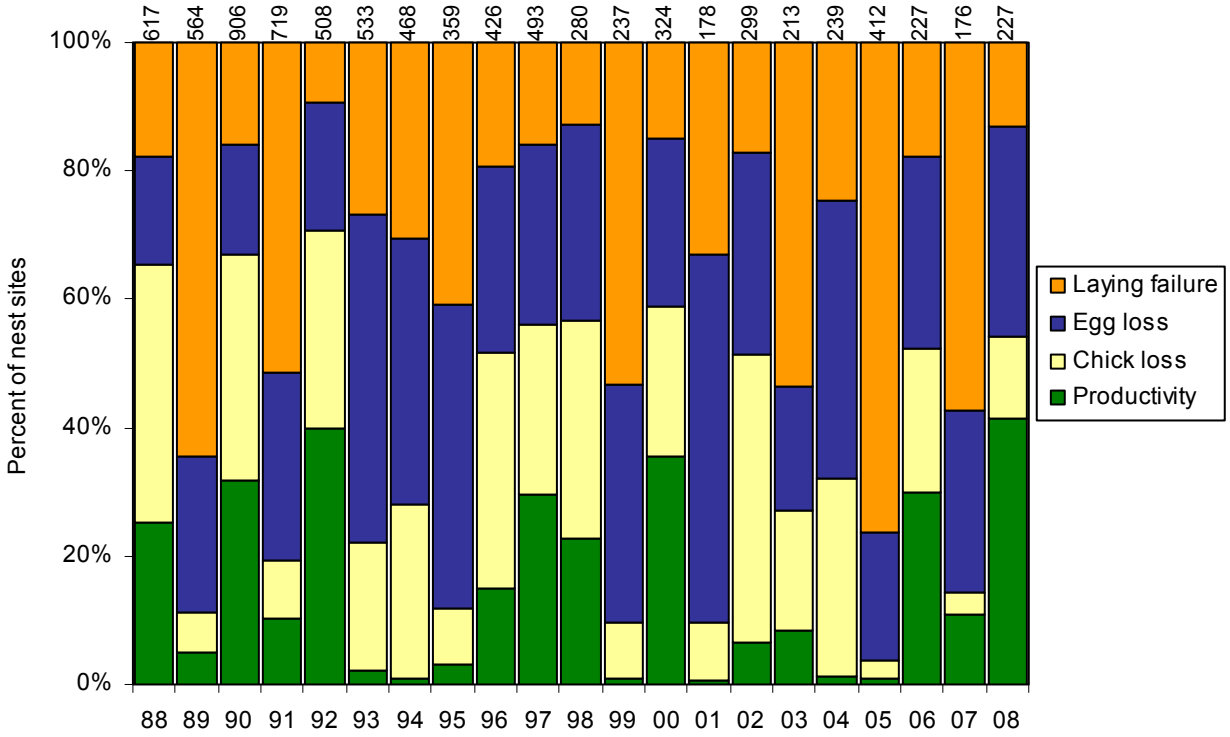

Figure 11. Reproductive performance of black-legged kittiwakes at Buldir Island, Alaska. Laying Failure=(A-B)/A; Egg Loss=(B-D)/A; Chick Loss=(D-F)/A; Productivity=F/A, where A=total number of nests; B=number of nests with ≥ 1 egg; D=number of nests with ≥ 1 chick; F=number of nests with ≥ 1 fledged chick. The number of nests monitored are given above each bar.

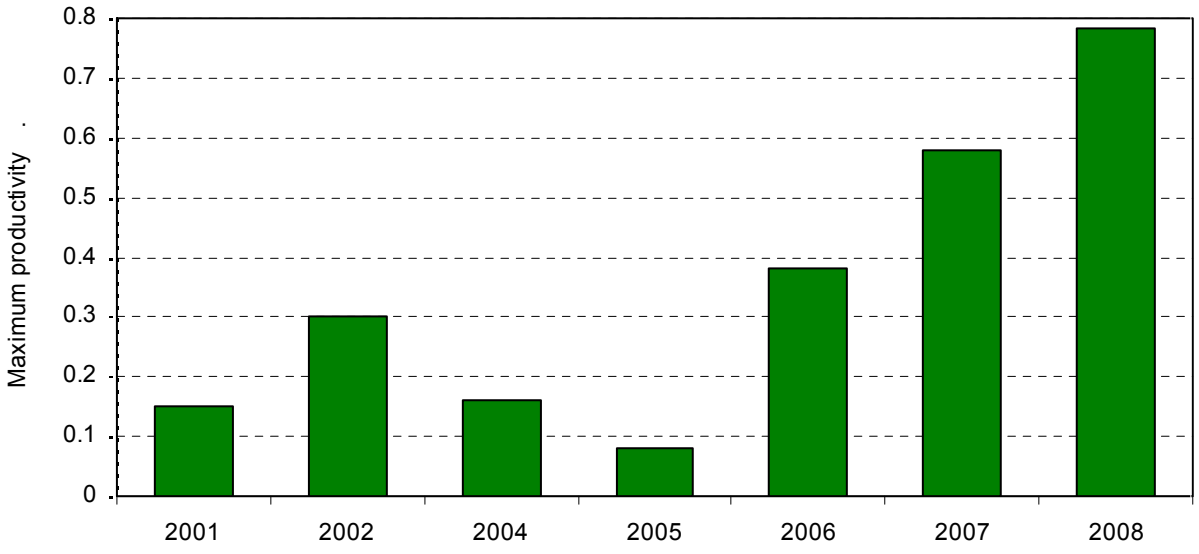

Figure 12. Maximum possible productivity for black-legged kittiwakes at Kittiwake Lane, Buldir Island, Alaska. Measurements were determined by the boom or bust method: number of chicks counted before fledging divided by number of nests counted early in the season.

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

Year	total nests (A)	mean clutch	no. nests w/ eggs (B)	no. nests w/ chicks (D)	no. nests w/ fledged chick (F)	laying success (B/A)	nesting success (D/B)	fledging success (F/D)	reproductive success (F/B)	productivity (F/A)
1976	--	1.61	--	--	--	--	--	--	--	--
1988	617	1.78	508	403	156	0.82	0.79	0.39	0.31	0.25
1989	564	1.22	201	64	28	0.36	0.32	0.44	0.14	0.05
1990	906	1.76	762	608	288	0.84	0.80	0.47	0.38	0.32
1991	719	1.35	350	138	74	0.49	0.39	0.54	0.21	0.10
1992	508	1.79	461	360	203	0.91	0.78	0.56	0.44	0.40
1993	533	1.58	391	118	12	0.73	0.30	0.11	0.03	0.02
1994	468	1.66	325	131	5	0.69	0.40	0.04	0.02	0.01
1995	359	1.41	213	42	11	0.59	0.20	0.29	0.05	0.03
1996	426	1.69	344	220	64	0.81	0.64	0.29	0.19	0.15
1997	493	1.73	415	277	146	0.84	0.67	0.53	0.35	0.30
1998	280	1.75	244	159	64	0.87	0.65	0.40	0.26	0.23
1999	237	1.49	111	26	2	0.47	0.23	0.08	0.02	0.01
2000	324	1.79	276	191	115	0.85	0.69	0.60	0.42	0.35
2001	178	--	119	17	1	0.67	0.14	0.06	0.01	0.01
2002	299	1.79	248	154	20	0.83	0.62	0.13	0.08	0.07
2003	213	1.51	99	58	18	0.46	0.59	0.31	0.18	0.08
2004	239	1.11	180	77	3	0.75	0.43	0.04	0.02	0.01
2005	412	1.11	98	16	4	0.24	0.16	0.25	0.04	0.01
2006	227	1.65	187	119	68	0.82	0.64	0.57	0.36	0.30
2007	176	1.36	75	25	19	0.43	0.33	0.76	0.25	0.11
2008	227	1.70	187	123	91	0.82	0.64	0.75	0.47	0.39

Table 23. Black-legged kittiwake productivity as determined by Boom or Bust methodology at Kittiwake Lane, Buldir Island, Alaska.

Parameter	2001	2002	2004	2005	2006	2007	2008
No. of plots monitored	3	3	2	2	3	3	7
No. of nests (A)	239	469	247	60	575	66	152
Date of nest count	26 Jun	9 Jun	17 Jun	23 Jun	23 Jun	19 Jun	18 Jun
No. of chicks (B)	38	143	40	5	220	38	119
Date(s) of chick counts	29 Jul	27 Jul	3 Aug	7 Aug	9 Aug	8 Aug	19 Jul, 12 Aug
Productivity (A/B)[a]	0.15	0.30	0.16	0.08	0.38	0.58	0.78

[a] Productivity measurements are based on the assumption that all chicks fledge and represent the maximum possible productivity

Table 24. Black-legged kittiwake clutch sizes at Buldir Island, Alaska.

	1976[a]	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
mean[b]	1.61	1.78	1.22	1.76	1.35	1.79	1.58	1.66	1.41	1.69	1.73	1.75	1.49	1.79	1.72	1.79	1.51	1.11	1.11	1.65	1.36	1.70
n	74	462	220	761	350	462	391	323	213	344	415	244	237	324	81	299	99	239	412	227	176	227
No. nests containing X eggs:																						
0	--	--	--	--	--	--	--	--	145	82	78	36	126	48	--	51	114	69	360	40	101	30
1	--	--	--	--	--	--	--	--	126	107	111	64	57	59	23	54	49	75	40	65	48	78
2	--	--	--	--	--	--	--	--	87	236	304	178	54	216	58	193	50	95	12	121	27	118
3	--	--	--	--	--	--	--	--	0	1	0	2	0	1	0	1	0	0	0	1	0	1

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

Table 25. Reproductive performance of black-legged kittiwakes on index plot at Buldir Island, Alaska, in 2008.

	Spike Camp Plots										
Parameter	36B	37	39A	40A	40B	45	46	Total	*n*	Mean	SD
Total no. nests (A)	31	49	34	24	30	29	30	227			
No. nests ≥1 egg (B)	22	43	22	22	29	23	26	187			
Total no. eggs[a] (C)	32	70	54	34	50	32	45	317			
No. nests ≥1 chick (D)	11	31	19	14	17	12	19	123			
Total chick (E)	14	40	21	15	24	13	25	152			
No. nests ≥1 chick fledged (F)	8	19	12	13	16	8	15	91			
Total chicks fledged (G)	8	20	12	14	16	8	16	94			
No. nests with 0 eggs	9	6	2	2	1	6	4	30			
No. nests with 1 egg	12	16	10	10	9	14	7	78			
No. nests with 2 eggs	10	27	22	12	19	9	19	118			
No. nests with 3 eggs	0	0	0	0	1	0	0	1			
Laying success (B/A)	0.71	0.88	0.65	0.92	0.97	0.79	0.87	5.78	7	0.82	0.11
Clutch size (C/B)	1.45	1.63	2.45	1.55	1.72	1.39	1.73	11.93	7	1.70	0.35
Nesting success (D/B)	0.50	0.72	0.86	0.64	0.59	0.52	0.73	4.56	7	0.64	0.13
Hatching success (E/C)	0.44	0.57	0.39	0.44	0.48	0.41	0.56	3.28	7	0.45	0.07
Chick success (G/E)	0.57	0.50	0.57	0.93	0.67	0.62	0.64	4.50	7	0.64	0.14
Egg success (G/C)	0.25	0.29	0.22	0.41	0.32	0.25	0.36	2.10	7	0.29	0.07
Fledging success (F/D)	0.73	0.61	0.63	0.93	0.94	0.67	0.79	5.30	7	0.75	0.14
Reproductive success (F/B)	0.36	0.44	0.55	0.59	0.55	0.35	0.58	3.42	7	0.47	0.10
Overall productivity (F/A)	0.26	0.39	0.35	0.54	0.53	0.28	0.50	2.85	7	0.39	0.12

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

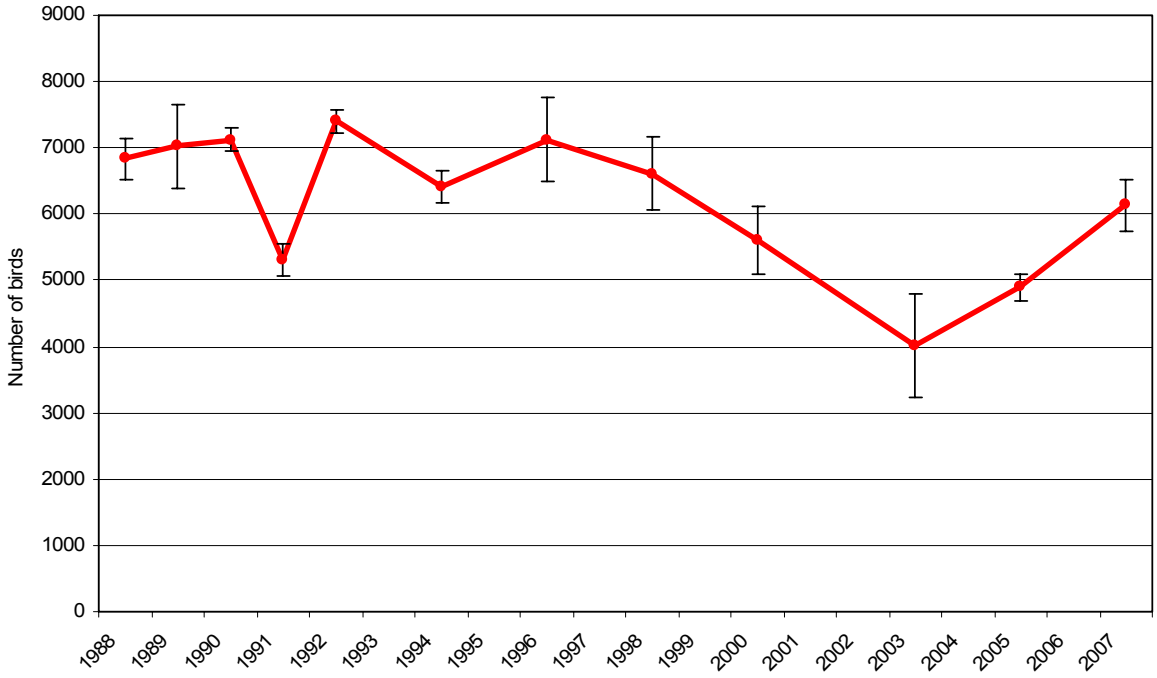

Figure 13. Counts of black-legged kittiwakes on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year.

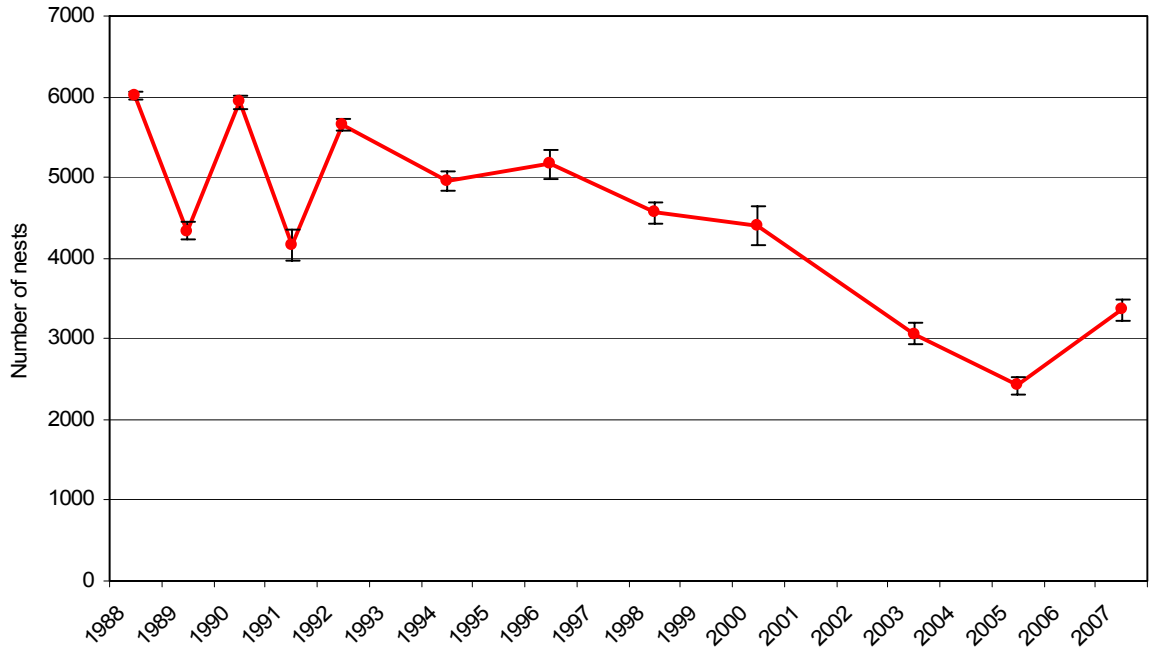

Figure 14. Counts of black-legged kittiwake nests on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year.

Table 26. 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	2007
1	5972	4452	5844	4079	5569	5106	4966	4393	4464	3122	2531	2952
2	6070	4194	5845	4432	5663	5004	5246	4697	4786	3028	2561	3098
3	6013	4403	6020	4254	5757	4867	5329	4711	4179	3200	2354	3098
4	--	4247	6012	3949	5625	4856	4969	4545	4339	2885	2365	2899
5	--	4393	5934	4088	--	--	5297	4471	4246	--	2324	2803
mean	6027.0	4337.8	5931.0	4160.4	5653.5	4958.3	5161.4	4564.4	4402.8	3058.8	2427.0	2970.0
n	3	5	5	5	4	4	5	5	5	4	5	5
SD	50.1	111.0	85.8	186.5	79.1	119.3	179.5	137.7	239.4	135.5	98.5	128.5
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 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	23 Jul

Table 27. 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	2007
1	6797	6534	6977	5125	7226	6185	6072	5821	5272	4848	5096	5004
2	6998	6276	7042	5671	7607	6721	7036	6969	6020	4157	4719	5193
3	6418	7048	7423	5145	7302	6463	7382	7263	5150	4084	4891	5161
4	7115	7812	7141	5177	7484	6271	7483	6398	5267	2979	5111	4901
5	--	7450	7019	5468	--	--	7639	6600	6291	--	4649	5913
mean	6832.0	7024.0	7120.4	5317.2	7404.8	6410.0	7122.4	6610.2	5600.0	4017.0	4893.2	5234.4
n	4	5	5	5	4	4	5	5	5	4	5	5
SD	305.7	633.0	98.9	242.0	172.9	237.7	627.5	552.9	518.4	772.9	189.0	397.4
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 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	23 Jul

Table 28. Numbers of black-legged kittiwake nests on index plots at Buldir Island, Alaska in 2007.

	Count							
Plot (segment)	1	2	3	4	5	mean	SD	max.
Spike (Dip)								
1	0	0	0	0	0	0.0	0.0	0
2	32	35	13	11	13	20.8	11.7	35
3	24	31	29	43	22	29.8	8.2	43
4	3	6	1	2	2	2.8	1.9	6
5	110	120	130	125	129	122.8	8.2	130
6	422	461	442	391	409	425.0	27.4	461
7	63	47	59	46	48	52.6	7.8	63
Total	654	700	674	618	623	653.8	34.5	700
Kittiwake Lane								
15(1)	19	28	25	20	16	21.6	4.8	28
16(2)	288	304	338	282	331	308.6	25.1	338
17(3)	273	316	319	357	312	315.4	29.8	357
18(4)	380	401	460	423	402	413.2	30.3	460
19(5)	212	204	217	220	192	209.0	11.3	220
20(6)	178	170	170	141	131	158.0	20.7	178
21(7)	195	209	179	194	189	193.2	10.9	209
22(8)	176	219	192	155	183	185.0	23.4	219
23(9)	266	210	200	195	165	207.2	36.9	266
24(10)	77	87	85	82	74	81.0	5.4	87
25(11)	76	86	84	74	67	77.4	7.7	86
26(12)	72	68	65	65	44	62.8	10.9	72
27(13)	45	53	48	39	42	45.4	5.4	53
28(14)	40	43	42	34	32	38.2	4.9	43
29(15)	1	0	0	0	0	0.2	0.4	1
KWLE[a]	960	1049	1142	1082	1061	1058.8	65.8	1142
KWLW	1338	1349	1282	1199	1119	1257.4	97.5	1349
KWL Total	2298	2398	2424	2281	2180	2316.2	98.0	2424
Index Plot Total[b]	2952	3098	3098	2899	2803	2970	128.5	3098

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

Table 29. Numbers of black-legged kittiwakes on index plots at Buldir Island, Alaska in 2007.

	Count							
Plot (segment)	1	2	3	4	5	mean	SD	max.
Spike (Dip)								
1	0	0	0	0	0	0.0	0.0	0
2	46	51	22	19	25	32.6	14.8	51
3	30	42	46	75	57	50.0	17.0	75
4	5	12	4	6	8	7.0	3.2	12
5	164	272	278	187	324	245.0	67.1	324
6	644	715	648	761	823	718.2	76.3	823
7	76	85	109	72	123	93.0	22.1	123
Total	965	1177	1107	1120	1360	1145.8	142.9	1360
Kittiwake Lane								
15(1)	147	153	152	144	225	164.2	34.2	225
16(2)	476	420	418	479	529	464.4	46.5	529
17(3)	391	398	389	541	458	435.4	65.5	541
18(4)	722	667	759	620	706	694.8	53.3	759
19(5)	397	405	444	367	465	415.6	38.9	465
20(6)	268	296	291	258	357	294.0	38.6	357
21(7)	307	374	315	308	402	341.2	44.0	402
22(8)	336	349	308	242	346	316.2	44.5	349
23(9)	408	335	349	298	363	350.6	40.2	408
24(10)	134	152	169	131	176	152.4	20.2	176
25(11)	155	161	158	118	169	152.2	19.8	169
26(12)	132	106	137	131	155	132.2	17.5	155
27(13)	93	97	81	87	111	93.8	11.4	111
28(14)	72	101	84	57	91	81.0	17.1	101
29(15)	1	2	0	0	0	0.6	0.9	2
KWLE[a]	1736	1638	1718	1784	1918	1758.8	103.4	1918
KWLW	2303	2378	2336	1997	2635	2329.8	227.5	2635
KWL Total	4039	4016	4054	3781	4553	4088.6	282.5	4553
Index Plot Total[b]	5004	5193	5161	4901	5913	5234.4	397.4	5913

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

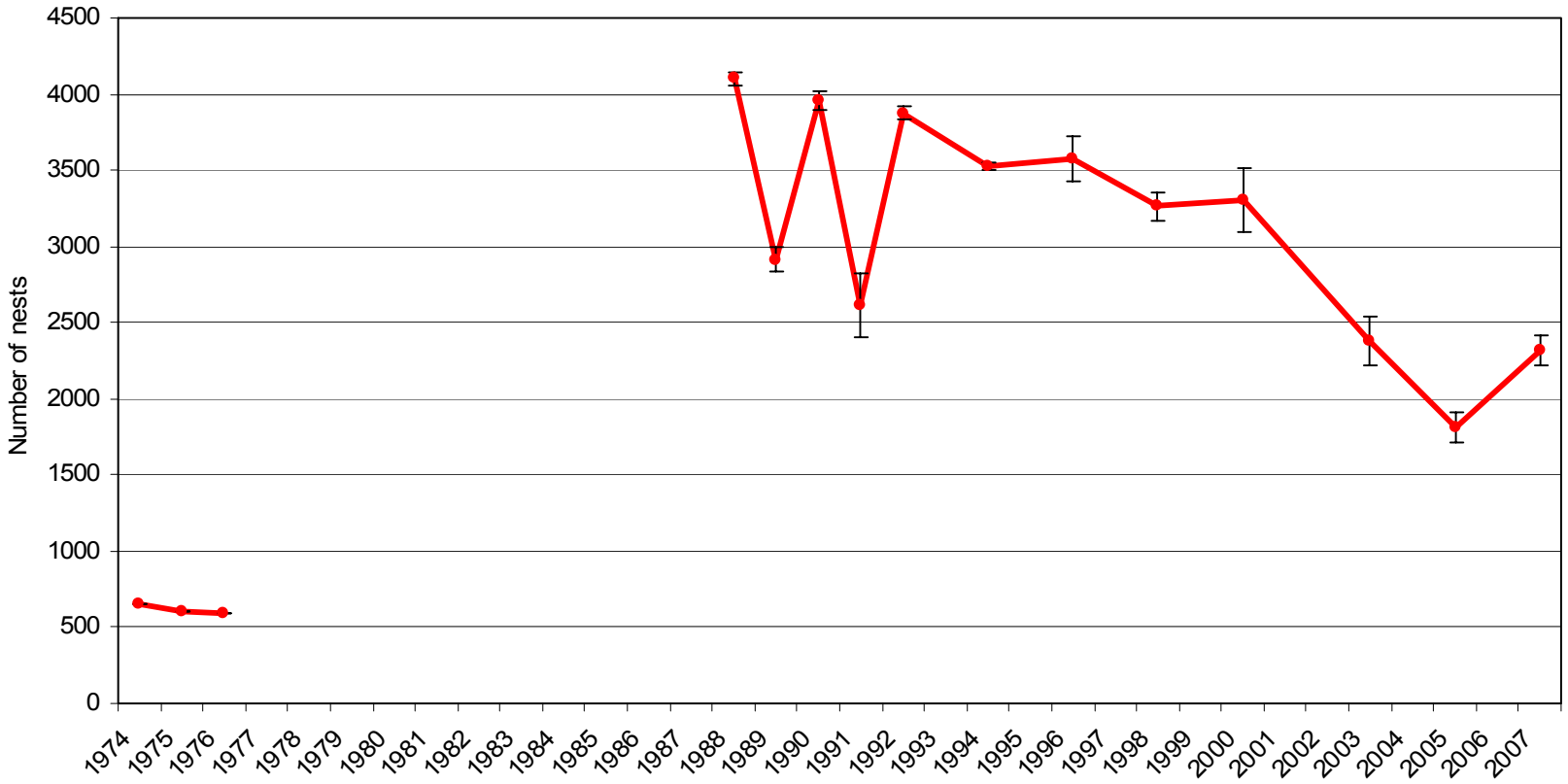

Figure 15. Counts of black-legged kittiwake nests at Kittiwake Lane, Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year. Note that the general trend at Kittiwake Lane from 1988 on mirrors that of the island counts in Fig. 11.

Table 30. 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	2006	2007
1 (15)	--	137	--	563	424	542	241	515	344	352	338	300	256	176	22
2 (16)	--	133	--	637	510	580	296	595	509	415	460	351	317	236	309
3 (17)	--	76	--	728	568	642	378	586	566	515	405	381	297	320	315
4 (18)	--	123	--	628	271	474	351	449	448	436	401	335	255	268	413
5 (19)	--	63	--	368	237	361	300	346	376	360	268	281	159	175	209
6 (20)	--	39	--	284	180	298	230	297	301	280	202	209	101	122	158
7 (21)	--	24	--	341	215	290	256	324	299	325	279	274	185	139	193
8 (22)	--	5	--	264	236	343	277	329	244	317	297	303	213	130	185
9 (23)	--	0	--	219	230	344	251	355	264	244	238	268	153	89	207
10 (24)	--	0	--	10	9	26	11	23	43	114	115	185	90	30	81
11 (25)	--	0	--	7	5	11	9	12	35	48	52	90	69	41	77
12 (26)	--	0	--	18	11	19	8	7	19	49	77	163	121	28	63
13 (27)	--	0	--	15	9	4	1	14	29	52	58	71	86	39	45
14 (28)	--	0	--	18	9	20	9	22	49	74	71	84	64	11	38
15 (29)	--	0	--	0	0	0	0	0	0	0	0	4	17	3	0
Total	649[a]	600	597	4100	2914	3954	2618	3874	3526	3581	3262	3299	2383	1809	2316
SD[b]	–	–	–	40.5	79.7	60.0	208.6	45.9	19.6	147.8	94.0	208.7	158.0	101.2	98.0
n	1	1	1	3	5	5	5	4	4	5	5	5	4	5	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	25 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	14 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.

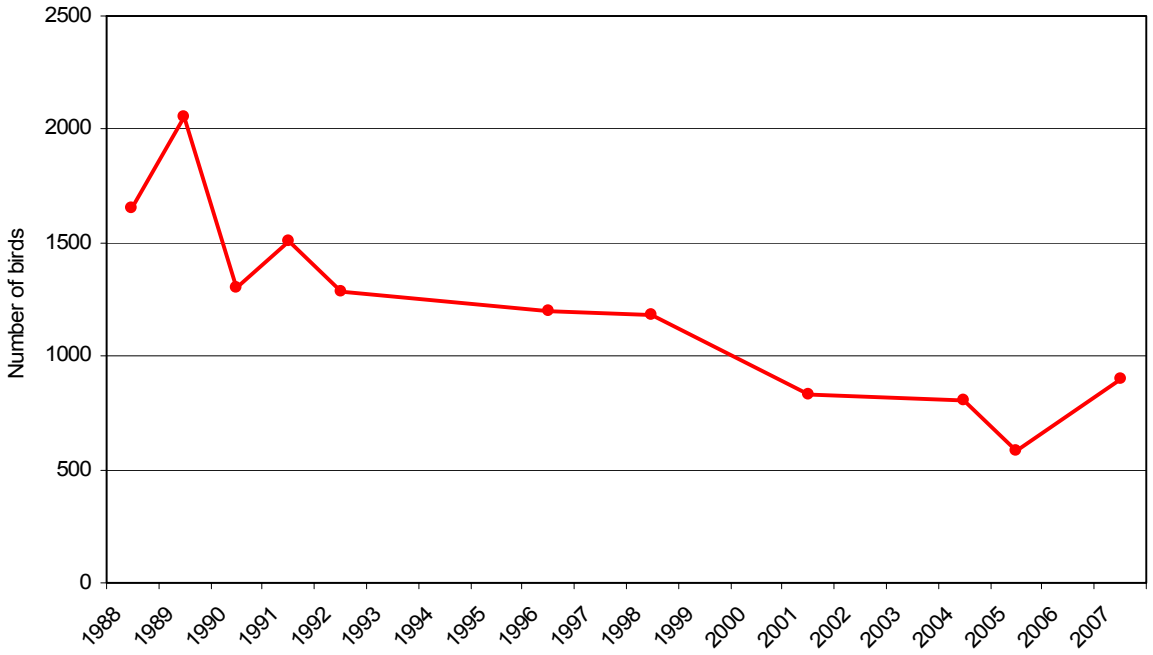

Figure 16. Counts of black-legged kittiwakes at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

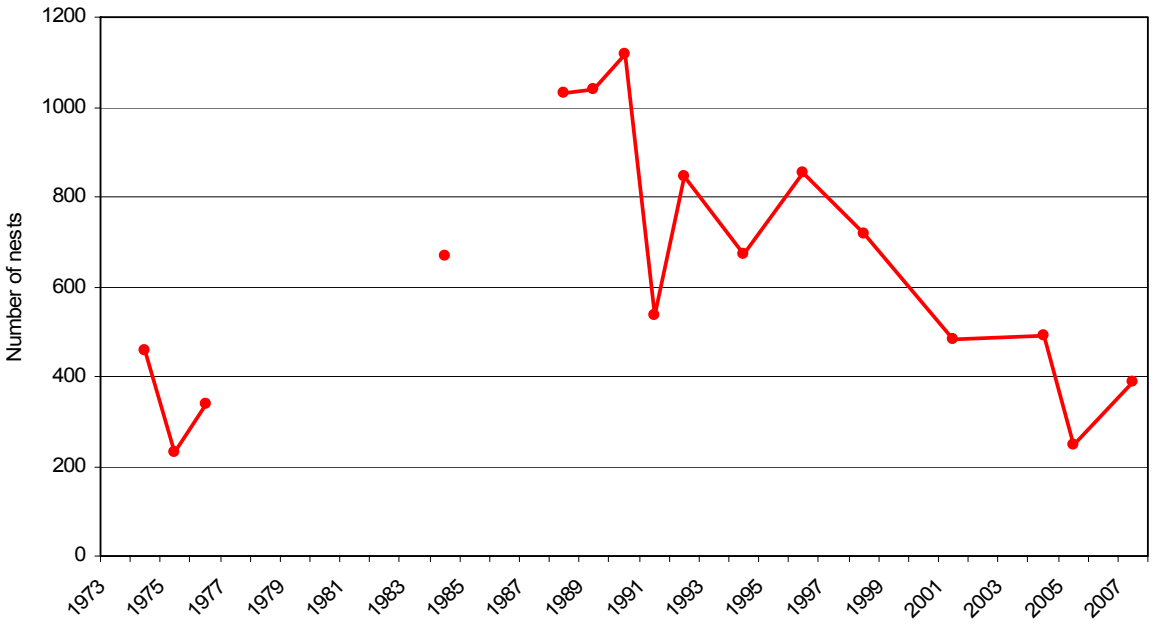

Figure 17. Counts of black-legged kittiwake nests at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

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

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

[a] Partial count, not for comparison.

Table 32. Black-legged kittiwake counts by sub-area at Middle Rock, Buldir Island, Alaska.

Segment	1974	1975	1976	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005	2007
I	--	--	--	--	206	342	211	229	239	--	161	125	136	122	76	163
II	--	--	--	--	135	225	128	111	120	--	96	111	139	132	49	82
III	--	--	--	--	241	175	125	68	106	--	40	102	0	0	0	6
IV	--	--	--	--	210	97	80	85	34	--	92	51	30	11	1	22
V	--	--	--	--	135	402	232	263	211	--	201	210	109	137	54	87
VI	--	--	--	--	300	296	203	309	236	--	241	271	94	92	76	130
VII	--	--	--	--	428	519	323	445	339	--	366	315	322	313	323	406
Total	--	--	--	--	1655	2056	1302	1510	1285	--	1197	1185	830	807	579	896
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	23 Jul

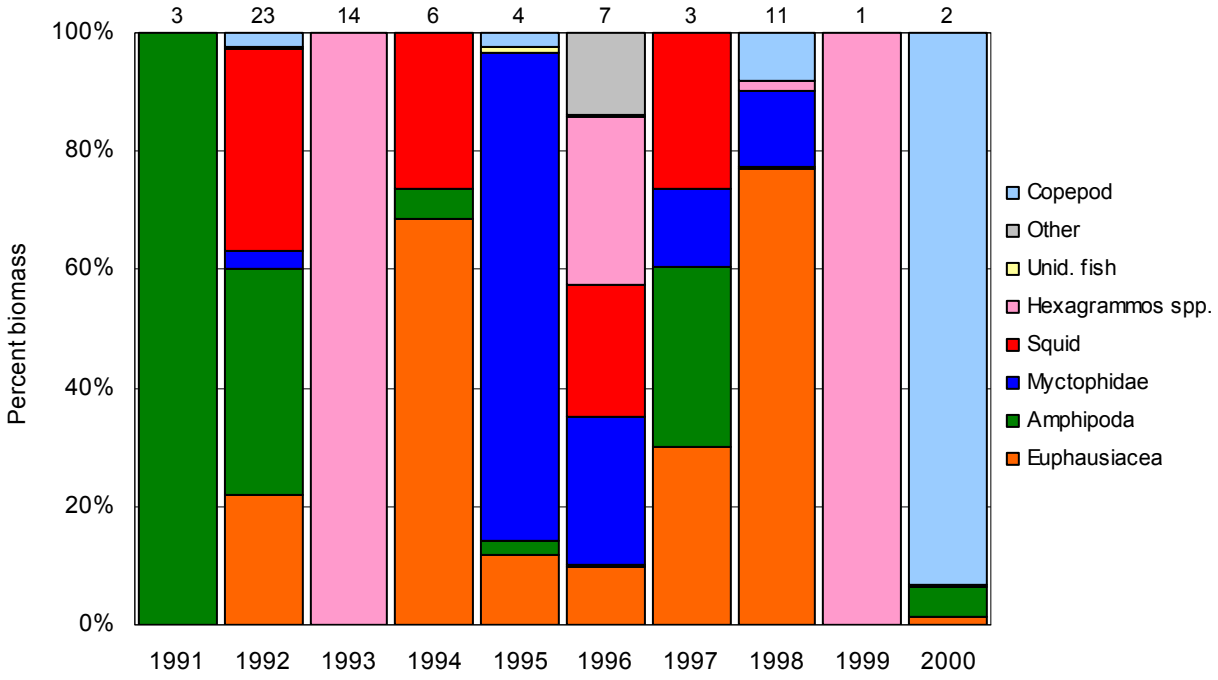

Figure 18. Relative biomass of prey in diets of black-legged kittiwakes at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

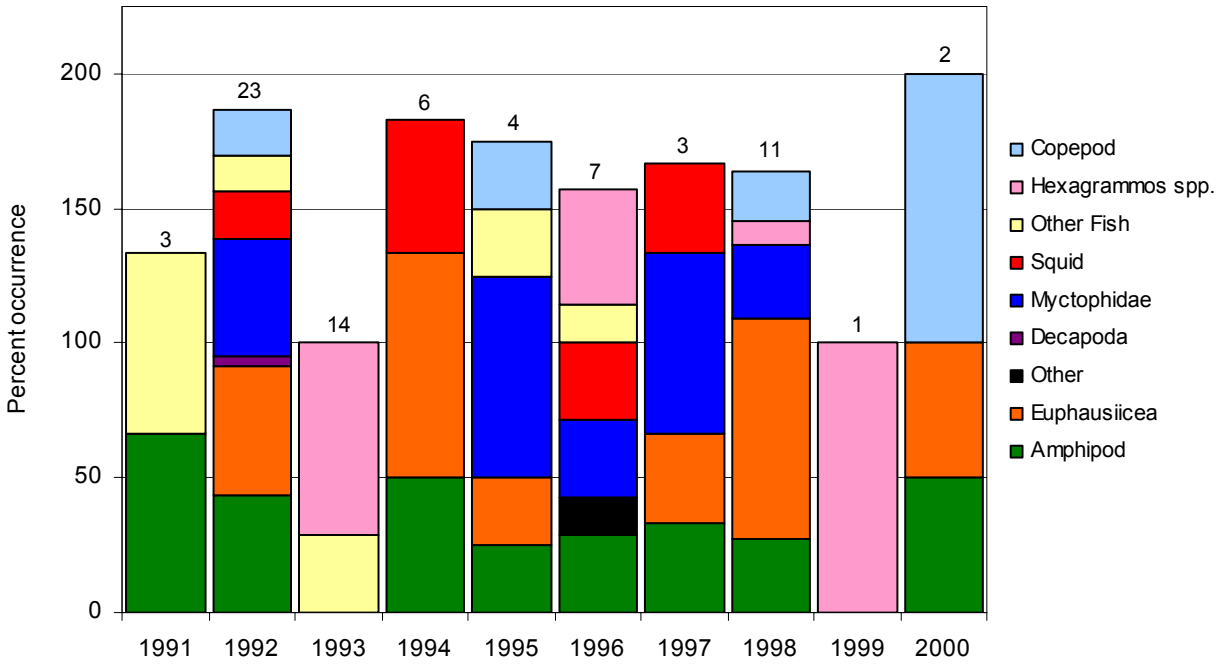

Figure 19. Frequency of occurrence of prey in diets of black-legged kittiwakes at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 33. Relative biomass of prey in diets of black-legged kittiwakes at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

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

Table 34. Frequency of occurrence of prey in diets of black-legged kittiwakes at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

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

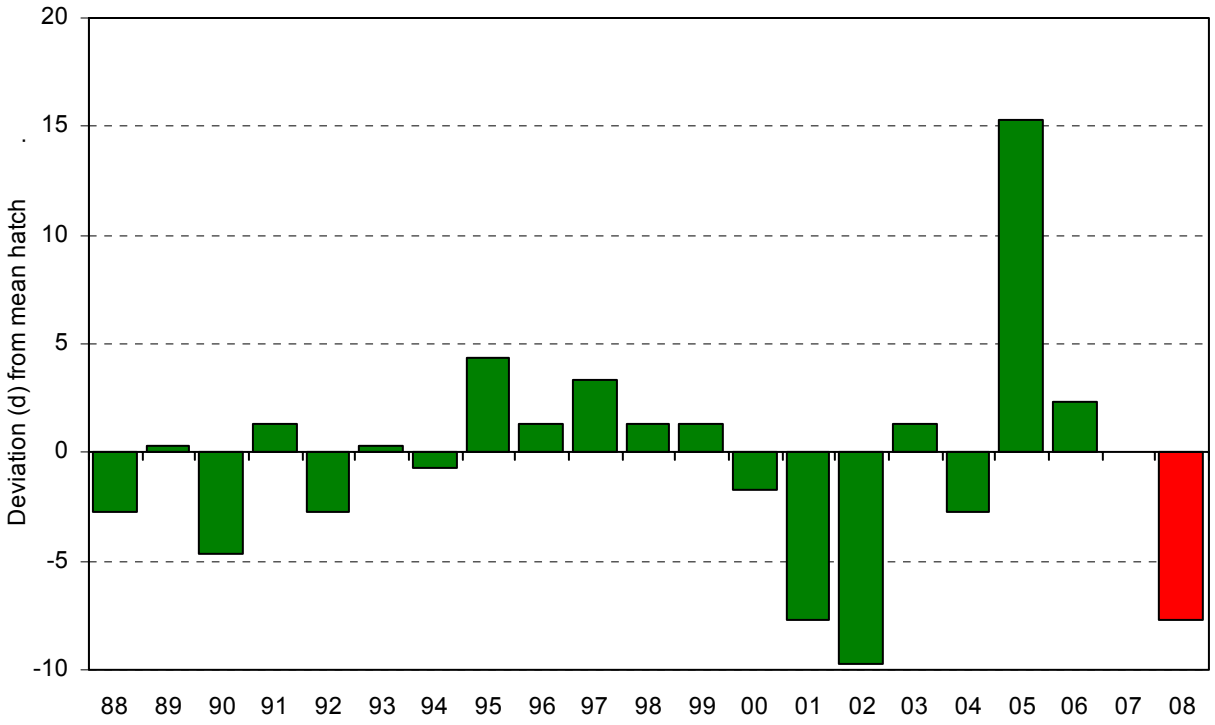

Figure 20. Yearly hatch date deviation (from the 1988-2006 average of 12 July) for red-legged kittiwakes at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later. No data that met chronology criteria were available in 2007.

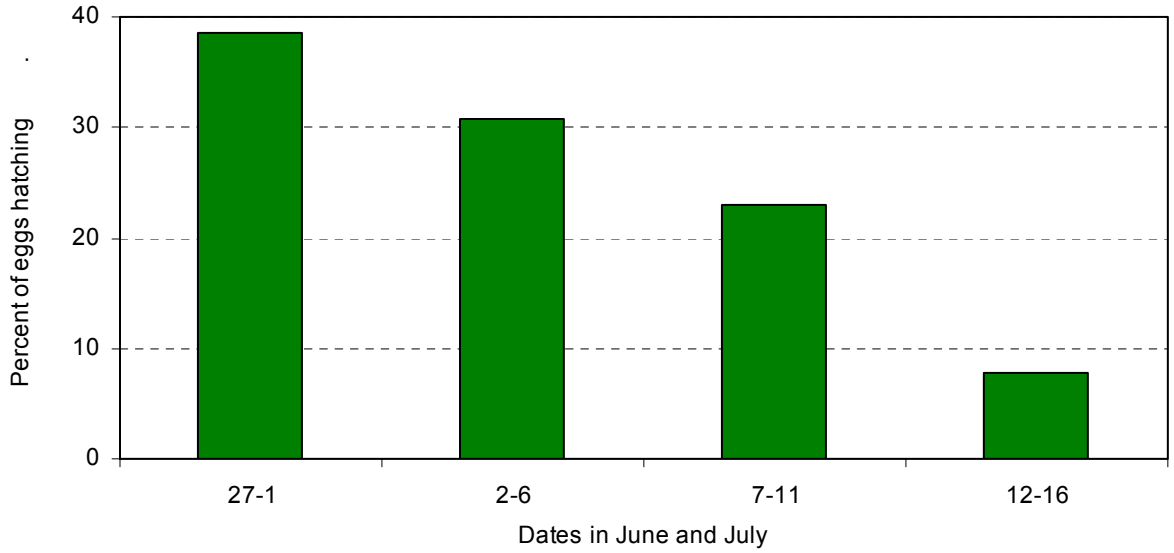

Figure 21. Hatching chronology of red-legged kittiwakes at Buldir Island, Alaska in 2008 (*n*=13).

Table 35. Breeding chronology dates for red-legged kittiwakes at Buldir Island Alaska.

Year	mean hatch	SD	*n*[a]	median hatch	no. nests monitored[b]	first lay	last lay	first hatch	last hatch	first fledge
1988	8 Jul	6.7	59	7 Jul	144	<21 Jun	28 Jun	28 Jun	1 Aug	6 Aug
1989	12 Jul	2.2	31	13 Jul	233	<12 Jun	25 Jun	8 Jul	13 Jul	>15 Aug
1990	7 Jul	6.9	110	5 Jul	218	3 Jun	3 Aug	22 Jun	25 Jul	31 Jul
1991	13 Jul	5.6	38	10 Jul	194	<14 Jun	27 Jul	1 Jul	22 Jul	10 Aug
1992	8 Jul	6.8	137	7 Jul	269	<4 Jun	20 Jul	20 Jun	30 Jul	5 Aug
1993	12 Jul	6.3	35	13 Jul	187	<7 Jun	13 Jul	1 Jul	23 Jul	16 Aug
1994	11 Jul	10.8	24	6 Jul	272	<15 Jun	30 Jun	25 Jun	6 Aug	12 Aug
1995	16 Jul	7.4	33	13 Jul	328	<15 Jun	17 Jul	7 Jul	8 Aug	>14 Aug
1996	12 Jul	9.7	62	13 Jul	206	<14 Jun	18 Jul	24 Jun	3 Aug	15 Jul
1997	15 Jul	7.1	73	13 Jul	259	<9 Jun	4 Jul	28 Jun	31 Jul	13 Aug
1998	13 Jul	6.0	62	12 Jul	147	<14 Jun	20 Jul	1 Jul	29 Jul	14 Aug
1999	13 Jul	10.7	18	11 Jul	126	<24 Jun	4 Jul	27 Jun	4 Aug	>19 Aug
2000	9 Jul	5.9	71	10 Jul	134	<11 Jun	10 Jul	27 Jun	27 Jul	13 Aug
2001	4 Jul	5.0	14	1 Jul	60	<17 Jun	26 Jun	26 Jun	17 Jul	none
2002	2 Jul	5.2	23	3 Jul	43	<6 Jun	<23 Jun	22 Jun	19 Jul	1 Aug
2003	13 Jul	--	1	13 Jul	17	<17 Jun	5 Jul	<30 Jun	13 Jul	16 Aug
2004	9 Jul	5.6	7	9 Jul	80	<15 Jun	13 Jul	25 Jun	<24 Jul	19 Aug
2005	27 Jul	8.7	3	25 Jul	36	<20 Jun	4 Aug	3 Jul	6 Aug	10 Aug
2006	14 Jul	7.1	22	11 Jul	61	<9 Jun	17 Jul	<27 Jun	28 Jul	20 Aug
2007	--	--	0	--	22	<13 Jun	<17 Jun	<9 Jul	<21 Jul	>26 Aug
2008	3 Jul	5.2	13	2 Jul	36	<16 Jun	<30 Jun	<22 Jun	13 Jul	6 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. The data from 1988-1990 and 1994 may contain observations > 7 days apart or estimated event dates.

[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 36. Frequency distribution of hatch dates for red-legged kittiwakes at Buldir Island, Alaska. Data from 1988-1990 and 1994 may contain observations > 7 days apart.

Julian	No. nests hatching on Julian date																		
Date	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005	2006	2008
170	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
171	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
172	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
173	--	--	2	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
174	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
175	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
176	--	--	--	--	3	--	2	--	2	--	--	--	--	--	--	--	--	--	--
177	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
178	--	--	6	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--
179	--	--	--	--	--	--	--	--	--	1	--	--	4	--	--	--	--	--	1
180	4	--	9	--	--	--	--	--	5	--	--	--	--	6	--	--	--	--	4
181	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
182	1	--	1	4	16	1	--	--	1	--	1	--	1	--	--	--	--	--	--
183	3	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
184	--	--	--	--	1	--	--	--	8	--	--	--	--	10	--	2	--	2	3
185	--	--	--	--	2	--	--	--	--	5	--	3	15	--	--	--	--	--	--
186	11	--	51	--	45	1	10	--	1	--	11	--	--	1	--	--	--	--	--
187	--	--	3	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--
188	7	--	2	--	--	14	1	2	--	1	--	--	--	3	--	--	--	3	1
189	8	7	--	--	--	--	--	--	8	--	2	--	2	--	--	--	--	1	--
190	1	--	--	--	5	--	--	4	3	14	1	4	--	--	--	3	--	--	3
191	--	2	4	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
192	2	--	--	--	29	1	4	1	--	3	21	--	39	--	--	--	--	6	--
193	10	--	6	--	--	--	--	--	--	3	--	--	--	--	--	--	--	1	--
194	--	22	13	--	--	5	--	12	--	17	--	3	--	--	1	1	--	--	--
195	--	--	--	--	3	--	--	--	5	--	1	--	--	--	--	--	--	--	1
196	7	--	--	--	21	--	--	4	2	--	15	--	1	--	--	--	--	--	--
197	--	--	--	2	--	1	1	--	--	1	--	--	3	--	--	--	--	3	--
198	--	--	--	14	--	--	--	4	2	2	--	--	--	--	--	--	--	--	--
199	--	--	--	--	1	7	--	--	--	--	--	--	--	--	--	--	--	--	--
200	--	--	6	--	1	--	--	1	11	9	--	--	1	1	--	1	--	1	--
201	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	1	--	--
202	1	--	4	2	5	--	--	--	--	2	--	--	2	--	--	--	--	2	--
203	--	--	--	1	--	2	--	--	--	1	--	--	--	--	--	--	--	--	--
204	2	--	--	--	--	3	--	1	8	--	--	4	--	--	--	--	--	--	--
205	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
206	--	--	3	--	1	--	4	1	--	11	3	--	--	--	--	--	1	2	--
207	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
208	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--
209	--	--	--	--	--	--	--	--	--	--	1	--	2	--	--	--	--	1	--
210	--	--	--	--	1	--	1	--	--	--	1	1	--	--	--	--	--	--	--
211	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
212	--	--	--	--	2	--	--	--	2	3	--	--	--	--	--	--	--	--	--
213	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
214	1	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--
215	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
216	--	--	--	--	--	--	--	--	1	--	--	1	--	--	--	--	--	--	--
217	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
218	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1	--	--
219	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
220	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
n	59	31	110	38	137	35	24	33	62	73	62	18	71	23	1	7	3	22	13

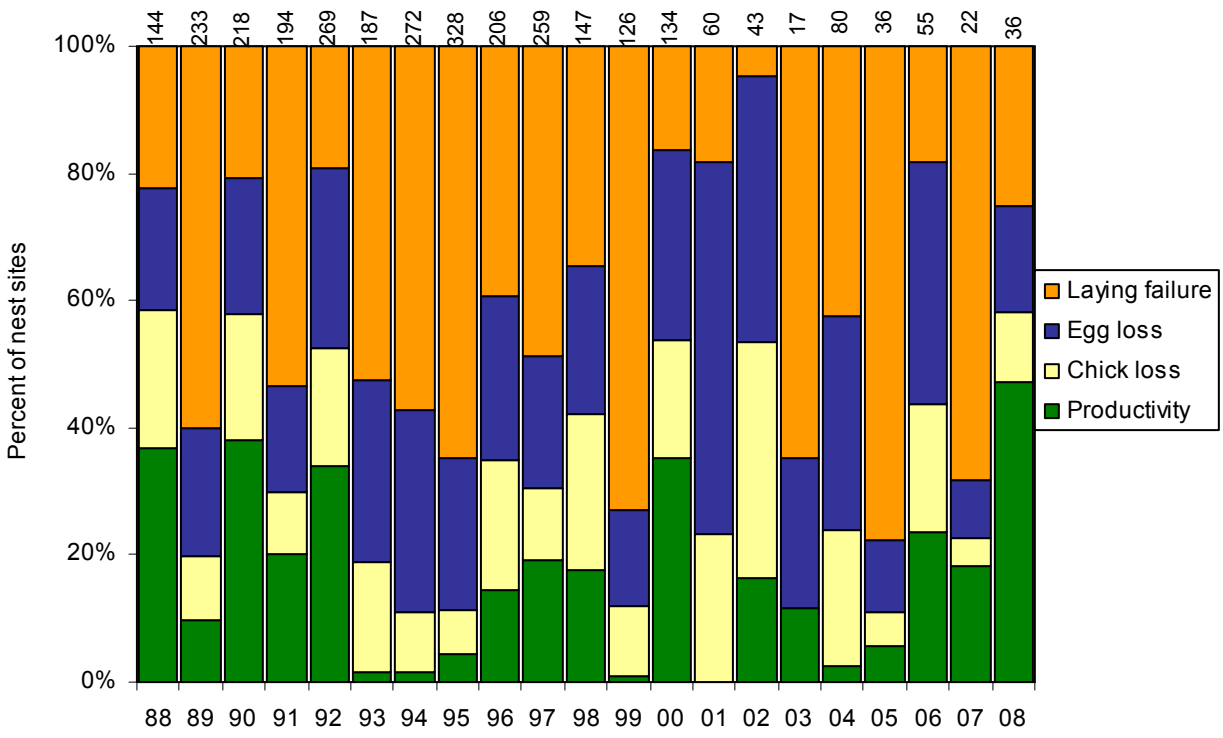

Figure 22. Reproductive performance of red-legged kittiwakes at Buldir Island, Alaska. Laying Failure=(A-B)/A; Egg Loss=(B-C)/A; Chick Loss=(C-D)/A; Productivity=D/A, where A=total number of nests; B=number of nests with ≥ 1 egg; C=number of nests with ≥ 1 chick; D= number of nests with ≥ 1 fledged chick. The number of nests monitored are given above each bar.

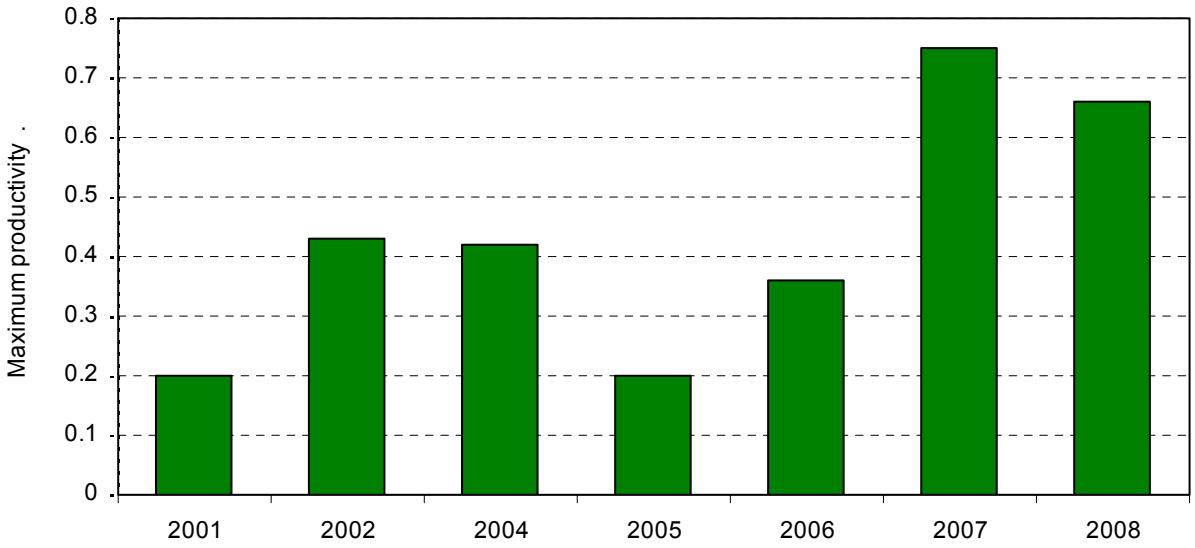

Figure 23. Maximum possible productivity for red-legged kittiwakes at Kittiwake Lane, Buldir Island, Alaska. Measurements were determined by the boom or bust method: number of chicks counted before fledging divided by number of nests counted early in the season.

Table 37. Reproductive performance of red-legged kittiwakes at Buldir Island, Alaska.

Year	total nests (A)	no. nests w/ eggs (B)	no. nests w/ chicks (C)	no. nests w/ fledged chick (D)	laying success (B/A)	nesting success (C/B)	fledging success (D/C)	reproductive success (D/B)	productivity (D/A)
1988	144	112	84	53	0.78	0.75	0.58	0.45	0.35
1989	233	93	46	23	0.40	0.49	0.50	0.25	0.10
1990	218	173	126	83	0.79	0.73	0.66	0.48	0.41
1991	194	90	58	39	0.46	0.64	0.67	0.43	0.20
1992	269	217	141	91	0.81	0.65	0.65	0.42	0.34
1993	187	89	35	3	0.48	0.44	0.09	0.03	0.02
1994	272	116	30	4	0.43	0.26	0.13	0.03	0.01
1995	328	116	37	14	0.35	0.32	0.38	0.12	0.04
1996	206	125	72	30	0.61	0.58	0.42	0.24	0.15
1997	259	133	79	50	0.51	0.59	0.63	0.38	0.19
1998	147	96	62	26	0.65	0.65	0.42	0.27	0.18
1999	126	34	15	1	0.27	0.44	0.07	0.03	0.01
2000	134	112	72	47	0.84	0.64	0.65	0.42	0.35
2001	60	47	14	0	0.78	0.30	0.00	0.00	0.00
2002	43	41	23	7	0.95	0.56	0.30	0.17	0.16
2003	17	6	2	2	0.35	0.33	1.00	0.33	0.12
2004	80	46	19	2	0.58	0.41	0.11	0.04	0.03
2005	36	8	4	2	0.22	0.50	0.50	0.25	0.06
2006[a]	55	45	24	13	0.82	0.53	0.54	0.29	0.24
2007	22	7	5	4	0.32	0.71	0.80	0.57	0.18
2008	37	27	21	17	0.75	0.78	0.81	0.63	0.47

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

Table 38. Red-legged kittiwake productivity as determined by Boom or Bust methodology at Kittiwake Lane, Buldir Island, Alaska.

	2001	2002	2004	2005	2006	2007	2008
No. of plots monitored	3	3	4	2	3	3	7
No. of nests (A)	84	167	195	49	264	32	37
Date of nest count	26 Jun	9 Jun	17 Jun	23 Jun	23 Jun	19 Jun	18 Jun
No. of chicks (B)	17	72	81	10	94	24	37
Date(s) of chick counts	29 Jul	27 Jul	3 Aug	7 Aug	9 Aug	8 Aug	19 Jul, 12 Aug
Productivity (A/B)[a]	0.20	0.43	0.42	0.20	0.36	0.75	0.66

[a] Productivity measurements are based on all chicks fledging and represent the maximum possible productivity

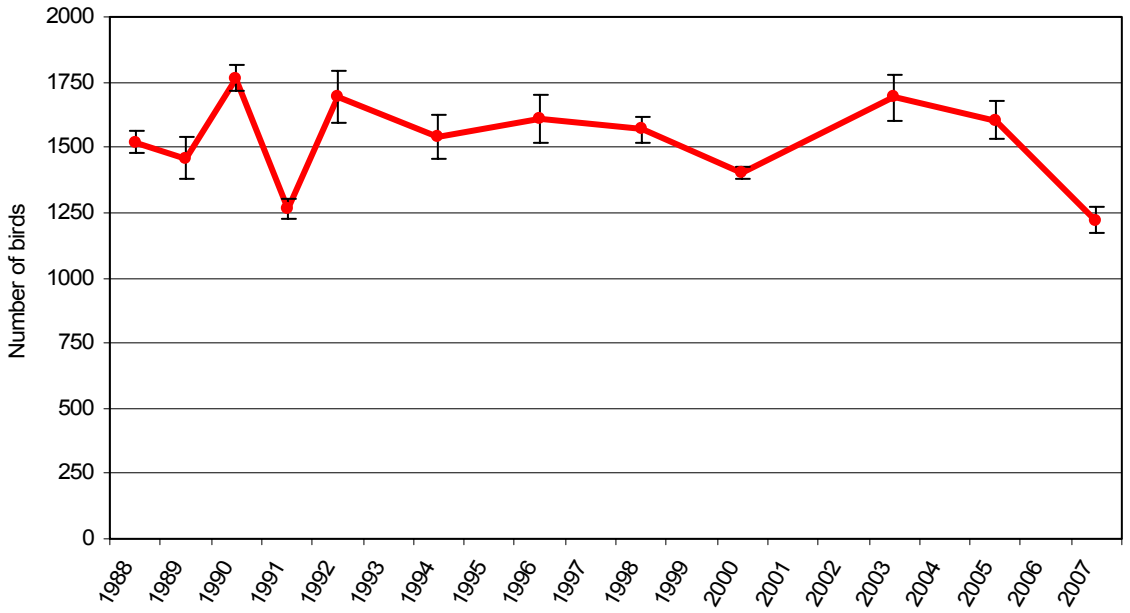

Figure 24. Counts of red-legged kittiwakes on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

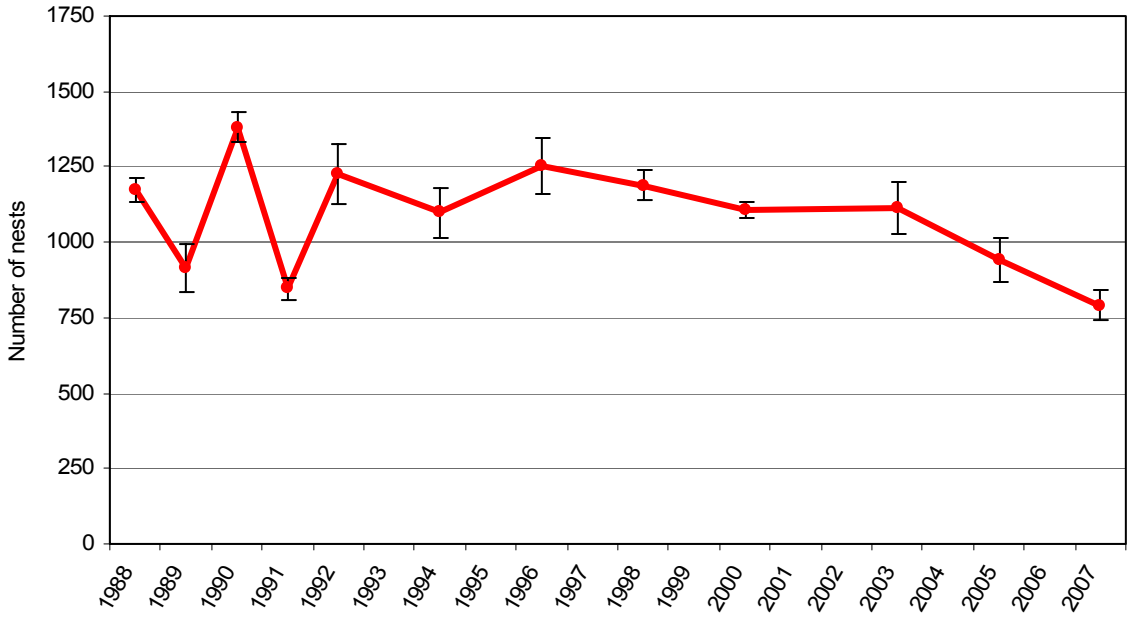

Figure 25. Counts of red-legged kittiwake nests on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

Table 39. 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	2007
1	1182	826	1441	806	1094	1030	1133	1168	1120	984	829	729
2	1130	828	1415	835	1237	1060	1196	1112	1147	1139	954	803
3	1208	973	1315	874	1251	1082	1299	1239	1092	1156	937	819
4	--	957	1366	828	1330	1217	1366	1210	1084	1179	956	748
5	--	988	1367	895	--	--	1274	1215	1099	--	1030	854
mean	1173.3	914.4	1380.8	847.6	1228.0	1097.3	1253.6	1188.8	1108.4	1114.5	941.2	788.8
n	3	5	5	5	4	4	5	5	5	4	5	5
SD	39.7	80.5	48.8	36.1	98.3	82.6	90.8	50.0	25.4	88.5	72.2	48.8
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 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	15 Jul

Table 40. 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	2007
1	1279	1220	1823	1139	1470	1387	1422	1506	1396	1630	1488	1026
2	1558	1389	1727	1165	1752	1466	1565	1487	1394	1790	1612	1110
3	1614	1533	1695	1320	1695	1565	1625	1582	1371	1742	1503	1229
4	1633	1560	1774	1320	1854	1747	1747	1605	1389	1602	1707	1289
5	--	1585	1811	1373	--	--	1697	1664	1455	--	1714	1453
mean	1521.0	1457.4	1766.0	1258.8	1692.8	1541.3	1611.2	1568.8	1401.0	1691.0	1604.8	1221.4
n	4	5	5	5	4	4	5	5	5	4	5	5
SD	164.4	152.9	54.5	101.7	162.4	155.3	126.4	72.8	31.8	89.5	107.7	165.0
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 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	15 Jul

Table 41. Numbers of red-legged kittiwake nests on index plots at Buldir Island, Alaska in 2007.

	Count							
Plot (segment)	1	2	3	4	5	mean	SD	max.
Spike (Dip)								
1	0	0	0	0	0	0.0	0.0	0
2	0	0	0	0	0	0.0	0.0	0
3	0	0	0	0	0	0.0	0.0	0
4	0	0	0	0	0	0.0	0.0	0
5	6	4	4	4	4	4.4	0.9	6
6	22	32	33	35	28	30.0	5.1	35
7	0	3	1	1	1	1.2	1.1	3
A	70	45	83	48	51	59.4	16.4	83
B	16	12	31	41	32	26.4	12.1	41
C	25	86	63	77	82	66.6	24.8	86
Total	139	182	215	206	198	188.0	30.0	215
Kittiwake Lane								
15(1)	0	6	0	0	0	1.2	2.7	6
16(2)	82	87	89	99	105	92.4	9.4	105
17(3)	95	104	107	47	93	89.2	24.3	107
18(4)	68	85	75	87	78	78.6	7.7	87
19(5)	44	43	32	32	54	41.0	9.3	54
20(6)	58	60	47	44	63	54.4	8.4	63
21(7)	92	92	94	89	93	92.0	1.9	94
22(8)	69	58	66	63	64	64.0	4.1	69
23(9)	46	42	52	38	53	46.2	6.4	53
24(10)	11	13	11	18	6	11.8	4.3	18
25(11)	11	12	18	18	15	14.8	3.3	18
26(12)	13	18	11	4	16	12.4	5.4	18
27(13)	1	1	2	3	1	1.6	0.9	3
28(14)	0	0	0	0	6	1.2	2.7	6
29(15)	0	0	0	0	0	0.0	0.0	0
KWLE[a]	245	282	271	233	276	261.4	21.2	282
KWLW	345	339	333	309	371	339.4	22.3	371
KWL Total	590	621	604	542	647	600.8	39.1	647
Index Plot Total[b]	729	803	819	748	845	788.8	48.8	845

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

Table 42. Numbers of red-legged kittiwakes on index plots at Buldir Island, Alaska in 2007.

	Count							
Plot (segment)	1	2	3	4	5	mean	SD	max.
Spike (Dip)								
1	0	0	0	0	0	0.0	0.0	0
2	0	0	0	0	0	0.0	0.0	0
3	0	0	0	0	0	0.0	0.0	0
4	0	0	0	0	0	0.0	0.0	0
5	9	5	4	7	9	6.8	2.3	9
6	37	55	54	55	62	52.6	9.3	62
7	0	8	5	4	5	4.4	2.9	8
A	101	82	151	156	158	129.6	35.5	158
B	24	15	47	64	48	39.6	19.8	64
C	46	124	111	132	169	116.4	44.9	169
Total	217	289	372	418	451	349.4	95.8	451
Kittiwake Lane								
15(1)	5	13	6	2	20	9.2	7.3	20
16(2)	97	107	116	134	143	119.4	19.0	143
17(3)	120	138	128	88	134	121.6	20.0	138
18(4)	104	108	107	145	144	121.6	21.0	145
19(5)	63	64	56	60	83	65.2	10.4	83
20(6)	76	72	65	64	77	70.8	6.1	77
21(7)	105	113	125	119	131	118.6	10.1	131
22(8)	95	83	94	87	93	90.4	5.2	95
23(9)	73	54	74	78	87	73.2	12.1	87
24(10)	23	19	25	38	22	25.4	7.4	38
25(11)	23	16	28	29	32	25.6	6.3	32
26(12)	18	26	23	17	26	22.0	4.3	26
27(13)	4	1	6	7	4	4.4	2.3	7
28(14)	3	7	4	3	6	4.6	1.8	7
29(15)	0	0	0	0	0	0.0	0.0	0
KWLE[a]	326	366	357	369	441	371.8	42.3	441
KWLW	483	455	500	502	561	500.2	38.9	561
KWL Total	809	821	857	871	1002	872.0	77.0	1002
Index Plot Total[b]	1026	1110	1229	1289	1453	1221.4	165.0	1453

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

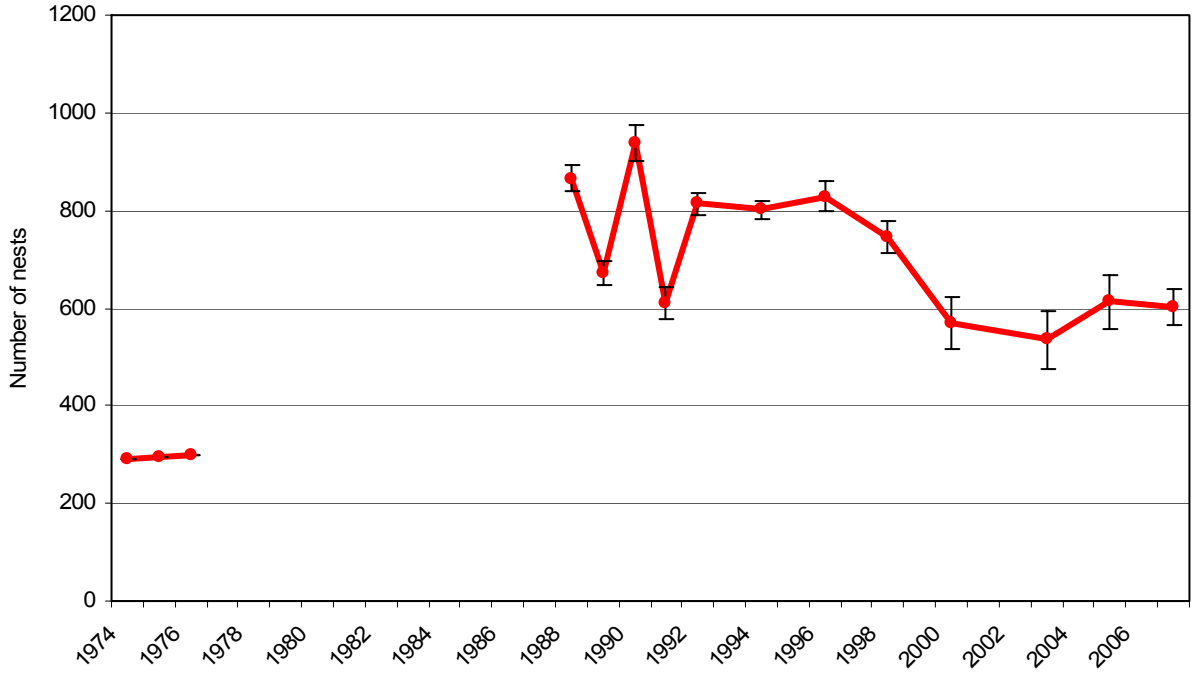

Figure 26. Counts of red-legged kittiwake nests at Kittiwake Lane, Buldir Island, Alaska. Error bars represent the standard deviation of counts in each year. Note that the general trend at Kittiwake Lane does not mirror that of the island counts in Figure 20.

Table 43. 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	2007
1 (15)	--	80	--	127	95	145	75	96	81	88	81	46	69	46	1
2 (16)	--	89	--	110	83	108	75	98	95	68	70	37	33	31	92
3 (17)	--	46	--	149	125	129	63	87	80	79	56	57	53	88	89
4 (18)	--	49	--	167	75	114	85	123	137	171	135	93	81	141	79
5 (19)	--	12	--	52	51	75	34	62	66	59	49	46	43	52	41
6 (20)	--	20	--	109	72	117	44	95	94	81	81	83	38	45	54
7 (21)	--	0	--	49	49	76	73	70	86	95	95	70	63	68	92
8 (22)	--	0	--	56	56	78	79	88	82	66	69	31	48	44	64
9 (23)	--	0	--	46	63	87	80	90	57	44	37	27	31	59	46
10 (24)	--	0	--	1	1	6	2	4	7	17	26	24	12	4	12
11 (25)	--	0	--	0	0	0	0	0	5	11	10	11	22	24	15
12 (26)	--	0	--	0	0	0	0	0	2	12	14	18	28	7	12
13 (27)	--	0	--	0	0	0	0	0	1	10	8	13	10	3	2
14 (28)	--	0	--	0	1	3	0	0	9	28	15	12	3	1	1
15 (29)	--	0	--	0	0	0	0	0	0	0	0	0	2	0	0
Total	289	296	299	866	671	938	610	813	802	829	746	568	536	613	647
SD[a]	--	--	--	27.1	25.9	36.5	33.1	21.3	17.9	30.6	31.9	53.8	59.3	54.4	39.1
n	1	1	1	3	5	5	5	4	4	5	5	5	4	5	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	25 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	15 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 44. Red-legged kittiwake nest counts by sub-area at Middle Rock, Buldir Island, Alaska.

Segment	1974	1975	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005	2007
I	9	5	0	--	0	0	0	0	0	0	0	0	0	2	0
II	0	0	0	--	0	0	0	0	1	0	0	2	0	0	0
III	0	0	0	--	0	0	0	0	2	0	0	0	0	0	0
IV	0	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	1
VI	0	0	0	--	0	0	0	0	0	1	9	0	0	0	5
VII	0	0	0	--	0	2	4	4	0	1	0	2	2	0	6
Total	10	7	1	--	0	2	4	4	3	2	9	5	2	2	12
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	23 Jul

Table 45. Red-legged kittiwake counts by sub-area at Middle Rock, Buldir Island, Alaska.

Segment	1974	1975	1984	1988	1989	1990	1991	1992	1994	1996	1998	2001	2004	2005	2007
I	--	--	--	--	0	0	0	0	0	0	0	0	0	4	0
II	--	--	--	--	0	0	0	0	0	0	0	2	0	0	0
III	--	--	--	--	0	0	0	0	0	0	0	0	0	0	0
IV	--	--	--	--	0	0	0	0	0	0	0	0	0	0	0
V	--	--	--	--	3	0	0	0	0	0	5	1	0	0	2
VI	--	--	--	--	0	0	0	0	0	1	13	0	0	3	23
VII	--	--	--	--	4	3	8	4	0	3	0	4	6	0	20
Total	--	--	--	--	7	3	8	4	0	4	18	7	6	7	45
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	23 Jul

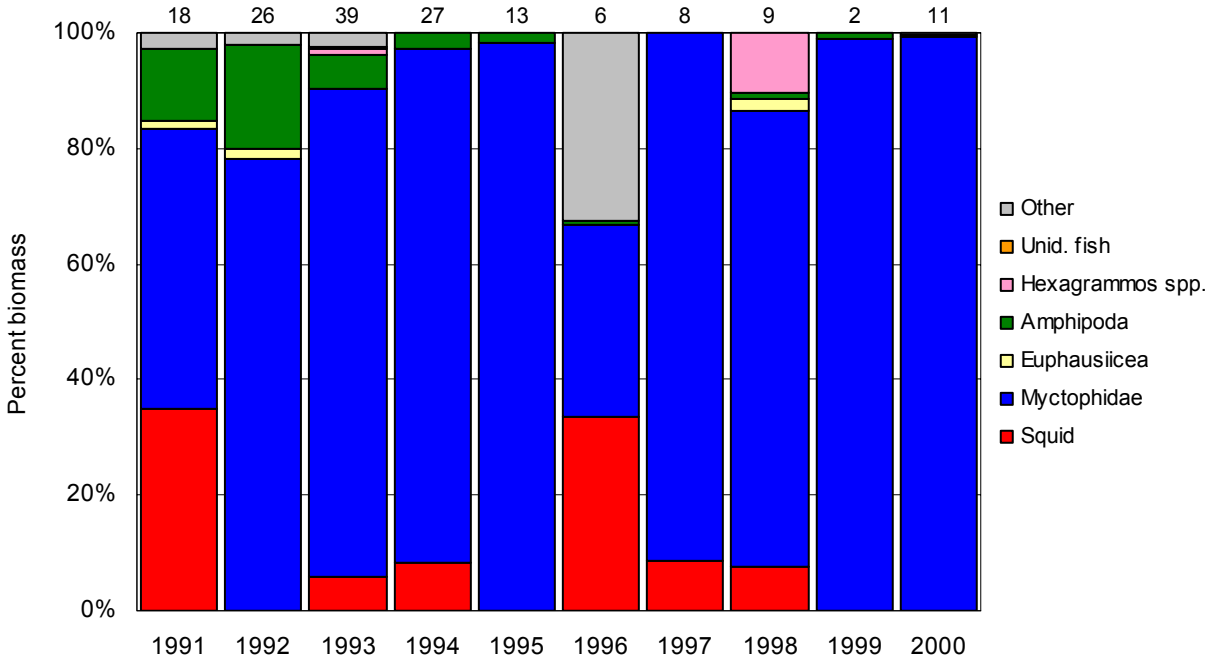

Figure 27. Relative biomass of prey in diets of red-legged kittiwakes at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

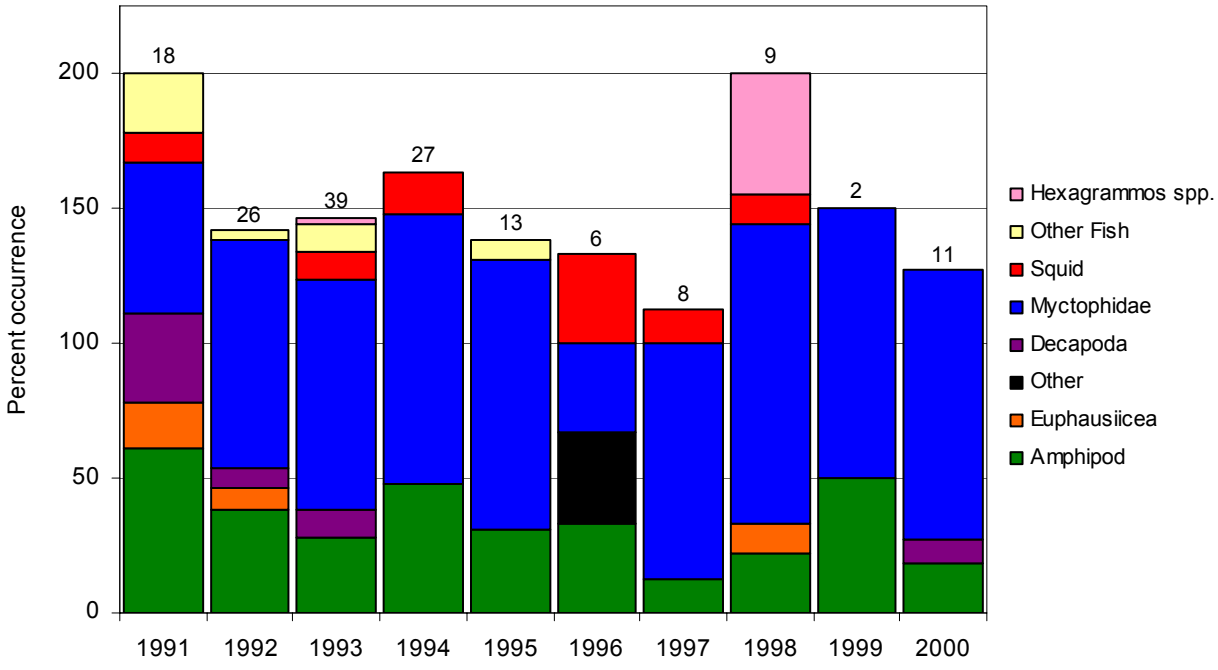

Figure 28. Frequency of occurrence of prey in diets of red-legged kittiwakes at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 46. Relative biomass of prey in diets of red-legged kittiwakes at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
No. samples	18	26	39	27	13	6	8	9	2	11
Total mass (g)	171.5	47.9	189.8	389.3	145.5	136.6	174.4	238.9	57.0	127.0
Cephalopoda - squid	35.0	--	5.8	8.3	--	33.7	8.6	7.5	--	--
Amphipoda										
Hyperiidea										
Parathemisto pacifica	--	--	--	0.2	--	--	--	--	--	--
Parathemisto spp.	--	3.3	0.6	--	--	--	--	--	--	--
Gammaridea										
Lysianassidae	9.6	10.4	5.0	2.4	1.7	0.8	0.1	0.8	0.9	0.5
Unid. Amphipoda	2.6	4.2	--	--	--	--	--	--	--	--
Euphausiacea										
Thysanoessa spp.	1.5	2.0	--	--	--	--	--	--	--	--
Unid. euphausid	--	--	--	--	--	--	--	2.1	--	--
Decapoda - shrimp	2.9	2.1	1.1	--	--	--	--	--	--	0.4
Fish										
Osmeridae	--	--	1.3	--	--	--	--	--	--	--
Myctophidae										
Stenobrachius leucopsarus	--	--	84.6	--	--	--	91.3	69.0	--	--
Unid. Myctophidae	48.3	78.0		89.0	98.3	32.9	--	10.0	99.1	99.1
Hexagrammos spp.	--	--	1.1	--	--	--	--	10.5	--	--
Unid. fish	--	--	0.5	--	--	--	--	--	--	--
Offal	--	--	--	--	--	32.6	--	--	--	--

Table 47. Frequency of occurrence of prey in diets of red-legged kittiwakes at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

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

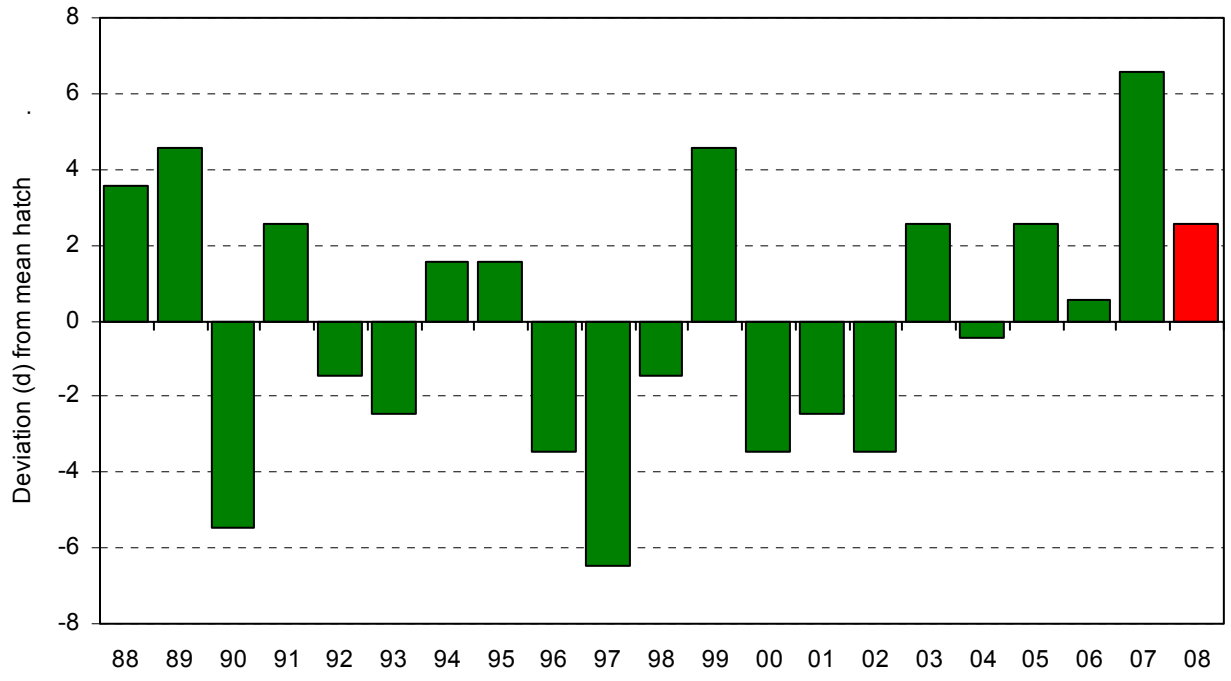

Figure 29. Yearly hatch date deviation (from the 1988-2007 average of 17 July) for thick-billed murres at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

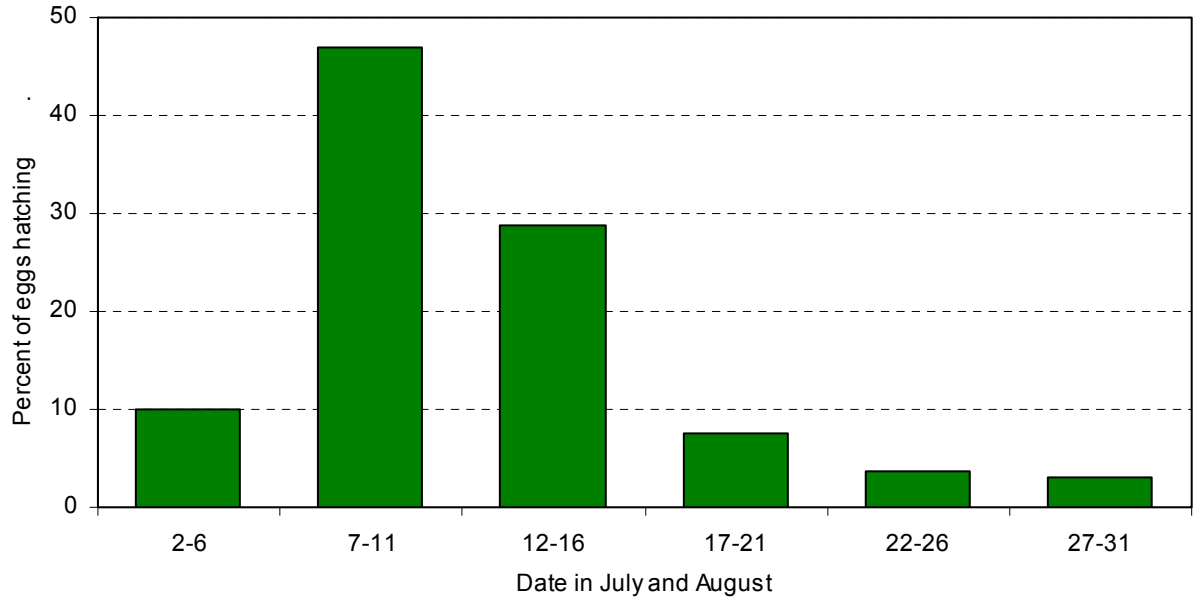

Figure 30. Hatching chronology of thick-billed murres at Buldir Island, Alaska in 2008 (*n*=99).

Table 48. Breeding chronology dates for thick-billed murres at Buldir Island, Alaska.

Year	mean hatch	SD	*n*[a]	median hatch	no. nests monitored[b]	first lay	last lay	first hatch	last hatch	first jump	last jump
1988	20 Jul	8.9	38	17 Jul	363	23 Jun	23 Jul	11 Jul	19 Aug	3 Aug	28 Aug
1989	22 Jul	6.1	42	21 Jul	545	14 Jun	22 Jul	14 Jul	10 Aug	2 Aug	>16 Aug
1990	12 Jul	5.7	60	13 Jul	473	6 Jun	10 Jul	7 Jul	3 Aug	23 Jul	>14 Aug
1991	20 Jul	4.4	195	21 Jul	514	14 Jun	19 Jul	15 Jul	27 Jul	3 Aug	>13 Aug
1992	16 Jul	7.1	39	14 Jul	345	7 Jun	17 Jul	4 Jul	3 Aug	29 Jul	>12 Aug
1993	15 Jul	5.5	89	15 Jul	271	14 Jun	12 Jul	5 Jul	31 Jul	24 Jul	>15 Aug
1994	19 Jul	7.6	44	19 Jul	385	13 Jun	22 Jul	5 Jul	12 Aug	25 Jul	26 Aug
1995	19 Jul	5.0	178	19 Jul	288	8 Jun	13 Jul	11 Jul	10 Aug	28 Jul	>17 Aug
1996	13 Jul	5.9	179	14 Jul	308	14 Jun	16 Jul	2 Jul	12 Aug	18 Jul	18 Aug
1997	11 Jul	5.7	182	11 Jul	407	12 Jun	18 Jul	2 Jul	11 Aug	27 Jul	--
1998	16 Jul	5.6	56	15 Jul	271	<14 Jun	15 Jul	5 Jul	13 Aug	20 Jul	21 Aug
1999	22 Jul	5.8	31	21 Jul	269	<27 Jun	19 Jul	16 Jul	12 Aug	2 Aug	>14 Aug
2000	15 Jul	6.5	263	14 Jul	329	<14 Jun	6 Jul	3 Jul	7 Aug	19 Jul	21 Aug
2001	15 Jul	6.5	59	13 Jul	181	<17 Jun	15 Jul	27 Jun	21 Aug	27 Jul	21 Aug
2002	13 Jul	5.2	50	11 Jul	238	<6 Jun	7 Jul	8 Jul	9 Aug	28 Jul	26 Aug
2003	20 Jul	6.9	150	19 Jul	316	<17 Jun	10 Jul	20 Jun	11 Aug	10 Jul	>26 Aug
2004	20 Jul	6.6	97	19 Jul	213	11 Jun	29 Jul	9 Jul	11 Aug	29 Jul	>24 Aug
2005	20 Jul	7.2	75	20 Jul	286	<15 Jun	28 Jul	8 Jul	16 Aug	31 Jul	22 Aug
2006	18 Jul	6.1	160	16 Jul	289	<13 Jun	28 Jul	7 Jul	4 Aug	31 Jul	>22 Aug
2007	24 Jul	6.1	58	21 Jul	249	<16 Jun	9 Jul	13 Jul	10 Aug	10 Aug	>26 Aug
2008	19 Jul	6.1	99	19 Jul	235	<15 Jun	10 Jul	8 Jul	6 Aug	31 Jul	>23 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 49. Frequency distribution of hatch dates for thick-billed murres at Buldir Island, Alaska.

Julian	No. nests hatching on Julian date																				
Date	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
183	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--
184	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--	--	--
185	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--
186	--	--	--	--	1	4	1	--	1	--	3	--	--	--	--	--	--	--	--	--	--
187	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
188	--	--	25	--	--	--	--	--	2	16	--	--	--	--	2	1	--	--	1	--	--
189	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	2	9	--	--
190	--	--	--	--	--	--	7	--	59	--	--	--	--	--	--	--	2	3	--	--	2
191	--	--	--	--	--	28	--	--	--	1	--	--	17	--	1	--	--	--	2	--	--
192	2	--	--	--	11	--	--	10	3	73	12	--	--	--	24	--	--	1	4	--	--
193	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--
194	1	--	11	--	--	1	2	1	--	1	--	--	1	--	2	33	22	4	4	2	4
195	--	1	7	--	--	--	--	1	--	5	--	--	1	--	--	--	1	10	1	--	23
196	6	--	1	3	13	38	7	45	60	49	29	--	6	--	10	--	--	1	--	--	--
197	7	--	1	7	--	--	--	--	--	--	--	6	--	--	--	--	1	1	44	--	--
198	8	14	9	4	--	--	--	3	--	--	--	--	--	--	--	--	3	--	--	7	--
199	--	--	--	--	5	1	--	2	3	--	--	--	--	--	--	--	--	--	--	--	2
200	--	6	3	--	--	--	17	65	38	--	--	1	--	--	9	67	33	13	--	--	5
201	--	--	--	--	5	--	--	--	--	--	3	--	7	--	--	--	--	21	--	--	34
202	3	--	--	11	--	10	--	1	1	23	--	17	--	--	--	--	--	--	46	23	--
203	--	1	--	--	--	--	--	3	--	--	--	--	1	--	--	--	1	--	--	--	--
204	4	--	1	--	--	--	--	31	2	--	--	--	--	--	1	1	18	--	1	--	2
205	2	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	2	--	--	--
206	--	16	--	--	--	--	4	--	--	--	6	--	--	--	--	24	--	12	11	1	8
207	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	10
208	--	--	--	8	--	5	--	--	2	6	--	3	--	--	--	--	--	--	--	--	--
209	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	2	--	--
210	1	--	1	--	--	--	2	--	--	--	3	--	1	--	--	--	6	--	--	--	--
211	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
212	--	--	--	--	--	2	--	2	1	1	--	--	--	--	--	14	--	2	4	6	1
213	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5
214	--	2	--	--	--	--	--	5	--	--	--	2	--	--	--	--	3	--	--	--	--
215	1		1	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
216	--	--	--	--	4	--	--	--	1	--	--	--	--	--	--	--	--	--	5	3	--
217	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	1	--	--	--	--
218	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	2	--	--	--	1
219	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2
220	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	1	--	--	--	--
221	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
222	--	1	--	--	--	--	--	1	--	--	--	--	--	--	--	--	1	1	--	2	--
223	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	4	--	--	--	--	--
224	--	--	--	--	--	--	1	--	--	--	--	1	--	--	--	--	--	--	--	--	--
225	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
226	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
227	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
228	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--
229	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
230	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n	37	42	60	33	39	89	44	178	175	179	56	31	36	0	50	150	95	75	160	58	99

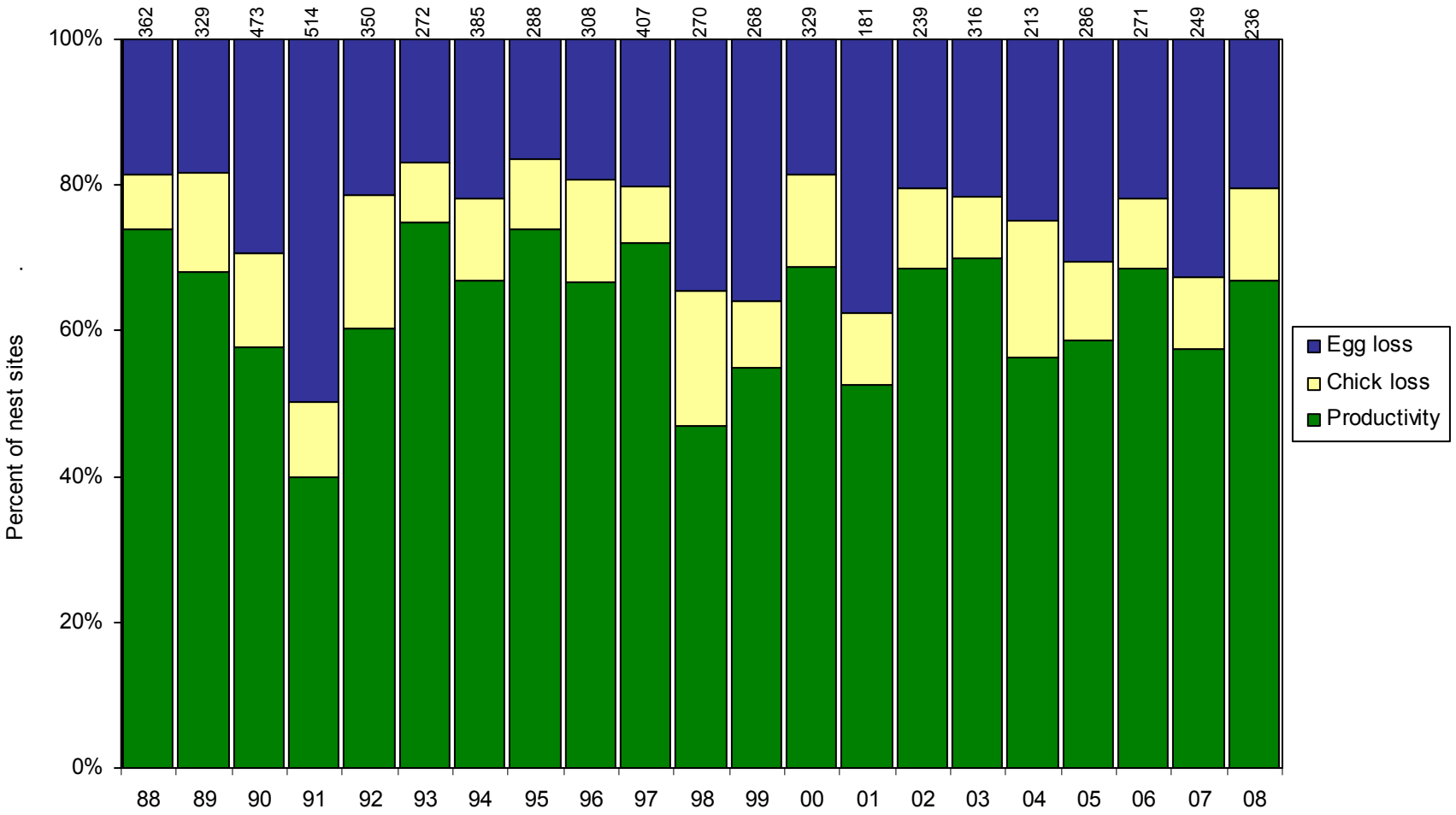

Figure 31. Reproductive performance of thick-billed murres at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick. The number of known fate eggs monitored are given above each bar.

Table 50. Reproductive performance of thick-billed murres on index plots at Buldir Island, Alaska.

Year	no. sites w/ egg (A)	no. sites w/ chick (B)	no. sites w/ fledged chick (C)	hatching success (B/A)	fledging success (C/B)	reproductive success (C/A)
1988	362	295	268	0.80	0.90	0.73
1989	329	269	224	0.82	0.83	0.68
1990	473	334	273	0.82	0.94	0.76
1991	514	258	205	0.79	0.80	0.64
1992	350	275	211	0.79	0.77	0.60
1993	272	226	204	0.83	0.90	0.75
1994	385	301	258	0.78	0.86	0.67
1995	288	241	213	0.84	0.88	0.74
1996	308	249	205	0.81	0.82	0.67
1997	407	325	293	0.80	0.90	0.72
1998	270	177	127	0.65	0.71	0.47
1999	268	172	147	0.64	0.85	0.55
2000	329	268	226	0.81	0.84	0.69
2001	181	113	95	0.62	0.84	0.52
2002	239	190	164	0.79	0.86	0.69
2003	316	248	221	0.78	0.89	0.70
2004	213	160	120	0.75	0.75	0.56
2005	286	199	168	0.70	0.84	0.59
2006	271	212	186	0.78	0.86	0.67
2007	249	168	143	0.67	0.85	0.57
2008	235	188	158	0.80	0.84	0.67

Table 51. Reproductive performance of thick-billed murres on index plots at Buldir Island, Alaska, in 2008.

	Plot												
Parameter	36A	36B	37R	37L	39A	39B	40A	40B	45	Total	n	mean	SD
No. of sites with an egg (A)	13	19	27	23	23	19	31	58	22	235			
No. of sites with chick (B)	12	18	23	19	21	8	26	47	14	188			
No. of sites where chick fledged (C)	11	14	19	19	21	6	18	38	12	158			
Hatching success (B/A)	0.92	0.95	0.85	0.83	0.91	0.42	0.84	0.81	0.64	0.80	9	0.80	0.17
Fledging success (C/B)	0.92	0.78	0.83	1.0	1.0	0.75	0..69	0.81	0.86	0.84	9	0.85	0.11
Reproductive success (C/A)	0.85	0.74	0.70	0.83	0.91	0.32	0.58	0.66	0.55	0.67	9	0.68	0.18

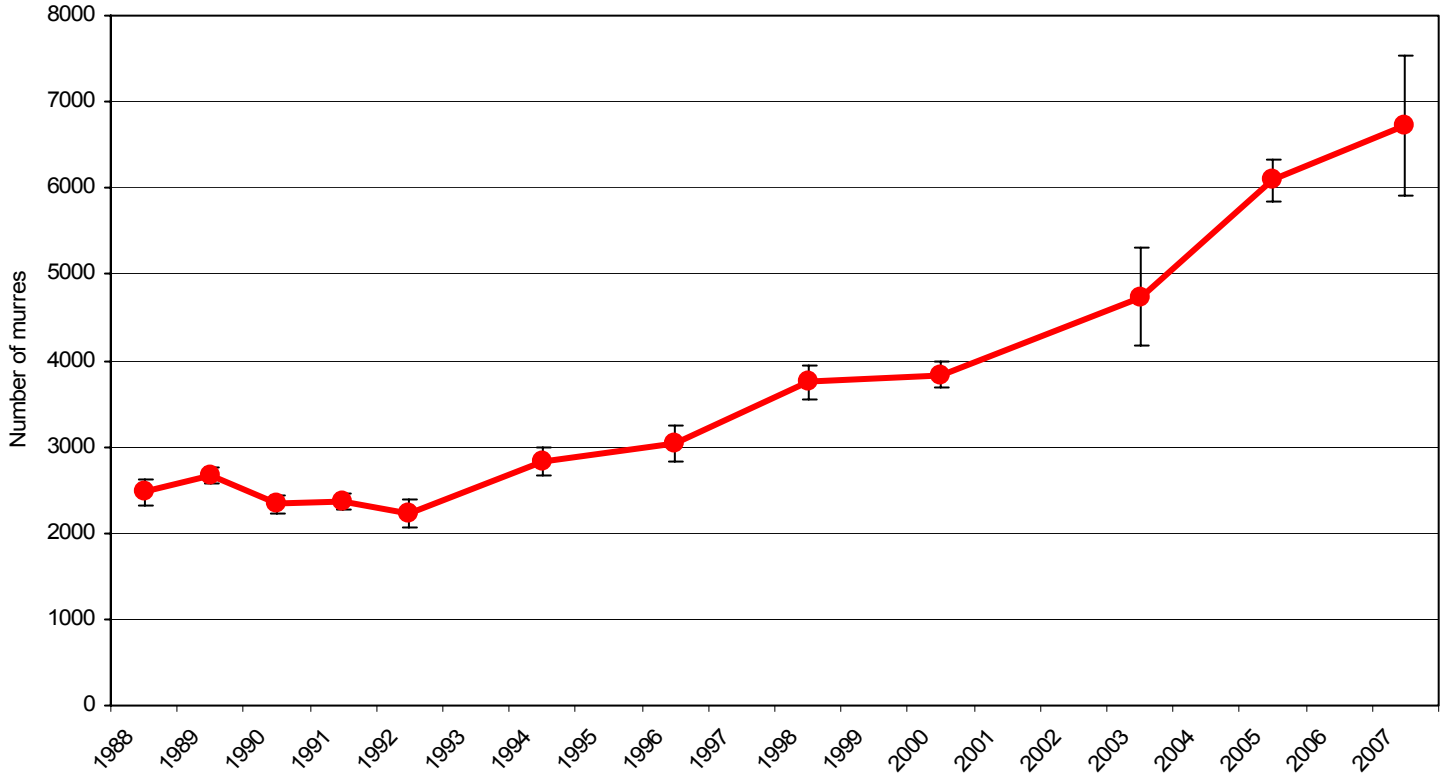

Figure 32. Counts of murres on index plots at Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

Table 52. 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	2007
1	2224	2637	2306	2245	2127	3046	3177	3575	3787	4362	5768	5537
2	2487	2529	2379	2504	2195	2662	2863	3970	3791	4544	5958	6450
3	2602	2798	2488	2354	2476	2758	3064	3812	3704	4482	6397	6743
4	2464	2704	2237	2350	2135	2837	2775	3848	4086	5572	6075	7241
5	2577	2692	2254	2386	--	--	3283	3522	3796	--	6268	7658
mean	2470.8	2672.0	2332.8	2367.8	2233.3	2825.8	3032.4	3745.4	3832.8	4740.0	6093.2	6725.8
n	5	5	5	5	4	4	5	5	5	4	5	5
SD	149.8	98.7	102.9	92.8	164.7	163.3	211.9	190.0	146.5	559.8	248.6	809.9
first survey	5 Jul	26 Jun	30 Jun	4 Jul	3 Jul	3 Jul	27 Jun	4 Jul	27 Jun	9 Jul	23 Jun	25 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	15 Jul

Table 53. Murre population counts on index plots at Buldir Island, Alaska in 2007.

	Count							
Plot (segment)	1	2	3	4	5	mean	SD	max.
Spike (Dip)								
1	0	0	0	0	0	0.0	0.0	0
2	7	11	0	0	0	3.6	5.1	11
3	155	183	181	159	198	175.2	17.9	198
4	76	81	59	58	61	67.0	10.7	81
5	129	151	151	151	166	149.6	13.2	166
6	129	114	116	138	167	132.8	21.5	167
7	137	125	136	111	139	129.6	11.7	139
8	243	230	229	244	230	235.2	7.6	244
9	0	0	0	0	0	0.0	0.0	0
10	0	0	0	0	0	0.0	0.0	0
11	104	145	134	123	137	128.6	15.9	145
12	729	833	805	773	789	785.8	38.7	833
13	190	235	205	260	242	226.4	28.4	260
14	23	26	30	36	26	28.2	5.0	36
A	235	462	707	745	774	584.6	231.2	774
B	393	396	709	689	669	571.2	161.9	709
C	467	601	835	1082	1059	808.8	272.9	1082
Total	3017	3593	4297	4569	4657	4027	842	4845
Kittiwake Lane								
15(1)	0	0	0	0	0	0.0	0.0	0
16(2)	623	798	573	765	754	702.6	98.4	798
17(3)	348	338	341	307	401	347.0	34.0	401
18(4)	233	248	185	229	246	228.2	25.5	248
19(5)	357	399	371	327	346	360.0	27.1	399
20(6)	285	320	271	260	380	303.2	48.5	380
21(7)	133	154	152	171	201	162.2	25.5	201
22(8)	111	127	111	133	165	129.4	22.2	165
23(9)	33	43	46	41	41	40.8	4.8	46
24(10)	0	0	0	0	0	0.0	0.0	0
25(11)	0	0	0	0	0	0.0	0.0	0
26(12)	40	44	40	41	52	43.4	5.1	52
27(13)	11	9	14	13	14	12.2	2.2	14
28(14)	276	314	267	309	325	298.2	25.3	325
29(15)	70	63	75	76	76	72.0	5.6	76
KWLE[a]	1204	1384	1099	1301	1401	1277.8	126.9	1401
KWLW	1316	1473	1347	1371	1600	1421.4	115.9	1600
KWL Total	2520	2857	2446	2672	3001	2699.2	230.7	3001
Index Plot Total[b]	5537	6450	6743	7241	7658	6725.8	809.9	7658

[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.

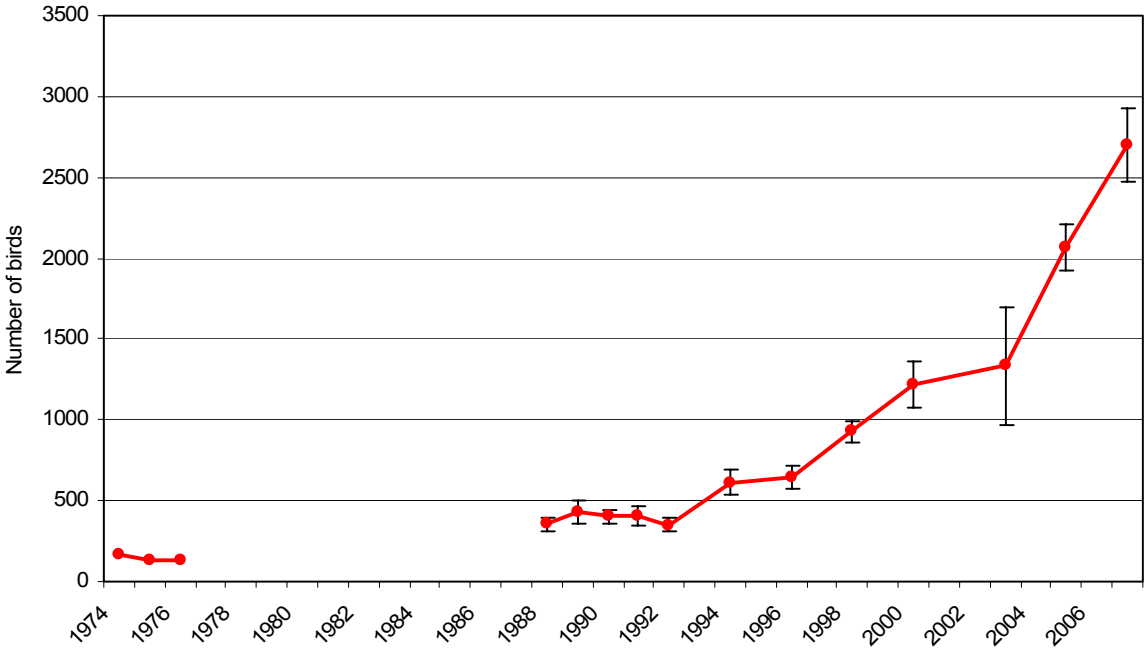

Figure 33. Counts of murres at Kittiwake lane, Buldir Island, Alaska. Error bars represent the standard deviation of replicate counts in each year.

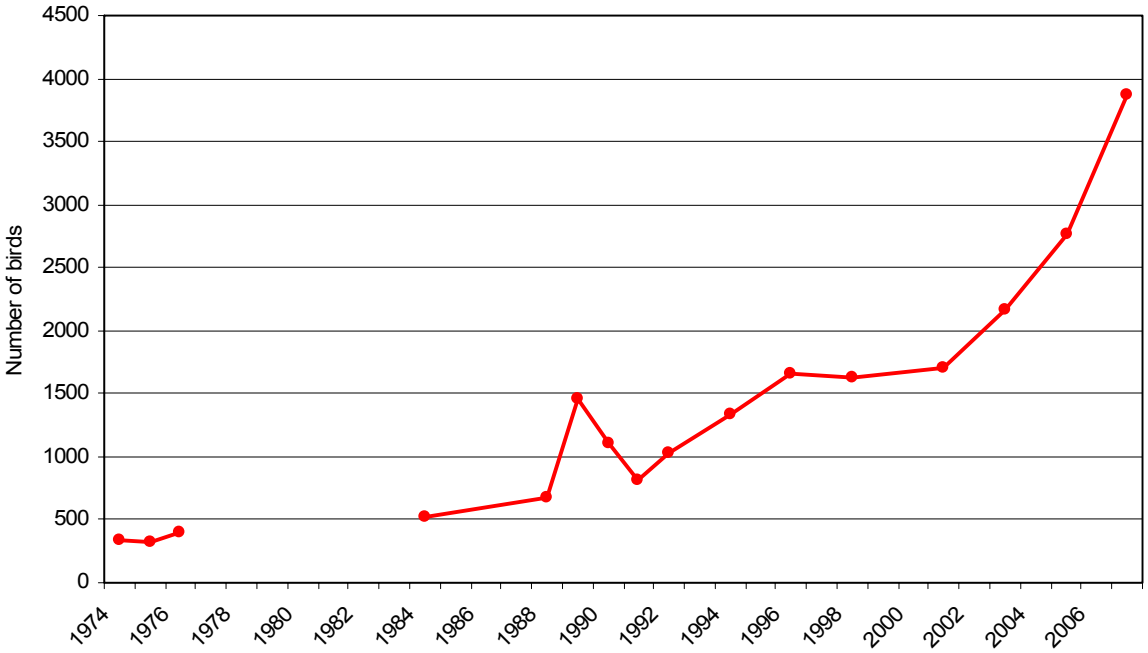

Figure 34. Counts of murres at Middle Rock, Buldir Island, Alaska. This area is not included in the island-wide index plot counts.

Table 54. 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	2007
15 (1)	--	20	--	73	70	93	65	73	85	88	163	116	146	220	0
16 (2)	--	43	--	99	167	144	126	119	195	158	370	407	343	412	703
17 (3)	--	37	--	113	125	112	116	78	145	136	101	230	273	375	347
18 (4)	--	35	--	71	67	55	85	57	121	149	94	145	114	176	228
19 (5)	--	0	--	0	0	0	0	0	0	0	31	81	119	211	360
20 (6)	--	0	--	0	0	0	13	22	42	46	88	135	99	181	303
21 (7)	--	0	--	0	0	0	0	0	0	0	0	0	16	95	162
22 (8)	--	0	--	0	0	0	0	0	0	0	0	0	11	94	129
23 (9)	--	0	--	0	0	0	0	0	0	0	0	0	0	6	41
24(10)	--	0	--	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	0
26(12)	--	0	--	0	0	0	0	0	0	0	0	0	0	13	43
27(13)	--	0	--	0	0	0	0	0	0	0	0	0	0	4	12
28(14)	--	0	--	0	0	0	0	0	24	67	82	103	190	236	298
29(15)	--	0	--	0	0	0	0	0	0	0	0	0	21	42	72
Total	173	135	135	355	429	404	406	349	612	645	928	1217	1332	2066	2699
SD[a]	--	--	--	38.5	76	40.3	56.4	43.0	79.0	66.3	62.3	140.9	366.5	139.0	230.7
n	1	1	1	6	5	5	5	4	4	5	5	5	4	5	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	25 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	15 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 55. Murre counts by sub-area at Middle Rock, Buldir Island, Alaska.

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

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

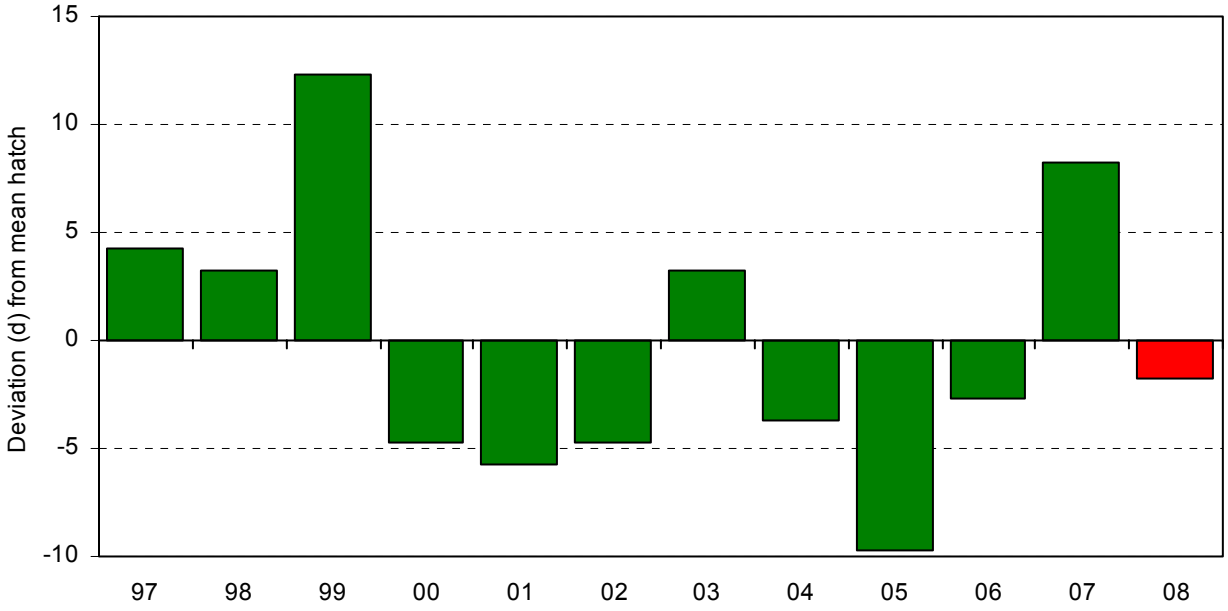

Figure 35. Yearly hatch date deviation (from the 1997-2007 average of 17 July) for common murres at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

Table 56. Breeding chronology dates for common murres at Buldir Island, Alaska.

Year	mean hatch	SD	*n*[a]	median hatch	mean jump	SD	*n*[a]	median jump	no. nests monitored[b]	first hatch	last hatch	first jump	last jump
1997	22-Jul	13.3	8	18-Jul	6-Aug	6.4	11	11-Aug	18	11-Jul	6-Aug	6-Aug	16-Aug
1998	21-Jul	9.5	4	18-Jul	16-Aug	6	6	17-Aug	11	15-Jul	4-Aug	4-Aug	19-Aug
1999	30-Jul	4.2	2	--	--	--	--	>14 Aug	8	27-Jul	2-Aug	>14 Aug	>14 Aug
2000	14-Jul	7.8	15	9-Jul	6-Aug	10.6	12	7-Aug	22	6-Jul	2-Aug	24-Jul	21-Aug
2001	12-Jul	1.7	3	13-Jul	9-Aug	5	3	6-Aug	7	10-Jul	13-Jul	6-Aug	15-Aug
2002	13-Jul	5.1	7	11-Jul	3-Aug	6.5	5	5-Aug	10	7-Jul	23-Jul	23-Jul	9-Aug
2003	21-Jul	8.3	7	19-Jul	13-Aug	6.1	6	11-Aug	15	13-Jul	31-Jul	6-Aug	24-Aug
2004	15-Jul	3.1	6	13-Jul	3-Aug	8.1	3	29-Jul	16	13-Jul	2-Aug	29-Jul	22-Aug
2005	8-Jul	--	1	8-Jul	16-Aug	--	1	16-Aug	8	8-Jul	19-Jul	25-Jul	16-Aug
2006	15-Jul	5.8	5	12-Jul	5-Aug	7.1	2	10-Aug	16	11-Jul	25-Jul	31-Jul	14-Aug
2007	26-Jul	12.7	2	26-Jul	13-Aug	2.9	3	15-Aug	10	17-Jul	4-Aug	10-Aug	10-Aug
2008	17-Jul	--	1	17-Jul	8-Aug	3.4	4	9-Aug	7	12-Jul	18-Jul	30-Jul	13-Aug

[a] Sample size is for the calculation of mean and median hatch and jump dates. These dates are a subsample for which we have observations ≤ 7 days apart from egg to chick or chick to nothing.

[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 57. Frequency distribution of hatch dates for common murres at Buldir Island, Alaska.

Julian	No. nests hatching on Julian date									
Date	1995	1998	1999	2000	2003	2004	2005	2006	2007	2008
188	--	--	--	1	--	--	--	--	--	--
189	--	--	--	--	--	--	1	--	--	--
190	--	--	--	--	--	--	--	--	--	--
191	--	--	--	8	--	--	--	--	--	--
192	--	--	--	--	--	--	--	--	--	--
193	--	--	--	--	--	--	--	4	--	--
194	--	--	--	--	3	4	--	--	--	2
195	--	--	--	--	--	--	--	--	--	--
196	1	2	--	2	--	--	--	--	--	--
197	--	--	--	--	--	--	--	--	--	--
198	--	--	--	--	--	--	--	--	1	--
199	--	--	--	--	--	--	--	--	--	1
200	1	--	--	--	1	2	--	--	--	1
201	--	1	--	1	--	--	--	--	--	--
202	--	--	--	--	--	--	--	--	--	--
203	--	--	--	--	--	--	--	--	--	--
204	1	--	--	--	--	--	--	--	--	--
205	--	--	--	--	--	--	--	--	--	--
206	--	1	--	2	1	--	--	1	--	--
207	--	--	--	--	--	--	--	--	--	--
208	--	--	1	--	--	--	--	--	--	--
209	--	--	--	--	--	--	--	--	--	--
210	--	--	--	--	--	--	--	--	--	--
211	--	--	--	--	--	--	--	--	--	--
212	--	--	--	--	2	--	--	--	--	--
213	--	--	--	--	--	--	--	--	--	--
214	--	--	1	--	--	--	--	--	--	--
215	--	--	--	1	--	--	--	--	--	--
216	--	--	--	--	--	--	--	--	1	--
n	3	4	2	15	7	6	1	5	2	4

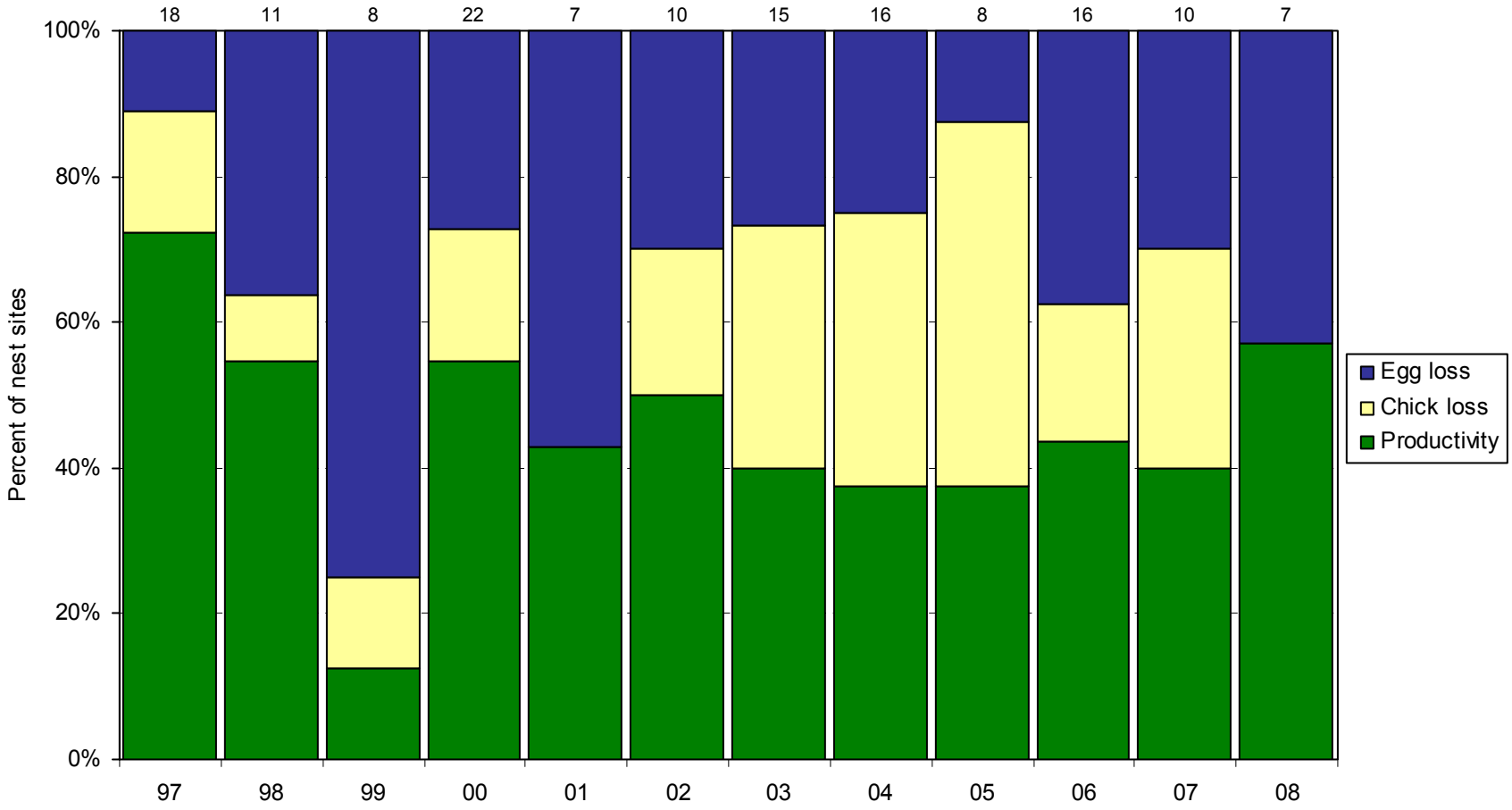

Figure 36. Reproductive performance of common murres at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick. The number of known fate eggs monitored are given above each bar.

Table 58. Reproductive performance of common murres at Buldir Island, Alaska.

Parameter	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. sites w/ egg (A)	18	11	8	22	7	10	15	16	8	16	10	7
No. sites w/ chick (B)	16	7	2	16	3	7	11	12	7	10	7	4
Sites where chick fledged (C)	13	6	1	12	3	5	6	6	3	7	4	4
Hatching success (B/A)	0.89	0.64	0.25	0.73	0.43	0.7	0.73	0.75	0.88	0.63	0.7	0.57
Fledging success (C/B)	0.81	0.86	0.5	0.75	1.0	0.71	0.55	0.5	0.43	0.7	0.57	1.0
Reproductive success (C/A)	0.72	0.55	0.13	0.55	0.43	0.5	0.4	0.38	0.38	0.44	0.4	0.57

Table 59. Counts of pigeon guillemots at Buldir Island, Alaska.

Coastline section	1972[a]	1979	1997	1998	1999	2000	2001	2002	2005[b]	2006	2007	2008
A-B	--	15	13	8	18	5	11	9	5	1	6	4
B-C	--	9	10	3	15	4	4	15	4	1	19	1
C-D	--	19	1	6	11	5	7	3	-	7	6	2
D-E	--	8	11	8	9	2	7	9	-	0	6	1
E-F	--	8	20	6	4	6	7	14	-	9	5	10
F-A	--	14	12	5	18	7	6	14	3[c]	7	11	3
Total	60	73	67	36	75	29	42	64	12	25	43	21
Date		24 Jun	3 Jun	13 Jun	1 Jul	20 Jun	5 Jun	2 Jul	10 Jun	7 Jun	2 Jun	3 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.

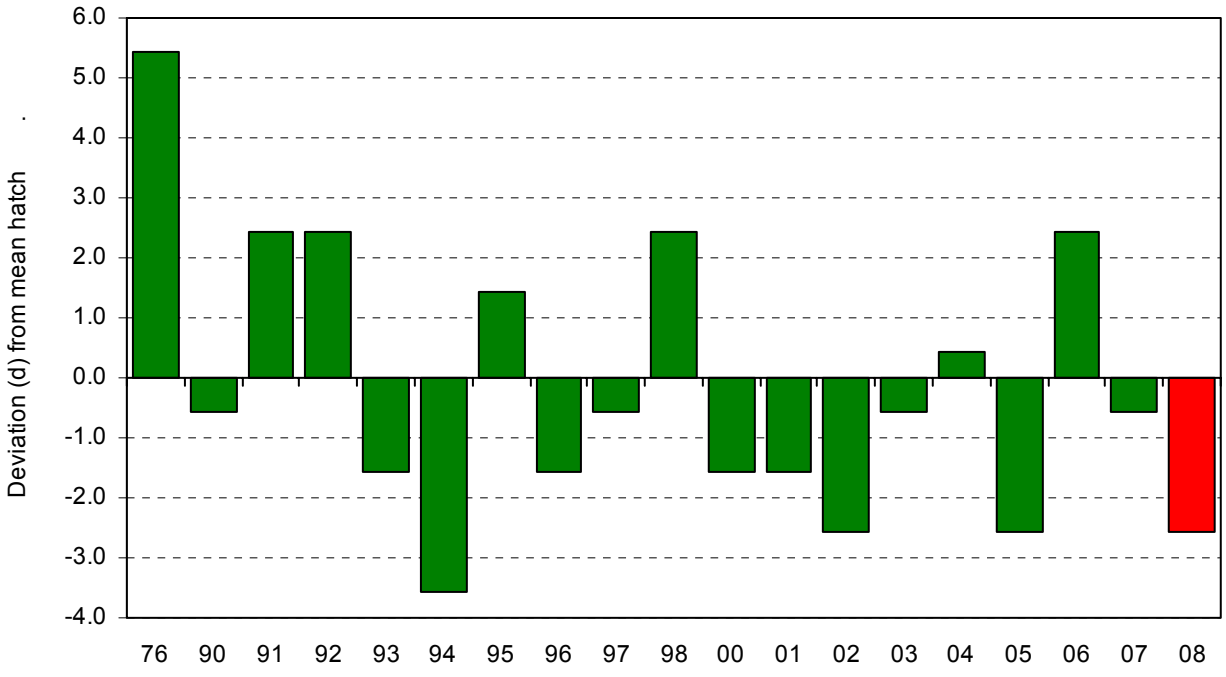

Figure 37. Yearly hatch date deviation (from the average of 28 June, excluding 2008) for least auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier, positive numbers indicate hatch dates later.

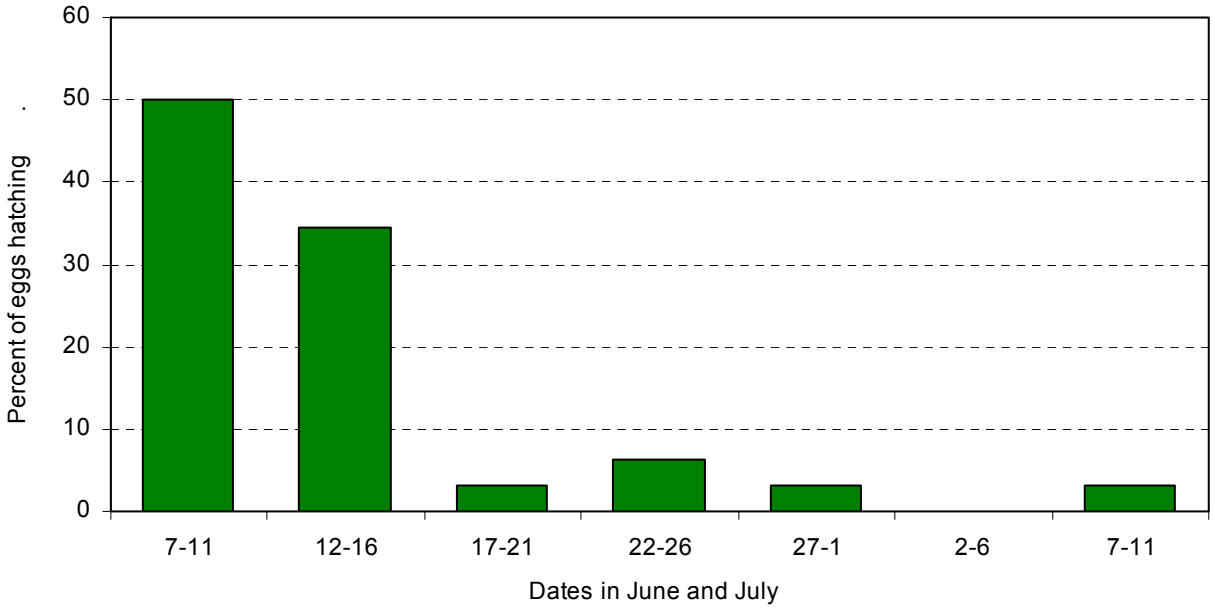

Figure 38. Hatching chronology of least auklets at Buldir Island, Alaska in 2008 (*n*=31).

Table 60. Breeding chronology dates for least auklets at Buldir Island, Alaska.

Year	mean hatch	SD	n[b]	median hatch	mean fledge	SD	n[c]	median fledge	no. nests monitored[d]	first hatch	last hatch	first fledge	last fledge
1976[a]	2 Jul	3.6	15	2 Jul	--	--	--	--	15	27 Jun	10 Jun	--	--
1990	27 Jun	6.3	10	1Jul	--	--	23	28 Jul	61	21 Jun	9 Jul	19 Jul	>1 Aug
1991	30 Jun	3.4	9	3 Jul	--	--	50	1 Aug	81	21 Jun	12 Jul	25 Jul	6 Aug
1992	29 Jun	8.0	12	23 Jun	--	--	43	26 Jul	89	16 Jun	13 Jun	13 Jul	5 Aug
1993	26 Jun	5.3	8	24 Jun	25 Jul	4.0	22	27 Jul	44	16 Jun	9 Jul	19 Jul	27 Jul
1994	24 Jun	4.3	26	24 Jun	21 Jul	5.1	26	23 Jul	64	19 Jun	15 Jul	15 Jul	1 Aug
1995	29 Jun	5.2	49	26 Jun	29 Jul	5.2	45	30 Jul	64	21 Jun	15 Jul	21 Jul	10 Aug
1996	25 Jun	6.5	23	22 Jun	25 Jul	5.7	34	26 Jul	57	16 Jun	12 Jul	12 Jul	1 Aug
1997	27 Jun	5.1	35	25 Jun	27 Jul	5.3	50	29 Jul	84	20 Jun	15 Jul	16 Jul	8 Aug
1998	30 Jun	5.5	44	29 Jun	28 Jul	5.3	34	29 Jul	76	19 Jun	9 Jul	19 Jul	8 Aug
1999	--	not monitored			--	--	--	--	--	26 Jun	--	27 Jul	14 Aug
2000	25 Jun	7.2	30	23 Jun	25 Jul	4.8	33	22 Jul	69	18 Jun	8 Jul	17 Jul	1 Aug
2001	26 Jun	5.0	20	29 Jun	27 Jul	4.7	34	29 Jul	65	21 Jun	3 Jul	20 Jul	8 Aug
2002	25 Jun	5.0	13	27 Jun	25 Jul	4.9	30	27 Jul	50	17 Jun	10 Jul	14 Jul	8 Aug
2003	27 Jun	5.3	14	26 Jun	26 Jul	3.9	28	27 Jul	83	13 Jun	9 Jul	21 Jul	1 Aug
2004	28 Jun	3.2	22	27 Jun	27 Jul	2.9	18	27 Jul	81	19 Jun	9 Jul	23 Jul	5 Aug
2005	25 Jun	5.8	33	25 Jun	24 Jul	5.6	40	21 Jul	73	11 Jun	11 Jul	16 Jul	6 Aug
2006	30 Jun	5.3	34	27 Jun	29 Jul	6.5	63	27 Jul	101	18 Jun	11 Jul	16 Jul	16 Aug
2007	27 Jun	7.8	24	25 Jun	24 Jul	4.2	24	23 Jul	68	15 Jun	18 Jul	14 Jul	2 Aug
2008	24 Jun	6.5	31	23 Jun	24 Jul	6.0	47	23 Jul	67	20 Jun	17 Jul	17 Jul	16 Aug

[a] Hatch dates in 1976 were assumed to be the midpoint of the interval reported in Knudtson and Byrd (1982).

[b] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations $\leq$ 7 day from egg to chick in all years except 1990 when $\leq$ 10 days egg to chick.

[c] Sample size is for the calculation of mean and median fledge dates.

[d] The total used for estimating the remaining parameters. These dates might contain observations > 7 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).

Table 61. Frequency distribution of hatch dates for least auklets at Buldir Island, Alaska. Intervals from egg to chick ≤7 days for all years except 1990 when ≤ 10 days. Data were not collected in 1999.

Julian	No. nests hatching on Julian date																		
Date	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008
166	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
167	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--
168	--	--	--	--	--	--	--	3	--	--	--	--	2	--	--	--	--	--	--
169	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--
170	--	--	--	--	--	6	--	--	--	2	6	--	--	--	--	--	--	--	--
171	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	5	--	--	--
172	--	4	--	--	--	--	3	--	7	--	--	1	--	--	--	--	--	9	16
173	--	--	--	--	--	--	--	--	--	--	--	11	--	--	2	2	--	--	--
174	--	--	--	--	--	--	1	12	--	9	2	--	4	7	--	--	4	1	--
175	--	--	--	7	7	15	1	--	--	--	8	--	--	--	--	1	--	--	1
176	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	13	--	6	10
177	--	--	--	--	--	--	27	--	--	--	1	--	--	--	--	--	--	--	--
178	--	--	4	--	--	2	--	--	--	--	1	--	5	--	13	--	13	--	--
179	--	--	--	--	--	--	--	--	--	--	5	7	--	--	--	1	--	--	--
180	--	--	--	--	--	1	1	4	1	19	--	--	--	4	--	3	--	--	--
181	--	--	--	--	--	1	--	--	--	--	--	--	--	--	1	--	--	--	--
182	3	5	--	--	--	--	--	--	8	1	--	--	1	--	5	--	7	4	1
183	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
184	--	--	4	--	--	--	11	--	1	1	5	1	--	--	--	--	--	--	--
185	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	1
186	--	--	2	--	--	--	--	3	3	6	--	--	1	--	--	4	6	1	--
187	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
188	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--
189	--	--	--	4	--	--	--	--	--	1	--	--	--	--	--	--	1	--	--
190	--	1	--	--	1	1	4	--	--	5	1	--	--	1	--	--	--	--	--
191	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	1	--
192	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	--	--
193	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
194	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
195	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
196	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
197	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
198	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
199	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
201	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
202	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
203	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
204	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
205	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n	3	10	10	12	8	26	49	23	35	44	30	20	13	14	22	33	34	24	32

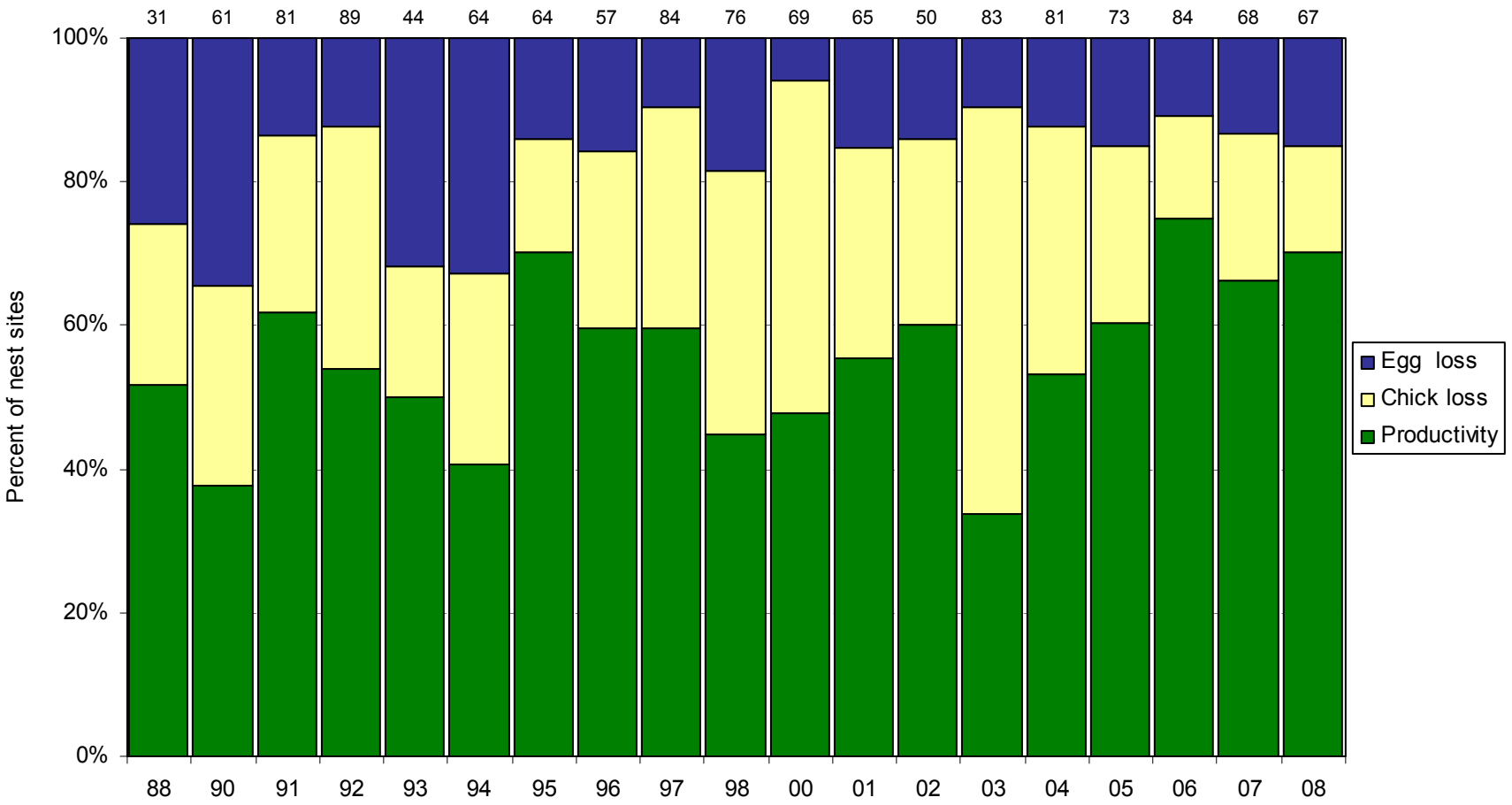

Figure 39. Reproductive performance of least auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick. The number of known fate eggs monitored are given above each bar.

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

Parameter[a]	1976	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
No. eggs found (A)	28	31	60	61	81	89	44	64	64	57	84
No. eggs lost to:											
disappearance	--	6	18	18	9	9	9	14	3	6	7
abandonment	--	0	2	2	0	1	3	6	3	1	0
breakage	--	2	3	1	2	1	2	1	3	2	1
No. eggs hatched (B)	19	23	37	40	70	78	30	43	55	48	76
No. chicks lost to:											
disappearance	--	5	--	16	14	26	4	10	9	7	22
death	--	2	--	1	6	4	4	7	1	7	3
No. chicks fledged (C)[b]	--	16	--	23	50	48	22	26	45	34	50
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
Fledging success (C/B)	--	0.7	--	0.58	0.71	0.61	0.73	0.60	0.81	0.71	0.66
Reproductive success (C/A)	--	0.52	--	0.38	0.62	0.54	0.50	0.41	0.70	0.60	0.60
Productivity (hs x fs)	--	0.52	--	0.38	0.61	0.54	0.50	0.40	0.70	0.60	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.

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

Parameter[a]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. eggs found (A)	76	0	69	65	50	83	81	73	84	68	67
No. eggs lost to:											
disappearance	8	--	4	5	4	2	3	4	10	3	6
abandonment	6	--	0	5	3	4	4	7	4	6	4
breakage	0	--	0	0	0	2	3	0	0	0	0
No. eggs hatched (B)	62	--	65	55	43	75	71	62	75	59	57
No. chicks lost to:											
disappearance	24	--	26	15	10	39	19	15	10	8	4
death	4	--	6	4	3	8	9	3	2	6	6
No. chicks fledged (C)[b]	34	--	33	36	30	28	43	44	63	45	47
Hatching success (B/A)	0.82	--	0.94	0.85	0.86	0.90	0.88	0.85	0.89	0.87	0.85
Fledging success (C/B)	0.55	--	0.51	0.65	0.70	0.37	0.61	0.71	0.84	0.76	0.83
Reproductive success (C/A)	0.45	--	0.48	0.55	0.60	0.34	0.53	0.60	0.75	0.66	0.70
Productivity (hs x fs)	0.45	--	0.48	0.55	0.60	0.33	0.54	0.60	0.75	0.66	0.70

[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.

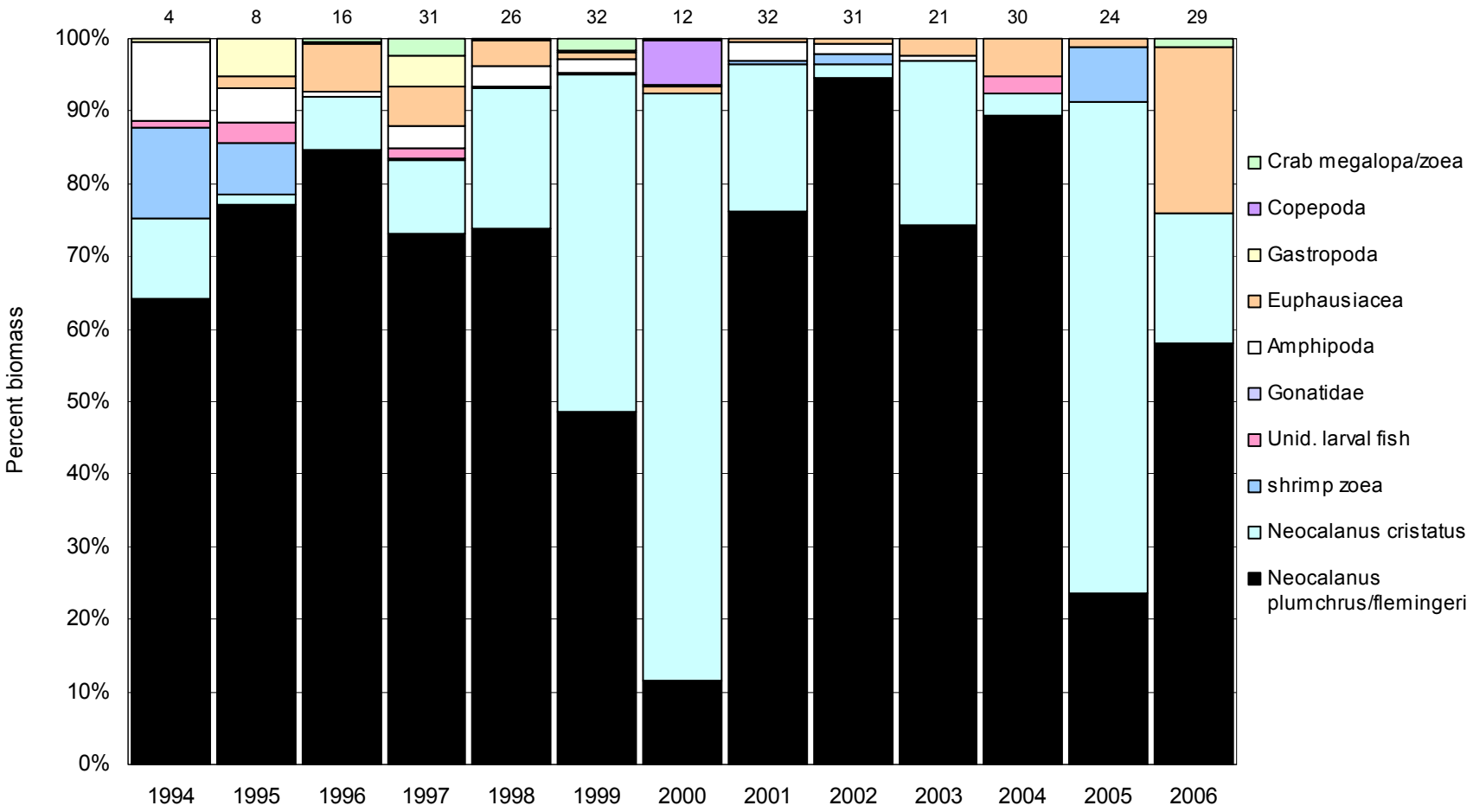

Figure 40. Relative biomass of prey in diets of least auklets at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

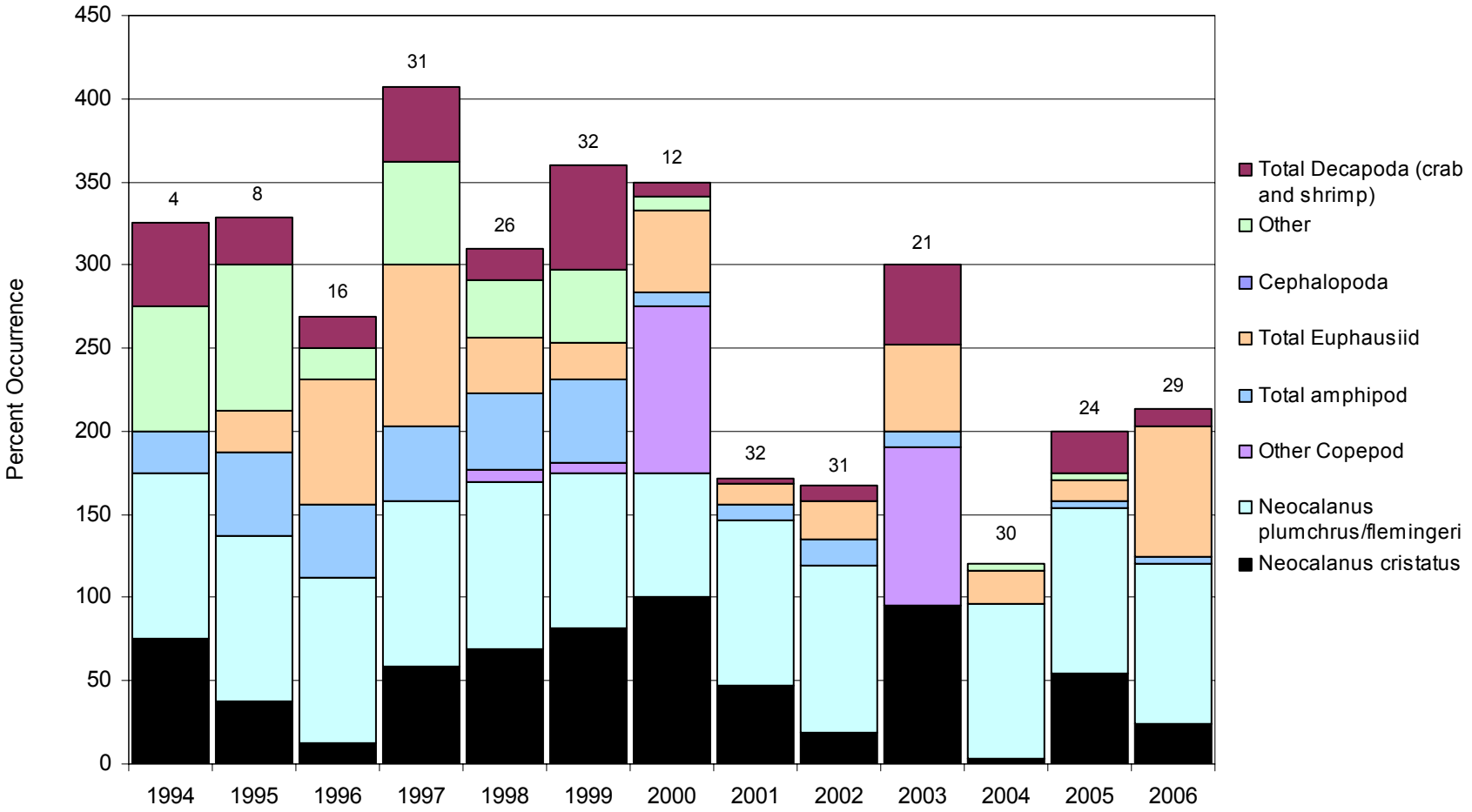

Figure 41. Frequency of occurrence of prey in diets of least auklets at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 63. 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	2000	2001	2002	2003	2004	2005	2006
No. samples	4	8	16	31	26	32	12	32	31	21	30	24	29
Total mass (g)	12.1	18.2	46.3	97.6	87.1	146.1	40.7	27.6	25.7	34.5	20.5	59.3	12.1
Gonatidae	--	--	--	--	--	0.1	--	--	--	--	--	--	--
Gastropoda													
Unid. snail	0.6	--	--	--	--	--	--	--	--	--	--	--	--
Limacina helicina	--	--	--	--	0.2	--	--	--	--	--	--	--	--
Pteropoda	--	5.3	0.3	4.4	--	0.3	.1	--	--	--	--	.12	--
Copepoda													
Neocalanus plumchrus/flemingeri	64.2	77.1	84.5	73.0	73.9	48.7	11.5	76.3	94.7	74.3	89.5	23.5	58.0
N. cristatus	11.1	1.5	7.2	10.2	19.5	46.3	80.9	20.2	1.7	22.7	3.1	67.6	17.9
N. spp.	--	--	--	--	--	--	5.9	--	--	--	--	--	--
Calanus marshallae	--	--	--	--	<0.1	--	.38	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	--	--	--	--	--	--
Pachyptilus pacificus	--	--	--	--	--	<0.1	--	--	--	--	--	--	--
Pareuchaeta birostrata	--	--	--	--	--	<0.1	--	--	--	--	--	--	--
Unid. Copepod	--	--	--	--	--	--	--	--	--	--	--	--	--
Amphipoda													
Hyperiidea													
Hyperoche medusarum	--	3.6	0.1	--	--	--	--	--	.01	--	--	--	--
Parathemisto pacifica	7.5	1.3	0.6	1.2	<0.1	0.6	.02	2.67	1.4	--	--	--	.06
Parathemisto spp.	--	--	--	--	--	--	--	--	--	.68	--	--	--
Primno macropa	3.3	--	--	1.8	--	1.1	--	--	.02	.02	--	--	--
Gammaridea													
Erichtonius spp.	--	--	--	--	2.7	--	--	--	--	--	--	--	--
Euphausiacea													
Thysanoessa spp.	--	1.5	6.7	5.4	--	--	--	--	--	.23	--	--	.65
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--	.99	.99
Euphausiid furcilla	--	--	--	--	1.0	0.3	--	--	--	--	--	--	--
Unid. euphausid	--	--	--	--	2.5	0.7	1.02	.37	.75	2.0	5.1	.08	22.4
Decapoda													
Pandalid shrimp	--	--	--	--	--	--	--	.53	1.5	--	--	.33	--
Larval shrimp	--	--	--	--	--	--	--	--	--	--	--	7.3	--
Shrimp zoea	12.4	7.0	0.2	0.4	0.1	0.1	--	--	--	--	--	--	--
Crab zoea	--	--	--	0.3	--	0.1	--	--	--	.04	--	--	--
Crab megalopa	--	--	0.4	1.9	--	--	.25	--	--	.03	--	.05	--
Hippolytidae juvenile	--	--	--	--	--	1.1	--	--	--	--	--	--	--
Atelecyclidae megalopa	--	--	--	--	0.1	0.1	--	--	--	--	--	--	1.1
Paguridae megalopa	--	--	--	--	--	0.3	--	--	--	--	--	--	--
Fish	0.1	2.8	--	1.3	--	0.1	--	--	--	--	2.4	--	--

Table 64. Frequency of occurrence of prey in diets of least auklets at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. samples	4	8	16	31	26	32	12	32	31	21	30	24	29
Gonatidae	--	--	--	--	--	3.1	--	--	--	--	--	--	--
Gastropoda													
Unid. snail	50.0	--	--	--	--	--	--	--	--	--	--	--	--
Limacina helicina	--	--	--	--	34.6	--	--	--	--	--	--	--	--
Pteropoda	--	75.0	18.8	54.8	--	40.6	--	--	--	--	--	4.2	--
Copepoda													
Neocalanus plumchrus/flemingeri	100.0	100.0	100.0	100.0	100.0	93.8	75.0	100.0	100.0	--	93.3	100.0	96.5
N. cristatus	75.0	37.5	12.5	58.1	69.2	81.3	100.0	46.9	19.4	95.2	3.3	54.2	24.1
N. spp.	--	--	--	--	--	--	--	--	--	95.2	--	--	--
Calanus marshallae	--	--	--	--	7.7	--	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	41.7	--	--	--	--	--	--
Pachyptilus pacificus	--	--	--	--	--	3.1	--	--	--	--	--	--	--
Pareuchaeta birostrata	--	--	--	--	--	3.1	--	--	--	--	--	--	--
Unid. copepod	--	--	--	--	--	--	--	--	--	95.2	--	--	--
Amphipoda													
Hyperiidea													
Hyperoche medusarum	--	50.0	12.5	--	--	--	--	--	3.2	--	--	--	--
Parathemisto pacifica	75.0	50.0	31.3	19.4	11.5	31.3	8.3	9.4	9.7	--	--	4.2	3.5
Parathemisto spp.	--	--	--	--	--	--	--	--	--	4.8	--	--	--
Primno macropa	25.0	--	--	25.8	--	18.8	--	--	3.2	4.8	--	--	--
Gammaridea													
Erichitonius spp.	--	--	--	--	34.6	--	--	--	--	--	--	--	--
Euphausiacea													
Thysanoessa spp.	--	25.0	75.0	35.5	--	--	--	--	--	23.8	--	--	3.5
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--	4.2	--
Euphausiid furcilla	--	--	--	--	61.5	6.3	--	--	--	--	--	--	--
Unid. euphausid	--	--	--	--	26.9	21.9	50.0	12.5	22.6	28.6	20.0	8.3	75.9
Decapoda													
Pandalid shrimp	--	--	--	--	--	--	--	--	--	--	--	4.2	--
Larval shrimp	--	--										12.5	--
Shrimp zoea	50.0	25.0	6.3	19.4	19.2	15.6	--	--	--	--	--	--	--
Crab zoea	--	--	--	3.2	--	3.1	--	--	--	42.9	--	--	--
Crab megalopa	--	--	6.3	22.6	--	--	8.3	--	--	4.8	--	8.3	--
Hippolytidae megalopa	--	--	--	--	--	37.5	--	--	--	--	--	--	--
Atelecyclidae megalopa	--	--	--	--	3.8	6.3	--	--	--	--	--	--	10.3
Paguridae megalopa	--	--	--	--	--	6.3	--	--	--	--	--	--	--
Fish	25.0	12.5	--	6.5	3.1	--	--	--	--	3.3	--	--	--

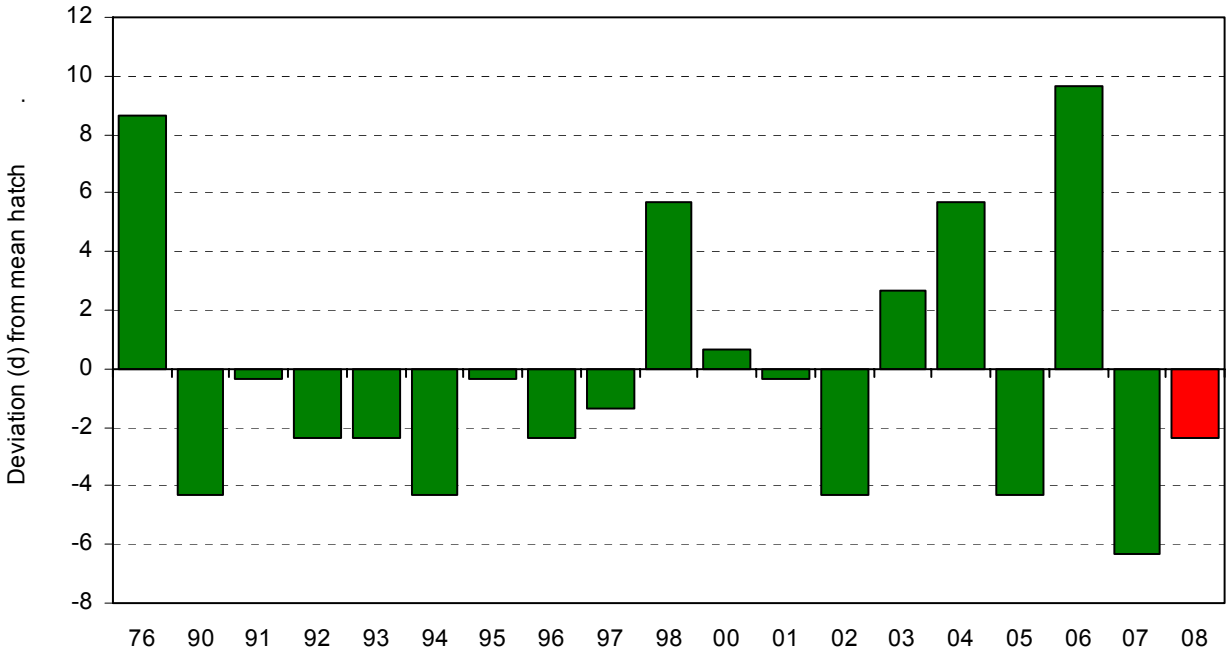

Figure 42. Yearly hatch date deviation (from the average of 29 June, excluding 2008) of crested auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

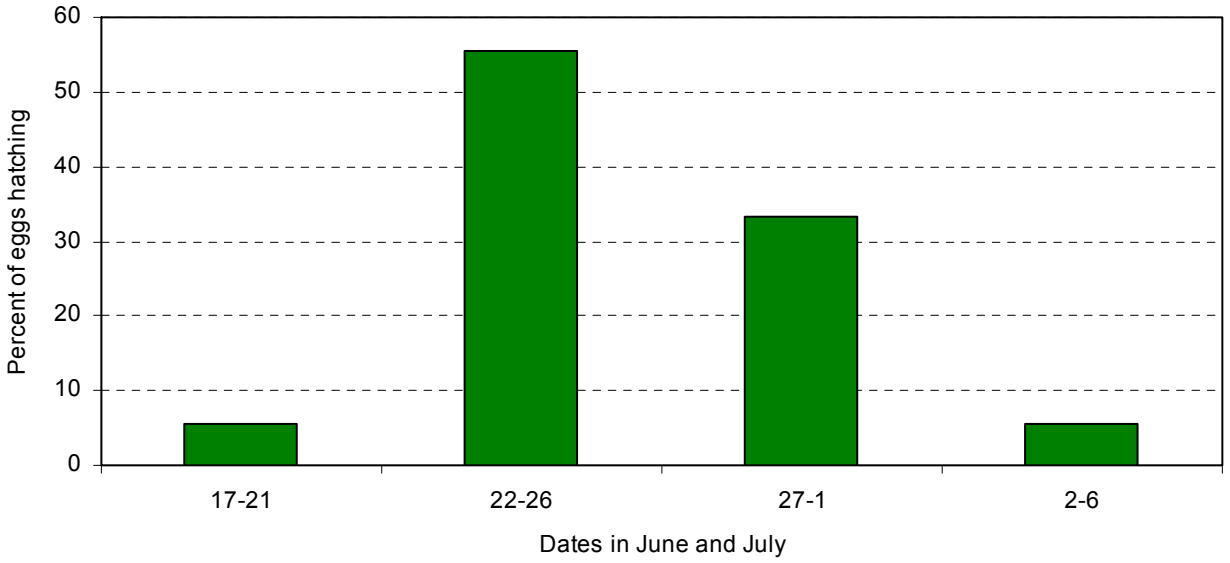

Figure 43. Hatching chronology of crested auklets at Buldir Island, Alaska in 2008 (*n*=36).

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

Year	mean hatch	SD	n[b]	median hatch	mean fledge	SD	n[c]	median fledge	no. nests monitored[d]	first hatch	last hatch	first fledge	last fledge
1976[a]	7 Jul	3.2	36	6 Jul	--	--	--	--	36	2 Jul	14 Jul	--	--
1990	25 Jun	5.1	12	21 Jun	--	--	26	28 Jul	68	21 Jun	19 Jul	19 Jul	>1 Aug
1991	29 Jun	5.2	6	30 Jun	--	--	43	1 Aug	74	21 Jun	12 Jul	25 Jul	8 Aug
1992	26 Jun	6.2	10	27 Jun	--	--	43	26 Jul	79	12 Jun	7 Jul	13 Jul	>10 Aug
1993	27 Jun	7.1	12	24 Jun	--	--	38	27 Jul	49	16 Jun	15 Jul	23 Jul	>31 Jul
1994	25 Jun	5.8	38	25 Jun	--	--	46	28 Jul	67	14 Jun	15 Jul	15 Jul	14 Aug
1995	29 Jun	6.7	48	26 Jun	31 Jul	4.1	51	30 Jul	66	21 Jun	21 Jul	26 Jul	16 Aug
1996	26 Jun	6.6	14	29 Jun	31 Jul	4.8	40	3 Aug	66	16 Jun	12 Jul	20 Jul	14 Aug
1997	28 Jun	6.4	11	25 Jun	--	--	62	29 Jul	82	15 Jun	15 Jul	16 Jul	8 Aug
1998	5 Jul	5.2	10	7 Jul	8 Aug	4.4	53	10 Aug	70	20 Jun	21 Jul	27 Jul	18 Aug
1999	--		not	monitored	--	--	--	--	--	26 Jun	23 Jul	27 Jul	19 Aug
2000	29 Jun	3.6	19	27 Jun	1 Aug	3.7	48	1 Aug	78	23 Jun	8 Jul	22 Jul	7 Aug
2001	29 Jun	4.6	16	28 Jun	31 Jul	4.0	42	29 Jul	75	22 Jun	2 Jul	23 Jul	8 Aug
2002	25 Jun	4.9	26	25 Jun	30 Jul	5.3	49	31 Jul	81	17 Jun	5 Jul	14 Jul	8 Aug
2003	2 Jul	4.6	9	4 Jul	31 Jul	5.5	6	1 Aug	45	23 Jun	<18 Jul	21 Jul	7 Aug
2004	5 Jul	4.7	17	7 Jul	7 Aug	4.3	7	10 Aug	67	22 Jun	17 Jul	27 Jul	10 Aug
2005	25 Jun	3.2	29	25 Jun	30 Jul	4.9	58	1 Aug	79	16 Jun	11 Jul	21 Jul	12 Aug
2006	9 Jul	6.7	28	10 Jul	11 Aug	5.7	46	11 Aug	102	27 Jun	27 Jul	27 Jul	22 Aug
2007	23 Jun	2.5	31	25 Jun	26 Jul	4.2	33	27 Jul	66	21 Jun	5 Jul	18 Jul	6 Aug
2008	26 Jun	3.6	36	24 Jun	31 Jul	4.6	61	29 Jul	75	20 Jun	5 Jul	23 Jul	10 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 from egg to chick in all years except 1990 when ≤ 10 days egg to chick and 1992 when ≤ 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.

Table 66. Frequency distribution of hatch dates for crested auklets at Buldir Island, Alaska. Intervals from egg to chick ≤7 days for all years except 1990 when ≤ 10 days and 1992 when ≤ 8 days. Data were not collected in 1999.

Julian	No. nests hatching on Julian date																	
Date	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008
165	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
166	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
167	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
168	--	--	1	--	--	--	1	--	--	--	--	3	--	--	--	--	--	--
169	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
170	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--
171	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--
172	7	1	1	--	--	2	--	1	--	--	--	1	--	--	--	--	16	2
173	--	--	--	--	--	--	--	--	--	--	3	--	--	--	1	--	--	--
174	--	--	--	--	--	--	2	--	--	--	--	9	1	--	1	--	--	--
175	--	--	3	10	23	--	2	2	--	1	--	--	--	--	--	--	1	--
176	--	--	--	--	--	--	--	3	1	--	--	--	--	--	16	--	13	20
177	--	--	--	--	--	32	--	1	--	1	--	--	--	--	--	--	--	--
178	--	2	--	--	1	--	--	--	--	--	--	6	--	1	1	1	--	--
179	--	--	--	--	--	--	--	1	1	10	6	--	--	--	1	--	--	1
180	--	--	--	--	--	--	--	1	--	--	2	2	3	--	4	--	--	--
181	--	--	--	--	--	1	5	--	--	--	--	1	--	--	--	--	--	--
182	5	--	4	--	1	--	2	1	1	--	--	2	--	6	--	4	1	11
183	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
184	--	2	--	--	--	8	--	--	--	6	3	--	--	--	--	--	--	--
185	--	--	--	--	--	--	--	--	1	--	--	--	4	--	--	--	--	1
186	--	1	--	--	--	--	--	--	1	--	--	2	--	--	1	6	--	--
187	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1
188	--	--	--	--	--	--	--	--	--	--	1	--	--	7	--	--	--	--
189	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
190	--	--	--	1	4	1	--	--	5	1	--	--	1	--	--	--	--	--
191	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
192	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	11	--	--
193	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
194	--	--	--	--	--	--	1	--	--	--	--	--	--	2	--	--	--	--
195	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
196	--	--	--	1	--	2	--	1	--	--	--	--	--	--	--	--	--	--
197	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--
198	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
199	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
201	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
202	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	1	--	--
203	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
204	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
205	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
206	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
207	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
208	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
209	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
210	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n	12	6	10	12	38	48	14	11	10	19	16	26	9	17	29	28	31	36

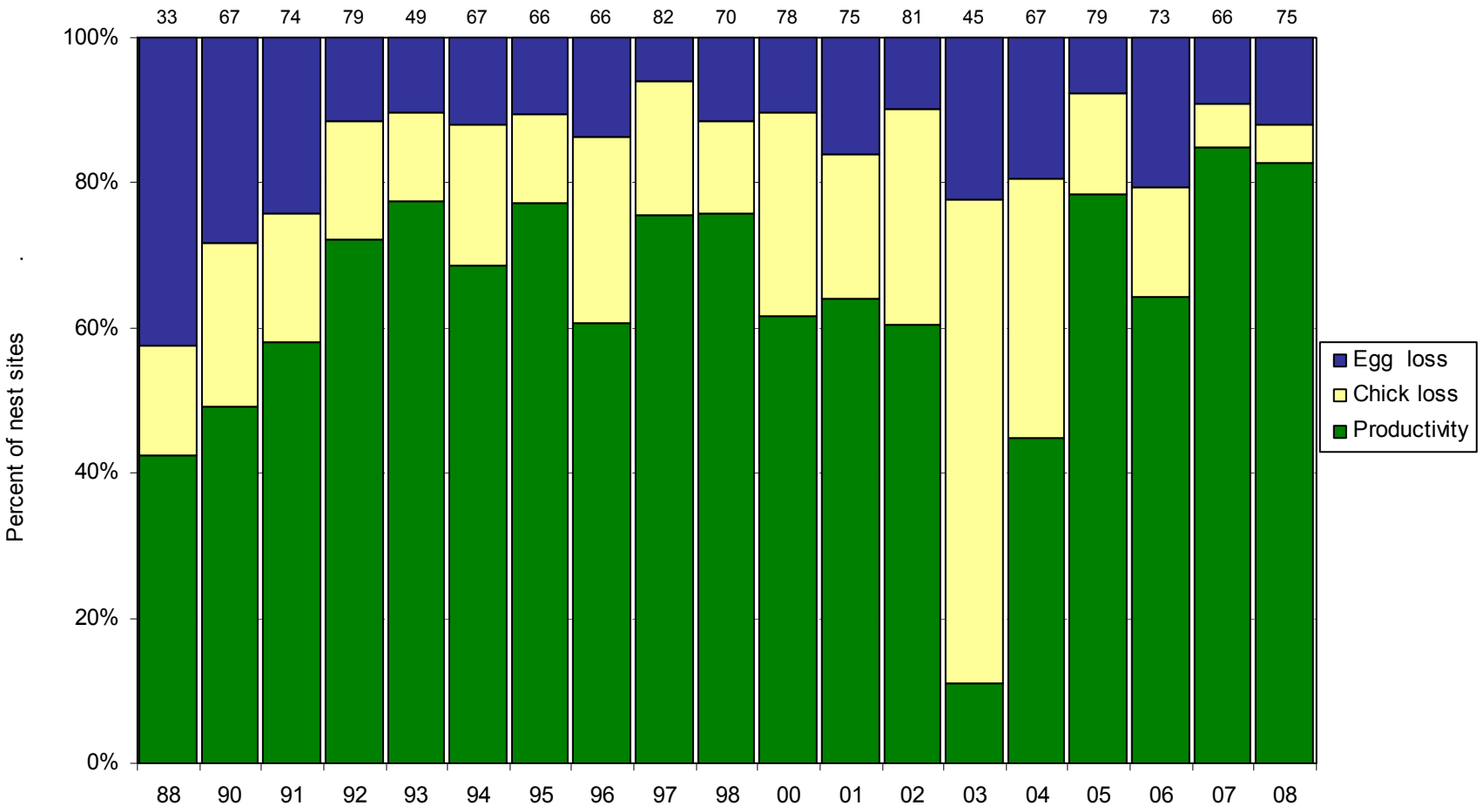

Figure 44. Reproductive performance of crested auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick. The number of known fate eggs monitored are given above each bar

Table 67. Reproductive performance of crested auklets at Buldir Island, Alaska.

Parameter[a]	1976	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
No. eggs found (A)	59	33	83	67	74	79	49	67	66	66	82
No. eggs lost to:											
disappearance	--	4	23	15	13	7	3	4	5	7	2
abandonment	--	9	4	3	3	2	2	2	1	2	2
breakage	--	1	3	1	2	0	0	2	1	0	1
No. eggs hatched (B)	45	19	53	48	56	70	44	59	59	57	77
No. chicks lost to:											
disappearance	--	1	--	13	12	12	6	9	7	9	14
death	--	4	--	2	1	1	0	4	1	8	1
No. chicks fledged (C)[b]	--	14	--	33	43	57	38	46	51	40	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
Fledging success (C/B)	--	0.74	--	0.69	0.77	0.81	0.86	0.78	0.86	0.70	0.81
Reproductive success (C/A)	--	0.42	--	0.49	0.58	0.72	0.78	0.69	0.77	0.61	0.76
Productivity (hs x fs)	--	0.42	--	0.49	0.59	0.70	0.78	0.69	0.77	0.60	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 26 days before disappearing or 22 days at time of last visit if chicks were still present.

Table 67 continued. Reproductive performance of crested auklets at Buldir Island, Alaska.

Parameter[a]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. eggs found (A)	70	0	78	75	81	45	67	79	73	66	75
No. eggs lost to:											
disappearance	4	--	6	6	3	4	6	4	0	3	4
abandonment	4	--	1	6	5	6	5	2	15	3	3
breakage	0	--	1	0	0	0	2	0	0	0	2
No. eggs hatched (B)	62	--	70	63	73	35	54	73	58	60	66
No. chicks lost to:											
disappearance	9	--	17	8	16	14	13	5	4	4	0
death	0	--	5	7	8	16	11	6	7	0	4
No. chicks fledged (C)[b]	53	--	48	48	49	5	30	62	47	56	62
Hatching success (B/A)	0.89	--	0.90	0.84	0.90	0.78	0.81	0.92	0.79	0.91	0.88
Fledging success (C/B)	0.85	--	0.69	0.76	0.67	0.14	0.56	0.85	0.81	0.93	0.94
Reproductive success (C/A)	0.76	--	0.62	0.64	0.60	0.11	0.45	0.79	0.64	0.85	0.83
Productivity (hs x fs)	0.76	--	0.62	0.64	0.60	0.11	0.45	0.78	0.64	0.85	0.83

[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.

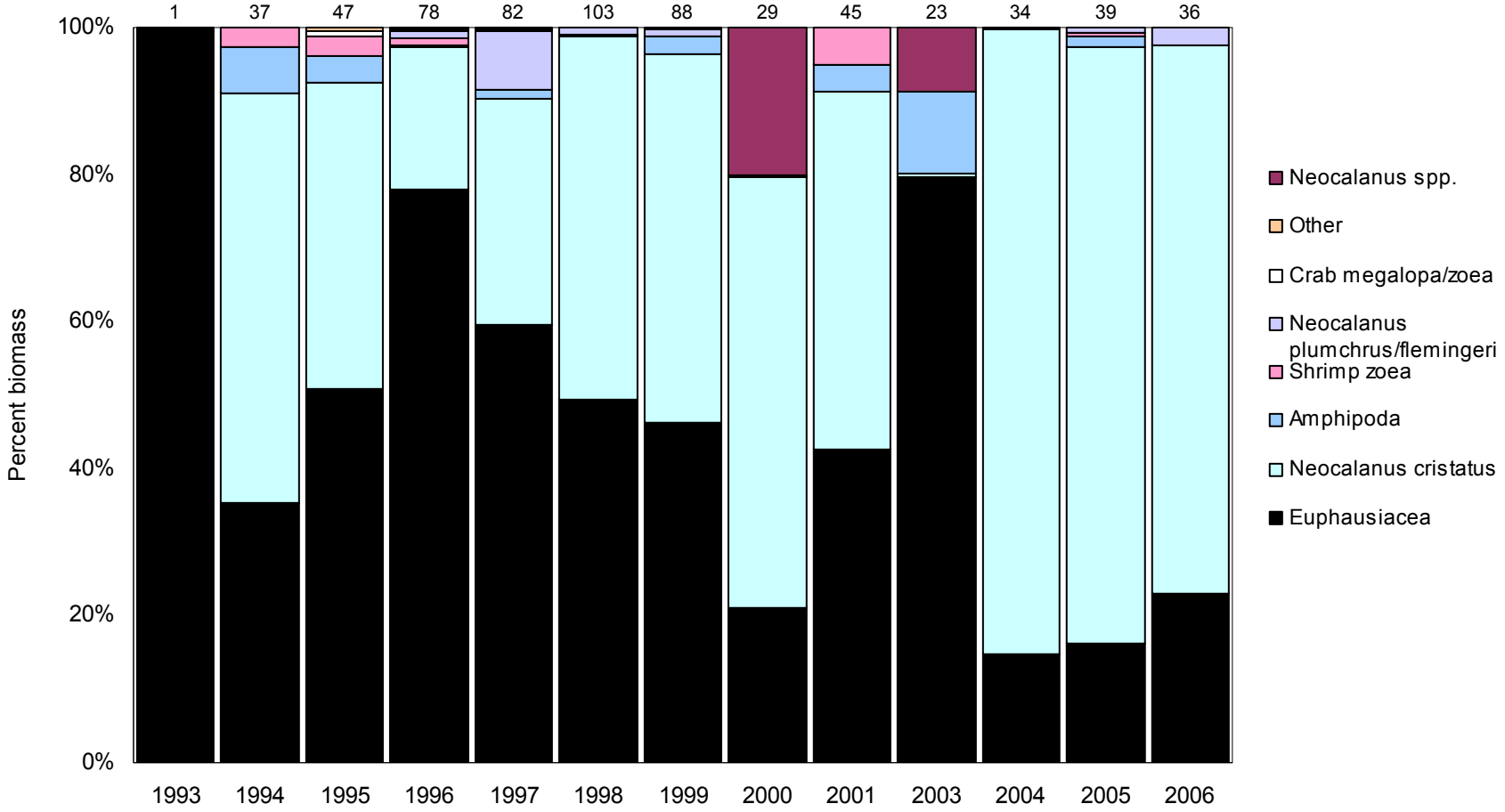

Figure 45. Relative biomass of prey in diets of crested auklets at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

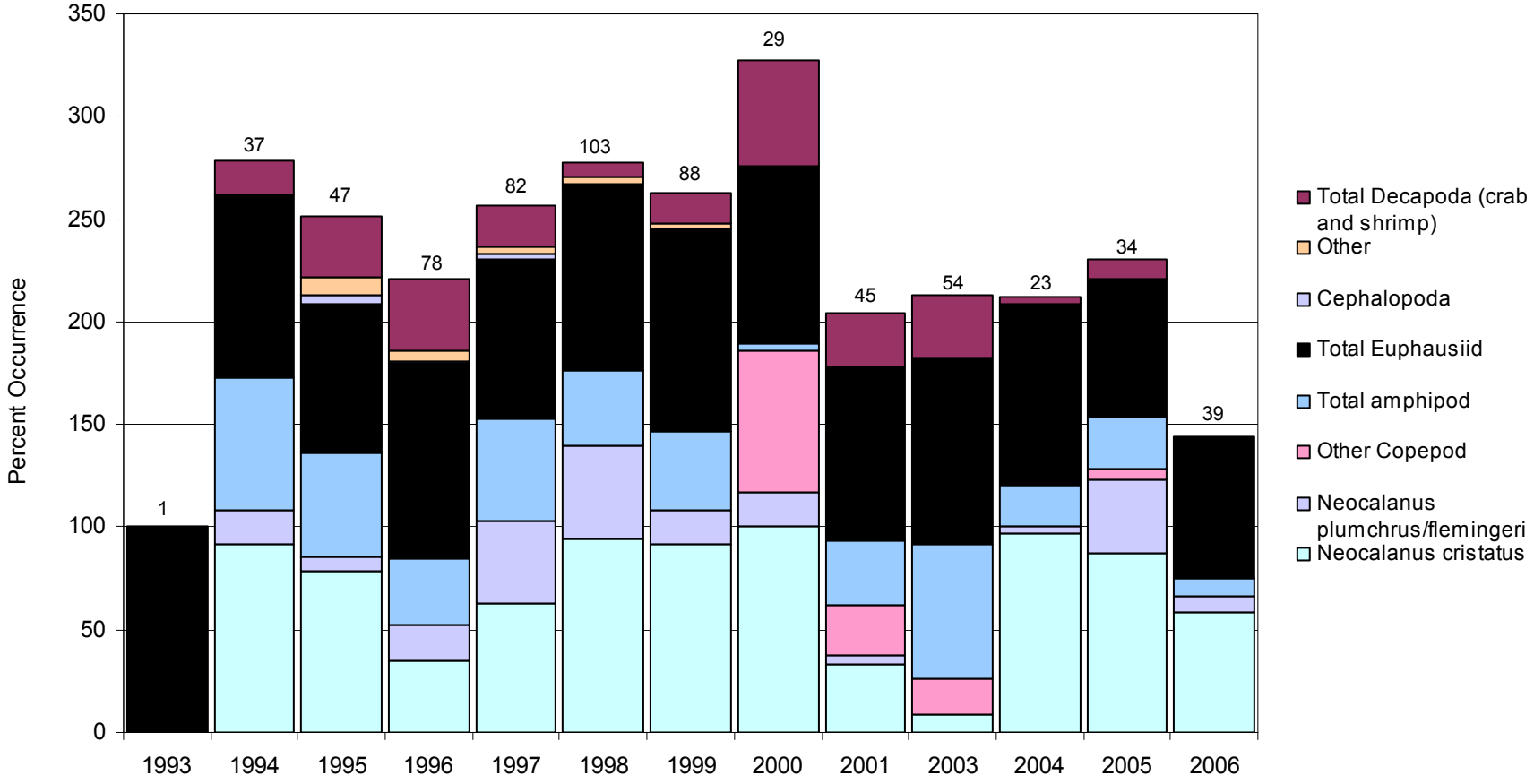

Figure 46. Frequency of prey occurrence in diets of crested auklets at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 68. 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. Data for 2002 have not yet been analyzed.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2003	2004	2005	2006
No. samples	1	37	47	78	82	103	88	29	45	23	34	39	36
Total mass (g)	1.2	335.4	487.6	745.0	904.7	1102.9	908.6	380.6	183.2	128.8	87.6	245.2	47.4
Pteropoda	--	--	--	<0.1	--	--	--	--	--	--	--	--	--
Cephalopoda - squid	--	--	0.2	0.1	<0.1	<0.1	--	--	--	--	--	--	--
Copepoda													
Neocalanus plumchrus/flemingeri	--	0.1	0.1	1.0	8.1	1.0	7.5	.14	.06	--	.05	.56	2.3
N. cristatus	--	55.8	41.6	19.3	30.7	49.5	50.2	68.7	48.7	.59	84.9	81.1	74.6
N. spp.	--	--	--	--	--	--	--	6.2	--	8.6	--	.07	--
Calanus marshallae	--	--	--	--	--	--	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	--	.53	--	--	--	--
Unid. copepod	--	--	--	--	--	--	--	--	--	--	--	--	--
Amphipoda													
Hyperiidea													
Hyperoche medusarum	--	--	--	<0.1	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	--	5.6	3.7	0.3	1.2	0.3	2.3	.01	2.83	--	.17	.01	.03
Parathemisto spp.	--	--	--	--	--	--	--	--	.2	10.9	--	1.24	.02
Primno macropa	--	0.7	--	--	--	--	0.1	--	--	--	--	--	--
Euphausiacea													
Thysanoessa spp.	100.0	35.2	50.9	78.1	59.6	--	--	4.1	36.5	66.7	12.4	13	--
Unid. euphausiid	--	--	--	--	--	49.3	46.2	20.6	6.1	12.5	2.4	3.3	23
Euphausiid furcilla	--	--	--	--	--	--	<0.1	--	--	--	--	--	--
Decapoda													
Pandalid shrimp	--	--	--	--	--	--	--	--	.11	1.1	.11	.69	--
Larval shrimp	--	--	--	--	--	--	--	--	4.96	--	--	--	--
Shrimp zoea	--	2.6	2.5	0.9	0.1	<0.1	--	.18	--	--	--	--	--
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 69. Frequency of occurrence of prey in diets of crested auklets at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present. Data for 2002 have not yet been analyzed.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2003	2004	2005	2006
No. samples	1	37	47	78	82	103	88	29	45	23	34	39	36
Pteropoda	--	--	--	1.3	--	--	--	--	--	--	--	--	--
Cephalopoda - squid	--	--	4.3	1.3	2.2	1.0	--	--	--	--	--	--	--
Copepoda													
Neocalanus plumchrus/flemingeri	--	16.2	6.4	17.9	39.6	45.6	15.9	17.2	4.4	--	2.9	35.9	8.3
N. cristatus	--	91.9	78.7	34.6	63.0	94.2	92.0	100.0	33.3	8.7	97.1	87.2	58.33
N. spp.	--	--	--	--	--	--	--	69.0	--	17.4	--	--	--
Calanus marshallae	--	--	--	--	--	--	--	--	--	--	--	5.1	--
Calanoid spp.	--	--	--	--	--	--	--	--	24.4	--	--	--	--
Unid. copepod	--	--	--	--	--	--	--	69.0	24.4	17.4	--	5.1	--
Amphipoda													
Hyperiidea													
Hyperoche medusarum	--	--	--	2.6	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	--	43.2	51.1	32.1	50.3	36.9	37.5	3.4	15.6	--	20.6	2.6	5.6
Parathemisto spp.	--	--	--	--	--	--	--	--	15.6	65.2	--	23.1	2.8
Primno macropa	--	21.6	--	--	--	--	1.1	--	--	--	--	--	--
Euphausiacea													
Thysanoessa spp.	100.0	89.2	72.3	94.9	77.6	--	--	17.2	28.9	65.2	14.7	10.3	--
Unid. euphausiid	--	--	--	--	--	90.3	97.7	69.0	55.6	26.1	73.5	56.4	69.4
Euphausiid furcilla	--	--	--	--	--	--	1.1	--	--	--	--	--	--
Decapoda													
Pandalid shrimp	--	--	--	--	--	--	--	--	--	--	--	10.2	--
Larval shrimp	--	--	--	--	--	--	--	--	24.4	--	--	--	--
Shrimp zoea	--	13.5	25.5	25.6	6.9	5.8	--	51.7	2.2	30.4	2.9	--	--
Crab zoea	--	2.7	4.3	--	3.4	1.0	5.7	--	--	--	--	--	--
Crab megalopa	--	--	--	9.0	9.1	--	--	--	--	--	--	--	--
Paguridae megalopa	--	--	--	--	--	--	1.1	--	--	--	--	--	--
Hippolytidae juvenile	--	--	--	--	--	--	8.0	--	--	--	--	--	--
Fish	--	8.5	3.8	4.2	--	3.9	2.3	--	--	--	--	--	--
(Nematodes - probably not prey)	--	--	--	--	28.3	--	--	--	--	--	--	--	--

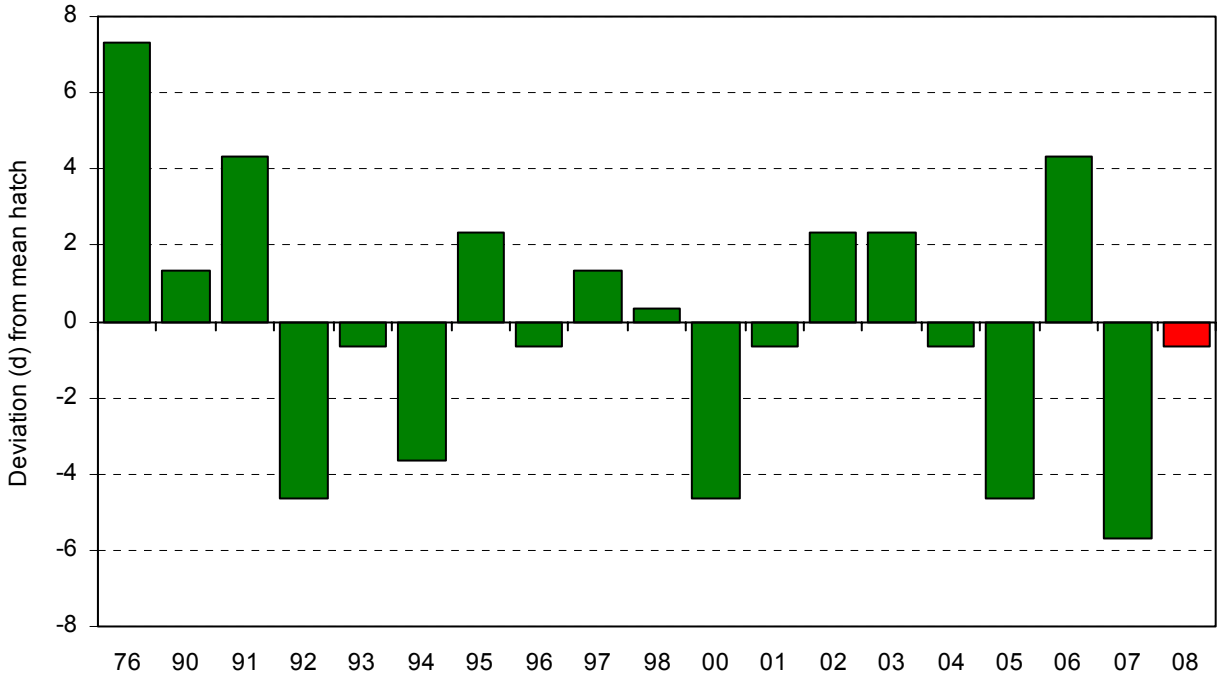

Figure 47. Yearly hatch date deviation (from the 1976-2007 average of 23 June) of whiskered auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

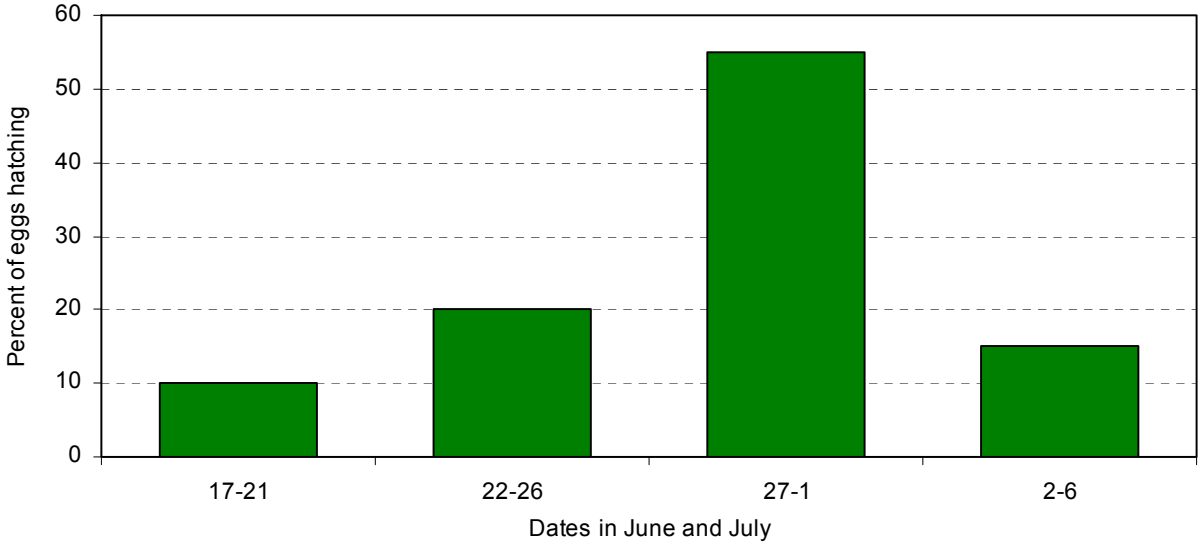

Figure 48. Hatching chronology of whiskered auklets at Buldir Island, Alaska in 2008 (*n*=40).

Table 70. 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	17 Jun	5.2	27	18 Jun	25 Jul	6.3	32	27 Jul	70	6 Jun	13 Jul	17 Jul	13 Aug
2001	22 Jun	6.2	36	20 Jun	28 Jul	4.2	26	29 Jul	75	9 Jun	15 Jul	15 Jul	2 Aug
2002	24 Jun	8.5	36	21 Jun	29 Jul	5.4	48	27 Jul	100	15 Jun	15 Jul	21 Jul	14 Aug
2003	25 Jun	2.9	4	25 Jun	30 Jul	7.1	25	1 Aug	44	9 Jun	4 Jul	15 Jul	12 Aug
2004	21 Jun	4.7	28	21 Jun	28 Jul	3.7	17	30 Jul	66	16 Jun	12 Jul	22 Jul	4 Aug
2005	18 Jun	6.0	29	16 Jun	26 Jul	6.2	53	21 Jul	70	9 Jun	5 Jul	16 Jul	12 Aug
2006	27 Jun	4.7	20	27 Jun	5 Aug	5.4	42	6 Aug	97	19 Jun	5 Jul	25 Jul	26 Aug
2007	17 Jun	7.8	24	15 Jun	24 Jul	6.5	26	23 Jul	67	9 Jun	10 Jul	14 Jul	12 Aug
2008	21 Jun	3.2	40	20 Jun	27 Jul	3.6	57	29 Jul	68	14 Jun	30 Jun	23 Jul	4 Aug

[a] Hatch dates in 1976 were assumed to be the midpoint of the interval reported in Knudtson and Byrd (1982).

[b] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations $\leq$ 7 days apart from egg to chick in all years except 1990 when $\leq$ 10 days egg to chick.

[c] Sample size is for the calculation of mean and median fledge dates.

[d] The total used for estimating the remaining parameters. These dates might contain observations > 7, but less than 10 days apart or estimate event dates (e.g. “bird Incubating” on first visit followed by “chick” on the next visit).

Table 71. Frequency distribution of hatch dates for Whiskered Auklets at Buldir Island, Alaska. Intervals from egg to chick ≤7 days for all years except 1990 when ≤ 10 days. Data were not collected in 1999.

Julian	No. nests hatching on Julian date																	
Date	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008
158	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
159	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
160	--	--	--	--	2	--	--	--	2	--	2	--	--	--	--	--	--	--
161	--	--	--	--	1	--	--	--	1	--	--	--	--	--	--	--	--	--
162	--	--	1	--	1	--	1	1	5	--	--	--	--	--	5	--	5	--
163	--	--	1	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--
164	--	--	1	2	2	--	--	--	1	8	--	--	--	--	1	--	6	--
165	--	--	1	--	6	--	--	--	--	2	--	--	--	--	1	--	--	--
166	--	--	2	--	3	--	--	--	9	--	--	3	--	--	4	--	7	4
167	--	--	1	--	1	--	--	--	--	--	--	1	--	--	7	--	--	--
168	--	--	1	--	1	--	12	9	1	--	--	5	--	8	--	--	--	--
169	--	--	--	--	--	1	--	--	2	--	2	1	--	--	--	--	--	--
170	--	--	--	6	4	--	--	--	11	9	1	--	--	--	1	2	--	2
171	--	--	--	--	3	--	--	1	--	--	16	--	--	--	1	--	--	--
172	3	--	--	--	1	30	--	8	2	--	--	10	--	4	1	--	3	--
173	--	--	--	--	--	--	--	--	--	1	4	--	--	8	--	2	--	--
174	--	--	1	--	--	1	8	--	6	--	--	2	2	--	--	2	--	1
175	--	--	1	3	3	--	--	--	--	4	--	--	--	--	--	--	--	--
176	--	3	--	--	--	--	--	5	1	--	5	2	--	--	7	--	--	9
177	--	--	--	--	3	9	--	--	1	--	--	--	1	--	--	--	--	--
178	--	3	--	--	--	--	--	--	--	1	--	3	--	5	--	9	--	--
179	--	--	--	--	--	--	--	--	--	1	3	1	--	--	--	--	--	--
180	--	--	--	--	--	--	2	--	5	--	1	--	1	--	--	--	--	--
181	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	1	--	--
182	2	--	--	--	--	--	--	4	--	--	--	2	--	--	--	1	1	1
183	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
184	--	3	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--
185	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--
186	--	--	--	--	1	--	2	3	7	--	1	1	--	--	1	3	1	--
187	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--
188	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--
189	--	--	--	--	2	--	--	--	--	--	--	1	--	--	--	--	--	--
190	--	--	--	2	--	3	--	--	4	--	--	--	--	--	--	--	--	--
191	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
192	--	--	--	--	--	--	--	--	1	--	--	2	--	--	--	--	--	--
193	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
194	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
195	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
196	--	--	--	--	--	1	--	--	2	--	1	1	--	--	--	--	--	--
197	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
198	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
199	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--
200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
201	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
202	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--
203	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
204	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
205	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n	5	9	10	13	37	50	27	33	61	27	36	36	4	28	29	20	24	17

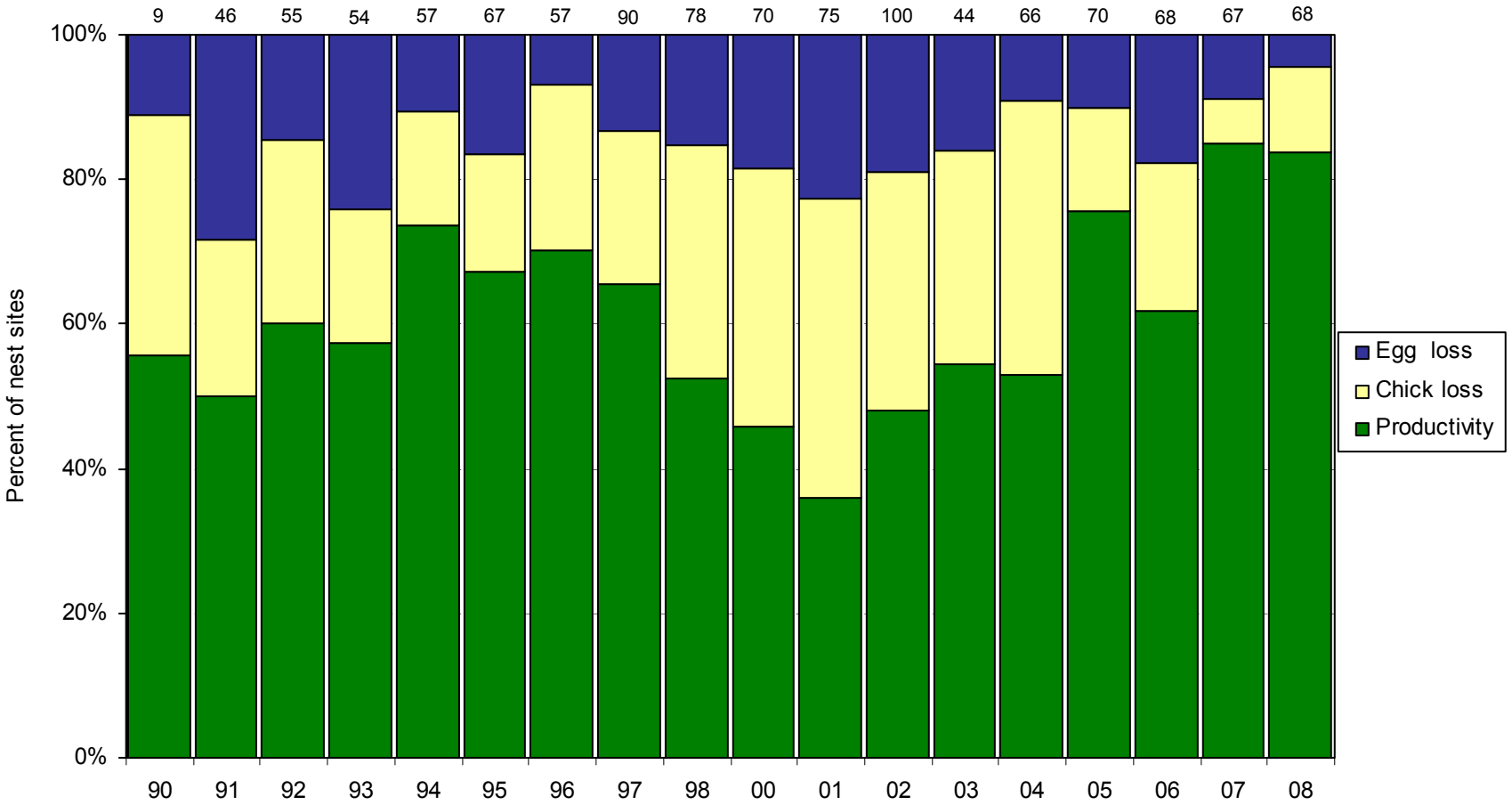

Figure 49. Reproductive performance of whiskered auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick. The number of known fate eggs monitored are given above each bar.

Table 72. Reproductive performance of whiskered auklets at Buldir Island, Alaska.

Parameter[a]	1976	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
No. eggs found (A)	7	7	16	9	46	55	54	57	67	57	90	78
No. eggs lost to:												
disappearance	--	0	1	1	5	5	8	4	2	1	8	9
abandonment	--	0	2	0	4	3	4b	2	9	3	3	2
breakage	--	0	2	0	4	0	1	0	0	0	1	1
No. eggs hatched (B)	6	7	11	8	33	47	41	51	56	53	78	66
No. chicks lost to:												
disappearance	--	--	--	2	7	9	6	6	10	6	17	20
death	--	--	--	1	3	5	4	3	1	7	2	5
No. chicks fledged (C)[b]	--	--	--	5	23	33	31	42	45	40	59	41
Hatching success (B/A)	0.86	1.00	0.69	0.89	0.72	0.85	0.76	0.89	0.84	0.93	0.87	0.85
Fledging success (C/B)	--	--	--	0.63	0.70	0.70	0.76	0.82	0.80	0.75	0.76	0.62
Reproductive success (C/A)	--	--	--	0.56	0.50	0.60	0.57	0.74	0.67	0.70	0.66	0.53
Productivity (hs x fs)	--	--	--	0.56	0.50	0.60	0.58	0.73	0.67	0.70	0.66	0.53

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

Table 72 continued. Reproductive performance of whiskered auklets at Buldir Island, Alaska.

Parameter[a]	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. eggs found (A)	0	70	75	100	44	66	70	68	67	68
No. eggs lost to:										
disappearance	--	4	5	6	3	3	3	2	2	1
abandonment	--	9	12	10	4	2	2	8	3	1
breakage	--	0	0	3	0	1	2	2	1	1
No. eggs hatched (B)	--	57	58	81	37	60	63	56	61	65
No. chicks lost to:										
disappearance	--	20	5	21	9	12	7	4	2	6
death	--	5	26	12	4	13	3	0	2	2
No. chicks fledged (C)[b]	--	32	27	48	24	35	53	42	57	57
Hatching success (B/A)	--	0.81	0.77	0.81	0.84	0.91	0.90	0.82	0.91	0.96
Fledging success (C/B)	--	0.56	0.47	0.59	0.65	0.58	0.84	0.75	0.93	0.88
Reproductive success (C/A)	--	0.46	0.36	0.48	0.55	0.53	0.76	0.62	0.85	0.84
Productivity (hs x fs)	--	0.46	0.36	0.48	0.55	0.53	0.76	0.62	0.85	0.84

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

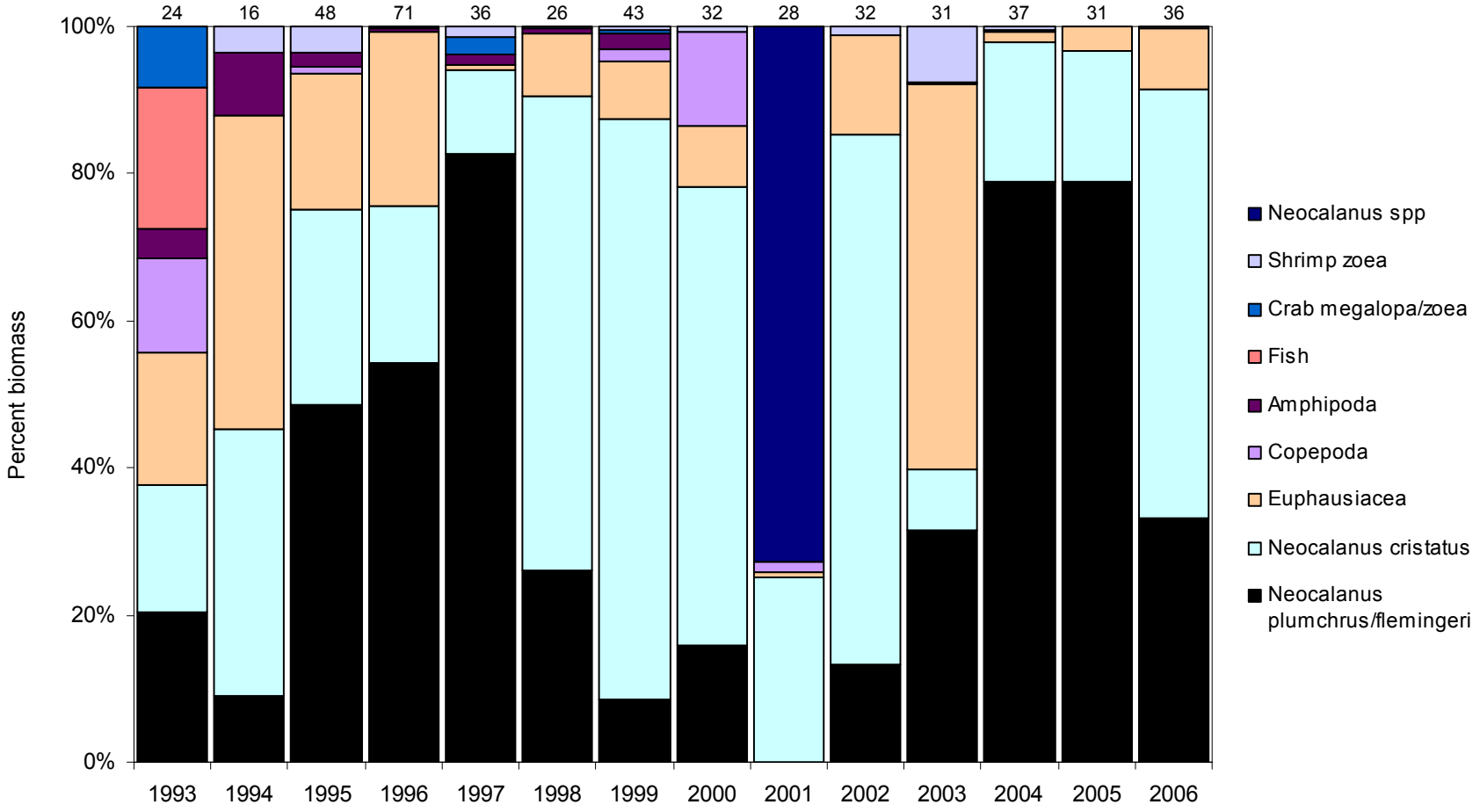

Figure 50. Relative biomass of prey in diets of whiskered auklets at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

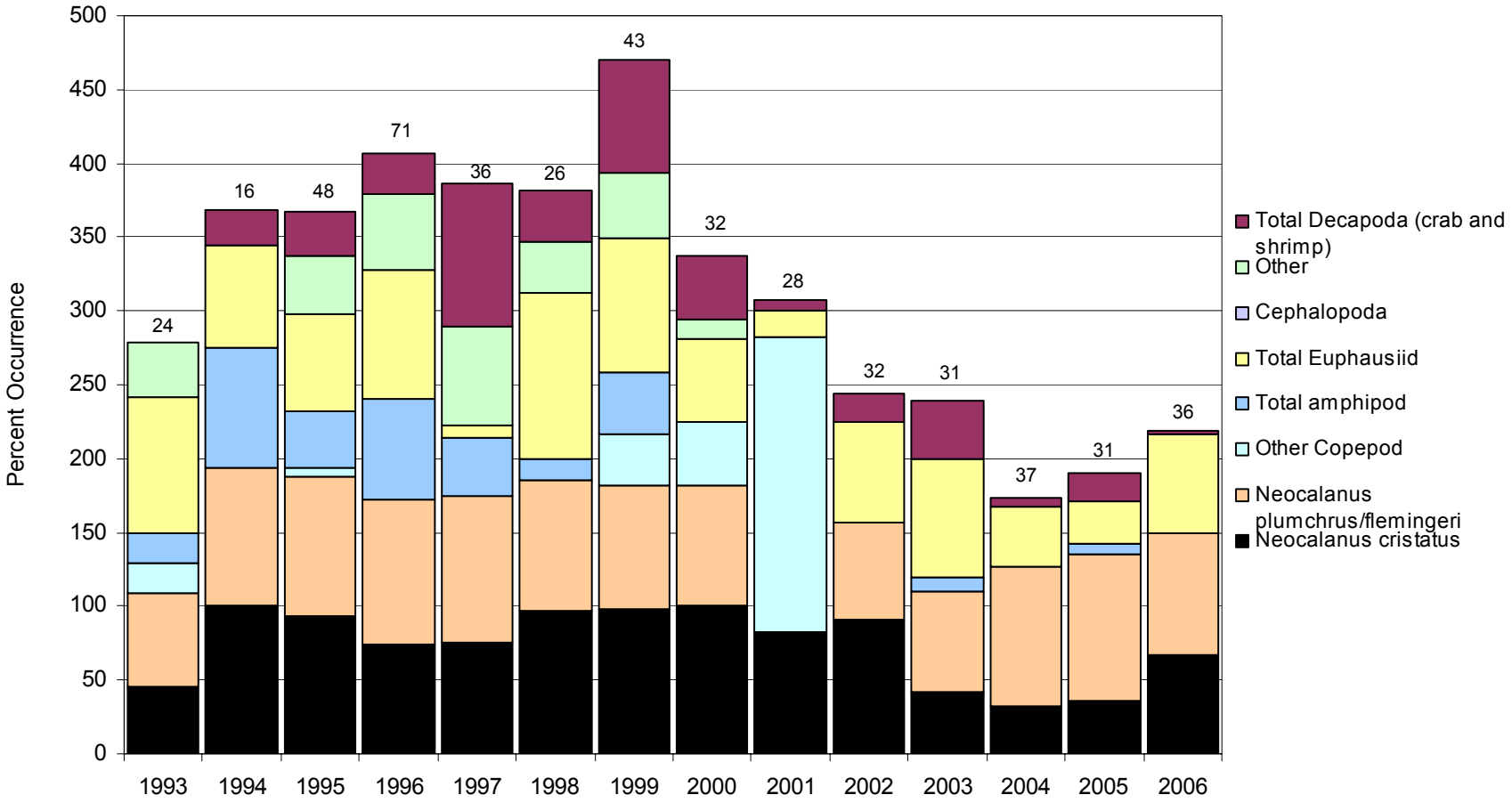

Figure 51. Frequency of occurrence of prey in diets of whiskered auklets at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 73. 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	2000	2001	2002	2003	2004	2005	2006
No. samples	24	16	48	71	36	26	43	32	28	32	31	37	31	36
Total mass (g)	53.4	93.9	387.5	481.3	300.2	214.1	434.1	288.9	182.2	151.6	94.8	36.1	75	57.9
Gastropoda														
Unid. snail	--	0.2	--	--	--	--	--	--	--	--	--	--	--	--
Pteropoda (*Limacina helicina*)	1.5	--	0.7	0.3	2.1	0.2	0.2	0.1	--	--	--	--	--	--
Copepoda														
Neocalanus cristatus	18.6	36.4	26.2	21.2	11.3	64.3	78.8	62.4	25.1	71.3	8.41	19	13.3	58.4
N. plumchrus/flemingeri	21.8	8.9	48.3	54.2	80.9	26.1	8.5	15.8	--	13.2	31.41	79.3	58.9	33.1
Neocalanus spp	--	--	--	--	--	--	--	12.6	72.7					
Calanus pacifica	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	0.4	1.5	--	--	--	--	--
Pachyptilus pacificus	--	--	--	--	--	--	1	--	--	--	--	--	--	--
Pareuchta birostrata	--	--	--	--	--	--	0.7	--	--	--	--	--	--	--
Pareuchaeta elongata	--	--	--	--	--	--	--	--	0.07	0.12	--	--	--	--
Lophotrix frontalis	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--
Unid. copepod	13.8	--	0.9	--	--	--	--	--	--	--	--	--	--	--
Amphipoda (unidentified)	--	--	--	--	--	--	--	--	--	--	0.22	--	--	--
Hyperiidea														
Hyperoche medusarum	--	--	1.7	0.5	--	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	3.9	0.5	0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	--	--	0.01	--
Primno macropa	0.3	7.9	--	--	1.3	0.7	2.1	--	--	--	--	--	--	--
Gammaridea														
Talitridae	--	--	--	0.1	--	--	--	--	--	--	--	--	--	--
Euphausiacea														
Thysanoessa spp.	19.5	42.5	18.5	23.6	0.6	--	--	--	--	1.77	48.1	1.1	--	--
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--	--	0.08	--
Unid. euphausid	--	--	--	--	--	8.4	7.9	8.1	0.6	11.6	4.3	0.51	2.3	8.45
Euphausiid furcilla	--	--	--	--	--	0.2	--	--	--	--	--	--	--	--
Decapoda														
Pandalid shrimp	--	--	--	--	--	--	--	--	0.01	.10	7.5	--	--	--
Larval shrimp	--	--	--	--	--	--	--	--	--	--	0.03	--	0.44	0.12
Unid. Shrimp	--	--	--	--	--	--	--	--	--	0.4	--	--	--	--
Shrimp zoea	--	3.6	3.6	0.1	1.5	0.1	0.6	0.6	--	--	--	--	--	--
Crab zoea	--	--	--	<0.1	0.6	--	--	--	--	--	--	0.04	0.02	--
Crab megalopa	--	--	--	0.1	1.6	--	--	--	--	--	--	0.03	0.03	--
Hippolytidae juvenile	--	--	--	--	--	--	0.3	--	--	--	--	--	--	--
Fish - Hexagrammos spp.	20.6	--	--	--	--	--	0.2	--	--	--	--	--	--	--

Table 74. Frequency of occurrence of prey in diets of whiskered auklets at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. samples	24	16	48	71	36	26	43	32	28	32	31	37	31	36
Scyphozoa	--	--	--	1.4	--	--	--	--	--	--	--	--	--	--
Gastropoda														
Unid. snail	--	25	--	--	--	--	--	--	--	--	--	--	--	--
Pteropoda (*Limacina helicina*)	4.2	--	39.6	50.7	66.7	34.6	44.2	12.5	--	--	--	--	--	--
Copepoda														
Neocalanus cristatus	45.8	100	93.8	74.6	75	96.2	97.7	100	82.1	90.6	41.9	32.4	35.5	66.7
N. plumchrus/flemingeri	62.5	93.8	93.8	97.2	100	88.5	83.7	81.3	--	65.6	67.7	94.6	100	83.3
Calanus pacifica	--	--	4.2	--	--	--	--	--	--	--	--	--	--	--
Calanoid spp.	--	--	--	--	--	--	--	43.8	100	--	--	--	--	--
Pachyptilus pacifica	--	--	--	--	--	--	14	--	--	--	--	--	--	--
Pareuchta birostrata	--	--	--	--	--	--	18.6	--	--	--	--	--	--	--
Pareuchaeta elongata	--	--	--	--	--	--	--	--	7.1	9.4	--	--	--	--
Lophotrix frontinalis	--	--	--	--	--	--	2.3	--	--	--	--	--	--	--
Unid. copepod	20.8	--	2.1	--	--	--	--	--	92.9	--	--	--	--	--
Amphipoda (unidentified)	--	--	--	--	--	--	--	--	--	--	6.5	--	--	--
Hyperiidea														
Hyperoche medusarum	--	--	31.3	62	--	--	--	--	--	--	--	--	--	--
Parathemisto pacifica	16.7	12.5	6.3	2.8	2.8	--	--	--	--	--	--	--	--	--
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	--	--	6.5	--
Primno macropa	4.2	68.8	--	--	36.1	15.4	41.9	--	--	--	--	--	--	--
Gammaridea														
Talitridae	--	--	--	4.2	--	--	--	--	--	--	--	--	--	--
Lysianassidae	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--
Euphausiacea														
Thysanoessa spp.	91.7	68.8	66.7	87.3	8.3	--	--	--	--	12.5	22.6	8.1	--	--
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	--	--	3.2	--
Unid. euphausid	--	--	--	--	--	92.3	90.7	56.3	17.9	56.2	58.1	32.4	25.8	66.7
Euphausiid furcilla	--	--	--	--	--	19.2	--	--	--	--	--	--	--	--
Decapoda														
Pandalid shrimp	--	--	--	--	--	--	--	43.8	--	6.3	35.5	2.7	--	--
Larval shrimp	--	--	--	--	--	--	--	--	7.1	9.4	3.2	--	6.5	2.8
Unid. Shrimp	--	--	--	--	--	--	--	--	--	3.1	--	--	--	--
Shrimp zoea	--	25	29.2	12.7	58.3	34.6	60.5	--	--	--	--	--	--	--
Crab zoea	--	--	--	9.9	16.7	--	--	--	--	--	--	2.7	6.5	--
Crab megalopa	--	--	--	5.6	22.2	--	--	--	--	--	--	--	6.5	--
Hippolytidae juvenile	--	--	--	--	--	--	16.3	--	--	--	--	--	--	--
Fish														
Hexagrammos spp.	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--

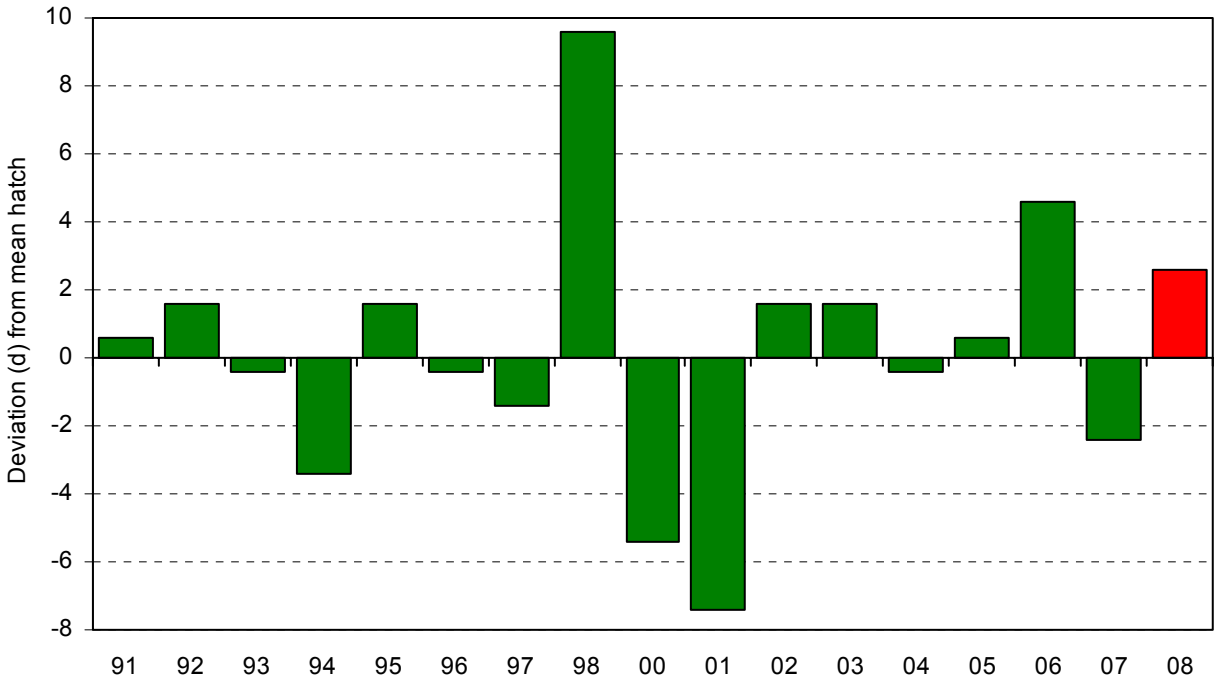

Figure 52. Yearly hatch date deviation (from the 1991-2007 average of 4 July) of parakeet auklets at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

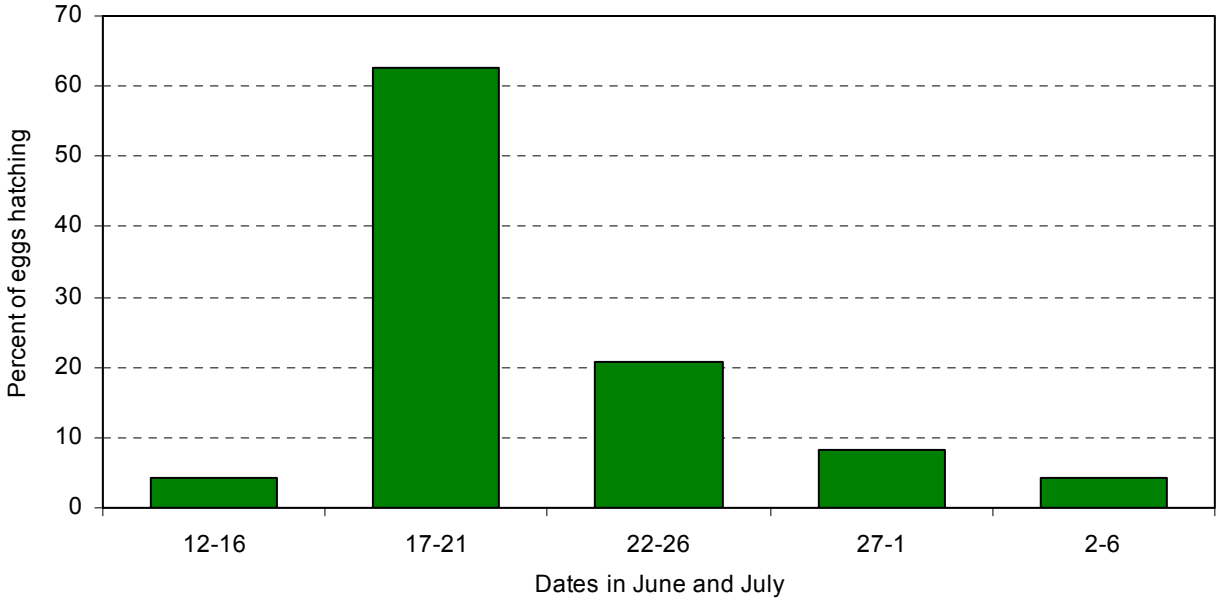

Figure 53. Hatching chronology of parakeet auklets at Buldir Island, Alaska in 2008 (*n*=24).

Table 75. Breeding chronology dates for parakeet auklets at Buldir Island, Alaska.

Year	mean hatch	SD	n[a]	median hatch	mean fledge	SD	n[b]	median fledge	no. nests monitored[c]	first hatch	last hatch	first fledge	last fledge
1991	5 Jul	5.5	14	5 Jul	--	--	27	9 Aug	53	30 Jun	9 Jul	3 Aug	>14 Aug
1992	5 Jul	6.8	8	4 Jul	--	--	28	4 Aug	43	25 Jun	15 Jul	27 Jul	>12 Aug
1993	4 Jul	7.9	12	1 Jul	--	--	17	4 Aug	35	19 Jun	15 Jul	27 Jul	10 Aug
1994	1 Jul	5.7	37	1 Jul	--	--	33	5 Aug	65	20 Jun	15 Jul	23 Jul	22 Aug
1995	5 Jul	6.1	37	3 Jul	--	--	49	6 Aug	70	21 Jun	17 Jul	30 Jul	>17 Aug
1996	3 Jul	5.0	31	4 Jul	--	--	38	11 Aug	64	16 Jun	20 Jul	26 Jul	14 Aug
1997	3 Jul	5.1	22	1 Jul	7 Aug	5.7	30	6 Aug	62	26 Jun	13 Jul	27 Jul	16 Aug
1998	14 Jul	6.3	34	14 Jul	--	--	43	16 Aug	71	29 Jun	31 Jul	10 Aug	>27 Aug
1999	--	--	--	--	--	--	--	not monitored	--	--	--	--	--
2000	28 Jun	6.6	22	27 Jun	1 Aug	4.7	29	2 Aug	65	12 Jun	14 Jul	23 Jul	13 Aug
2001	27 Jun	2.7	9	29 Jun	none	--	--	n/a	40	22 Jun	29 Jun	n/a	n/a
2002	5 Jul	4.9	19	5 Jul	1 Aug	8.6	7	2 Aug	55	27 Jun	22 Jul	29 Jul	12 Aug
2003	6 Jul	7.0	6	4 Jul	8 Aug	7.7	15	6 Aug	34	19 Jun	19 Jul	25 Jul	18 Aug
2004	3 Jul	5.4	12	4 Jul	8 Aug	3.4	4	9 Aug	37	24 Jun	14 Jul	4 Aug	11 Aug
2005	5 Jul	11.6	10	4 Jul	4 Aug	4.5	17	4 Aug	36	15 Jun	27 Jul	25 Jul	16 Aug
2006	9 Jul	5.4	13	8 Jul	13 Aug	4.4	34	11 Aug	59	1 Jul	21 Jul	4 Aug	26 Aug
2007	2 Jul	7.8	9	29 Jun	3 Aug	4.6	30	4 Aug	50	21 Jun	22 Jul	23 Jul	15 Aug
2008	7 Jul	4.8	24	5 Jul	12 Aug	6.2	28	13 Aug	54	30 Jun	19 Jul	29 Jul	20 Aug

[a] Sample size is for the calculation of mean and median hatch dates. These dates are a subsample for which we have observations ≤ 7 days from egg to chick in all years except 1991 when ≤ 9 days egg to chick, and 1993 when ≤ 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).

Table 76. Frequency distribution of hatch dates for Parakeet Auklets at Buldir Island, Alaska. Intervals from egg to chick ≤7 days for all years except 1991 and 1993 when ≤ 9 days.

Julian	No. nests hatching on Julian date																
Date	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008
160	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
161	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
162	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
163	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
164	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
166	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--
167	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
168	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
169	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
170	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
171	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
172	--	--	--	2	1	--	--	--	2	--	--	--	--	--	--	--	--
173	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--
174	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
175	--	--	1	--	--	--	--	--	1	--	--	--	--	--	--	--	--
176	--	--	--	--	--	--	--	--	--	3	--	--	1	--	--	1	--
177	--	1	--	7	5	--	4	--	--	--	--	--	--	--	--	--	--
178	--	--	--	5	--	--	--	--	6	--	--	--	1	2	--	--	--
179	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--
180	--	1	--	1	--	6	--	--	1	5	1	1	2	1	--	4	--
181	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
182	--	--	5	4	--	4	8	--	--	--	3	--	--	--	1	1	1
183	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--
184	--	--	--	--	15	1	--	--	6	--	2	2	--	2	3	2	10
185	--	--	--	--	--	--	--	1	--	--	--	1	--	--	--	--	--
186	--	2	--	1	--	5	3	3	--	--	5	--	4	--	1	--	--
187	--	1	--	1	--	--	--	--	--	--	1	--	--	--	--	--	4
188	--	--	--	--	5	11	3	--	--	--	1	--	1	--	--	--	1
189	--	1	--	1	--	1	--	--	--	--	2	1	--	--	3	--	--
190	6	--	3	2	7	1	--	7	--	--	3	--	2	2	--	--	3
191	--	--	--	2	--	--	1	--	1	--	--	--	--	--	--	--	--
192	--	1	--	--	--	--	--	5	--	--	--	--	--	--	4	--	--
193	--	--	--	--	--	--	1	1	--	--	--	--	--	--	1	--	3
194	--	--	--	--	--	--	1	--	--	--	--	--	1	--	--	--	--
195	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2
196	--	--	2	1	1	--	--	10	1	--	--	--	--	--	--	--	--
197	1	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--
198	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--
199	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
200	--	--	--	--	--	--	--	2	--	--	--	1	--	--	--	--	--
201	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
202	--	--	--	--	--	1	--	1	--	--	--	--	--	--	--	--	--
203	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	1	--
204	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--
205	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
206	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
207	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
208	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--
209	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
210	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--
211	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
212	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--
n	14	8	12	37	37	31	21	34	22	9	19	6	12	10	13	9	25

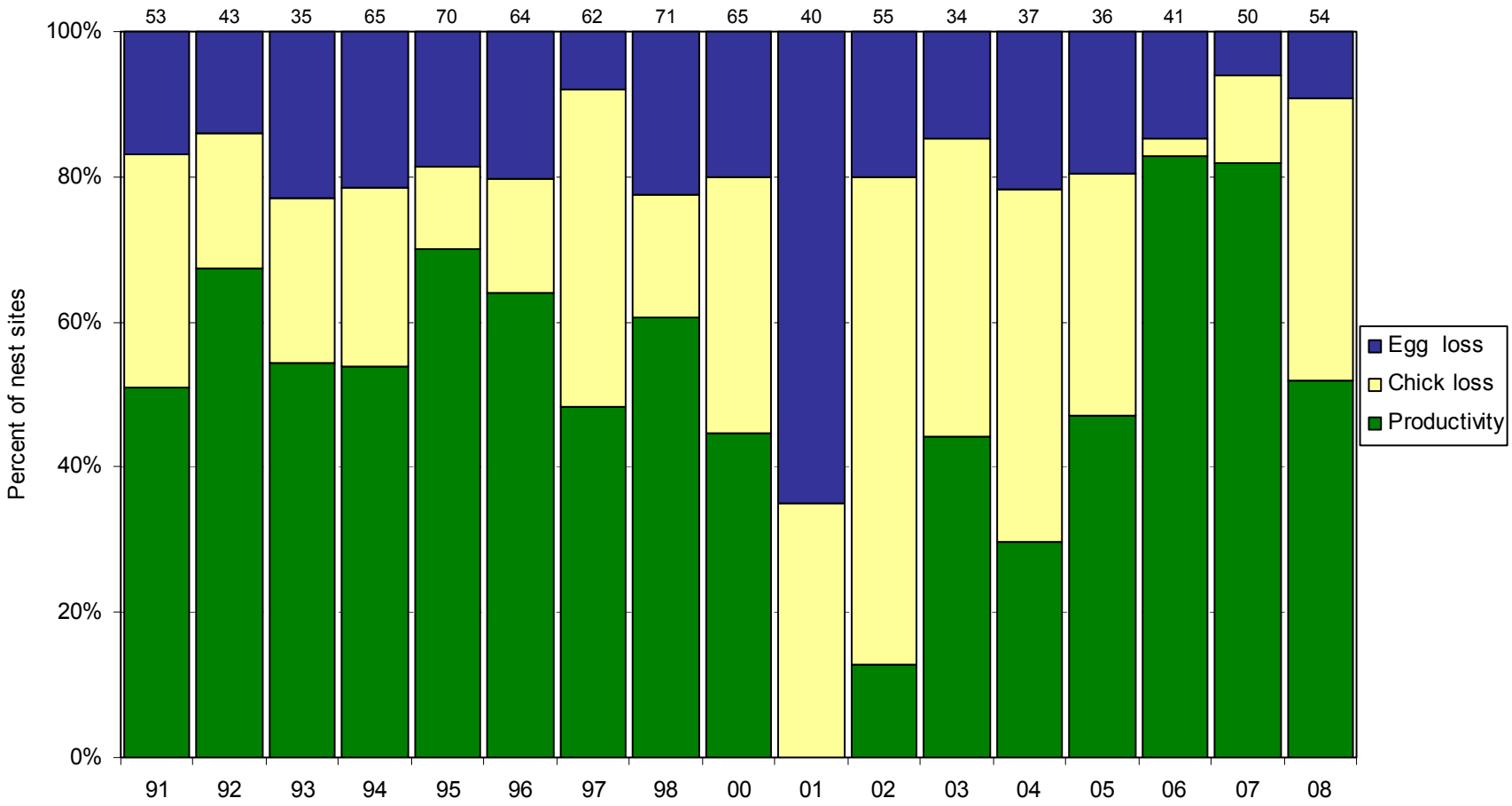

Figure 54. Reproductive performance of parakeet auklets at Buldir Island, Alaska. Egg loss=(A-B)/A; Chick loss=(B-C)/A; Productivity=C/A, where A=number of nest sites, B=number of nest sites with a chick, C=number of sites with fledged chick. The number of known fate eggs monitored are given above each bar.

Table 77. Reproductive performance of parakeet auklets at Buldir Island, Alaska.

Parameter[a]	1991	1992	1993	1994	1995	1996	1997	1998	1999
No. eggs found (A)	53	43	35	65	70	64	62	71	0
No. eggs lost to:									
disappearance	2	3	4	6	5	9	1	11	--
abandonment	3	3	3	6	6	3[b]	2	5	--
breakage	4	0	1	2	2	1	2	0	--
No. eggs hatched (B)	44	37	27	51	57	51	57	55	--
No. chicks lost to:									
disappearance	8	6	7	12	8	2	9	0	--
death	9	2	1	4	0	8	18	12	--
No. chicks fledged (C)[c]	27	29	19	35	49	41	30	43	--
Hatching success (B/A)	0.83	0.86	0.77	0.78	0.81	0.8	0.92	0.77	--
Fledging success (C/B)c	0.61	0.78	0.7	0.69	0.86	0.8	0.53	0.78	--
Reproductive success (C/A)	0.51	0.67	0.54	0.54	0.7	0.64	0.48	0.61	--
Productivity (hs x fs)	0.51	0.67	0.54	0.54	0.7	0.64	0.49	0.6	--

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

Table 77 continued. Reproductive performance of parakeet auklets at Buldir Island, Alaska.

Parameter[a]	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. eggs found (A)	65	40	55	34	37	36	41	50	54
No. eggs lost to:									
disappearance	10	8	6	0	3	2	1	2	0
abandonment	3	18	5	5	3	5	4	0	2
breakage	0	0	0	0	2	0	0	1	3
No. eggs hatched (B)	52	14	44	29	29	29	35	47	49
No. chicks lost to:									
disappearance	22	3	6	10	6	5	0	3	0
death	1	11	27	4	12	7	1	3	21
No. chicks fledged (C)[c]	29	0	7	15	11	17	34	41	28
Hatching success (B/A)	0.8	0.35	0.8	0.85	0.78	0.81	0.85	0.94	0.91
Fledging success (C/B)	0.56	0	0.16	0.52	0.38	0.59	0.97	0.87	0.57
Reproductive success (C/A)	0.45	0	0.13	0.44	0.3	0.47	0.83	0.82	0.52
Productivity (hs x fs)	0.45	0	0.13	0.44	0.3	0.48	0.82	0.82	0.52

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

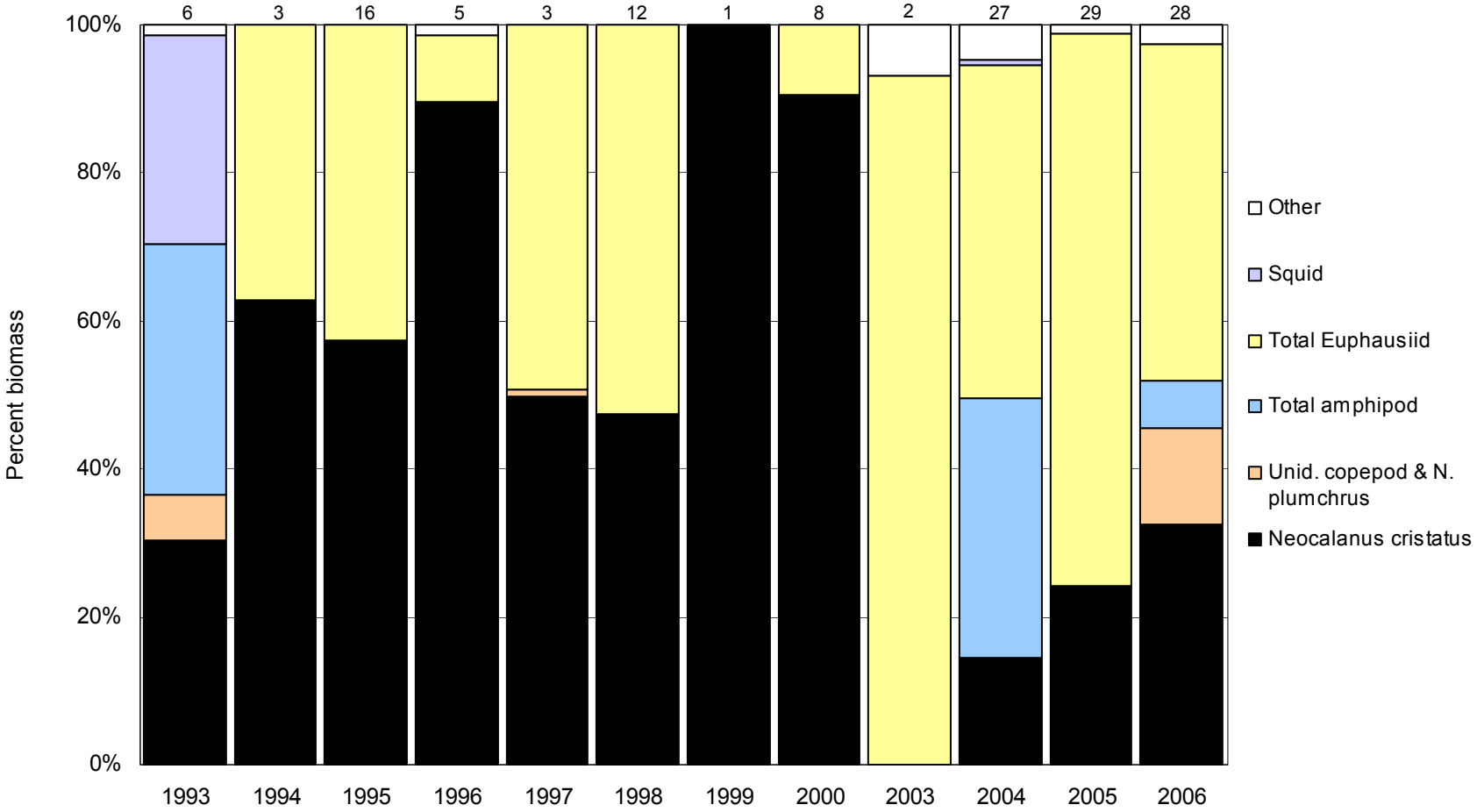

Figure 55. Relative biomass of prey in diets of parakeet auklets at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

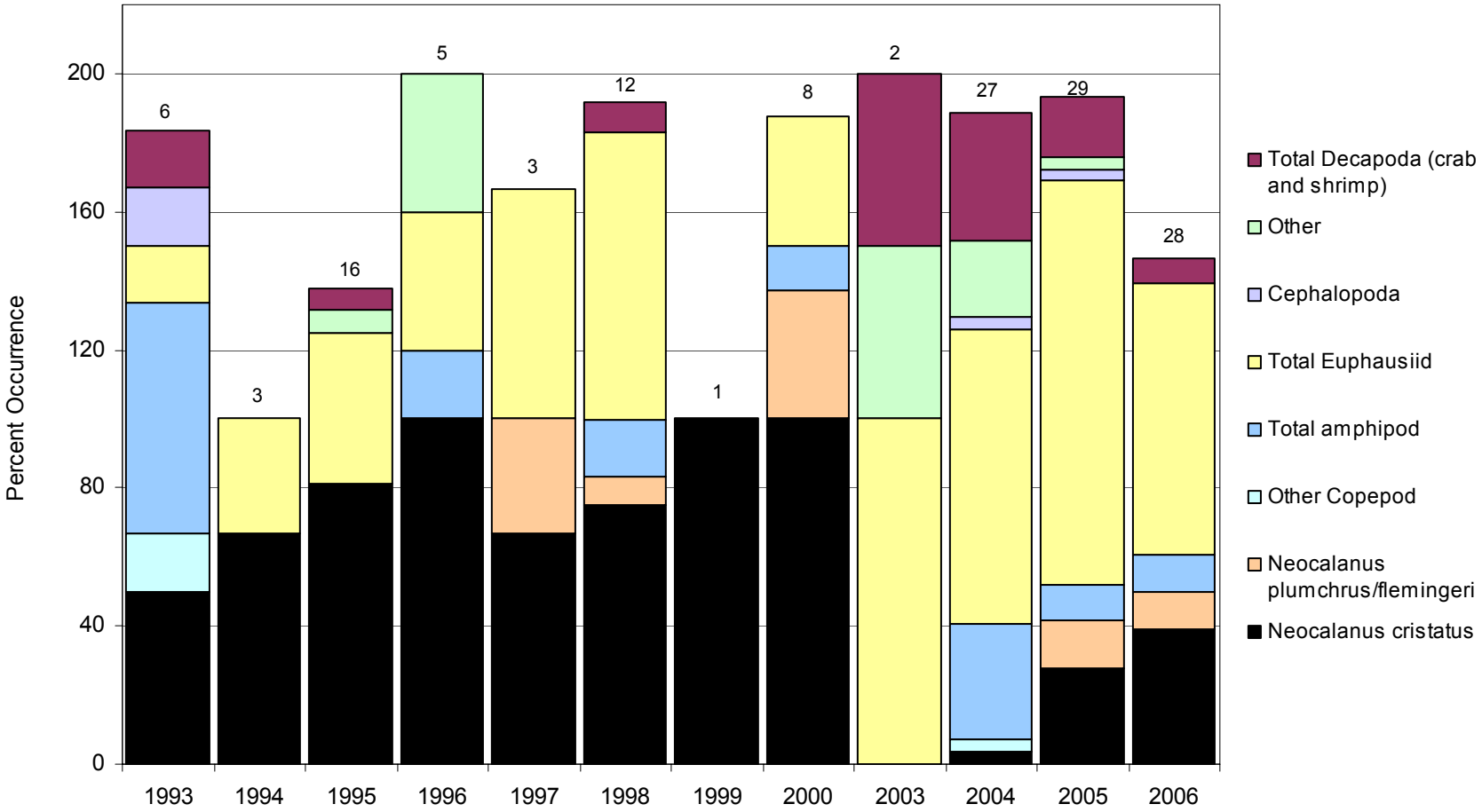

Figure 56. Frequency of occurrence of prey in diets of parakeet auklets at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 78. 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. Data from 2001-2002 have not yet been analyzed.

	1993	1994	1995	1996	1997	1998	1999	2000	2003	2004	2005	2006
No. samples	6	3	16	5	3	12	1	8	2	27	29	28
Total mass (g)	14.2	8.6	174.3	24.6	36.8	91.1	0.7	37.2	2.96	31.8	98.2	18.7
Pteropoda	--	--	<0.1	1.3	--	--	--	--	--	--	--	--
Periostracum	--	--	--	--	--	--	--	--	--	.14	--	--
Cephalopoda - squid	28.2	--	--	--	--	--	--	--	2.0	.75	.18	--
Gonatidae	--	--	--	--	--	--	--	--	--	--	--	--
Worm	--	--	--	--	--	--	--	--	--	--	--	--
Copepoda												
Neocalanus cristatus	30.3	62.8	57.4	89.2	49.6	43.0	100.0	90.4	--	14.3	24	32.4
N. plumchrus/flemingeri	--	--	--	--	1.1	<0.1	--	--	--	--	.24	13
Calanoid spp.	--	--	--	--	--	--	--	--	--	.08	--	--
Unid. copepod	6.2	--	--	--	--	--	--	--	--	--	--	--
Amphipoda												
Hyperiidea												
Parathemisto pacifica	32.8	--	--	<0.1	--	--	--	.2	--	35.1	--	6.4
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	.03	--
Primno macropa	1.1	--	--	--	--	--	--	--	--	--	--	--
Hyperoche medusarum	--	--	--	--	--	0.1	--	--	--	.01	--	--
Gammaridea												
Lysianassidae	--	--	--	--	--	0.1	--	--	--	--	--	--
Euphausiacea												
Thysanoessa spp.	0.1	37.2	42.5	9.5	49.2	--	--	--	69.3	28.3	57.8	4.2
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	2.8	--
Unid. euphausid	--	--	--	--	--	47.8	--	9.5	21.9	16.8	13.9	41.4
Decapoda												
Pandalid shrimp	--	--	--	--	--	--	--	--	6.6	--	--	--
Larval shrimp	--	--	--	--	--	--	--	--	--	.04	1.1	2.1
Crab zoea	--	--	0.1	--	--	--	--	--	--	.06	.01	--
Oregoninae	1.4	--	--	--	--	--	--	--	--	--	--	--
Atelecyclidae megalopa	--	--	--	--	--	<0.1	--	--	--	4.4	.02	.5
Unid mollusk	--	--	--	--	--	--	--	--	--	--	--	--
Insect	--	--	--	--	--	--	--	--	--	--	--	--

Table 79. Frequency of occurrence of prey in diets of parakeet auklets at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

	1993	1994	1995	1996	1997	1998	1999	2000	2003	2004	2005	2006
No. samples	6	3	16	5	3	12	1	8	2	27	29	28
Pteropoda	--	--	6.3	40.0	--	--	--	--	--	--	--	--
Periostracum	--	--	--	--	--	--	--	--	--	14.8	--	--
Cephalopoda - squid	16.7	--	--	--	--	--	--	--	--	3.7	--	--
Gonatidae	--	--	--	--	--	--	--	--	--	--	3.5	--
Worm	--	--	--	--	--	--	--	--	--	--	3.5	--
Copepoda												
Neocalanus cristatus	50.0	66.7	81.3	100.0	66.7	75.0	100.0	100.0	--	3.7	27.6	39.3
N. plumchrus/flemingeri	--	--	--	--	33.3	8.3	--	37.5	--	--	--	10.7
Calanoid spp.	--	--	--	--	--	--	--	--	--	3.7	13.8	--
Unid. copepod	16.7	--	--	--	--	--	--	--	--	3.7	--	--
Amphipoda (Unknown)	--	--	--	--	--	--	--	--	--	--	--	7.1
Hyperiidea												
Parathemisto pacifica	50.0	--	--	20.0	--	--	--	12.5	--	33.3	--	3.6
Parathemisto spp.	--	--	--	--	--	--	--	--	--	--	10.3	--
Primno macropa	16.7	--	--	--	--	--	--	--	--	--	--	--
Hyperoche medusarum	--	--	--	--	--	8.3	--	--	--	--	--	--
Gammaridea												
Lysianassidae	--	--	--	--	--	8.3	--	--	--	--	--	--
Euphausiacea												
Thysanoessa spp.	16.7	33.3	43.8	40.0	66.7	--	--	--	50.0	18.5	31.0	3.6
Thysanoessa raschii	--	--	--	--	--	--	--	--	--	--	6.9	--
Unid. euphausid	--	--	--	--	--	83.3	--	37.5	50.0	66.7	79.3	75
Decapoda												
Pandalid shrimp	--	--	--	--	--	--	--	--	50.0	--	--	--
Larval shrimp	--	--	--	--	--	--	--	--	--	3.7	10.3	3.6
Crab zoea	--	--	6.3	--	--	--	--	--	--	3.7	3.5	--
Crab megalopa	--	--	--	--	--	--	--	--	--	--	3.5	3.6
Oregoninae	16.7	--	--	--	--	--	--	--	--	--	--	--
Atelecyclidae megalopa	--	--	--	--	--	8.3	--	--	--	29.6	--	--
Unid mollusk	--	--	--	--	--	--	--	--	50.0	--	--	--
Insect	--	--	--	--	--	--	--	--	--	7.4	--	--

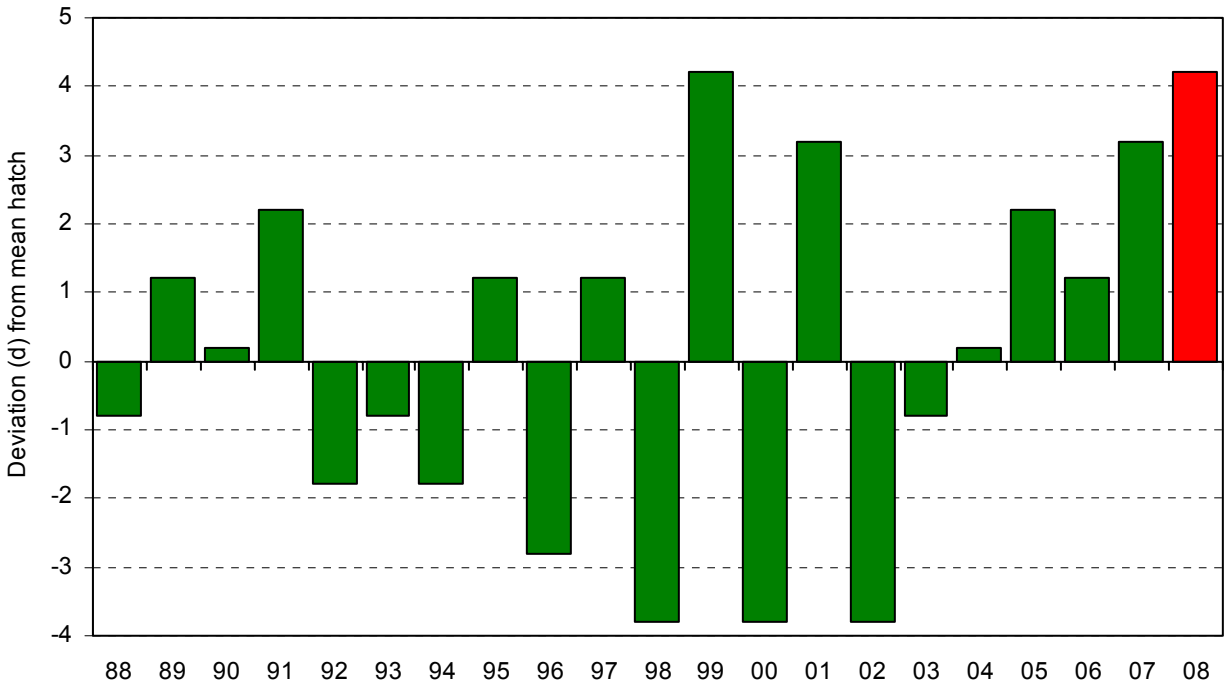

Figure 57. Yearly hatch date deviation (from the 1988-2007 average of 24 July) of horned puffins at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

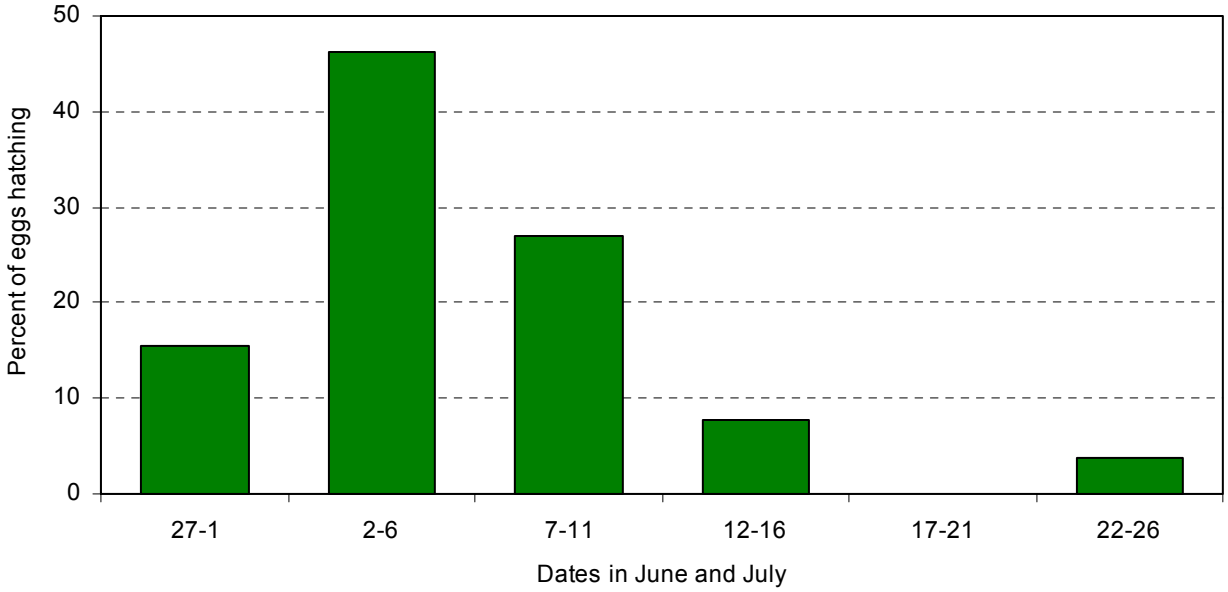

Figure 58. Hatching chronology of horned puffins at Buldir Island, Alaska in 2008 (*n*=26).

Table 80. Breeding chronology dates for horned puffins at Buldir Island, Alaska.

Year	mean hatch	SD	*n*[a]	median hatch	no. nests monitored[b]	first hatch	last hatch	first fledge
1988	22 Jul	6.8	18	23 Jul	38	30 Jun	14 Aug	3 Sep
1989	25 Jul	6.1	7	23 Jul	39	9 Jul	8 Aug	>22 Aug[c]
1990	24 Jul	7.9	19	19 Jul	52	9 Jul	10 Aug	12 Aug
1991	26 Jul	4.7	15	27 Jul	71	15 Jul	6 Aug	>14 Aug
1992	21 Jul	4.8	8	20 Jul	27	11 Jul	5 Aug	>12 Aug
1993	23 Jul	4.5	12	25 Jul	19	15 Jul	3 Aug	28 Aug
1994	22 Jul	3.6	15	23 Jul	36	9 Jul	1 Aug	28 Aug
1995	25 Jul	6.0	10	24 Jul	38	15 Jul	4 Aug	>18 Aug
1996	20 Jul	2.7	13	20 Jul	51	10 Jul	7 Aug	>18 Aug
1997	25 Jul	4.7	21	24 Jul	52	15 Jul	6 Aug	>19 Aug
1998	20 Jul	7.4	16	23 Jul	39	5 Jul	2 Aug	>27 Aug
1999	28 Jul	5.9	13	25 Jul	25	22 Jul	8 Aug	>26 Aug
2000	19 Jul	8.3	21	18 Jul	62	2 Jul	2 Aug	>28 Aug
2001	27 Jul	8.0	13	25 Jul	60	16 Jul	12 Aug	25 Aug
2002	20 Jul	5.1	42	19 Jul	91	21 Jun	7 Aug	>4 Sep
2003	23 Jul	8.4	10	19 Jul	26	9 Jul	12 Aug	24 Aug
2004	24 Jul	5.5	15	23 Jul	53	29 Jun	2 Aug	>24 Aug
2005	26 Jul	3.0	8	25 Jul	24	19 Jul	6 Aug	>24 Aug
2006	26 Jul	9.9	24	25 Jul	60	1 Jul	16 Aug	16 Aug
2007	27 Jul	4.6	18	26 Jul	40	17 Jul	4 Aug	>24 Aug
2008	27 Jul	5.6	26	25 Jul	47	19 Jul	13 Aug	>25 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 from egg to chick except in 1989 when ≤ 8 days; 1990 when ≤10 days; and1993 when ≤ 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 ">".

Table 81. Frequency distribution of hatch dates for horned puffins at Buldir Island, Alaska. Data in 1989, 1990, and 1993 include egg to chick intervals of ≤ 8, 10, and 9 days, respectively.

Julian	No. nests hatching on Julian date																				
Date	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
180	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
181	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
182	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
183	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
184	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--
185	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
186	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	1	--	--
187	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
188	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
189	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
190	--	--	1	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--
191	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
192	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
193	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
194	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--
195	--	--	--	--	--	--	--	--	1	--	--	--	4	--	1	--	--	--	--	--	--
196	--	--	--	--	--	1	1	1	--	1	2	--	--	--	--	1	--	--	--	--	--
197	--	--	--	--	--	--	--	--	--	--	1	--	--	6	2	--	--	--	--	--	--
198	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	2	--	--	1	--
199	--	--	--	--	--	--	--	--	--	--	--	--	2	--	3	--	--	--	--	--	--
200	2	--	9	2	--	4	--	--	--	4	3	--	3	--	11	5	1	--	--	--	--
201	--	--	--	1	--	--	4	--	--	--	--	--	--	--	--	--	1	--	--	--	4
202	5	--	--	1	4	--	--	4	11	--	--	--	--	--	--	1	2	1	5	1	--
203	--	--	--	--	--	--	--	--	--	2	--	1	--	--	6	--	--	--	--	1	--
204	1	6	--	--	--	1	8	--	--	2	3	5	1	4	4	--	4	--	--	--	--
205	2	--	--	--	--	--	--	--	--	2	--	--	3	--	--	--	--	--	1	1	2
206	3	--	1	3	1	--	1	--	--	--	2	1	--	--	--	--	--	4	6	1	--
207	--	--	--	--	--	--	--	3	--	--	--	--	1	--	--	--	--	1	--	3	10
208	2	--	--	4	2	6	--	--	1	3	--	--	--	--	2	1	1	--	2	2	--
209	--	--	5	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	1	--
210	--	--	1	--	--	--	--	--	--	5	2	2	1	--	2	--	1	1	--	--	--
211	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	5
212	1	--	--	2	--	--	--	--	--	1	--	--	--	--	2	1	--	1	3	2	--
213	--	--	--	--	--	--	1	--	--	1	--	--	--	--	--	--	1	--	--	--	2
214	--	--	--	--	--	--	--	1	--	--	1	1	2	--	1	--	1	--	--	--	--
215	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
216	1	--	--	1	--	--	--	1	--	--	--	2	--	--	--	--	--	--	2	2	--
217	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2
218	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	1	--	--
219	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
220	--	1	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--
221	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
222	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
223	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
224	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1	--	--	--	--	--
225	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
226	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
227	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
228	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
n	18	7	19	15	8	12	15	10	13	21	16	13	21	12	42	10	14	8	24	16	25

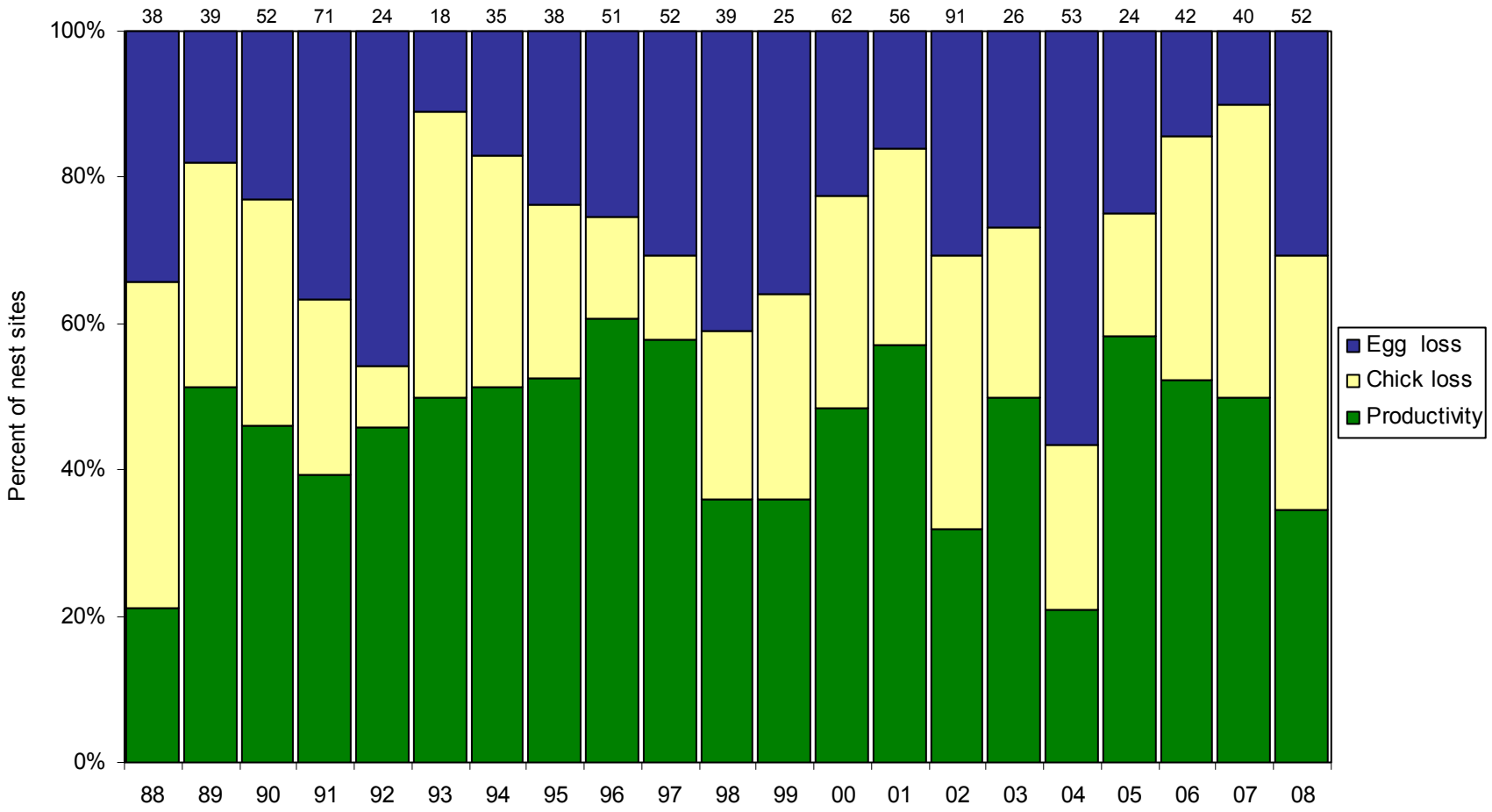

Figure 59. Reproductive performance of horned puffins at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick. The number of known fate eggs monitored are given above each bar.

Table 82. Reproductive performance of horned puffins at Buldir Island, Alaska.

Parameter[a]	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
No. eggs found (A)	38	39	52	71	24	18	35	38	51	52	39	25
No. eggs lost to:												
disappearance	11	4	12	11	9	2	5	6	8	11	8	7
abandonment	2	2	0	11	1	0	0	1	1	2	7	0
breakage	0	1	0	4	1	0	1	2	4	3	1	2
No. eggs hatched (B)	25	32	40	45	13	16	29	29	38	36	23	16
No. chicks lost to:												
disappearance	12	9	13	9	0	5	7	5	3	5	5	6
death	5	3	3	8	2	2	4	4	4	1	4	1
No. "successful" chicks (C_{1+2})	8	20	24	28	11	9	18	20	31	30	14	9
fledged[b] (C_1)	8	2	1	0	0	9	18	0	9	2	0	0
still present (C_2)	0	18	23	28	11	0	0	20	22	28	14	9
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
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
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
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

[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.

Table 82 continued. Reproductive performance of horned puffins at Buldir Island, Alaska.

Parameter[a]	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. eggs found (A)	62	56	91	26	53	24	42	40	52
No. eggs lost to:									
disappearance	14	5	14	5	14	2	5	3	12
abandonment	0	4	3	1	12	3	0	1	4
breakage	0	0	11	1	3	1	1	0	0
No. eggs hatched (B)	48	47	63	19	23	18	36	36	36
No. chicks lost to:									
disappearance	16	4	21	3	8	3	0	4	1
death	2	11	13	3	4	1	13	12	17
No. "successful" chicks (C_{1+2})	30	32	29	13	11	14	22	20	18
fledged[b] (C_1)	2	9	0	2	0	0	10	4	13
still present (C_2)	28	23	29	11	11	14	12	16	5
Hatching success (B/A)	0.77	0.84	0.69	0.73	0.43	0.75	0.86	0.9	0.69
Fledging success (C_{1+2}/B)	0.63	0.68	0.46	0.68	0.48	0.78	0.61	0.56	0.50
Reproductive success (C_{1+2}/A)	0.48	0.57	0.32	0.50	0.21	0.58	0.52	0.50	0.35
Productivity (hs x fs)	0.49	0.57	0.32	0.50	0.21	0.59	0.52	0.50	0.35

[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.

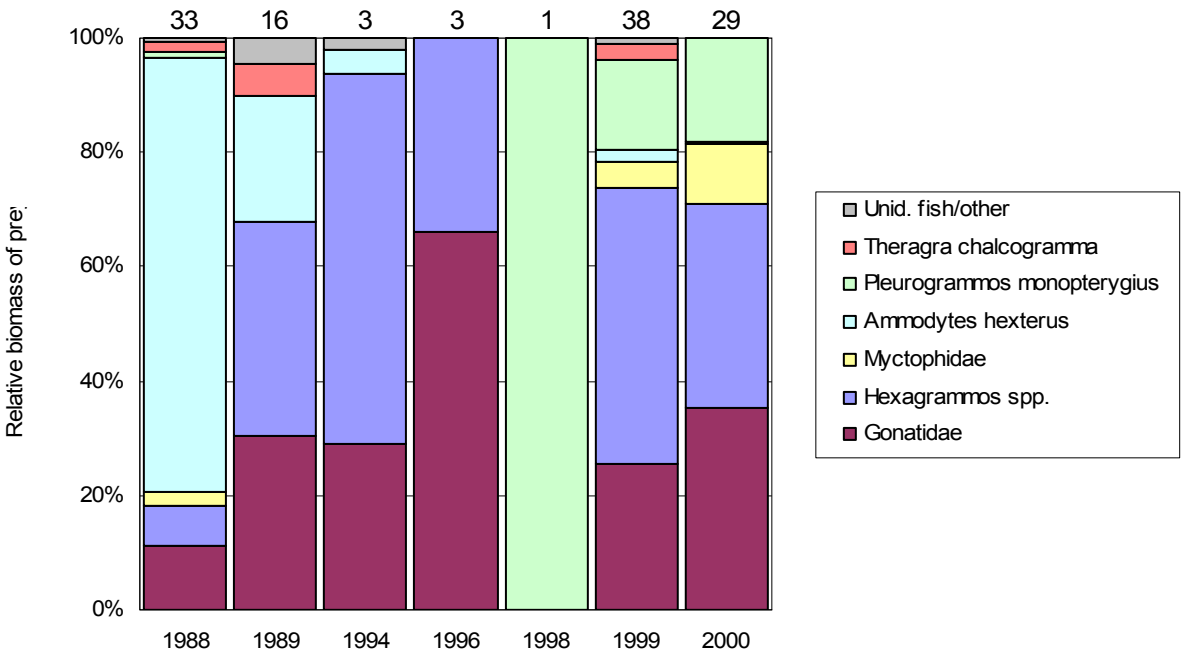

Figure 60. Relative biomass of prey in diets of horned puffins at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

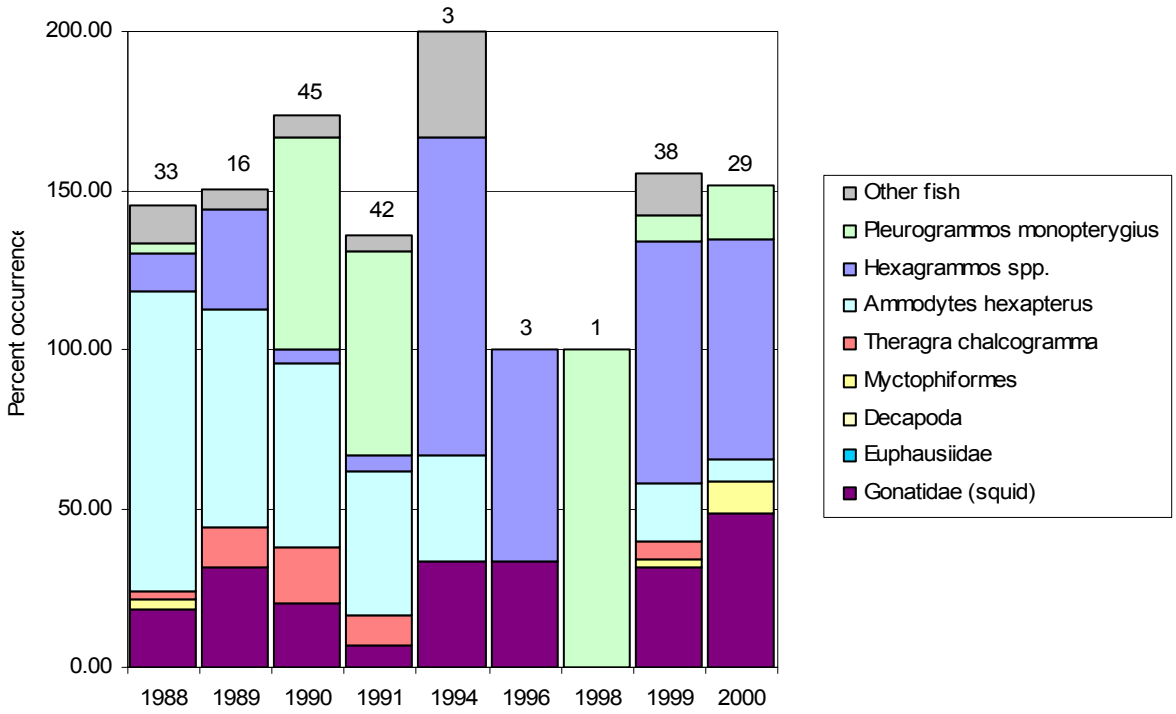

Figure 61. Frequency of occurrence of prey in diets of horned puffins at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 83. Relative biomass of prey in diets of horned puffins at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

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

Table 84. Frequency of occurrence of prey in diets of horned puffins at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

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

Table 85. Species composition of prey in diets of horned puffins at Buldir Island, Alaska. Values are expressed as the percentage of total individual prey items comprised by each species.

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

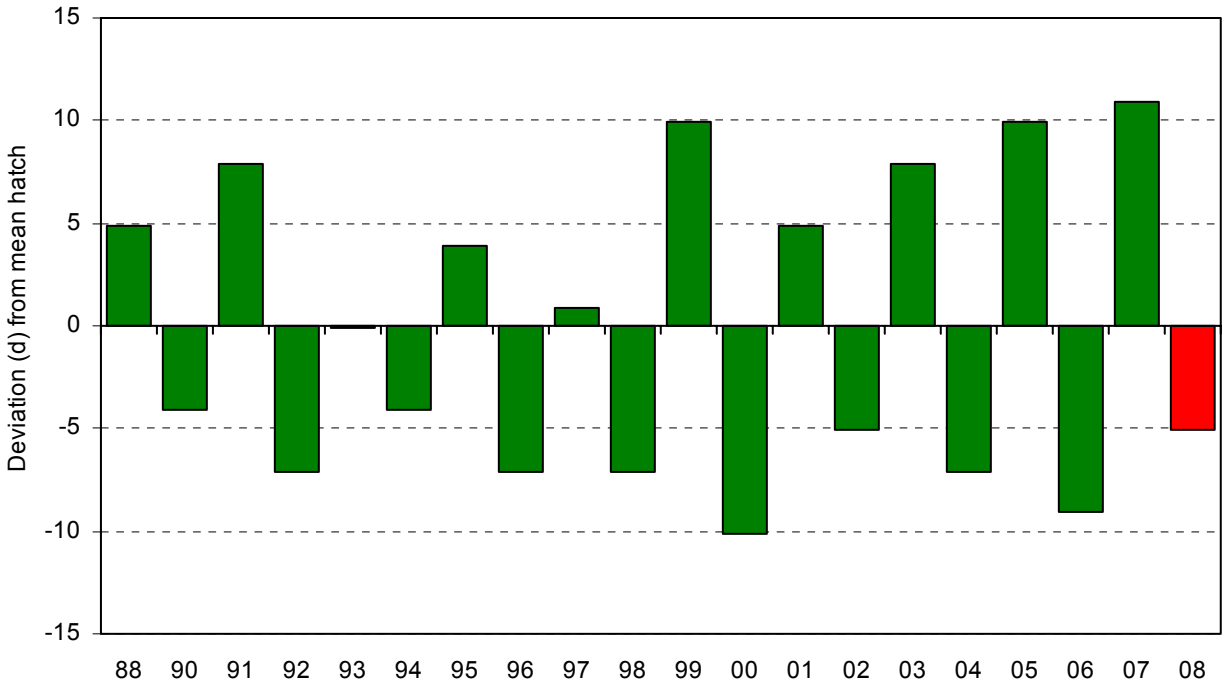

Figure 62. Yearly hatch date deviation (from the 1988-2007 average of 15 July) of tufted puffins at Buldir Island, Alaska. Numbers below the mean indicate hatch dates earlier; positive numbers indicate hatch dates later.

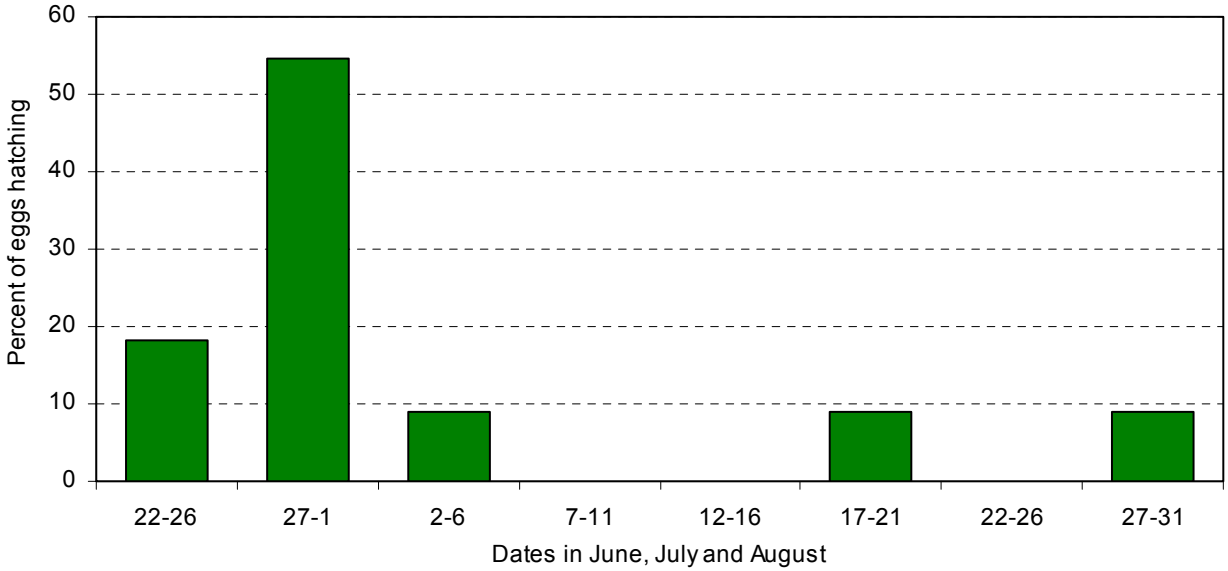

Figure 63. Hatching chronology of tufted puffins at Buldir Island, Alaska in 2008 (*n*=11).

Table 86. Breeding chronology dates for tufted puffins at Buldir Island, Alaska.

Year	mean hatch	SD	*n*[a]	median hatch	no. nests monitored[b]	first hatch	last hatch	first fledge
1988	19 Jul	3.9	8	18 Jul	17	14 Jul	24 Jul	30 Aug
1990	11 Jul	9.2	15	11 Jul	29	2 Jul	2 Aug	12 Aug
1991	23 Jul	5.9	26	21 Jul	32	12 Jul	6 Aug	>14 Aug[c]
1992	8 Jul	7.2	35	8 Jul	37	26 Jun	26 Jul	>10 Aug
1993	15 Jul	4.0	33	15 Jul	39	8 Jul	23 Jul	24 Aug
1994	10 Jul	6.3	13	9 Jul	24	2 Jul	25 Jul	18 Aug
1995	19 Jul	5.7	33	15 Jul	42	15 Jul	2 Aug	>18 Aug
1996	7 Jul	5.8	7	5 Jul	40	4 Jul	20 Jul	14 Aug
1997	16 Jul	4.8	27	15 Jul	29	9 Jul	24 Jul	>17 Aug
1998	8 Jul	8.9	21	9 Jul	52	25 Jun	23 Jul	>26 Aug
1999	25 Jul	6.7	10	23 Jul	24	13 Jul	4 Aug	24 Aug
2000	4 Jul	7.9	12	2 Jul	30	26 Jun	27 Jul	19 Aug
2001	20 Jul	0.0	1	20 Jul	30	5 Jul	25 Jul	14 Aug
2002	10 Jul	9.9	12	10 Jul	35	25 Jul	4 Aug	6 Aug
2003	23 Jul	6.9	3	27 Jul	13	10 Jul	27 Jul	18 Aug
2004	8 Jul	6.4	11	11 Jul	30	20 Jun	17 Jul	10 Aug
2005	25 Jul	4.6	5	25 Jul	11	21 Jul	1 Aug	>24 Aug
2006	6 Jul	5.1	7	4 Jul	38	1 Jul	11 Jul	22 Aug
2007[d]	26 Jul	5.5	8	25 Jul	17	<3 Jul	6 Aug	>25 Aug
2008	9 Jul	10.8	11	5 Jul	27	29 Jun	4 Aug	>25 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.
[d] In 2007 only two nests that met the chronology criteria also fledged. In order to increase the sample size we also included nests that were egg to chick ≤ 7 days apart but ultimately failed.

Table 87. Frequency distribution of hatch dates for tufted puffins at Buldir Island, Alaska. Data for 1988-1997 include intervals of both eggs or incubating birds to chicks. Data in 1998 include intervals of egg to chick ≤ 13 days. Data were not collected in 1999.

Julian	No. nests hatching on Julian date																			
Date	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
175	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
176	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--
177	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--
178	--	--	--	3	--	--	--	--	--	1	--	1	--	--	--	--	--	--	--	--
179	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
180	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
181	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	1
182	--	--	--	--	--	--	--	--	--	--	--	1	--	2	--	4	--	3	--	1
183	--	3	--	--	--	1	--	--	--	1	--	--	--	--	--	--	--	--	--	--
184	--	3	--	8	--	--	--	--	--	1	--	6	--	1	--	--	--	--	--	--
185	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1
186	--	--	--	--	--	--	--	3	--	3	--	--	--	2	--	1	--	--	--	--
187	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	5
188	--	1	--	1	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
189	--	--	--	--	1	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--
190	--	--	--	12	6	8	--	--	1	3	--	2	--	1	--	--	--	--	--	--
191	--	--	--	--	--	--	--	--	6	--	--	--	--	2	--	--	--	--	--	--
192	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	3	--	--
193	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
194	--	2	1	--	--	--	--	--	1	--	1	--	--	--	--	3	--	--	--	--
195	--	--	--	6	--	--	--	--	--	--	--	--	--	1	--	1	--	--	--	--
196	1	--	1	--	16	--	19	--	10	4	--	--	--	1	1	--	--	--	--	--
197	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--
198	2	3	1	--	--	--	--	--	2	--	--	--	--	--	--	1	--	--	--	--
199	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
200	2	--	5	--	8	--	--	--	2	3	--	--	--	--	--	--	--	--	--	--
201	--	--	4	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--
202	--	--	--	4	--	--	7	1	--	--	--	--	--	--	--	--	2	--	--	--
203	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
204	1	1	1	--	2	1	--	--	--	1	3	--	--	1	--	--	--	--	3	--
205	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	1
206	2	--	8	--	--	1	1	--	--	--	--	--	--	--	--	--	1	--	--	--
207	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--
208	--	--	1	1	--	--	--	--	--	--	--	--	--	--	2	--	1	--	3	--
209	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
210	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--
211	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
212	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
213	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--
214	--	1	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--
215	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
216	--	--	1	--	--	--	--	--	--	--	1	--	--	1	--	--	--	--	--	--
217	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
218	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
219	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
220	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n	8	15	26	35	33	13	33	7	27	21	10	12	1	12	3	11	5	7	8	11

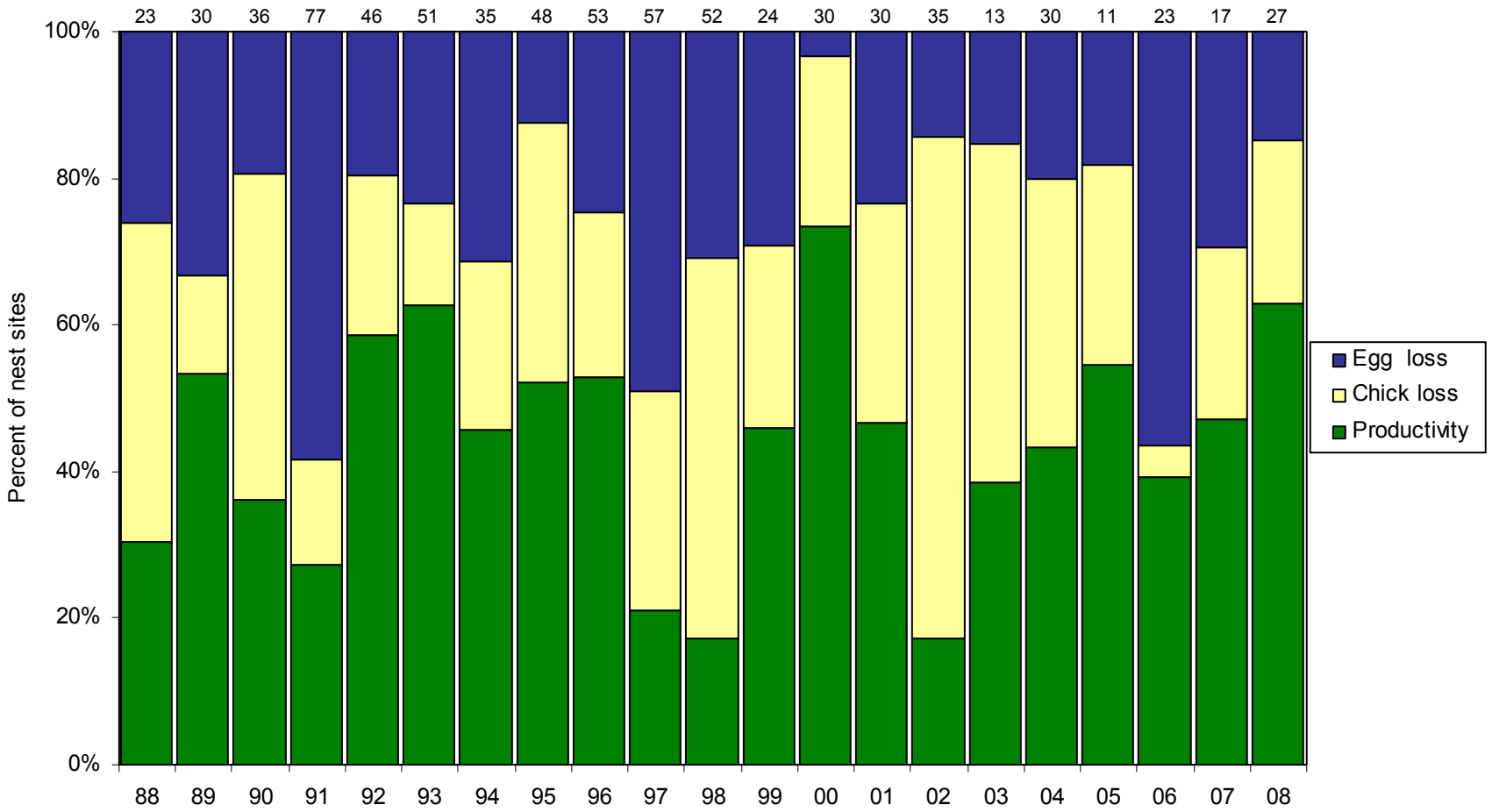

Figure 64. Reproductive performance of tufted puffins at Buldir Island, Alaska. Egg Loss=(A-B)/A; Chick Loss=(B-C)/A; Productivity=C/A, where A=number nest sites, B=number of nest sites with a chick; C=number of nests sites with fledged chick. The number of known fate eggs monitored are given above each bar.

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

Parameter[a]	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
No. eggs found[b] (A)	23	30	36	77	46	51	35	48	53	57	52	24
No. eggs lost to:												
disappearance	2	5	5	23	4	11	7	2	6	18	10	2
abandonment	3	4	2	18	5	1	3	0	1	2	6	5
breakage	1	1	0	4	0	0	1	4	6	8	0	0
No. eggs hatched (B)	17	20	29	32	37	39	24	42	40	29	36	17
No. chicks lost to:												
disappearance	2	0	14	9	7	6	6	13	6	11	15	6
death	8	4	2	2	3	1	2	4	6	6	12	2
No. "successful" chicks (C_{1+2})	7	16	13	21	27	32	16	25	28	12	9	11
fledged[c] (C_1)	6	6	7	2	9	30	15	8	25	8	0	1
still present (C_2)	1	10	6	19	18	2	1	17	3	4	9	10
Hatching success (B/A)	0.74	0.67	0.81	0.42	0.8	0.76	0.69	0.88	0.75	0.51	0.69	0.71
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
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
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

[a] Nest sites included in productivity estimates were visited at intervals of < 10 days at hatch and fledge/disappearance, but sites with larger intervals were included when the fate was known (dead chick observed, chick still alive at last visit, chick disappeared so early or so late that its fate would be the same even at ±half the visit interval).

[b] Sites at which an apparently incubating bird was observed on 2 consecutive visits were assumed to have an egg, regardless of whether or not a chick was later observed at that site.

[c] For chicks to be considered fledged, they had to be at least 38 days old before disappearing or 33 days old at the time of the last visit, if still present.

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

Parameter[a]	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. eggs found[b] (A)	30	30	35	13	30	11	23	17	27
No. eggs lost to:									
disappearance	0	3	4	2	5	1	1	1	3
abandonment	1	4	0	0	1	1	4	4	1
breakage	0	0	1	0	0	0	8	0	0
No. eggs hatched (B)	29	23	30	11	24	9	10	12	23
No. chicks lost to:									
disappearance	7	6	14	4	6	3	0	2	1
death	0	3	10	2	5	0	1	2	5
No. "successful" chicks (C_{1+2})	22	14	6	5	13	6	9	8	17
fledgedc (C_1)	2	2	2	3	2	0	3	7	16
Still present (C_2)	20	12	4	2	11	6	6	1	1
Hatching success (B/A)	0.97	0.77	0.86	0.85	0.80	0.82	0.44	0.71	0.85
Fledging success (C_{1+2}/B)	0.76	0.61	0.20	0.46	0.55	0.67	0.90	0.67	0.74
Reproductive success (C_{1+2}/A)	0.73	0.47	0.17	0.38	0.43	0.55	0.39	0.47	0.63
Productivity (hs x fs)	0.74	0.47	0.17	0.39	0.44	0.55	0.39	0.47	0.63

[a] Nest sites included in productivity estimates were visited at intervals of < 10 days at hatch and fledge/disappearance, but sites with larger intervals were included when the fate was known (dead chick observed, chick still alive at last visit, chick disappeared so early or so late that its fate would be the same even at ±half the visit interval).

[b] Sites at which an apparently incubating bird was observed on 2 consecutive visits were assumed to have an egg, regardless of whether or not a chick was later observed at that site.

[c] For chicks to be considered fledged, they had to be at least 38 days old before disappearing or 33 days old at the time of the last visit, if still present.

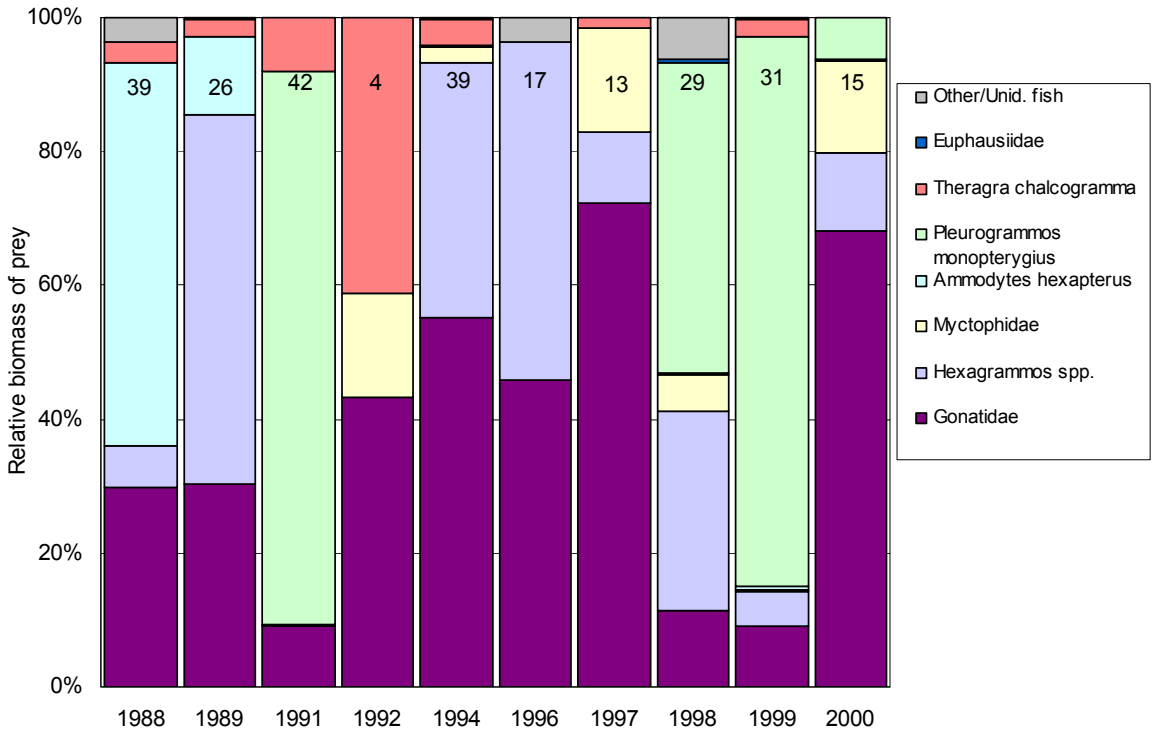

Figure 65. Relative biomass of prey in diets of tufted puffins at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

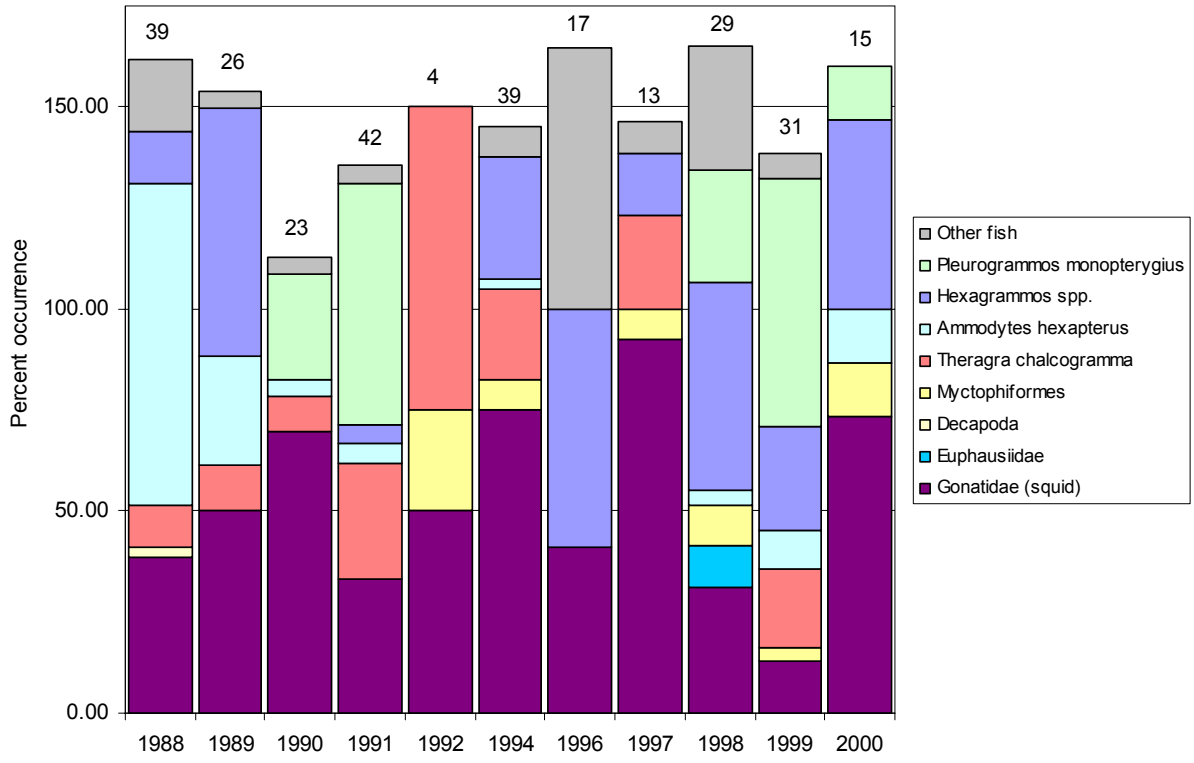

Figure 66. Frequency of occurrence of prey in diets of tufted puffins at Buldir Island, Alaska. Numbers above columns indicate sample sizes.

Table 89. Relative biomass of prey in diets of tufted puffins at Buldir Island, Alaska. Numbers represent the percentage of the mass of combined food samples comprised by each species.

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

Table 90. Frequency of occurrence of prey in diets of tufted puffins at Buldir Island, Alaska. Frequency is expressed as the percentage of food samples in which each species was present.

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

Table 91. Species composition of prey in diets of tufted puffins at Buldir Island, Alaska. Values are expressed as the percentage of total number of individual prey items comprised by each species for each year.

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

Table 92. Numbers of birds detected on off-road point count route number 315, Buldir Island, Alaska. Point counts were not conducted in 1999, 2000, 2004, 2007, or 2008.

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

[a] For those species marked with an asterisk, we observed pairs, nests, and/or territorial males.
[b] Total number of individuals detected on survey.
[c] In 2005 the count at point 5 was missed and points 6-12 were conducted in conditions which made detection difficult.

Table 93. Numbers of resident passerine birds detected on off-road point count route number 315, Buldir Island, Alaska, in 2008..

Species	Point no. 1	2	3	4	5	6	7	8	9	10	11	12	Total[a]	% of total[b]	% of points[c]

NO POINT COUNT CONDUCTED IN 2008

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

Table 94. 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	USFWS unpublished data
1992	April	--	--	--	--	--	--	11	aerial	Evans et al. 1997
1995	28 June	0	0	2	0	0	0	2	boat	USFWS unpublished data
1997	3 June	--	--	--	--	--	--	4	boat	USFWS unpublished data
1998	13 June	0	1	5	3	1	0	10	boat	USFWS unpublished data
1999	1 July	0	0	0	0	2	2	4	boat	USFWS unpublished data
2000	20 June	0	0	0	0	5	0	5	boat	USFWS unpublished data
2001	5 June	0	0	0	0	0	0	0	boat	USFWS unpublished data
2002	2 July	0	0	0	6	0	1	7	boat	USFWS unpublished data
2005	10 June	0	0	--	--	--	0[h]	0	boat	USFWS unpublished data
2006	7 June	0	0	0	0	0	0	0	boat	USFWS unpublished data
2007	2 June	0	1	0	1	0	0	2	boat	USFWS unpublished data
2008	3 June	0	0	0	0	0	0	0	boat	USFWS unpublished 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

Table 95. Annotated list of species observed at Buldir Island, Alaska, 26 May through 27 August 2008.

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 or less

Birds

Aleutian cackling goose (*Branta hutchinsii leucopareia*) – Abundant breeder. Twenty-four eggs from the western side of the island were floated on 13 June: mean hatch date was estimated at 21 June and mean clutch size was 4.1 eggs. One bird with a color band was resighted: blue 370, and one band (blue 63J) was recovered without obvious sign of a mortality event.

Eurasian wigeon (*Anas penelope*) – Eurasian wigeon was an uncommon spring migrant on the island in 2008. A maximum of 8 individuals were present at Bean Goose Pond on 27 May.

American wigeon (*Anas Americana*) – A single bird was present during the last week of May.

Mallard (*Anas platyrhynchos*) – A single mallard was present during June and the first week of July.

Northern pintail (*Anas acuta*) – Northern pintail was an uncommon spring migrant; 2-5 individuals were present during late May and early June.

Green-winged teal (*Anas crecca*) – The Eurasian subspecies of green-winged teal (*A. c. crecca*) was an uncommon migrant on Buldir Island. A maximum of eight individuals were recorded in June.

Common pochard (*Aythya ferina*) – A lone male was observed on 3 June during the circumnavigation.

Tufted duck (*Aythya fuligula*) – A tufted duck was seen at least two times in late May. Tufted duck is considered rare on the Checklist of Alaska Birds.

Greater scaup (*Aythya marila*) – A dead greater scaup was found in late may near Whale Pond in South Marsh.

Common eider (*Somateria mollissima*) – Common breeder. Eighty-six individuals were counted on the 3 June circumnavigation. Chicks were first observed on 22 June.

Harlequin duck (*Histrionicus histrionicus*) – Harlequin ducks were found along the entire coast of the island throughout the season, but abundance was highest early and late in the season. Forty-two individuals were counted on the 3 June circumnavigation.

White-winged scoter (*Melanitta fusca*) – One bird was seen on the 3 June circumnavigation and two individuals were seen off of North Bight beach on 12 June.

Black scoter (*Melanitta nigra*) – Four black scoters were present off of North Bight Beach in late May.

Red-breasted merganser (*Mergus serrator*) – A red-breasted merganser female was present off North Bight Beach on 17 and 27 June.

Laysan albatross (*Phoebastria immutabilis*) – This species is uncommon offshore and could occasionally be seen in small numbers from North Bight Beach when scoped for.

Northern fulmar (*Fulmarus glacialis*) – Abundant breeder. Nests colonially at East Cape, Kittiwake Lane, and Spike Camp. Most birds were dark morphs, but several light morph individuals also nested on the island.

Fork-tailed storm-petrel (*Oceanodroma furcata*) – Abundant breeder. Nests in burrows and crevices throughout lower elevations of the island. Productivity rates were average this year (81%).

Leach's storm-petrel (*Oceanodroma leucorhoa*) – Abundant breeder. Nests sympatrically with Fork-tailed storm-petrel. Productivity rates were average this year (83%).

Red-faced cormorant (*Phalacrocorax urile*) – Common breeder. Nests on sea-facing cliffs around the island, but most activity confined to the south side. Five of the nine monitored nests produced 14 large chicks this year.

Pelagic cormorant (*Phalacrocorax pelagicus*) – Abundant breeder. Nests on sea-facing cliffs around the island, especially the north side. Forty-four of 82 monitored nests produced 112 large chicks this year.

Bald eagle (*Haliaeetus leucocephalus*) – Rare breeder. A few adults and one immature bird were observed throughout the season. Only one nest site (on the east end of Camp Valley) was located. This nest subsequently failed in mid-June.

Peregrine falcon (*Falco peregrinus*) – Uncommon breeder. Adult and immature peregrine falcons were observed throughout the season; recently fledged birds were seen regularly near camp in August.

Sandhill crane (*Grus canadensis*) – One bird was observed on 10 July near camp. Another individual was observed near the pass on 16 Aug and two birds were spotted in the same area on 17 Aug.

Lesser sand-plover (*Charadrius monolus*) – A single individual was present near Crested Point on 3-4 June (Figure 67).

Wandering tattler (*Heteroscelus incanus*) – This species was present in small numbers from 26 May through 13 June and again on 18 July and 17 August. A maximum of three individuals were recorded in the spring and only one was noted in the fall. All sightings were between North Bight Beach and Main Talus.

Wood sandpiper (*Tringa glareola*) – Wood sandpiper (Figure 68) was present in small numbers from 27 May-7 June (high count of 2 individuals) and again from 17-22 August (high of three birds).

Whimbrel (*Numenius phaeopus*) – A single bird was observed in North Marsh on 2 June.

Black-tailed godwit (*Limosa limosa*) – A black-tailed godwit was observed and photographed (Figure 69) in North Marsh on 27 May.

Ruddy turnstone (*Arenaria interpres*) – Ruddy turnstones were seen on multiple occasions throughout the season, with peak numbers (high count of two on 19 June) occurring in mid-June.

Sanderling (*Calidris alba*) – A single bird (Figure 70) was observed near Tattler creek on 11 and 13 June.

Little stint (*Calidris minuta*) – A little stint was recorded at Teal Pond on 17 August.

Long-toed stint (*Calidris subminuta*) – A lone long-toed stint was observed in North Marsh on 4 June. This species is considered rare on the Checklist of Alaska Birds.

Pectoral sandpiper (*Calidris melanotos*) – A single pectoral sandpiper was found near Crested Point on 24 – 26 July (Figure 71).

Long-billed dowitcher (*Limnodromus scolopaceus*) – A single bird was recorded in the small ponds near Spike Camp on 29 July and 4 August (Figure 72). These records are earlier than the earliest record provided Gibson and Byrd (2007).

Common snipe (*Gallinago gallinago*) – A common snipe was recorded in South Marsh on 7 June.

Red-necked phalarope (*Phalaropus lobatus*) – A single bird was observed and photographed near the outflow of Tattler Creek on 31 July (Figure 73).

Black-legged kittiwake (*Rissa tridactyla*) – Abundant breeder. Black-legged kittiwakes nested in large colonies at East Cape, Kittiwake Lane, Spike Camp, and Middle and Outer Rocks. Productivity was very high at Spike Camp (39%) and was the highest ever recorded at the Kittiwake Lane plots (79%).

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. Productivity was the highest ever recorded at Spike Camp (47%) while the Kittiwake Lane plots were the second highest ever (66%).

Slaty-backed gull (*Larus schistisagus*) – An adult bird (likely the same resident individual that hybridized with a glaucous-winged gull and hatched chicks in 2005) was seen on several occasions throughout the summer.

Glaucous-winged gull (*Larus glaucescens*) – Abundant breeder. This seemed to be a relatively good year for glaucous-winged gull productivity. The number of fledglings between Crested Point and the western end of North Bight Beach—an area where many juvenile gulls congregate— routinely had several hundred fledglings (maximum estimate of 410 in mid-August).

Glaucous gull (*Larus hyperboreus*) – Two immature glaucous gulls were seen sporadically on North Bight Beach from 31 May until 27 July.

Parasitic jaeger (*Stercorarius parasiticus*) – Uncommon to fairly common breeder. Parasitic jaegers (primarily dark –morph birds) were commonly observed throughout the island, with the greatest concentrations occurring in higher elevations.

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*) – Uncommon breeder. Pigeon guillemots were regularly seen just offshore around the island. Twenty-one birds were counted on the 3 June circumnavigation.

Ancient murrelet (*Synthliboramphus antiquus*) – Abundant breeder. Although seen only occasionally during the day, this species nested on Buldir Island in large numbers.

Cassin's auklet (*Ptychoramphus aleuticus*) – This species breeds on Buldir but the abundance is difficult to determine. Cassin's auklets were rarely encountered, primarily during nighttime hours.

Parakeet auklet (*Cyclorrhynchus psittacula*) – Abundant breeder. Parakeet auklets nested in talus at Northwest Ridge, Spike Camp, and in smaller numbers at Main Talus and Crested Point. Parakeet auklet productivity was average (52%) but was likely reduced by a very high chick loss rate of 39%.

Least auklet (*Aethia pusilla*) – Abundant breeder. This auklet, the second most abundant on Buldir, seems to be most common at Main Talus. Least auklets exhibited an above average productivity rate of 70%.

Whiskered auklet (*Aethia pygmaea*) – Abundant breeder. This nocturnal auklet was found nesting throughout coastal areas of the island, but are most common at Northwest Ridge, Main Talus, and Crested Point. Whiskered auklets exhibited a very high productivity rate of 85%.

Crested auklet (*Aethia cristatella*) – Abundant breeder. Crested Auklets were the most abundant auklet species on Buldir Island—nests in large colonies, the greatest concentrations are at Main Talus and near Spike Camp. Crested auklets exhibited a very high productivity rate of 83%.

Horned puffin (*Fratercula corniculata*) – Abundant breeder. Horned puffins nested most commonly in crevices at Main Talus and the Spike Camp area. Horned puffins experienced low productivity (35%) and a high chick loss rate of 35%.

Tufted puffin (*Fratercula cirrhata*) – Abundant breeder. This species nested on grassy and rocky slopes around the island. Tufted puffins hatched five days earlier than the mean this year.

Short-eared owl (*Asio flammeus*) – One individual was observed in Camp Valley on 25 June and 11 July (Figure 74).

Common raven (*Corvus corax*) – Lone birds were observed on 27 May, 2 June, and 26 June. In late July and early August 2 – 4 individuals were seen frequently around Camp Valley.

Barn swallow (*Hirundo rustica erythrogaster*) – A barn swallow (unknown subspecies) was present in Camp Valley on 7 June. Another swallow (likely this individual) was observed a few days later but species identification was not possible.

Winter wren (*Troglodytes troglodytes*) – Common breeder. This species was most abundant along coastal areas. Fledglings were first noted in mid-June.

Song sparrow (*Melospiza melodia*) – Common breeder. This species is most abundant in low elevation areas with dense forbs. The first fledgling was found on 5 June.

Lapland longspur (*Calcarius lapponicus*) – Abundant breeder. This species is present in a wider variety of habitats than song sparrows. It was commonly seen above 300m in elevation.

Snow bunting (*Plectrophenax nivalis*) – Fairly common breeder. This resident species is mostly found at higher elevations on Buldir Island.

Gray-crowned rosy-finch (*Leucosticte tephrocotis*) – Common breeder. Fledglings were first noted on 17 June.

Common redpoll (*Carduelis flammea*) – A single common redpoll (figure 75) was observed near Spike Camp on 5, 16, and 17 July.

Figure 67. Lesser sand-plover near Crested Point.

Figure 68. Wood sandpiper at South Marsh.

Figure 69. Black-tailed godwit at North Marsh.

Figure 70. Sanderling at North Bight Beach.

Figure 71. Pectoral sandpiper near Crested Point.

Figure 72. Long-billed dowitcher near Spike Camp.

Figure 73. Red-necked phalarope at Tattler Creek.

Figure 74. Short-eared owl in Camp Valley.


Figure 75. Common redpoll near Spike Camp.

Marine Mammals

Sea otter (*Enhydra lutris*) – No sea otters were observed during our tour.

Orca (*Orcinus orca*) – Orcas were seen on three occasions during our tour. No notes on group composition were taken. All sightings occurred between North Bight Beach and Main Talus.

Sperm whale (*Physeter macrocephalus*) – Sperm whales were observed once during our tour.

Steller sea lion (*Eumetopias jubatus*) – Sea lions were observed only rarely on the north side of Buldir Island. Twenty adults were observed during the 3 June circumnavigation.

Harbor seal (*Phoca vitulina*) – Harbor seals were seen irregularly in 2008. Only one individual was recorded on the 3 June circumnavigation.

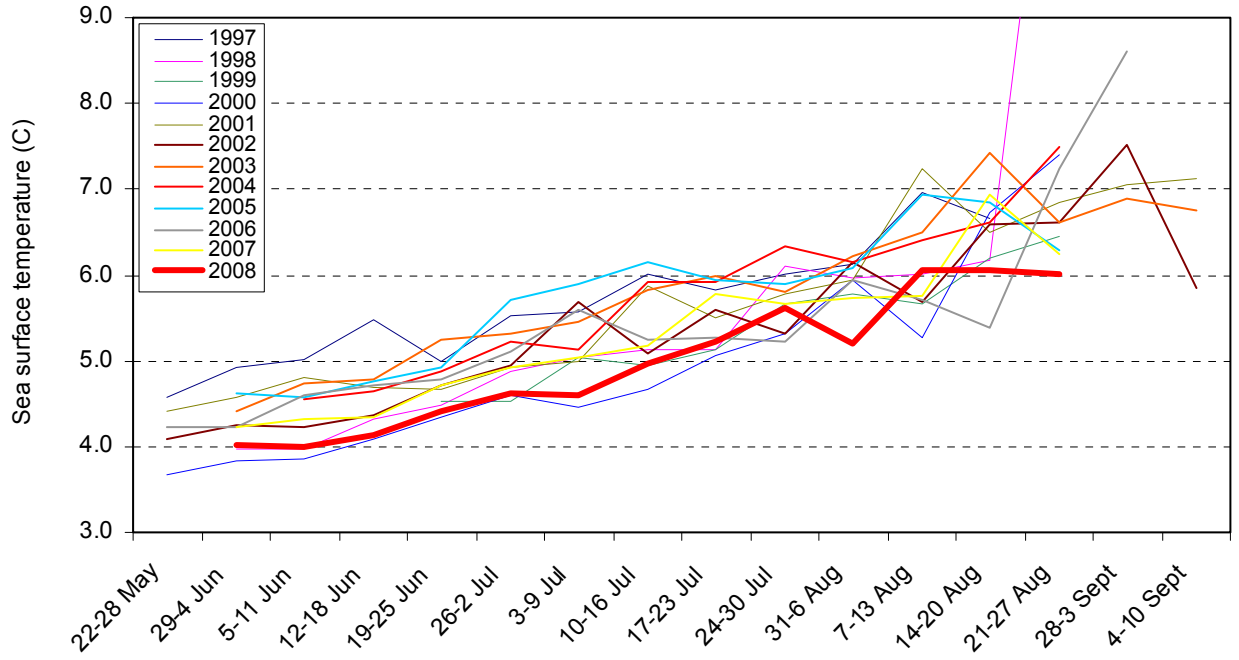

Figure 76. Mean weekly sea surface temperature (ºC) at Buldir Island, Alaska. Values represent means of daily mean temperatures.

Table 96. Mean weekly sea surface temperature (ºC) at Buldir Island, Alaska. Values represent means of daily mean temperatures.

Date	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
22-28 May	4.6	--	--	3.7	4.4	4.1	--	--	--	4.2	--	
29-4 Jun	4.9	4.0	--	3.8	4.6	4.2	4.4	--	4.61	4.2	4.2	4.0
5-11 Jun	5.0	4.0	--	3.8	4.8	4.2	4.7	4.5	4.57	4.6	4.3	4.0
12-18 Jun	5.5	4.3	--	4.1	4.7	4.4	4.8	4.6	4.77	4.7	4.4	4.1
19-25 Jun	5.0	4.5	4.5	4.3	4.7	4.7	5.3	4.9	4.93	4.8	4.7	4.4
26-2 Jul	5.5	4.9	4.5	4.6	4.9	5.0	5.3	5.2	5.71	5.1	4.9	4.6
3-9 Jul	5.6	5.0	5.0	4.5	5.0	5.7	5.4	5.1	5.90	5.6	5.0	4.6
10-16 Jul	6.0	5.1	4.9	4.7	5.9	5.1	5.8	5.9	6.14	5.3	5.2	5.0
17-23 Jul	5.8	5.1	5.1	5.1	5.5	5.6	6.0	5.9	5.95	5.3	5.8	5.2
24-30 Jul	6.0	6.1	5.7	5.3	5.8	5.3	5.8	6.3	5.89	5.2	5.7	5.6
31-6 Aug	6.1	6.0	5.8	5.9	6.0	6.2	6.2	6.2	6.09	5.9	5.7	5.2
7-13 Aug	7.0	6.0	5.7	5.3	7.2	5.7	6.5	6.4	6.94	5.7	5.8	6.1
14-20 Aug	6.7	6.2	6.2	6.7	6.5	6.6	7.4	6.6	6.84	5.4	6.9	6.1
21-27 Aug	--	12.7	6.4	7.4	6.8	6.6	6.6	7.5	6.29	7.2	6.2	6.0
28-3 Sep	--	--	--	--	7.1	7.5	6.9	--	--	8.6	4.2	--
4-10 Sep	--	--	--	--	7.1	5.9	6.8	--	--	--	--	--

Figure 77. Mean daily sea surface temperature (ºC) at Buldir Island, Alaska.

Table 97. History of official visits to Buldir Island, Alaska.

Year	Dates	Type of work	No. people	Names	Source
1936	July 27 & 31	faunal recon	3	Olaus Murie, Homer Jewell, Douglas Gray,	?
1937	18 Jun	faunal recon	?	Olaus Murie	13
1943		U.S. Army weather station	5	Dave Grehl, 3 groups of 5 for around 7 mo. each	1
1947	19-22 July	geological reconnaissance	2	Robert R. Coats, Will F. Thompson	2
1962	25-27Jun	ACG survey	2	Robert Jones, Vern Berns	14
1963	6-19 July	obtain ACG goslings	6	Vern Berns, Erwin Boeker, Robert Jones, Karl Kenyon, Alexander Peden, Milsted Zhan	3
1972	30 June-8 July	ACG, faunal recon.	6	Vernon Byrd, Palmer Sekora, Glen Smart, Clayton White, Allen McCartney, Dan Gibson	4
1974	9 May-6Sep	ACG biology	4	Vernon Byrd, Chris Dau, Matt Dick, John Trapp*	
	16-24 Jul	ACG capture	3	Dave Spencer, Jim Shaw, Jim Bartonek	
1975	18 May-5 Sep	ACG biology	5	Vernon Byrd*, Dennis Woolington, Eric Hoberg, Elaine Rhode*, John Trapp*, John Sarvis*	
	3-25 Jul	Film Chain of Life	2	Tom Ramsey, Cecilia Ramsey	
	17 May-5 Sep	ACG, puffins	2	D.H.S. Wehle, Bob Day	7
1976	19 May-28 Sep	ACG			
1977	25 May-2 July	ACG nest census	5	Dennis Woolington, Bob Day, Eric Knudtson, Tom Early, Bob Schulmeister*	
1979	4-30 Jun	ACG nest survey, petrels	4	Tom Early, Bill Henry, Andy --, Jock --	
	23-24 June	faunal survey	4	Bob Day, Tom Early, Brian Lawhead, Elaine Rhode	6
1982	28 May-27 Jun	ACG nest census	6	Van Klett, Fred Deines, Mark Oswald, Tom Early, Don Dragoo, Dana Bradley	15
1984	8-25 June	ACG eggs, petrel work	2	Anthony DeGange, Richard Wood	5
1987	1-9 Aug	ACG capture			
1988	7 Jun-7 Sep	Refuge monitoring	4	Colleen Baggot, Lisa Climo, Dave Backstrom*, Hector Douglas*, Vernon Byrd*	
	19 Jun-5 Jul	Seabird investigations	3	John Piatt, John Wells , Andrea Mc Charles	
	29 Jul-10 Aug	ACG capture & seabirds	5	Alan Springer, Gus Van Vliet, Greg McClellan, Mark Pfost, Brian Anderson	
1989	29 May	BIA ANSCA site visit Refuge monitoring	4	Ken Pratt, Randall Cooper, Brian Hoffman, Robert Drozda	19
1990		Refuge monitoring			
1991	4 Jun-14 Aug	Refuge monitoring	4	Jeff Williams, Mark Hipfner, Ron Walder, Ken Russell	
	25-29 July	ACG capture	4	Jim Schneeweiss, Vernon Byrd, Jim Fuller, Rob Lewis	
	4 Jun-6 Aug	Auklet biology	2	Ian Jones, Christine Adkins	
	25 Jul-6 Aug	Photography	1	Ed Steele	
	25 July-6 Aug	Archaeology	3	Doug Siegel-Causey, Debbie Corbett, C. Lefevre	12
1992	31 May-14 Aug	Refuge monitoring	4	Jeff Williams, Hugh Knechtel, Andrew Durand, Geoff Beyersdorff	
	31 May-1 Aug	Auklet biology	2	Ian Kones, Fiona Hunter	
1993	30 May-31 Aug	Refuge monitoring	2	Jeff Williams, Julian Fischer	
	30 May-31 Aug	Auklet biology Auklet biology	2	Victor Zubakin, Nicolai Konyukhov Ian Jones…….	
	31 May-17 June	Archaeology	7	Dixie West, Debbie Corbett, Christine Lefevre, Liz Wilmerding, Stephen Loring, Tom Corbett, Ann Andres	10
1994		Refuge monitoring Auklet biology			
1995	1 June-21 Aug	Refuge monitoring Auklet biology	3	Julian Fischer, Mari Ortwerth, Lisa Meehan	18
1996	4 June-24 Aug	Refuge monitoring Auklet biology	4	Julian Fischer, Lisa Meehan, Pat Ryan, Dave Clutter Gail Fraser	17

Table 97 continued. History of official visits to Buldir Island, Alaska.

Year	Dates	Type of work	No. people	Names	Source
1997	21 May-24 Aug	Refuge monitoring	4	Mary Ortwerth, Nora Rojek, Emily Drew, Jeff Williams*	16
	5-23 May	Archaeology	6	Christine Lefevre, Debbie Corbett, Carole Fritz, Margaret Beck, Gena Weinberger, Anne Young	11
	5 May-7 Aug	Auklet biology	4	Ian Jones, Fiona Hunter, Gail Fraser, Laura Cowen	
1998	3 June-28 Aug	Refuge monitoring	4	Julian Fischer, Angela Palmer, Susan Hootman, Kim Elkin	9
	3 June-????	Auklet biology	?	Gail Fraser,	
1999	21 June-29 Aug	Refuge monitoring	6	Jason Daniels, Jessica Peterson, Jeff Williams*	8
		Auklet biology		Allison Veit, Nicole Winter, Nicolai Konyukhov	
2000	27 May-29 Aug	Refuge monitoring	4	Heather Moore, Karen Brenneman, Graeme Loh, Sarah Lantz	
	27 May-6 Aug	Auklet biology	?	Ian Jones, Martin Renner, Jolene Sutton, Josh Pennell	
2001	25 May-5 Sep	Refuge monitoring	3	Heather Moore, Peter Kappes, Matthew Grinnell	
	25 May-5 Sep	PAAU/HOPU attendance	2	Nikolai Konyukhov, Kyle Juk	
	1 Aug-5 Sep	Archaeology	5	Debbie Corbett, Dixie West, Ginny Hatfield, Kale Brennerman	
	25 May-1 Aug	Auklet biology	3	Martin Renner, Fiona Hunter, Heather Major, Ian Jones*	
	28 May-1 Aug	CRAU smell	2	Julie Hagelin, Peter Elsner	
2002	24 May-5 Sep	Refuge monitoring	3	Erica Sommer, Trevor Joyce, Nikolai Konyukhov	
	24 May- 7 Aug	Auklet biology	3	Martin Renner, Jason Wade, Greg McClelland	
2003	1 June-5 Sep	Refuge monitoring	3	Nathan Jones, Martin Murphy, Namoi Sugimura*	
	1 June-5 Sep	Regime forcing project	2	Hector Douglas, Brie Drummond	
	1 June-? Aug	Auklet biology	1	Travis Clarke, Ian Jones*	
2004	26 May-25 Aug	Refuge monitoring	2	Martin Murphy, Slade Sapora	
	26 May-? Aug	Auklet biology	1	Christina _____	
	26 May-7 June	Auklet biology	2	Ian Jones, Dan Roby	
	26 May-25 Aug	Regime Forcing project	2	John Citta, Joe Seyfried	
2005	29 May-27 Aug	Refuge monitoring	4	Erik Andersen, Trevor Joyce, Meredith Barrett, Aaron Stoertz	
	29 May-10 Aug	Auklet biology	1	Paul Regular	
	29 May-7 June	Auklet biology	4	Ian Jones, Sampath Seneviratne, Chris Eggleston, Cari Eggleston	
2006	24 May-30 Aug	Refuge monitoring	3	Rachael Orben, Corey Van Stratt, Stephan Lorenz	
	24 May-13 Aug	Auklet biology	3	Sampath Seneviratne, Grant Humphries, Adam Hunt, Ian Jones*	
	13 Aug-30 Aug	Cabin building	2	Jeff Williams, Craig Williams	
2007	29 May-27 Aug	Refuge monitoring	4	Erik Andersen, Scott Freeman, Nick Seferovic, Cornelius Schlawe	
	29 May-4 Aug	Auklet biology	4	Sampath Seneviratne, Stefan Lorenz, Pam Woodman, Chris Smalls	
2008	26 May-27 Aug	Refuge monitoring	3	Scott Freeman, Kevin Payne, Bob Keller	
	26 May-5 Aug	Auklet biology	2	??	
	26 May-? June	Auklet biology	2	Ian Jones, Rachel Buxton	

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

Sources

1 letter from Paul Grehl dated 28 March 1977.
2 Coats, R.R. 1953. Geology of Buldir Island, Aleutian Islands, Alaska. Geological Survey Bulletin 989-A.. Washington D.C. 26pp.
3 Kenyon, K.W. 1963. Buldir Island expedition 1-22 July 1963. Bureau of Sport Fisheries and Wildlife Report, Seattle WA.
4 Byrd, G.V. 1972. Notes of the Buldir Island expedition 30 June-8 July 1972. U.S. Fish and Wildlife Service Report. Adak, AK. 12pp.
5 DeGange, A.R., and R.A. Wood. Trip report: Buldir Island – June 1984, U.S. Fish and Wildlife Service Report. Anchorage AK 22pp.

6 Day, R.H., B.E. Lawhead, T.J. Early, E.B. Rhode. 1980. Results of bird and mammal surveys of the western Aleutian Islands- summer 1979. U.S. Fish and Wildlife Service Report. Adak AK. 140pp.
7 Wehle, D.H.S. 1983. The food, feeding, and development of tufted and horned puffins in Alaska
8 Williams, J.C., and J. Daniels. 2001. Biological monitoring at Buldir Island, Alaska: summary appendices. U.S. Fish and Wildlife Service Report. AMNWR 01/15. 103pp.
9 Williams, J.C., J. Fischer, and A. Palmer. 2001. Biological monitoring at Buldir Island, Alaska in 1998: summary appendices. U.S. Fish and Wildl. Serv. Rep. AMNWR 99/03. 132 pp.
10 Siegel-Causey, D., D. Corbett, and C. Lefevre. 1993. Report of the Buldir Island Expedition- Second season in the Aleut Midden Site. Memo.
11 West, D., D. Corbett, C. Lefevre. 1997. The western Aleutians Archaeological and paleobiological project: annual report for 1997. Memo.
12 Siegel-Causey, D., C. Lefevre, D. Corbett. 1991. Report of the Buldir Island expedition – preliminary excavation of the Aleut midden site – July – August 1991. Memo.
13 Field notes of Olaus Murie
14 Jones, R.D. 1962. Buldir Island, site of a remnant breeding population of Aleutian Canada geese. U.S. Fish and Wildlife Service Trip Report. Cold Bay, Alaska
15 Deines, F.G. and T.J. Early. 1982. 1982 progress report on study of Aleutian Canada geese at Buldir Island, Alaska. U.S. Fish and Wildlife Service Report, Adak Alaska.
16 Williams, J.C., M. Ortwerth, N. Rojek, and L. Scharf. 1998. Biological monitoring at Buldir Island, Alaska in 1997: summary appendices. U.S. Fish and Wildlife Service Report. AMNWR 98/05. Adak, Alaska. 184pp.
17 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 Wildlife Service Report AMNWR 97/08. 78 pp.
18 Williams, J.C., J.B. Fischer, L.J. Meehan, and M.A. Ortwerth. 1997. The status of kittiwakes and murres at Buldir Island, Alaska in 1995. U.S. Fish and Wildlife Service Report AMNWR 97/04. 55pp.
19 Bureau of Indian Affairs. 1992. Report of investigation for Rat islands overview – the Aleut corporation BLM AA-11927 et al. BIA ANSCA office, Anchorage, Alaska.