

BIOLOGICAL MONITORING IN THE CENTRAL ALEUTIAN ISLANDS, ALASKA IN 2009-2015



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Key words: Alaska, Aleutian Islands, black-legged kittiwake, common murre, fork-tailed storm-petrel, Kasatochi Island, Koniuji Island, Leach's storm-petrel, *Oceanodroma furcata*, *Oceanodroma leucorhoa*, pelagic cormorant, *Phalacrocorax pelagicus*, *Phalacrocorax urile*, populations, productivity, red-faced cormorant, red-legged kittiwake, reproductive performance, *Rissa brevirostris*, *Rissa tridactyla*, thick-billed murre, Ulak Island, *Uria aalge*, *Uria lomvia*

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Ulak Island from the ridge above the storm-petrel plot.

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INTRODUCTION

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

The central Aleutian Islands annual monitoring "site" included seabird monitoring plots on three nearby islands: Kasatochi, Koniuji, and Ulak. Prior to 1996, biological surveys consisted primarily of boat-based circumnavigations (Early et al. 1981; Bailey and Trapp 1986; Byrd and Williams 1994; Byrd 1995a, 1995b). Incidental seabird observations were also recorded at Kasatochi during an effort to remove introduced arctic foxes (*Alopex lagopus*) in the 1980s (Deines 1985, Deines and Willging 1985), and in 1991 crested and least auklet (*Aethia cristatella* and *A. pusilla*, respectively) population plots were set up and monitored for several days (Thomson and Wraley 1992). In 1996, intensive season-long seabird monitoring began at Kasatochi and brief annual surveys (one to three per year) began at Ulak and Koniuji (Scharf et al. 1996; Scharf and Williams 1997; Scharf 1998, 2000a, 2000b; Syria 2001, 2002; Barton and Lindquist 2003; Drummond and Kissler 2004; Drummond and Rehder 2005; Drummond 2006; Drummond and Larned 2007; Buchhiet and Ford 2008). Bird distributions at sea around Kasatochi, Koniuji, and Ulak were described by Drew et al. (2003).

Kasatochi erupted violently on 7 August 2008, covering the island under tens of meters of ash and pyroclastic flow material and destroying the former seabird breeding colonies (Scott et al. 2010, Williams et al. 2010). While the island has become the center of a collaborative project examining recovery and recolonization of flora and fauna in the Aleutians following volcanic eruptions (details presented elsewhere; see Degange et al. 2010), the seabird monitoring program on Kasatochi has ended. To maintain some long-term dataset in the central Aleutians, surveys at Ulak and Koniuji islands continue; data are presented here with historic data from Kasatochi for comparison.

The specific goal since the eruption has been to estimate population and/or productivity parameters for five indicator species representing two major feeding guilds: 1) diving fish-feeders (pelagic and red-faced cormorants [*Phalacrocorax pelagicus* and *P. urile*, respectively], and common and thick-billed murrens [*Uria aalge* and *U. lomvia*, respectively]), and 2) plankton-feeders (fork-tailed storm-petrels [*Oceanodroma furcata*]).

Detailed results of the 2015 monitoring program are contained in these appendices and archived at the AMNWR headquarters in Homer, Alaska. Summary data will also be included in the annual Alaska seabird monitoring summary report. Due to occasional reanalysis of some data, correction of typographical errors, and efforts to standardize presentation across sites, some values used in this report have changed from previous versions. The values presented here are considered the cleanest data set available at the time this report was issued and should supersede previous reports.

STUDY AREA

Koniuji, Ulak, and Kasatochi islands are located in the Andreanof Island group of Alaska's central Aleutian Islands (Figure 1). 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 8.8°C in the summer and 4.8°C annually. Average annual precipitation is 166 cm. Snow accumulation at sea level rarely exceeds 0.5 m, and there is no permafrost. Vegetation on the islands is composed of maritime and alpine tundra and consists mostly of grasses, sedges, sphagnum mosses, lichens, and a variety of forbs. There are no erect trees or shrubs.

Koniuji and Kasatochi are located on the southern edge of the Aleutian Basin, and are bordered to the north by deep water and to the south by relatively shallow water. Ulak is surrounded by shallow water. All three islands are relatively exposed, and are often subject to rough surf conditions that restrict small boat operations.

Koniuji Island.--Located 25.6 km east of Kasatochi and 16 km north of Atka Island, Koniuji Island (52°13'N, 175°08'W) encompasses approximately 110 ha and is about 1.3 km long and 0.9 km wide (Figure 2). Although volcanic in origin, the island is deeply eroded, suggesting that reports of activity in historic times were mistaken (Coats 1950, Sekora 1973). Almost the entire coastline is sheer, rising to a rugged 268 m peak on the northern end of the island. A low, flat, rocky point extends about 200 m on the northwest coast. A grassy ravine separates the north side of the island from the less precipitous southern bluffs. There is no fresh water on the island.

Although Koniuji was leased for fox farming in 1934, there is no record of foxes ever having been introduced. As a result, the island hosts a diverse and prolific seabird colony, with an estimated 30,000 breeding diurnal seabirds and probably hundreds of thousands of nocturnal seabirds, including Leach's (*O. leucorhoa*) and fork-tailed storm-petrels, ancient murrelets (*Synthliboramphus antiquus*), and whiskered auklets (*A. pygmaea*) (Bailey and Trapp 1986). Thousands of kittiwakes and murrelets nest on the sheer coastal cliffs, and tens of thousands of tufted puffins (*Fratercula cirrhata*) nest on the grassy slopes above the southern bluffs. Tens of thousands of crested and least auklets can be observed circling the vegetated talus flanking the highest point on the island, and hundreds of parakeet auklets (*A. psittacula*) inhabit the boulder beaches along the west coast. In 1982, Bailey and Trapp (1986) noted an amazing abundance of bald eagles (*Haliaeetus leucocephalus*), counting 17 at once, though no nests were evident. They surmised that eagles were coming over from Atka to feed on seabirds.

Ulak Island.--Located 2.5 km east of Great Sitkin Island and 46 km southwest of Kasatochi, Ulak Island (52°02'N, 175°54'W) is small and rugged. Encompassing approximately 46.5 ha, the island is 1.4 km long and 0.3 km wide, with a maximum elevation of 206 m (Figure 2). The south side is comprised of steep slopes covered with relatively deep soil and densely vegetated with large *Leymus* hummocks. These slopes provide habitat for thousands of nesting seabirds, including storm-petrels, tufted puffins, and Cassin's auklets (*Ptychoramphus aleuticus*). The north side of the island is characterized by cliffs inhabited by cormorants, puffins, and thousands of murrelets. Whiskered auklets nest in abundance along the boulder beaches and on vegetated talus slopes. Foxes were apparently never introduced to the island.

Kasatochi Island.--Located approximately 19.5 km northwest of the westernmost point of Atka Island, Kasatochi Island (52°11'N, 175°30'W) is a volcanic caldera, roughly circular in shape that, prior to the eruption, encompassed approximately 287 ha and had a diameter of about 2.7 km (Figure 3).

Arctic foxes were introduced on Kasatochi by 1927, and were trapped for fur through at least the winter of 1935. The Service attempted to eliminate foxes in the 1960s (Jones 1963), but foxes were not removed until the 1980s (Deines 1985, Deines and Willging 1985). Foxes likely decimated burrow-nesting seabirds on the island and by the time annual monitoring began in 1996, surviving storm-petrel and tufted puffins at Kasatochi nested only in rock crevices (Drummond 2007).

Before the eruption, seabird colonies on the island included several hundred thousand least and crested auklets; thousands of fork-tailed storm-petrels; hundreds of glaucous-winged gulls (*Larus glaucescens*), parakeet and whiskered auklets, pigeon guillemots (*Cephus columba*), and horned (*F. corniculata*) and tufted puffins; and smaller numbers of red-faced and pelagic cormorants, Leach’s storm-petrels, ancient murrelets, and common and thick-billed murre (Williams et al. 2010).

METHODS

Personnel: Ulak storm-petrel data in 2015 was collected by Jeff Williams and Gary Drew on 16 June, Jeff Williams and Heather Renner on 1 August, and McKenzie Mudge and Kevin Pietrzak on 31 August. Ulak ledgenester surveys in 2015 were conducted by Judy Alderson and Barry Sampson on 1 August.

Data Collection and Analysis: After 2008, surveys at Ulak and Koniuji have been somewhat intermittent rather than annual. The following table details the recent history of surveys at these sites.

History of data collected at Ulak and Koniuji islands after 2008. An “X” indicates data were collected; in 2011 ledgenester data were collected but have been lost.

Year	Ulak Storm-petrel productivity	Ulak Ledgenester population	Ulak Ledgenester productivity	Koniuji Ledgenester population	Koniuji Ledgenester productivity
2009	X	-	-	-	-
2010	-	X	X	X	X
2011	X	<i>Data lost</i>	<i>Data lost</i>	<i>Data lost</i>	<i>Data lost</i>
2012	-	-	-	-	-
2013	-	-	-	-	-
2014	-	-	-	-	-
2015	X	X	X	-	-

No monitoring data has been collected at Kasatochi after the 2008 eruption.

Data were collected following methods outlined in Williams et al. (2002) and AMNWR 2015, with the following exceptions:

- No ledgenester population or productivity surveys were conducted at Koniuji in 2015.
- Burrow-nester population data (for storm-petrels, tufted puffins, and all burrow-nesters) at Ulak have not been collected since 2007. Although storm-petrel productivity data have been collected on plot 2, not all burrows were checked every year to stream-line work, so density and occupancy rates on the plot would not be comparable.

- All reproductive performance data from Kasatochi in 2008 is presented as a maximum potential value, assuming chicks still alive at the last check prior to the 7 August eruption could have fledged. In actuality, all chicks still in nests at the time of the eruption would have perished, but for the purposes of our seabird monitoring program, we are interested in how reproductive parameters vary in relation to environmental impacts and not catastrophic events.

ACKNOWLEDGMENTS

We are indebted to all the field crews that collected data at Koniuji, Ulak and Kasatochi over the years. We also thank the crew of the M/V Tiglax for excellent transportation, logistical support and hospitality.

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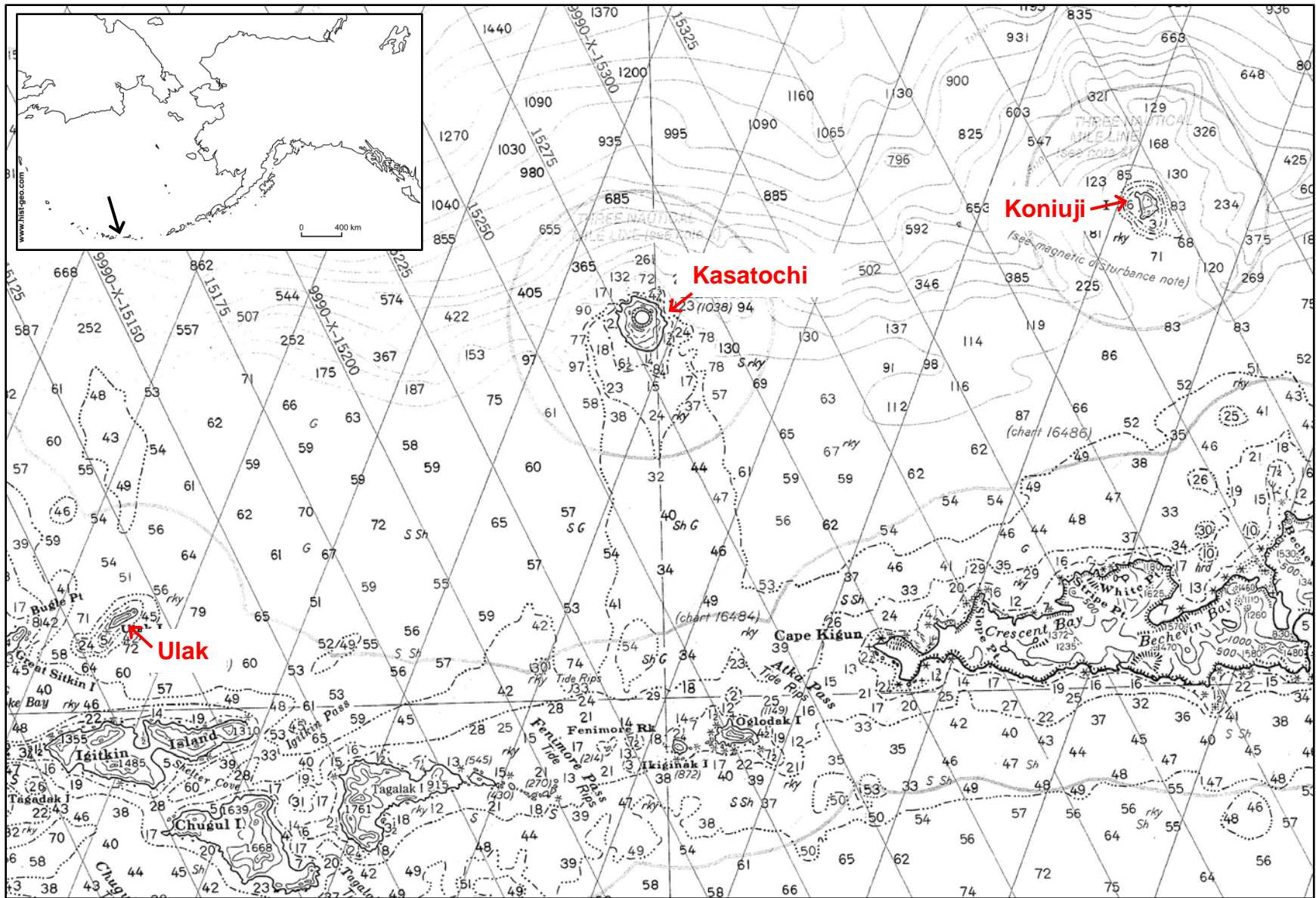


Figure 1. Map of Koniuji, Ulak and Kasatochi islands, Alaska.

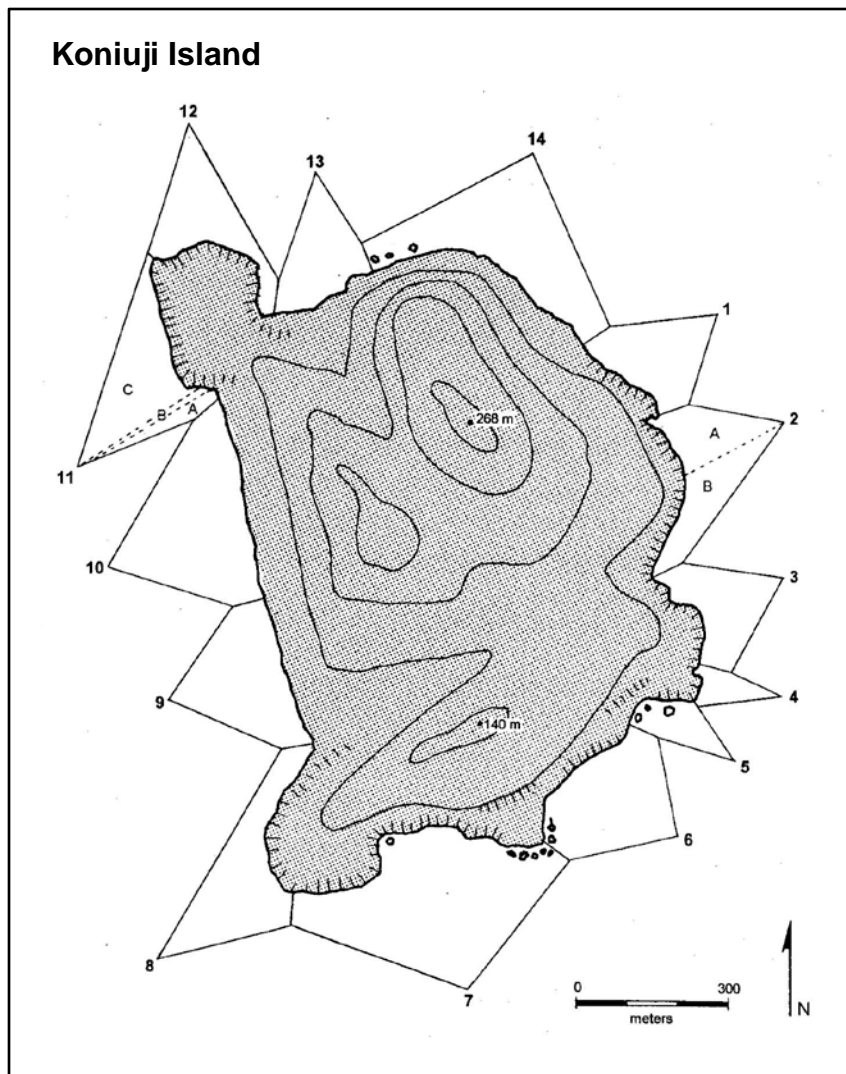
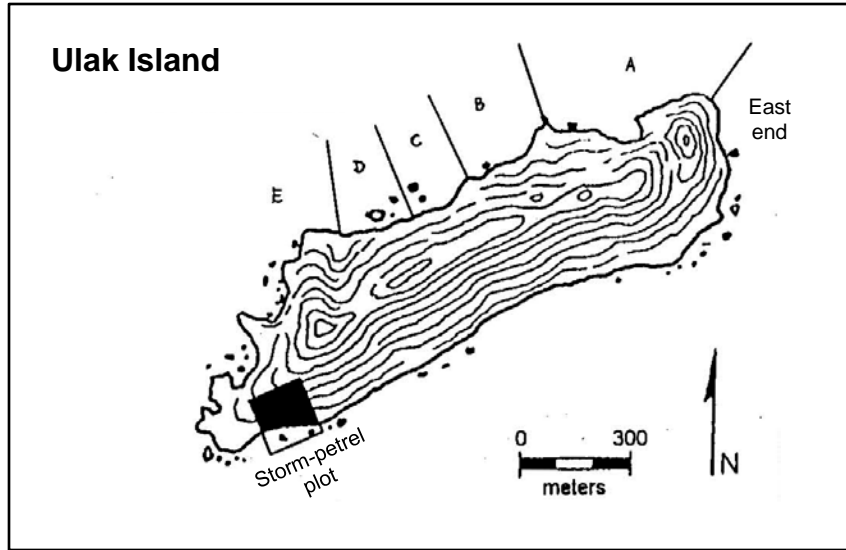


Figure 2. Maps of Ulak and Koniuji islands showing plot locations.

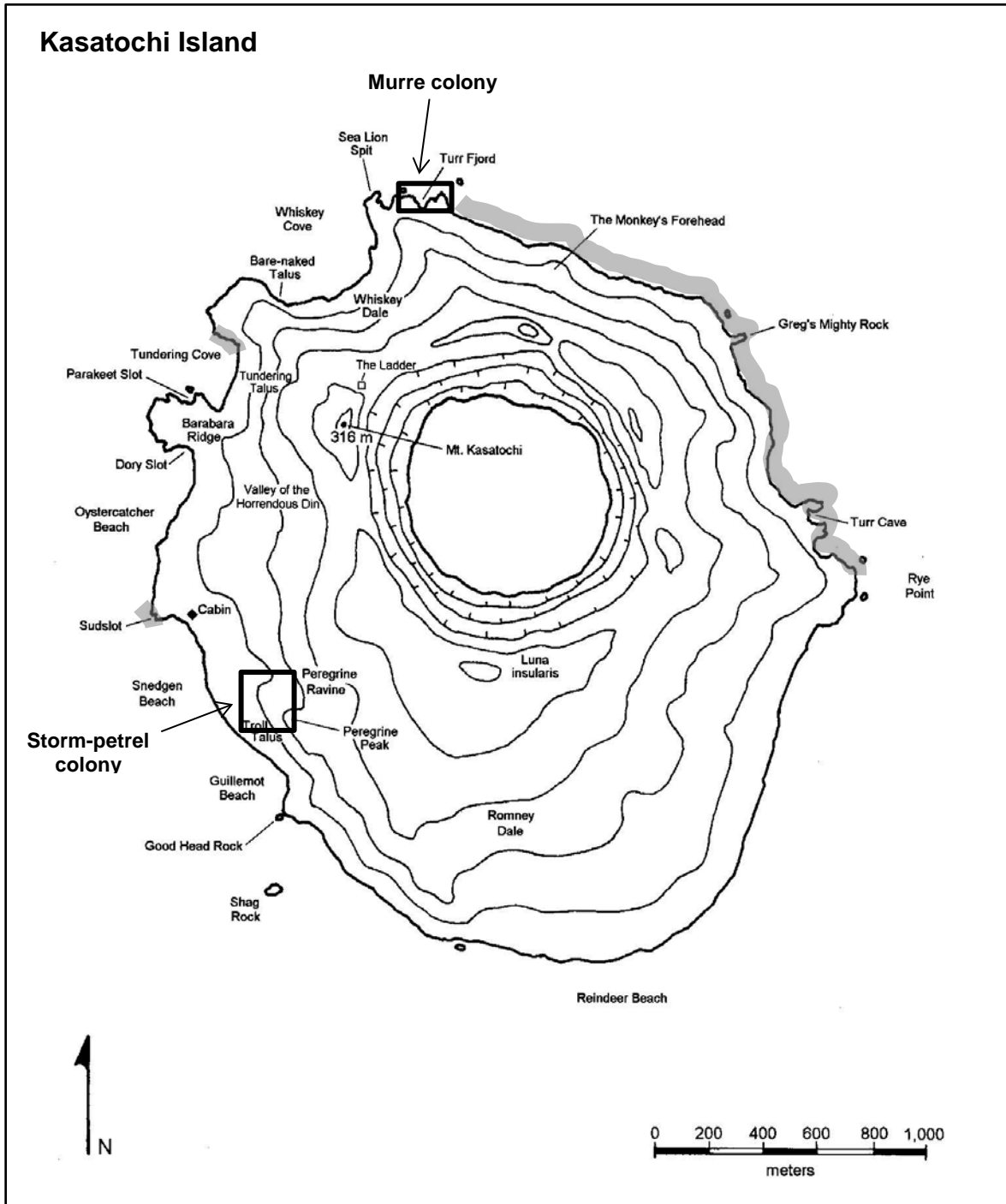


Figure 3. Map of Kasatochi Island showing former plot locations and island place-names (prior to the 2008 eruption that buried the island under ash and pyroclastic flow material). Former storm-petrel and murre colonies are shown by black boxes; former cormorant nesting locations are denoted with gray shading along coastline.

FIGURES AND TABLES

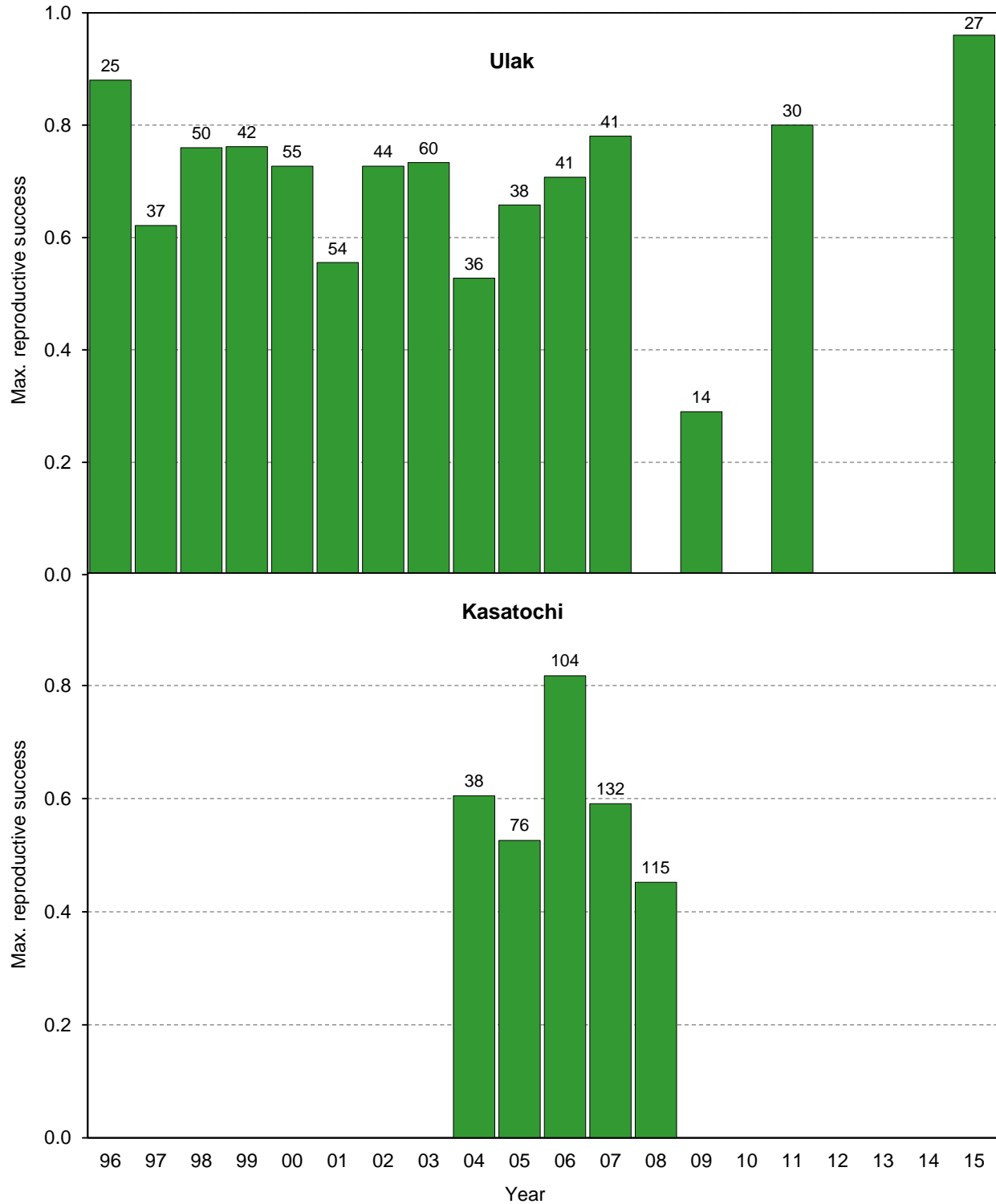


Figure 4. Reproductive performance of fork-tailed storm-petrels at Ulak and Kasatochi islands, Alaska. Maximum potential reproductive success = $(F+H)/(B+H)$, where $B+H$ = maximum nest sites with eggs and $F+H$ = maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes ($B+H$). No monitoring data has been collected at Kasatochi since 2008.

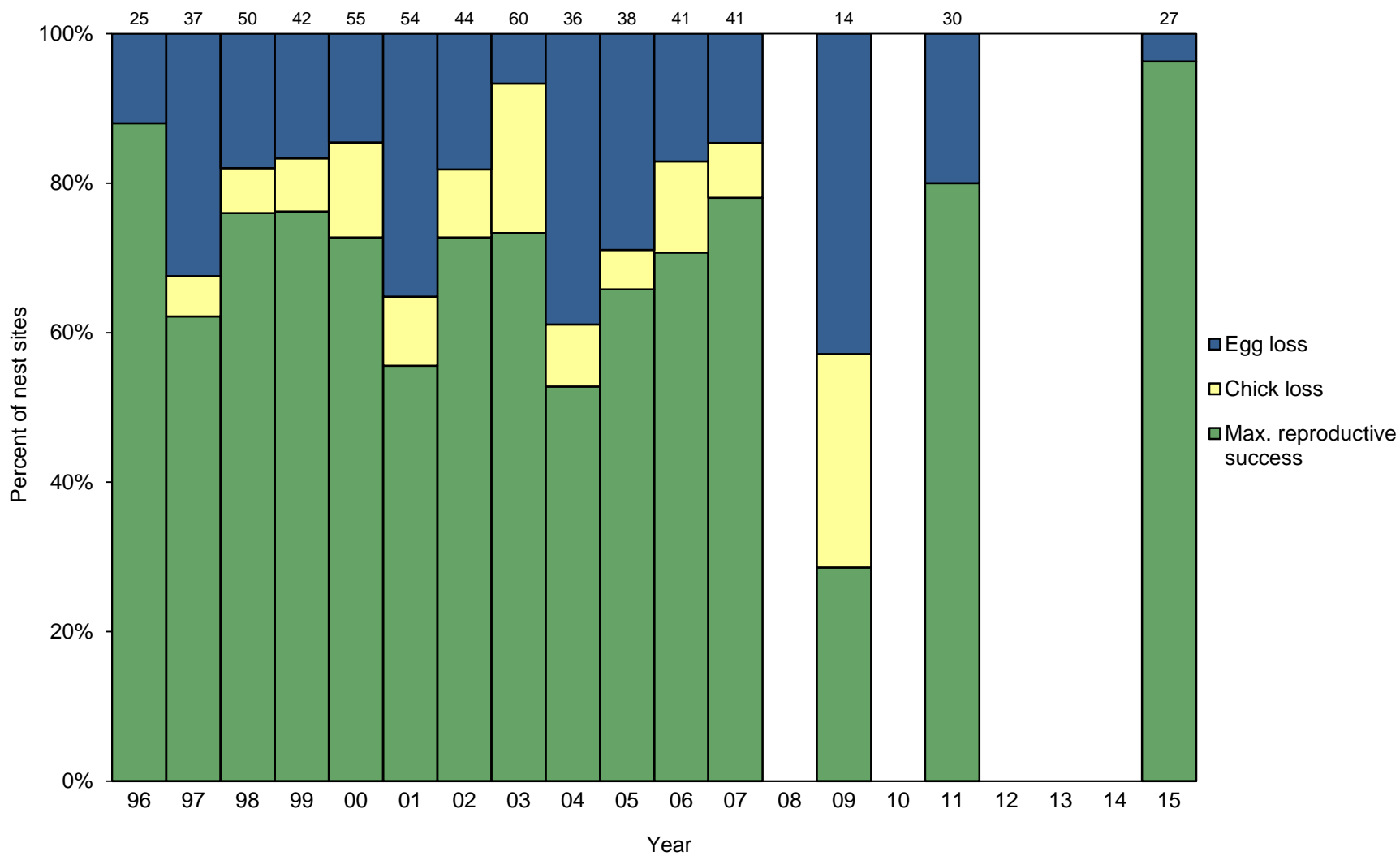


Figure 5. Reproductive performance of fork-tailed storm-petrels at Ulak Island, Alaska. Egg loss= $[(B+H)-(D+H)]/(B+H)$; Chick loss= $[(D+H)-(F+H)]/(B+H)$; Maximum potential reproductive success= $(F+H)/(B+H)$, where B+H=maximum nest sites with eggs; D+H=maximum nest sites with chicks; F+H=maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes (B+H).

Table 1. Reproductive performance of fork-tailed storm-petrels at Ulak Island, Alaska. Measures of success are based on only a few nest checks during the early, middle, and late periods of the season (usually intervals of about 30 days) on plot 2. Most chicks are too young to fledge by the time of last visit so measures of success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge.

Year	Max. nest sites w/ eggs (B+H)	Max nest sites w/ chicks (D+H)	Max. nest sites w/ chicks fledged (F+H) ^a	Nest sites w/ viable eggs at last visit ^b	Max. potential nesting success [(D+H)/(B+H)] ^c	Max. potential fledging success [(F+H)/(D+H)] ^d	Max. potential reproductive success [(F+H)/(B+H)]
1996	25	22	22	0	0.88 ^e	1.00 ^e	0.88 ^e
1997	37	25	23	0	0.68	0.92	0.62
1998	50	41	38	0	0.82	0.93	0.76
1999	42	35	32	0	0.83	0.91	0.76
2000	55	47	40	0	0.86	0.85	0.73
2001	54	35	30	0	0.65	0.86	0.56
2002	44	36	32	0	0.82	0.89	0.73
2003	60	56	44	0	0.93	0.79	0.73
2004	36	22	19	0	0.61	0.86	0.53
2005	38	27	25	0	0.71	0.93	0.66
2006	41	34	29	0	0.83	0.85	0.71
2007	41	35	32	0	0.85	0.91	0.78
2008	<i>no data</i>	-	-	-	-	-	-
2009	14	8	4	0	0.57	0.50	0.29
2010	<i>no data</i>	-	-	-	-	-	-
2011	30	24	24	0	0.80	1.00	0.80
2012	<i>no data</i>	-	-	-	-	-	-
2013	<i>no data</i>	-	-	-	-	-	-
2014	<i>no data</i>	-	-	-	-	-	-
2015	27	26	26	0	0.96	1.00	0.96

^aF+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

^bEggs still present and apparently viable at last check are considered unknown fate and are not included in sample sizes or success estimates.

^cFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^dFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^eProductivity estimates in 1996 are based on just two visits (early June and late August) and thus are probably artificially high.

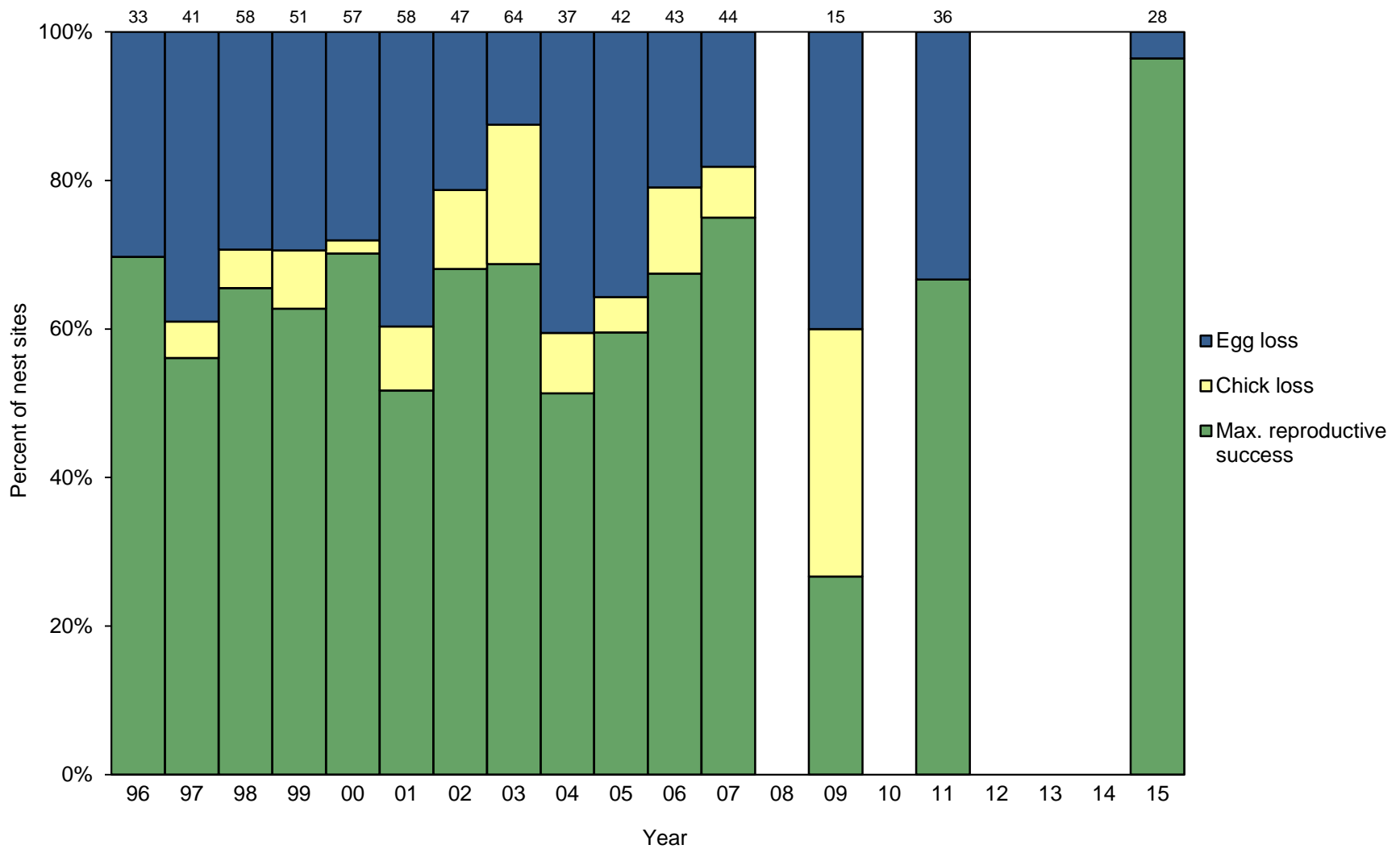


Figure 6. Reproductive performance of all storm-petrels (fork-tailed and unknown storm-petrels) at Ulak Island, Alaska. Unknown storm-petrels are almost certainly also fork-tailed storm-petrels, as no Leach's storm-petrels have ever been observed in the plot. Egg loss= $[(B+H)-(D+H)]/(B+H)$; Chick loss= $[(D+H)-(F+H)]/(B+H)$; Maximum potential reproductive success= $(F+H)/(B+H)$, where B+H=maximum nest sites with eggs; D+H=maximum nest sites with chicks; F+H=maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes (B+H).

Table 2. Reproductive performance of all storm-petrels (fork-tailed and unknown storm-petrel species) at Ulak Island, Alaska. Unknown storm-petrels are almost certainly also fork-tailed storm-petrels, as no Leach's storm-petrels have ever been observed in the plot. Measures of success are based on only a few nest checks during the early, middle, and late periods of the season (usually intervals of about 30 days) on plot 2. Most chicks are too young to fledge by the time of last visit so measures of success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge.

Year	Max. nest sites w/ eggs (B+H)	Max nest sites w/ chicks (D+H)	Max. nest sites w/ chicks fledged (F+H) ^a	Nest sites w/ viable eggs at last visit ^b	Max. potential nesting success [(D+H)/(B+H)] ^c	Max. potential fledging success [(F+H)/(D+H)] ^d	Max. potential reproductive success [(F+H)/(B+H)]
1996	33	23	23	0	0.70 ^e	1.00 ^e	0.70 ^e
1997	41	25	23	0	0.61	0.92	0.56
1998	58	41	38	0	0.71	0.93	0.66
1999	51	36	32	0	0.71	0.89	0.63
2000	57	41	40	0	0.83	0.85	0.70
2001	58	35	30	0	0.60	0.86	0.52
2002	47	37	32	0	0.79	0.87	0.68
2003	64	56	44	0	0.88	0.79	0.69
2004	37	22	19	0	0.60	0.86	0.51
2005	42	27	25	0	0.64	0.93	0.60
2006	43	34	29	0	0.79	0.85	0.67
2007	44	36	33	0	0.82	0.92	0.75
2008	<i>no data</i>	-	-	-	-	-	-
2009	15	9	4	0	0.60	0.44	0.27
2010	<i>no data</i>	-	-	-	-	-	-
2011	36	24	24	0	0.67	1.00	0.67
2012	<i>no data</i>	-	-	-	-	-	-
2013	<i>no data</i>	-	-	-	-	-	-
2014	<i>no data</i>	-	-	-	-	-	-
2015	28	27	27	0	0.96	1.00	0.96

^aF+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

^bEggs still present and apparently viable at last check are considered unknown fate and are not included in sample sizes or success estimates.

^cFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^dFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^eProductivity estimates in 1996 are based on just two visits (early June and late August) and thus are probably artificially high.

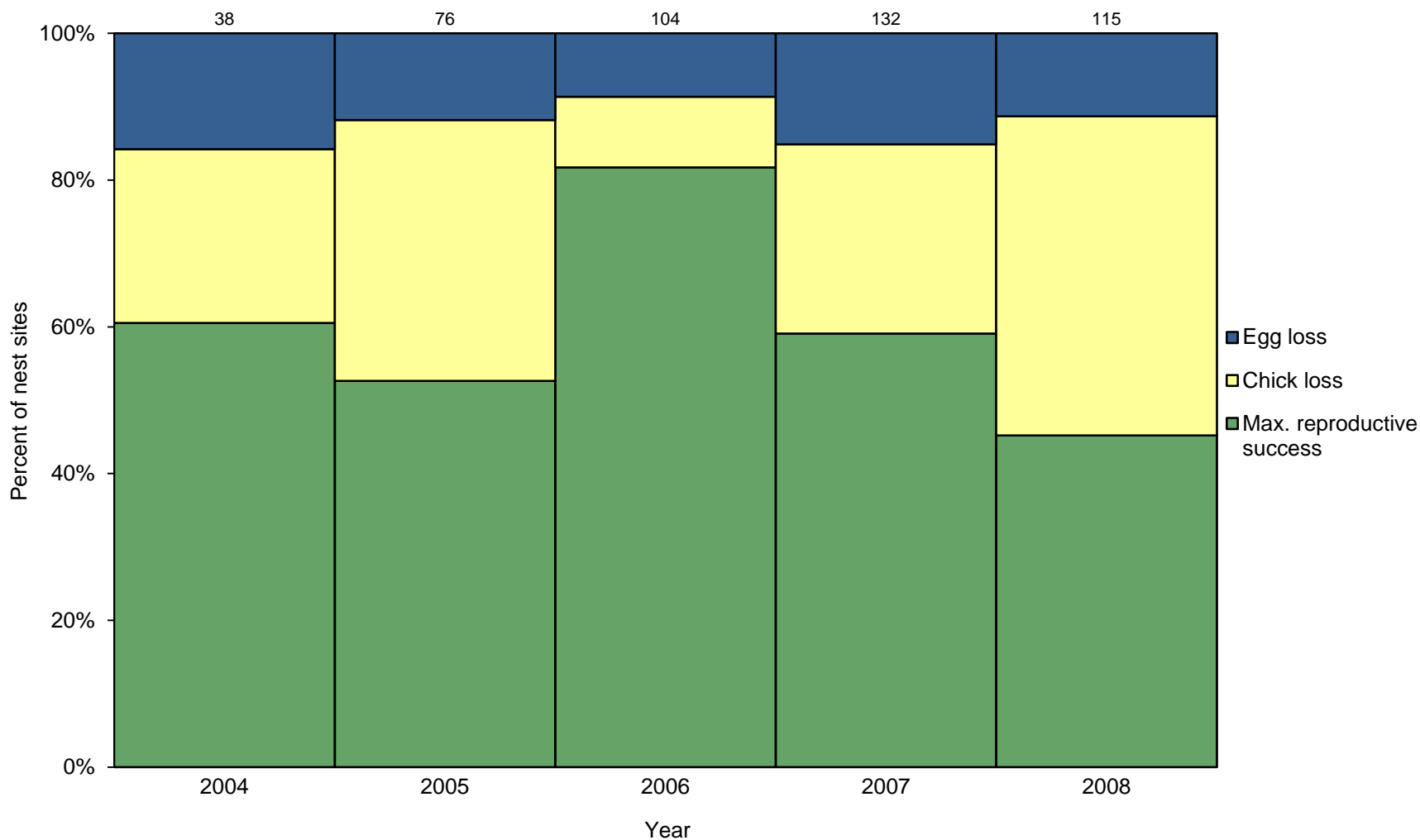


Figure 7. Reproductive performance of fork-tailed storm-petrels at Kasatochi Island, Alaska. Egg loss= $[(B+H)-(D+H)]/(B+H)$; Chick loss= $[(D+H)-(F+H)]/(B+H)$; Maximum potential reproductive success= $(F+H)/(B+H)$, where $B+H$ =maximum nest sites with eggs; $D+H$ =maximum nest sites with chicks; $F+H$ =maximum nest sites with chicks fledged. Numbers above columns indicate sample sizes ($B+H$). Data from 2008 represent maximum potential success, assuming all chicks still present at last check prior to the eruption (4 August) could have survived to fledging had the island not erupted. No monitoring data has been collected at Kasatochi since 2008.

Table 3. Reproductive performance of fork-tailed storm-petrels at Kasatochi Island, Alaska. Measures of success are based on nests monitored on an interval of about 7 days. Most chicks are too young to fledge by the time of last visit so measures of success represent maximum potential estimates, based on the assumption that any chick still present at last check could fledge. No monitoring data has been collected at Kasatochi since 2008.

Year	Max. nest sites w/ eggs (B+H)	Max nest sites w/ chicks (D+H)	Max. nest sites w/ chicks fledged (F+H) ^a	Nest sites w/ viable eggs at last visit ^b	Max. potential nesting success [(D+H)/(B+H)] ^c	Max. potential fledging success [(F+H)/(D+H)] ^d	Max. potential reproductive success [(F+H)/(B+H)]
2003	-	28	24	0	- ^e	0.86	- ^e
2004	38	32	23	0	0.84	0.72	0.61
2005	76	67	40	0	0.88	0.60	0.53
2006	104	95	85	0	0.91	0.90	0.82
2007	132	112	78	0	0.85	0.70	0.59
2008	115	102	52	0	0.89	0.51 ^f	0.45 ^f

^aF+H=maximum number of chicks potentially fledged and includes both fledged chicks (F) and chicks still present at last check but too young to have fledged (H).

^bEggs still present and apparently viable at last check are considered unknown fate and are not included in sample sizes or success estimates.

^cFor single-egg species, nesting success (D/B) is the same as hatching success (E/C) because nest sites w/ eggs (B)=total eggs (C) and nest sites w/ chicks (D)=total chicks (E).

^dFor single-egg species, fledging success (F/B) is the same as chick success (G/E) because nest sites w/ chicks (D)=total chicks (E) and nest sites w/ chicks fledged (F)=total chicks fledged (G).

^eIn 2003, nests were not monitored until after all chicks hatched so measures of nesting and reproductive success could not be calculated.

^fData from 2008 are calculated with assumption that all chicks still present at the last check prior to the eruption (4 August) could have survived to fledging had the island not erupted (in actuality, all chicks perished in the eruption). This probably results in a slight overestimate of maximum fledging and reproductive success.

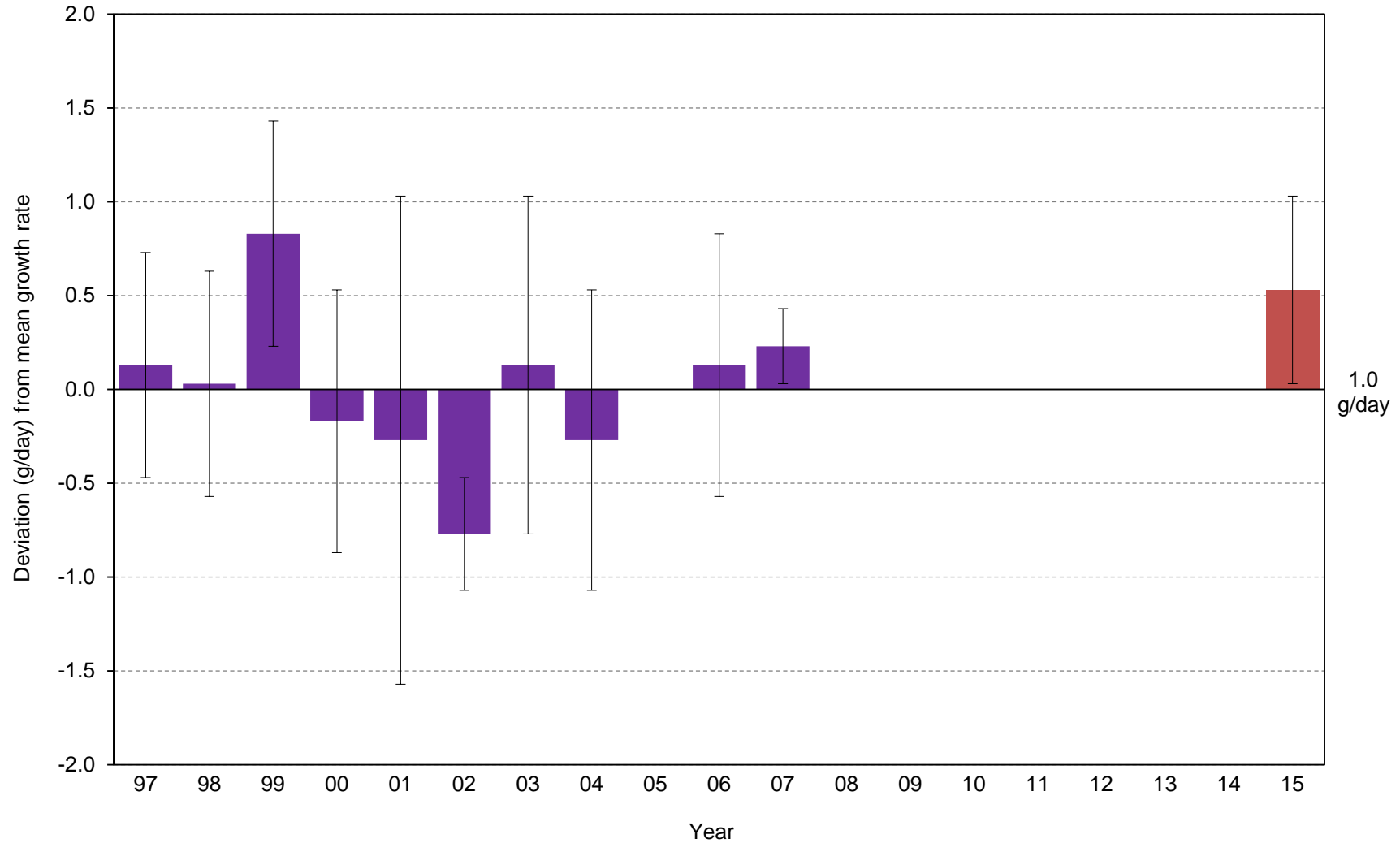


Figure 8. Yearly chick growth rate deviation (from the 2003-2008 average of 1.5 g/day) for fork-tailed storm-petrels at Ulak Island, Alaska. Negative values indicate less than the mean growth rate, positive values exceed the mean growth rate. Error bars represent standard deviation around each year's mean growth rate; red highlights the current year.

Table 4. Mean growth rates of fork-tailed storm-petrel chicks at Ulak Island, Alaska. Data include chicks measured at least two times during the linear phase of growth (approximately mass 0-80g; wing chord 20-140mm); chicks that died or did not exhibit linear growth were excluded.

Year	Mass (g/day)				Wing chord (mm/day) ^a			
	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>
1996	<i>no data</i>	-	-	-	-	-	-	-
1997	1.1	0.6	0.0 - 2.0	8	3.1	0.3	2.6 - 3.5	8
1998	1.0	0.6	0.2 - 1.8	13	3.2	0.3	2.6 - 3.6	13
1999	1.8	0.6	0.1 - 2.6	15	3.2	0.3	2.7 - 3.6	15
2000	0.8	0.7	-1.0 - 1.4	10	3.2	0.4	2.6 - 3.9	10
2001	0.7	1.3	-1.4 - 2.1	7	2.8	0.6	1.7 - 3.5	7
2002	0.2	0.3	-0.1 - 0.4	2	2.3	0.7	1.8 - 2.8	2
2003	1.1	0.9	-0.1 - 2.7	30	3.0	0.5	1.8 - 4.0	30
2004	0.7	0.8	-0.5 - 1.5	5	2.7	0.8	1.3 - 3.3	5
2005	<i>no data</i>	-	-	-	-	-	-	-
2006	1.1	0.7	-0.5 - 2.1	26	3.3	0.6	2.0 - 4.6	26
2007	1.2	0.2	1.1 - 1.4	3	3.1	0.1	3.0 - 3.2	3
2008	<i>no data</i>	-	-	-	-	-	-	-
2009	<i>no data</i>	-	-	-	-	-	-	-
2009	<i>no data</i>	-	-	-	-	-	-	-
2011	<i>no data</i>	-	-	-	-	-	-	-
2012	<i>no data</i>	-	-	-	-	-	-	-
2013	<i>no data</i>	-	-	-	-	-	-	-
2014	<i>no data</i>	-	-	-	-	-	-	-
2015	1.5	0.5	0.8 - 2.2	7	3.2	-	-	1

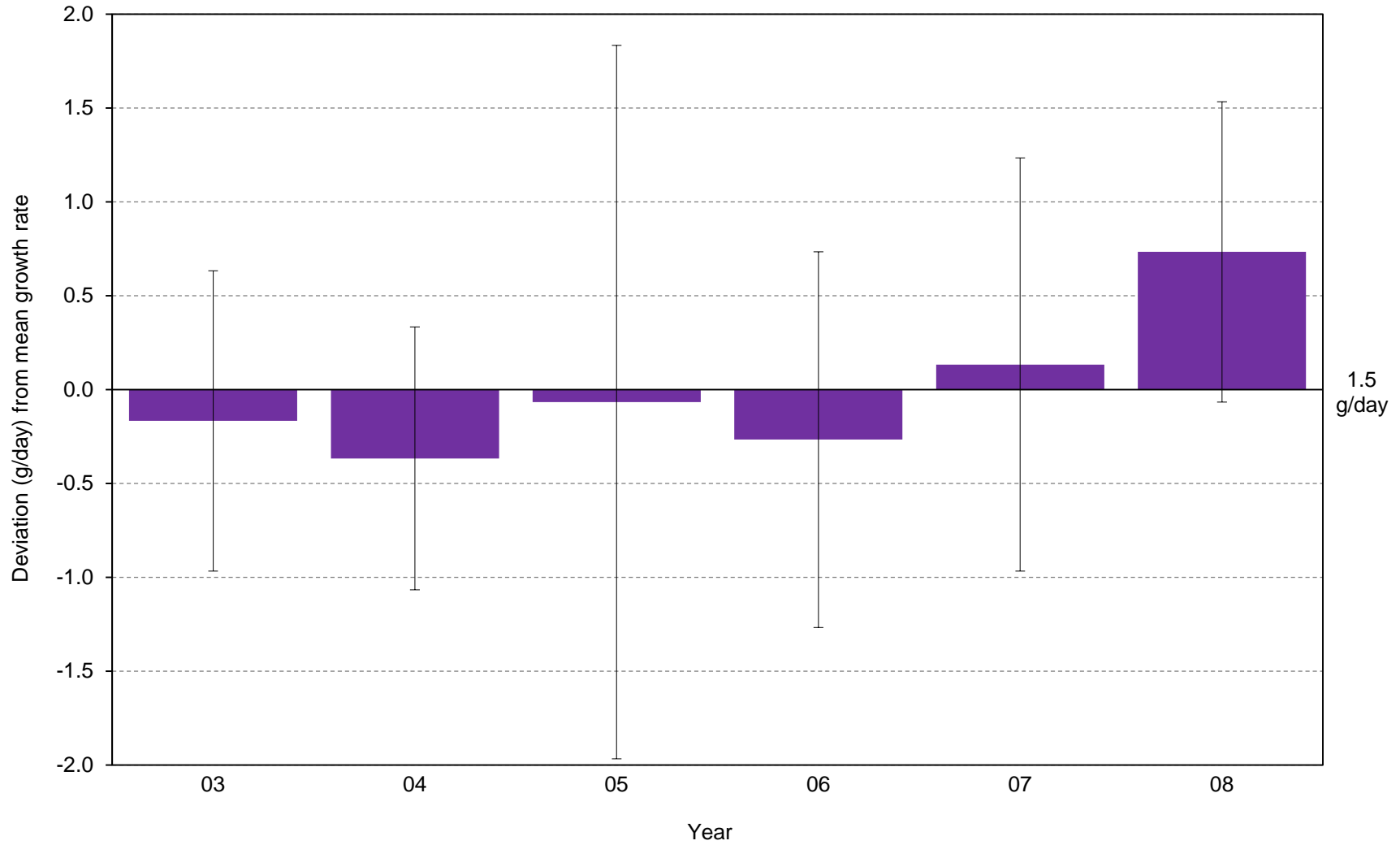


Figure 9. Yearly chick growth rate deviation (from the 2003-2008 average of 1.5 g/day) for fork-tailed storm-petrels at Kasatochi Island, Alaska. Negative values indicate less than the mean growth rate, positive values exceed the mean growth rate. Error bars represent standard deviation around each year's mean growth rate; no monitoring data has been collected at Kasatochi since 2008.

Table 5. Mean growth rates of fork-tailed storm-petrel chicks at Kasatochi Island, Alaska. Data include chicks measured at least two times during the linear phase of growth (approximately mass 0-80g; wing chord 20-140mm); chicks that died or did not exhibit linear growth were excluded. No monitoring data has been collected at Kasatochi since 2008.

Year	Mass (g/day)				Wing chord (mm/day) ^a			
	Mean	SD	Range	<i>n</i>	Mean	SD	Range	<i>n</i>
2003	1.3	0.8	-0.1 - 2.7	7	3.6	0.6	3.0 - 4.7	7
2004	1.1	0.7	-0.6 - 2.1	16	3.2	0.9	0.1 - 3.9	16
2005	1.4	1.9	-0.3 - 10.0	24	3.4	0.5	2.0 - 4.0	24
2006	1.2	1.0	0.1 - 6.0	39	3.6	0.2	3.0 - 4.0	39
2007	1.6	1.1	-0.3 - 6.3	34	3.4	0.4	2.2 - 4.1	34
2008	2.2	0.8	0.4 - 3.2	12	3.3	1.0	1.1 - 5.1	12

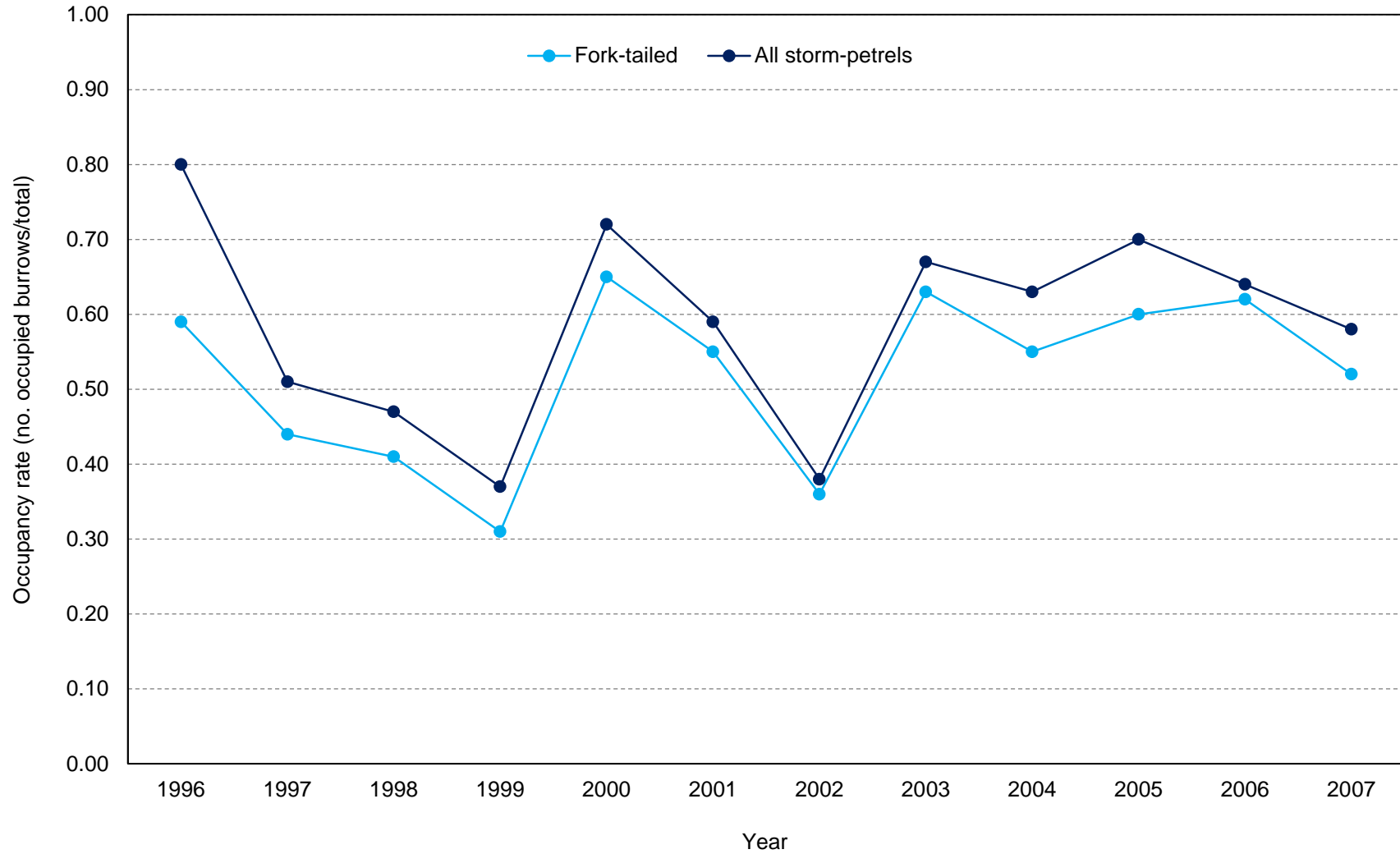


Figure 10. Occupancy rates of storm-petrels on index plots at Ulak Island, Alaska. Occupancy is expressed as the number of occupied burrows over the number of burrows with known contents. All storm-petrels include fork-tailed and unknown storm-petrels (which are almost certainly also fork-tailed storm-petrels, as no Leach's storm-petrels have ever been observed on plots). No data exist since 2007 because not all burrows were monitored in recent years.

Table 6. Occupancy rates of storm-petrels on index plots at Ulak Island, Alaska. Occupancy is expressed as the number of occupied burrows over the number of burrows with known contents. Data were collected only on plot 2; no data exist since 2007 because not all burrows were monitored in recent years.

Parameter	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
No. burrows occupied (O) ^a by:												
Fork-tailed storm-petrels	39	45	55	48	66	55	59	67	56	56	53	47
All storm-petrels ^b	53	52	63	57	73	59	62	71	64	65	55	52
Total no. burrows w/ known contents (N) ^c	66	102	133	155	102	100	163	106	102	93	86	90
Occupancy rate (O/N) of:												
Fork-tailed storm-petrels	0.59	0.44	0.41	0.31	0.65	0.55	0.36	0.63	0.55	0.60	0.62	0.52
All storm-petrels ^b	0.80	0.51	0.47	0.37	0.72	0.59	0.38	0.67	0.63	0.70	0.64	0.58

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

^bIncludes fork-tailed and unknown storm-petrels (which are almost certainly also fork-tailed storm-petrels, as no Leach's storm-petrels have been observed on plots).

^cBurrows with known contents are those with a chamber that were either occupied (see definition above) or confirmed empty (burrow ends could be reached).

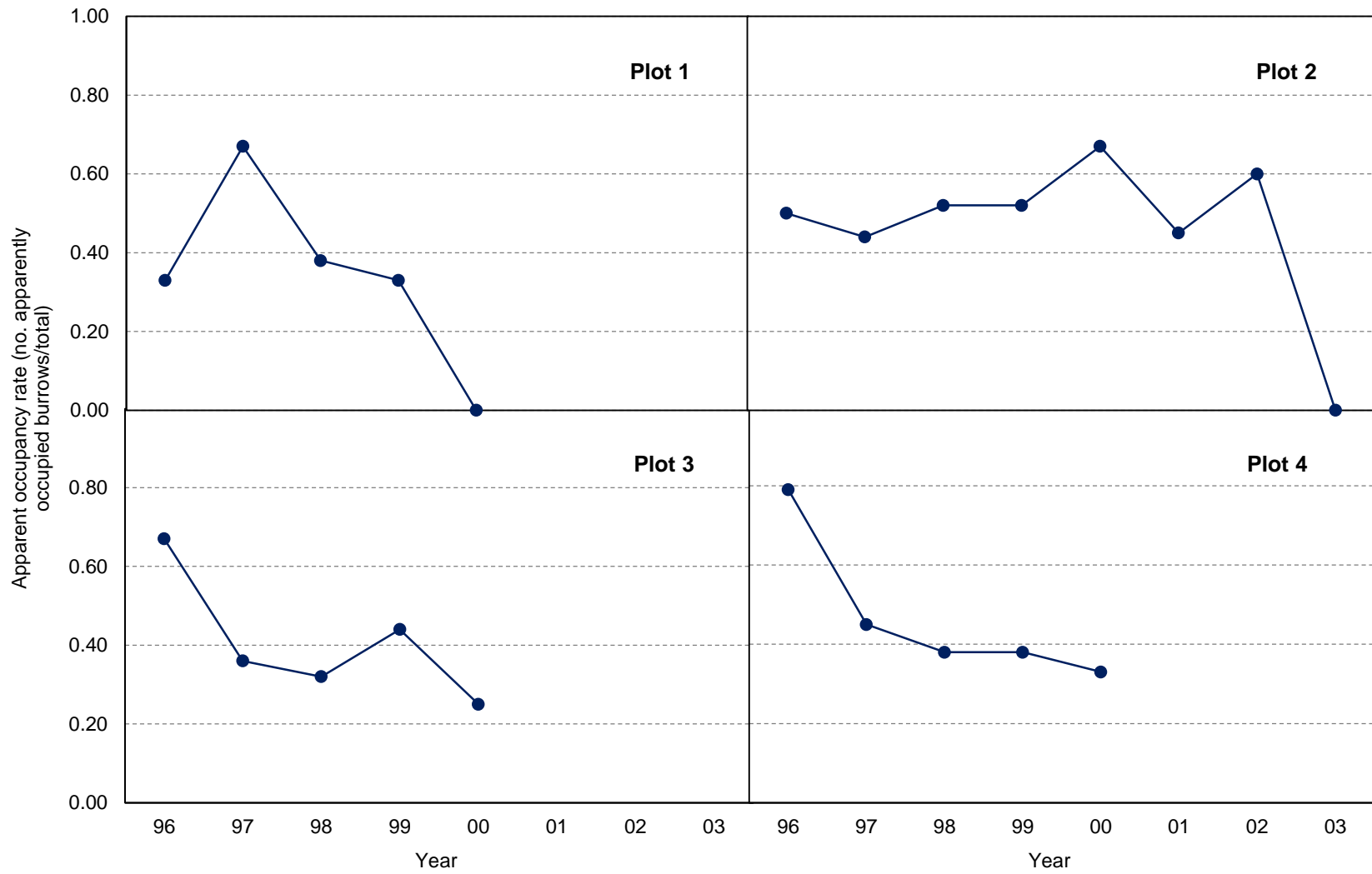


Figure 11. Apparent occupancy rates of tufted puffins on index plots at Ulak Island, Alaska. No apparent occupancy data were collected on plots 1, 3, and 4 since 2000, and on plot 2 since 2003.

Table 7. Apparent occupancy rates of tufted puffins on index plots at Ulak Island, Alaska. Apparent occupancy rate is expressed as the proportion of large (>14.5 cm) burrows with evidence of apparent occupancy late in the nesting period. Evidence of apparent occupancy includes observations of feathers, droppings, fresh vegetation, clipped vegetation and roots, eggs, eggshell fragments, or chicks in the burrow. Apparent occupancy rate is assessed in mid to late August, towards the end of the chick-rearing period, except in 1996. No apparent occupancy data were collected on plots 1, 3, and 4 since 2000, and on plot 2 since 2003.

Year	Plot				Total	Mean	SD	Survey Date
	1	2	3	4				
1996	0.33	0.50	0.67	0.79	0.65	0.65	0.11	10 Jun
1997	0.67	0.44	0.36	0.45	0.44	0.44	0.03	28 Aug
1998	0.38	0.52	0.32	0.38	0.38	0.38	0.04	31 Aug
1999	0.33	0.52	0.44	0.38	0.42	0.42	0.03	2 Sep
2000	0.00	0.67	0.25	0.33	0.37	0.37	0.09	1 Sep
2001	-	0.45	-	-	- ^a	- ^a	- ^a	3 Sep
2002	-	0.60	-	-	- ^a	- ^a	- ^a	3 Sep
2003	-	0.00	-	-	- ^a	- ^a	- ^a	26 Aug
Plot area (m ²)	100	100	100	100	400	-	-	-

^aSummary statistics are not calculated in years when not all plots are monitored.

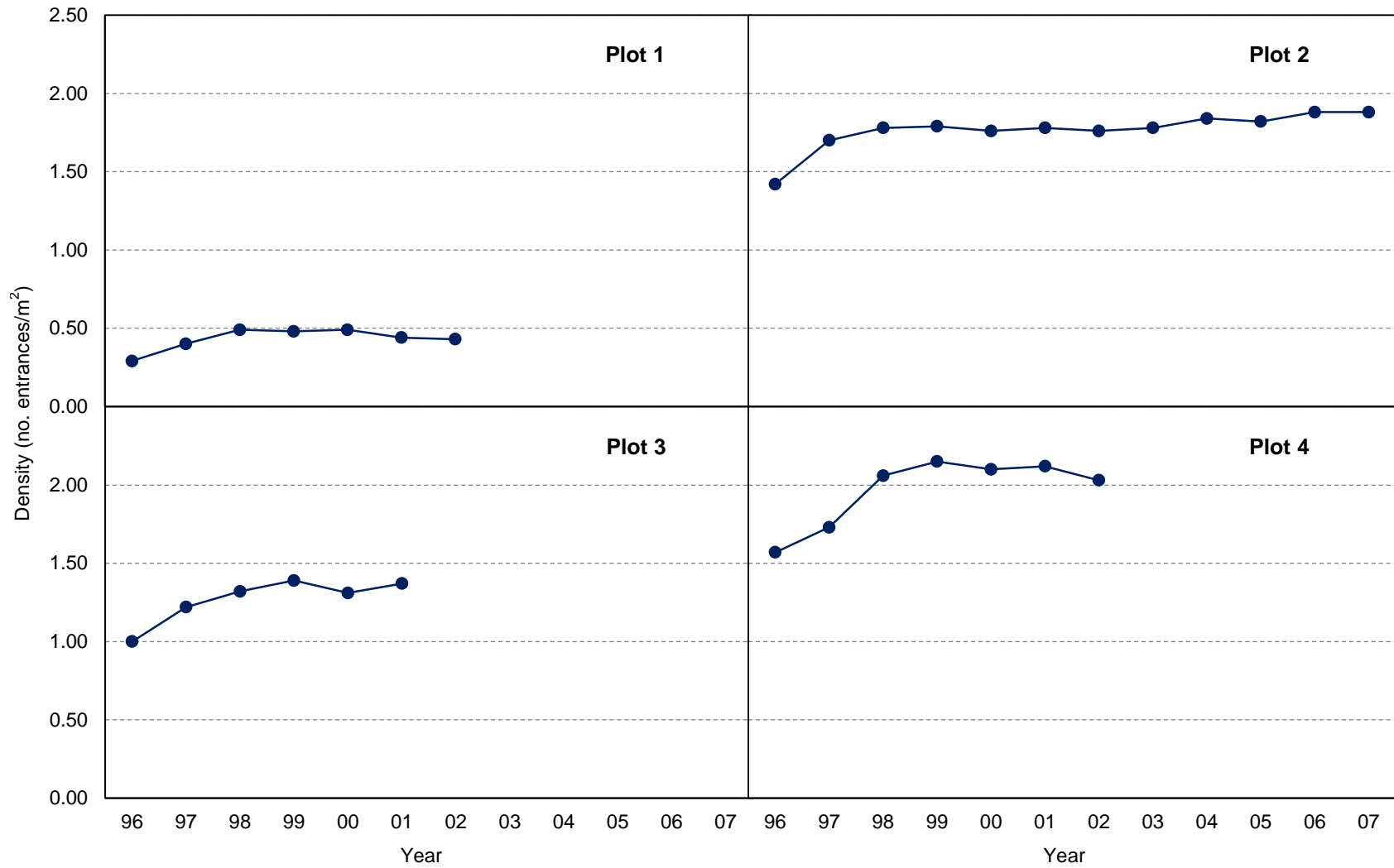


Figure 12. Burrow entrance densities of all burrow-nesting species on index plots at Ulak Island, Alaska. Densities are calculated for burrows of all sizes due to inconsistent classification among years and represent storm-petrels, Cassin's auklets and tufted puffins. Data are shown for each plot separately because not all plots were sampled each year (no density data were collected on plots 1, 3, and 4 since 2002, and on plot 2 since 2007).

Table 8. Burrow entrance densities of all burrow-nesting species on index plots at Ulak Island, Alaska. Densities are calculated for burrows of all sizes due to inconsistent classification among years and represent storm-petrels, Cassin's auklets and tufted puffins. No density data were collected on plots 1, 3, and 4 since 2002, and on plot 2 since 2007.

Year	Plot				Total	Mean	SD	Survey Date
	1	2	3	4				
1996	0.29	1.42	1.00	1.57	1.07	1.07	0.57	10 Jun
1997	0.40	1.70	1.22	1.73	1.26	1.26	0.62	19 May
1998	0.49	1.78	1.32	2.06	1.41	1.41	0.69	13 Jun
1999	0.48	1.79	1.39	2.15	1.45	1.45	0.72	20 Jun
2000	0.49	1.76	1.31	2.10	1.42	1.42	0.70	12 Jun
2001	0.44	1.78	1.37	2.12	1.43	1.43	0.73	1 Jun
2002	0.43	1.76	-	2.03	- ^a	- ^a	- ^a	8 Jun
2003	-	1.78	-	-	- ^a	- ^a	- ^a	16 Jun
2004	-	1.84	-	-	- ^a	- ^a	- ^a	9 Jun
2005	-	1.82	-	-	- ^a	- ^a	- ^a	11 Jun
2006	-	1.88	-	-	- ^a	- ^a	- ^a	20 Jun
2007	-	1.88	-	-	- ^a	- ^a	- ^a	17 Jun
Plot area (m ²)	100	100	100	100	400	-	-	-

^aSummary statistics are not calculated in years when not all plots are monitored.

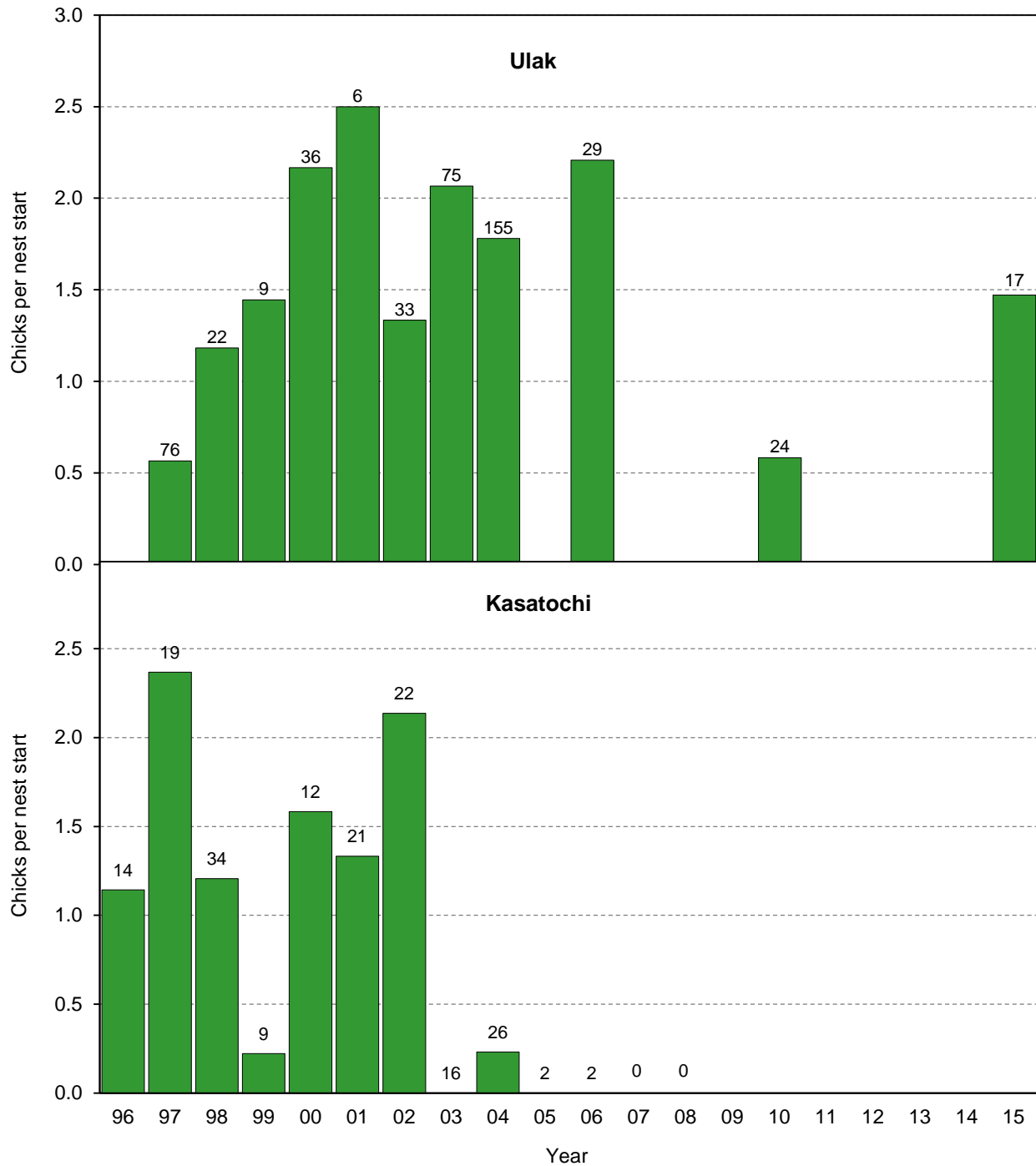


Figure 13. Reproductive performance of red-faced cormorants at Ulak and Kasatochi islands, Alaska. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A). Measures of success may not be directly comparable between islands because total nest starts (A) are counted late in the nesting period at Ulak and early in the nesting period at Kasatochi. No monitoring data has been collected at Kasatochi since 2008.

Table 9. Reproductive performance of red-faced cormorants at Ulak Island, Alaska, as determined by a Boom or Bust methodology. Measures of success are based on a single count of nests and large chicks conducted late in the nesting period in 1997-1998 and 2000-2015, and on a maximum of two counts conducted late in the nesting period in 1999. Data were collected during boat-based surveys but may not be comparable to estimates of success at Kasatochi because total nest starts were not counted early in the nesting period.

Year	Total nest starts (A)	Nest sites w/ unk. contents ^a	Nest sites w/ x chicks ^b :							Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)	Prop. nest sites w/ chicks (D/A) ^c	Chicks/nest start (E/A) ^c	Date(s) of max. nest count	Date(s) of max. chick count
			0	1	2	3	4	5	6							
1996	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	76	0	44	22	9	1	0	0	0	32	43	1.3	0.42	0.57	10 Aug	10 Aug
1998	22	19	8	6	4	4	0	0	0	14	26	1.9	0.64	1.18	5 Aug	5 Aug
1999	9	1	3	3	0	2	1	0	0	6	13	2.2	0.67	1.44	13 Aug	2 Sep
2000	36	3	6	3	11	11	5	0	0	30	78	2.6	0.83	2.17	4 Aug	4 Aug
2001	6	0	0	0	3	3	0	0	0	6	15	2.5	1.00	2.50	7 Aug	7 Aug
2002	33	35	9	9	11	3	1	0	0	24	44	1.8	0.73	1.33	4 Aug	4 Aug
2003	75	0	12	8	23	27	5	0	0	63	155	2.5	0.84	2.07	4 Aug	4 Aug
2004	155	0	48	14	35	42	14	2	0	107	276	2.6	0.69	1.78	23 Jul	23 Jul
2005	0	0	0	0	0	0	0	0	0	0	0	-	-	-	15 Jul	15 Jul
2006	29	0	0	8	9	10	2	0	0	29	64	2.2	1.00	2.21	7 Aug	7 Aug
2007	- ^d	-	0	0	0	0	0	0	0	- ^c	- ^c	- ^c	- ^c	- ^c	21 Jul	21 Jul
2008	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	24	5	16	3	4	1	0	0	0	8	14	1.8	0.33	0.58	22 Jul	22 Jul
2011	<i>data lost</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2013	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	17	1	3	6	5	3	0	0	0	14	25	1.8	0.82	1.47	1 Aug	1 Aug

^aNest sites with unknown contents (usually nests with brooding adults) are not included in total nest starts (A).

^bNumbers of chicks may represent a minimum count as not all may have been visible.

^cProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^dProductivity could not be estimated in 2007 because chicks were too small at the time of visit to view contents in any nests.

Table 10. Reproductive performance of red-faced cormorants at Kasatochi Island, Alaska, as determined by either Boom or Bust or frequent nest check methodologies. Measures of success for Boom or Bust monitoring are based on a count of nests (or maximum of several counts) conducted early in the nesting period and a count of large chicks (or maximum of several counts) conducted late in the nesting period. Measures of success for frequent nest check monitoring are based on obtaining nest statuses at 7-14 day intervals throughout the nesting period. Data were collected during boat-based surveys and represent all nests with visible contents on the island each year: all nests were located on the northeast side of the island in all years except 2005, when all nests were located in Tundering Cove. Data may not be comparable to estimates of success at Ulak because of varying methods. No monitoring data has been collected at Kasatochi since 2008.

Year	Total nest starts (A)	Nest sites w/ unk. contents ^a	Nest sites w/ x chicks ^b :					Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)	Prop. nest sites w/ chicks (D/A) ^c	Chicks/nest start (E/A) ^c	Method ^d	Date(s) of max. nest count ^e	Date(s) of max. chick count ^e	
			0	1	2	3	4									5
1996	14	0	4	4	6	0	0	0	10	16	1.6	0.71	1.14	BB	31 Jul	31 Jul
1997	19	1	1	3	5	8	2	0	18	45	2.5	0.95	2.37	FNC	-	-
1998 ^f	34	0	20	0	6	4	3	1	14	41	2.9	0.41	1.21	FNC	-	-
1999	9	0	7	2	0	0	0	0	2	2	1.0	0.22	0.22	FNC	-	-
2000	12	0	4	0	5	3	0	0	8	19	2.4	0.67	1.58	FNC	-	-
2001	21	0	6	6	5	4	0	0	15	28	1.9	0.71	1.33	BB	13 Aug	13 Aug
2002	22	1	1	1	11	8	0	0	20	47	2.4	0.91	2.14	BB	15 Jul	7 Aug
2003	16	2	16	0	0	0	0	0	0	0	-	0.00	0.00	FNC	-	-
2004	26	2	21	4	1	0	0	0	5	6	1.2	0.19	0.23	BB	24+27 Jul	24+27 Jul
2005	2	0	2	0	0	0	0	0	0	0	-	0.00	0.00	FNC	-	-
2006	2	0	2	0	0	0	0	0	0	0	-	0.00	0.00	BB	20 Jun	6 Aug
2007	0	0	0	0	0	0	0	0	0	0	-	-	-	FNC	-	-
2008	0	0	0	0	0	0	0	0	0	0	-	-	-	FNC	-	-

^aNest sites with unknown contents (usually nests with brooding adults) are not included in total nest starts (A).

^bNumbers of chicks may represent a minimum count as not all may have been visible.

^cProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^dBB=Boom or Bust methodology; FNC=frequent nest checks.

^eDates for maximum nest and chick counts apply only to Boom or Bust monitoring.

^fIn 1998, a few nests were never attended and were assumed to be red-faced nests based on nesting distribution in previous years.

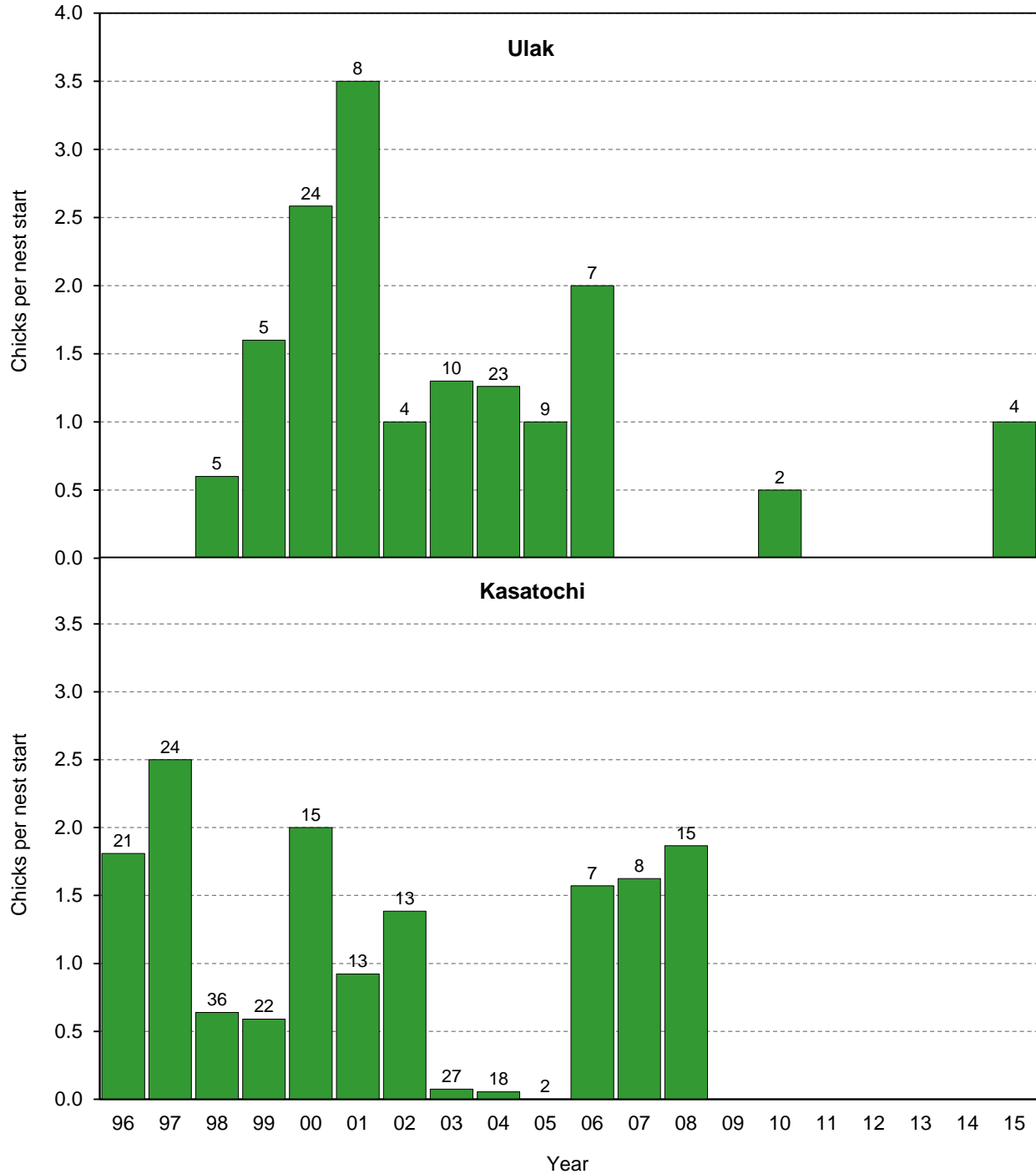


Figure 14. Reproductive performance of pelagic cormorants at Ulak and Kasatochi islands, Alaska. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A). Measures of success may not be directly comparable between islands because total nest starts (A) are counted late in the nesting period at Ulak and early in the nesting period at Kasatochi. No monitoring data has been collected at Kasatochi since 2008.

Table 11. Reproductive performance of pelagic cormorants at Ulak Island, Alaska, as determined by a Boom or Bust methodology. Measures of success are based on a single count of nests and large chicks conducted late in the nesting period in 1997-1998 and 2000-2015, and on a maximum of two counts conducted late in the nesting period in 1999. Data were collected during boat-based surveys but may not be comparable to estimates of success at Kasatochi because total nest starts were not counted early in the nesting period.

Year	Total nest starts (A)	Nest sites w/ unk. contents ^a	Nest sites w/ x chicks ^b :							Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)	Prop. nest sites w/ chicks (D/A) ^c	Chicks/nest start (E/A) ^c	Date(s) of max. nest count	Date(s) of max. chick count
			0	1	2	3	4	5	6							
1996	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	0	0	0	0	0	0	0	0	0	0	0	-	-	-	10 Aug	10 Aug
1998	5	4	2	3	0	0	0	0	0	3	3	1.0	0.60	0.60	5 Aug	5 Aug
1999	5	6	1	2	0	2	0	0	0	4	8	2.0	0.80	1.60	13 Aug	2 Sep
2000	24	1	2	3	6	8	3	1	1	22	62	2.8	0.92	2.58	4 Aug	4 Aug
2001	8	0	0	0	1	2	5	0	0	8	28	3.5	1.00	3.50	7 Aug	7 Aug
2002	4	0	2	0	2	0	0	0	0	2	4	2.0	0.50	1.00	4 Aug	4 Aug
2003	10	0	1	6	2	1	0	0	0	9	13	1.4	0.90	1.30	4 Aug	4 Aug
2004	23	0	4	11	6	2	0	0	0	19	29	1.5	0.83	1.26	23 Jul	23 Jul
2005	9	0	0	9	0	0	0	0	0	9	9	1.0	1.00	1.00	15 Jul	15 Jul
2006	7	0	0	3	2	1	1	0	0	7	14	2.0	1.00	2.00	7 Aug	7 Aug
2007	^d	^d	0	0	0	1	0	0	0	^d	^d	^d	^d	^d	21 Jul	21 Jul
2008	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	2	0	0	1	0	0	0	0	0	1	2	2.0	0.50	1.00	22 Jul	22 Jul
2011	<i>data lost</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2013	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	4	2	1	2	1	0	0	0	0	3	4	1.3	0.75	1.00	1 Aug	1 Aug

^aNest sites with unknown contents (usually nests with brooding adults) are not included in total nest starts (A).

^bNumbers of chicks may represent a minimum count as not all may have been visible.

^cProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^dProductivity could not be estimated in 2007 because chicks were too small at the time of visit to view contents in any nests.

Table 12. Reproductive performance of pelagic cormorants at Kasatochi Island, Alaska, as determined by either Boom or Bust or frequent nest check methodologies. Measures of success for Boom or Bust monitoring are based on a count of nests (or maximum of several counts) conducted early in the nesting period and a count of large chicks (or maximum of several counts) conducted late in the nesting period. Measures of success for frequent nest check monitoring are based on obtaining nest statuses at 7-14 day intervals throughout the nesting period. Data were collected during boat-based surveys and represent all nests with visible contents on the island each year: all nests were located only on the northeast side of the island in all years except 1998, 2003, and 2004, when some nests were also located in Tundering Cove and on the rocks of Sud Slot in front of camp. Data may not be comparable to estimates of success at Ulak because of varying methods. No monitoring data has been collected at Kasatochi since 2008.

Year	Total nest starts (A)	Nest sites w/ unk. contents ^a	Nest sites w/ x chicks ^b :					Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)	Prop. nest sites w/ chicks (D/A) ^c	Chicks/nest start (E/A) ^c	Method ^d	Date(s) of max. nest count ^e	Date(s) of max. chick count ^e	
			0	1	2	3	4									5
1996	21	0	4	4	7	4	2	0	17	38	2.2	0.81	1.81	BB	31 Jul	31 Jul
1997	24	1	2	1	8	10	2	1	22	60	2.7	0.92	2.50	FNC	-	-
1998 ^f	36	1	26	1	5	4	0	0	10	23	2.3	0.28	0.64	FNC	-	-
1999	22	0	18	0	1	1	2	0	4	13	3.3	0.18	0.59	FNC	-	-
2000	15	0	3	2	3	6	1	0	12	30	2.5	0.80	2.00	FNC	-	-
2001	13	1	6	2	5	0	0	0	7	12	1.7	0.54	0.92	BB	13 Aug	13 Aug
2002	13	1	4	0	6	2	0	0	8	18	2.3	0.62	1.38	BB	15 Jul	7 Aug
2003	27	4	26	0	1	0	0	0	1	2	2.0	0.04	0.07	FNC	-	-
2004	18	2	17	1	0	0	0	0	1	1	1.0	0.06	0.06	BB	24+27 Jul	24+27 Jul
2005	2	2	2	0	0	0	0	0	0	0	-	0.00	0.00	FNC	-	-
2006	7	2	3	0	2	1	1	0	4	11	2.8	0.57	1.57	BB	20 Jun	6 Aug
2007	8	0	1	3	2	2	0	0	7	13	1.9	0.88	1.63	FNC	-	-
2008	15	2	4	1	4	5	1	0	11	28	2.5	0.73	1.87	FNC	-	-

^aNest sites with unknown contents (usually nests with brooding adults) are not included in total nest starts (A).

^bNumbers of chicks may represent a minimum count as not all may have been visible.

^cProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^dBB=Boom or Bust methodology; FNC=frequent nest checks.

^eDates for maximum nest and chick counts apply only to Boom or Bust monitoring.

^fIn 1998, a few nests were never attended and were assumed to be pelagic nests based on nesting distribution in previous years.

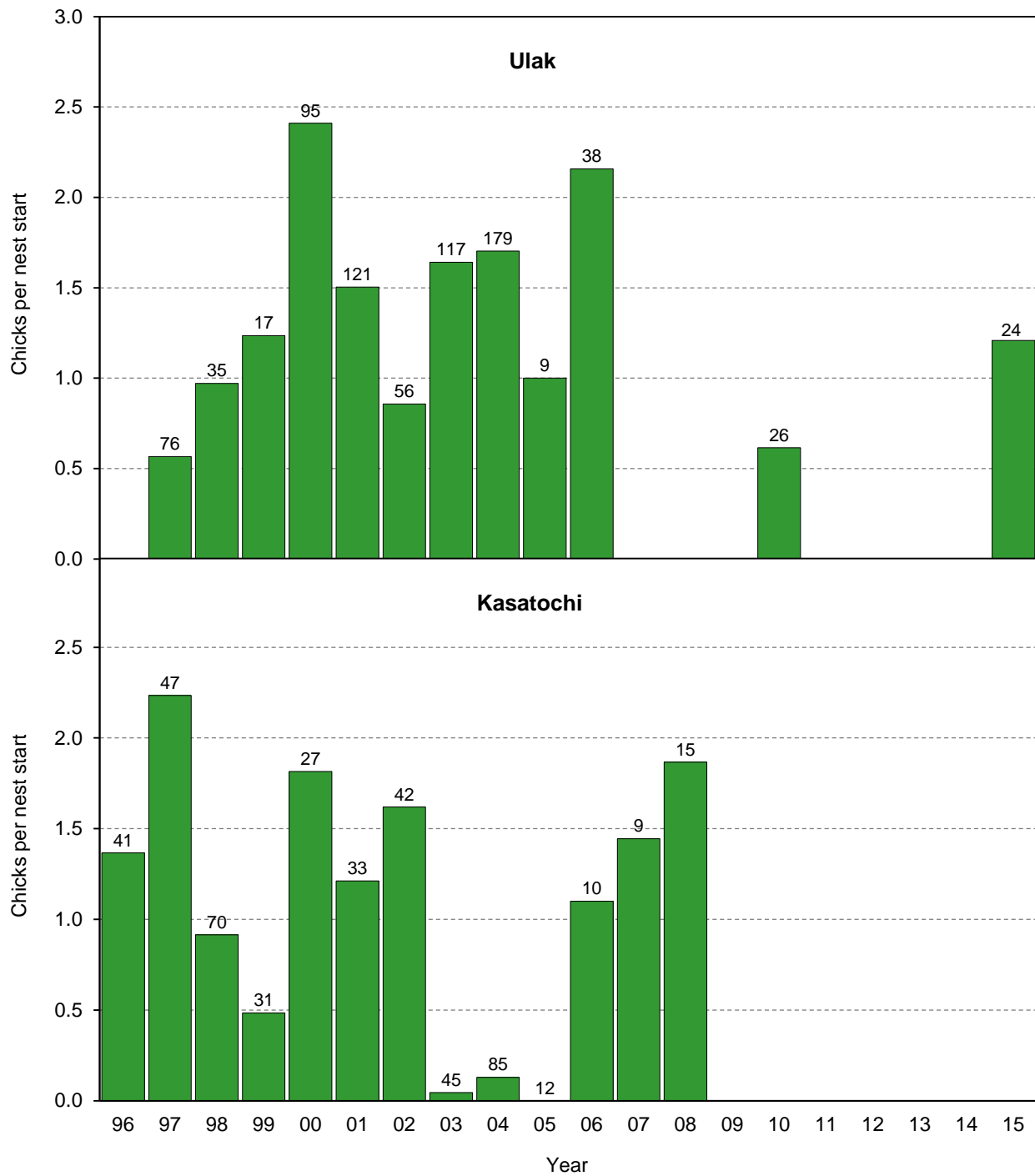


Figure 15. Reproductive performance of all cormorants (includes red-faced, pelagic, and unknown cormorants) at Ulak and Kasatochi islands, Alaska. Success is measured by the number of chicks per nest start (E/A), where E=total chicks and A=total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A). Measures of success may not be directly comparable between islands because total nest starts (A) are counted late in the nesting period at Ulak and early in the nesting period at Kasatochi. No monitoring data has been collected at Kasatochi since 2008.

Table 13. Reproductive performance of all cormorants (includes red-faced, pelagic, and unknown cormorants) at Ulak Island, Alaska, as determined by a Boom or Bust methodology. Measures of success are based on a single count of nests and large chicks conducted late in the nesting period in 1997-1998 and 2000-2015, and on a maximum of two counts conducted late in the nesting period in 1999. Data were collected during boat-based surveys but may not be comparable to estimates of success at Kasatochi because total nest starts were not counted early in the nesting period.

Year	Total nest starts (A)	Nest sites w/ unk. contents ^a	Nest sites w/ x chicks ^b :									Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)	Prop. nest sites w/ chicks (D/A) ^c	Chicks/nest start (E/A) ^c	Date(s) of max. nest count	Date(s) of max. chick count
			0	1	2	3	4	5	6	7	8							
1996	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	76	0	44	22	9	1	0	0	0	0	0	32	43	1.3	0.42	0.57	10 Aug	10 Aug
1998	35	2	16	9	5	5	0	0	0	0	0	19	34	1.8	0.54	0.97	5 Aug	5 Aug
1999	17	1	7	5	0	4	1	0	0	0	0	10	21	2.1	0.59	1.24	13 Aug	2 Sep
2000	95	0	13	6	27	30	17	1	1	0	0	82	229	2.8	0.86	2.41	4 Aug	4 Aug
2001	121	0	51	9	29	20	10	0	0	1	1	70	182	2.6	0.58	1.50	7 Aug	7 Aug
2002	56	1	30	9	13	3	1	0	0	0	0	26	48	1.8	0.46	0.86	4 Aug	4 Aug
2003	117	2	35	15	32	31	5	0	0	0	0	83	192	2.3	0.71	1.64	4 Aug	4 Aug
2004	179	6	53	25	41	44	14	2	0	0	0	126	305	2.4	0.70	1.70	23 Jul	23 Jul
2005	9	4	0	9	0	0	0	0	0	0	0	9	9	1.0	1.00	1.00	15 Jul	15 Jul
2006	38	2	0	11	13	11	3	0	0	0	0	38	82	2.2	1.00	2.16	7 Aug	7 Aug
2007	- ^d	- ^d	0	0	0	1	0	0	0	0	0	- ^d	- ^d	- ^d	- ^d	- ^d	21 Jul	21 Jul
2008	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	26	5	17	3	5	1	0	0	0	0	0	9	16	1.8	0.35	0.62	22 Jul	22 Jul
2011	<i>data lost</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2013	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	<i>no counts</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	24	6	7	8	6	3	0	0	0	0	0	17	29	1.7	0.71	1.21	1 Aug	1 Aug

^aNest sites with unknown contents (usually nests with brooding adults) are not included in total nest starts (A).

^bNumbers of chicks may represent a minimum count as not all may have been visible.

^cProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledged.

^dProductivity could not be estimated in 2007 because chicks were too small at the time of visit to view contents in any nests.

Table 14. Reproductive performance of all cormorants (includes red-faced, pelagic, and unknown cormorants) at Kasatochi Island, Alaska, as determined by either Boom or Bust or frequent nest check methodologies. Measures of success for Boom or Bust monitoring are based on a count of nests (or maximum of several counts) conducted early in the nesting period and a count of large chicks (or maximum of several counts) conducted late in the nesting period. Measures of success for frequent nest check monitoring are based on obtaining nest statuses at 7-14 day intervals throughout the nesting period. Data were collected during boat-based surveys and represent all nests with visible contents on the island each year: all nests were located only on the northeast side of the island in all years except 1998, 2003, and 2004, when some nests were also located in Tundering Cove and on the rocks of Sud Slot in front of camp. Data may not be comparable to estimates of success at Ulak because of varying methods. No monitoring data has been collected at Kasatochi since 2008.

Year	Total nest starts (A)	Nest sites w/ unk. contents ^a	Nest sites w/ x chicks ^b :					Nest sites w/ chicks (D)	Total chicks (E)	Mean brood size (E/D)	Prop. nest sites w/ chicks (D/A) ^c	Chicks/nest start (E/A) ^c	Method ^d	Date(s) of max. nest count ^e	Date(s) of max. chick count ^e	
			0	1	2	3	4									5
1996	41	0	12	10	13	4	2	0	29	56	1.9	0.71	1.37	BB	31 Jul	31 Jul
1997	47	2	7	4	13	18	4	1	40	105	2.6	0.85	2.23	FNC	-	-
1998	70	1	46	1	11	8	3	1	24	64	2.7	0.34	0.91	FNC	-	-
1999	31	0	25	2	1	1	2	0	6	15	2.5	0.19	0.48	FNC	-	-
2000	27	0	7	2	8	9	1	0	20	49	2.5	0.74	1.81	FNC	-	-
2001	33	1	11	8	10	4	0	0	22	40	1.8	0.67	1.21	BB	13 Aug	13 Aug
2002	42	2	13	1	17	11	0	0	29	68	2.3	0.69	1.62	BB	15 Jul	7 Aug
2003	45	6	44	0	1	0	0	0	1	2	2.0	0.02	0.04	FNC	-	-
2004	85	4	77	6	1	1	0	0	8	11	1.4	0.09	0.13	BB	24+27 Jul	24+27 Jul
2005	12	2	12	0	0	0	0	0	0	0	-	0.00	0.00	FNC	-	-
2006	10	2	6	0	1	2	1	0	4	11	2.8	0.40	1.10	BB	20 Jun	6 Aug
2007	9	0	2	3	2	2	0	0	7	13	1.9	0.78	1.44	FNC	-	-
2008	15	2	4	1	4	5	1	0	11	28	2.5	0.73	1.87	FNC	-	-

^aNest sites with unknown contents (usually nests with brooding adults) are not included in total nest starts (A).

^bNumbers of chicks may represent a minimum count as not all may have been visible.

^cProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

^dBB=Boom or Bust methodology; FNC=frequent nest checks.

^eDates for maximum nest and chick counts apply only to Boom or Bust monitoring.

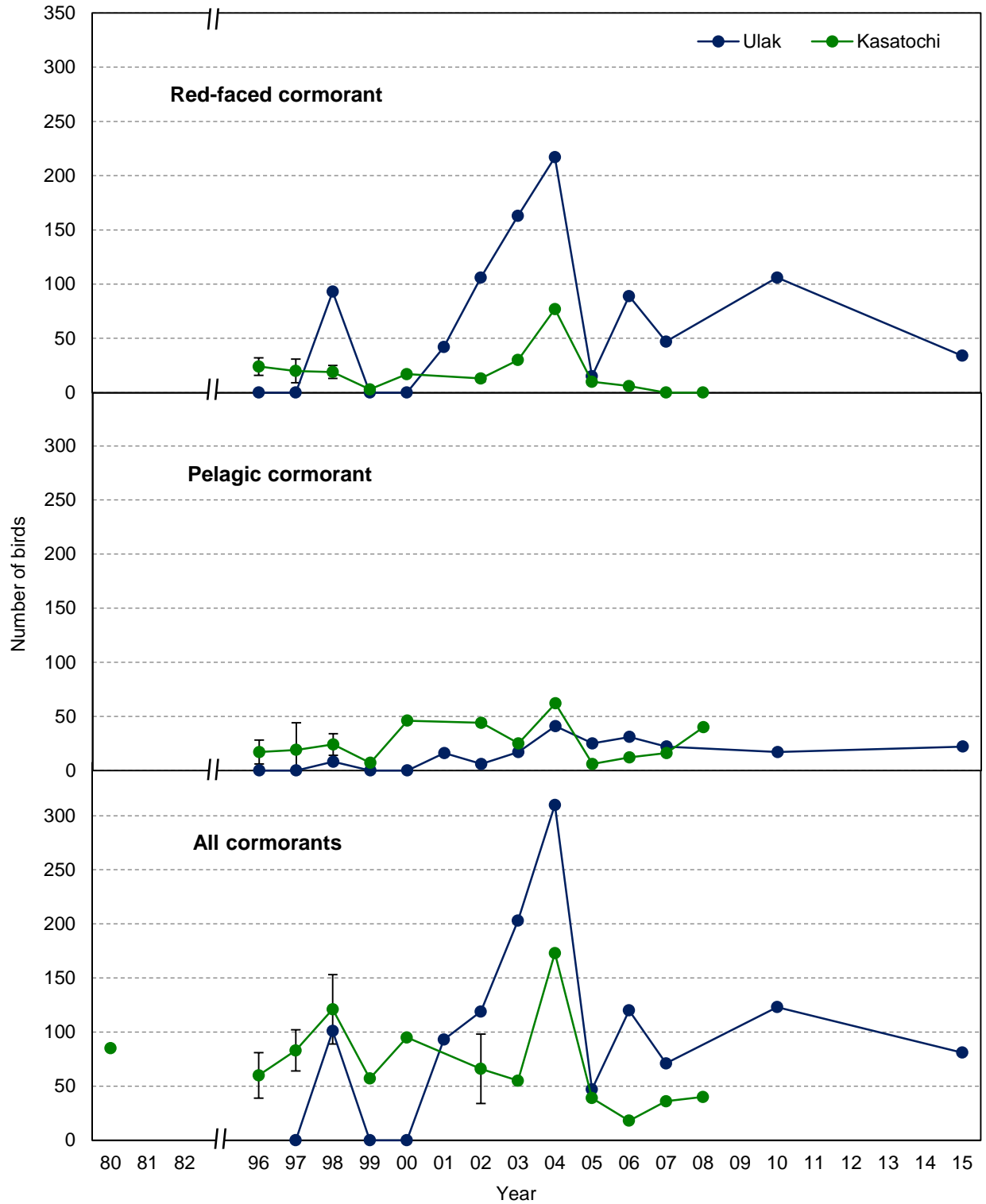


Figure 16. Numbers of cormorants counted at Ulak and Kasatochi islands, Alaska. Values from Ulak represent single counts; values from Kasatochi represent single counts or the mean of multiple counts. Error bars represent standard deviations around means. No monitoring data has been collected at Kasatochi since 2008.

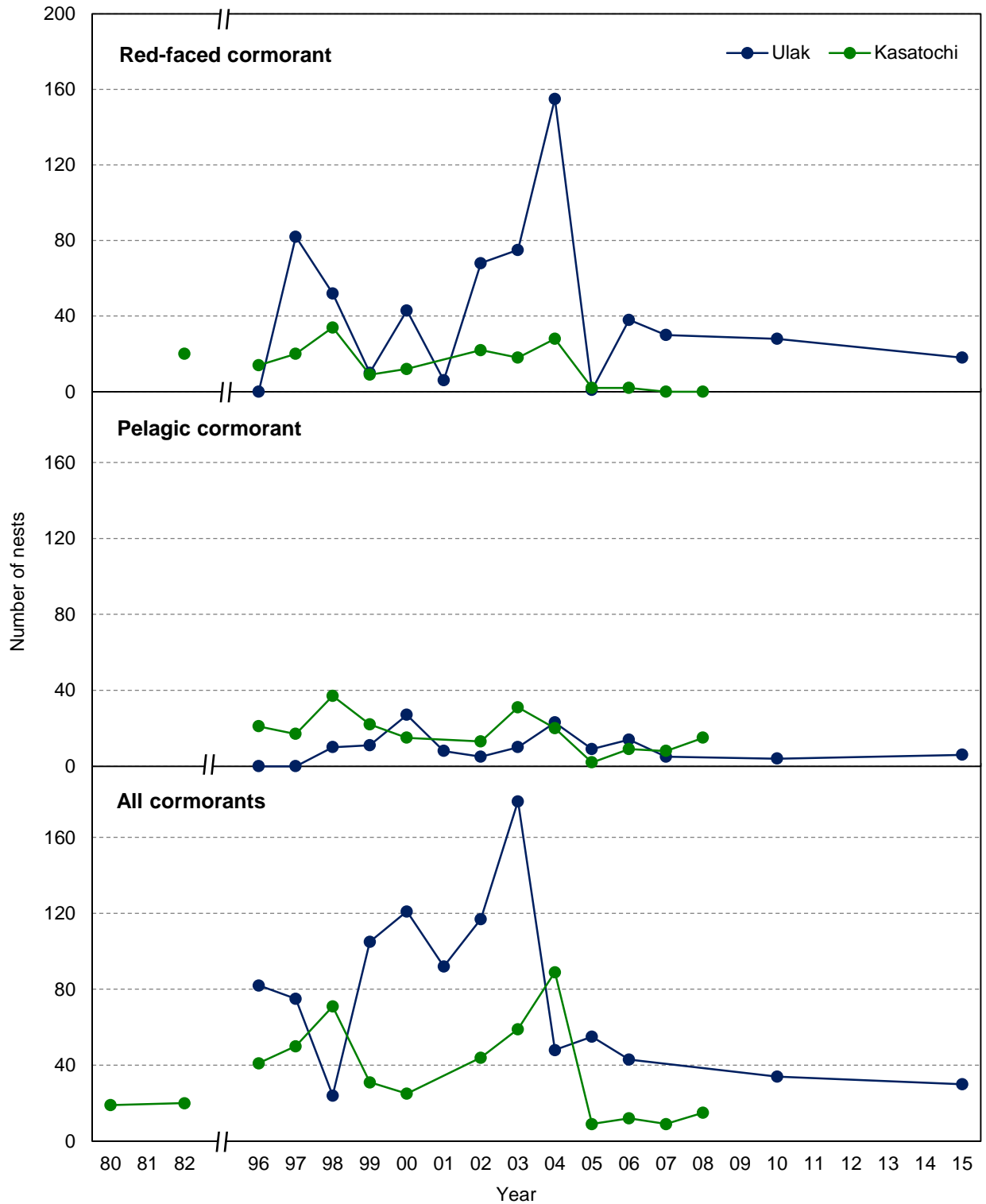


Figure 17. Maximum numbers of cormorant nests counted at Ulak and Kasatochi islands, Alaska. Values from Ulak represent single counts or the maximum of multiple counts; values from Kasatochi represent the maximum of multiple counts (1980-1998, 2008) or the cumulative number of nests present based on season-long monitoring (1999-2007). No monitoring data has been collected at Kasatochi since 2008.

Table 15. Numbers of red-faced cormorants counted on index plots at Ulak Island, Alaska. Data are based on a single count each year.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
East end	<i>no count</i>	NC ^a	0	0	0	0	0	0	0	3	6	1	<i>no count</i>	<i>no count</i>	0	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	0
A	<i>no count</i>	NC	0	0	0	0	39	1	0	0	44	1	<i>no count</i>	<i>no count</i>	17	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	22
B	-	0	0	0	0	0	15	0	3	1	0	0	-	-	7	-	-	-	-	12
C	-	0	0	0	0	0	12	6	3	0	0	0	-	-	0	-	-	-	-	0
D	-	0	1	0	0	0	38	137	136	10	30	31	-	-	1	-	-	-	-	0
E	-	0	92	0	0	42	2	19	75	1	9	14	-	-	81	-	-	-	-	0
Total	-	≥0	93	0	0	42	106	163	217	15	89	47	-	-	106	-	-	-	-	34
Count date	-	10 Aug	22 Jul	13 Aug	4 Aug	7 Aug	4 Aug	4 Aug	23 Jul	15 Jul	4 Aug	21 Jul	-	-	22 Jul	-	-	-	-	1 Aug

^aNC = section not counted.

Table 16. Numbers of red-faced cormorant nests counted on index plots at Ulak Island, Alaska. Data are based on a single count each year, except in 1998 and 1999 when data represent the maximum of two counts.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
East end	<i>no count</i>	NC ^a	0	0	0	0	0	0	0	0	3	0	<i>no count</i>	<i>no count</i>	0	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	0
A	<i>no count</i>	NC	0	0	0	0	24	0	0	0	17	0	<i>no count</i>	<i>no count</i>	20	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	15
B	-	5	0	0	0	0	8	0	3	0	0	0	-	-	0	-	-	-	-	3
C	-	0	0	0	0	0	9	3	1	0	0	0	-	-	0	-	-	-	-	0
D	-	42	0	0	0	0	27	67	111	0	18	29	-	-	0	-	-	-	-	0
E	-	35	52	10	43	6	0	5	40	1	0	1	-	-	8	-	-	-	-	0
Total	-	≥82	52	10	43	6	68	75	155	1	38	30	-	-	28	-	-	-	-	18
Count date	-	10 Aug	22 Jul	2 Sep	4 Aug	7 Aug	4 Aug	4 Aug	23 Jul	15 Jul	4 Aug	21 Jul	-	-	22 Jul	-	-	-	-	1 Aug

^aNC = section not counted.

Table 17. Numbers of pelagic cormorants counted on index plots at Ulak Island, Alaska. Data are based on a single count each year.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
East end		NC ^a	0	0	0	0	0	1	3	10	1	2			2	data lost	no count	no count	no count	0
A	no count	NC	0	0	0	0	2	0	1	0	18	0	no count	no count	0	data lost	no count	no count	no count	7
B	-	0	4	0	0	0	0	3	5	13	1	0	-	-	5	-	-	-	-	11
C	-	0	0	0	0	0	0	0	2	1	1	0	-	-	0	-	-	-	-	4
D	-	0	1	0	0	0	3	8	4	0	0	0	-	-	6	-	-	-	-	0
E	-	0	3	0	0	16	1	5	26	1	10	20	-	-	4	-	-	-	-	0
Total	-	≥0	8	0	0	16	6	17	41	25	31	22	-	-	17	-	-	-	-	22
Count date	-	10 Aug	22 Jul	13 Aug	4 Aug	7 Aug	4 Aug	4 Aug	23 Jul	15 Jul	4 Aug	21 Jul	-	-	22 Jul	-	-	-	-	1 Aug

^aNC = section not counted.

Table 18. Numbers of pelagic cormorant nests counted on index plots at Ulak Island, Alaska. Data are based on a single count each year, except in 1998 and 1999 when data represent the maximum of two counts.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
East end		NC ^a	0	0	0	0	0	0	1	9	0	1			0	data lost	no count	no count	no count	0
A	no count	NC	0	0	0	0	2	0	0	0	10	0	no count	no count	0	data lost	no count	no count	no count	4
B	-	0	1	0	0	0	0	1	4	0	1	0	-	-	2	-	-	-	-	0
C	-	0	0	0	0	0	0	0	1	0	0	0	-	-	0	-	-	-	-	2
D	-	0	0	0	0	0	2	5	4	0	0	0	-	-	1	-	-	-	-	0
E	-	0	9	11	27	8	1	4	13	0	3	4	-	-	1	-	-	-	-	0
Total	-	≥0	10	11	27	8	5	10	23	9	14	5	-	-	4	-	-	-	-	6
Count date(s)	-	10 Aug	22 Jul+ 5 Aug ^b	13 Aug	4 Aug	7 Aug	4 Aug	4 Aug	23 Jul	15 Jul	4 Aug	21 Jul	-	-	22 Jul	-	-	-	-	1 Aug

^aNC = section not counted.

^bMaximum count on plot B occurred on 22 July; maximum count on plot E occurred on 5 August.

Table 19. Numbers of all cormorants (includes red-faced, pelagic, and unknown cormorants) counted on index plots at Ulak Island, Alaska. Data are based on a single count each year.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
East end	<i>no count</i>	NC ^a	0	0	0	0	0	1	3	13	7	3	<i>no count</i>	<i>no count</i>	2	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	0
A	<i>no count</i>	NC	0	0	0	0	41	1	1	0	62	2	<i>no count</i>	<i>no count</i>	17	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	49
B	-	0	4	0	0	0	21	3	8	14	1	0	-	-	12	-	-	-	-	26
C	-	0	0	0	0	0	13	6	5	1	1	0	-	-	0	-	-	-	-	5
D	-	0	2	0	0	0	41	168	140	16	30	32	-	-	7	-	-	-	-	1
E	-	0	95	0	0	93	3	24	153	3	19	34	-	-	85	-	-	-	-	0
Total	-	≥0	101	0	0	93	119	203	310	47	120	71	-	-	123	-	-	-	-	81
Count date	-	10 Aug	22 Jul	13 Aug	4 Aug	7 Aug	4 Aug	4 Aug	23 Jul	15 Jul	4 Aug	21 Jul	-	-	22 Jul	-	-	-	-	1 Aug

^aNC = section not counted.

Table 20. Numbers of all cormorant nests (includes red-faced, pelagic, and unknown cormorants) counted on index plots at Ulak Island, Alaska. Data are based on a single count each year, except in 1998 and 1999 when data represent the maximum of two counts.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
East end	<i>no count</i>	NC ^a	0	0	0	0	0	0	2	9	3	1	<i>no count</i>	<i>no count</i>	0	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	0
A	<i>no count</i>	NC	2	0	0	0	35	0	0	0	29	2	<i>no count</i>	<i>no count</i>	20	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	22
B	-	5	1	0	0	0	8	4	7	0	1	0	-	-	2	-	-	-	-	6
C	-	0	0	0	0	0	11	3	2	0	0	0	-	-	2	-	-	-	-	2
D	-	42	0	0	0	0	29	98	115	12	19	35	-	-	1	-	-	-	-	0
E	-	35	72	24	105	121	9	12	53	27	3	5	-	-	9	-	-	-	-	0
Total	-	≥82	75	24	105	121	92	117	179	48	55	43	-	-	34	-	-	-	-	30
Count date(s)	-	10 Aug	22 Jul+ 5 Aug ^b	13 Aug+ 2 Sep ^c	4 Aug	7 Aug	4 Aug	4 Aug	23 Jul	15 Jul	4 Aug	21 Jul	-	-	22 Jul	-	-	-	-	1 Aug

^aNC = section not counted.

^bMaximum count on plot A, B, and plot E (red-faced) occurred on 22 July; maximum count on plot E (pelagic and unspecified) occurred on 5 August.

^cMaximum count for red-faced occurred on 13 August; maximum count for pelagic and unspecified occurred on 2 September.

Table 21. Numbers of red-faced cormorants counted during circumnavigation surveys at Kasatochi Island, Alaska. Counts of adult birds come from full island circumnavigation surveys and do not include additional visits to the cormorant colony for productivity monitoring in some years that are used to determine number of nests. No data exist after 2008.

Replicate	1980	1982	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0 ^a	NC ^b	36	17	14	3	17	<i>no count</i>	11	30	77	10	6	0	0
2	-	-	22	8	23	-	-	-	15	-	-	-	-	-	-
3	-	-	19	21	-	-	-	-	-	-	-	-	-	-	-
4	-	-	20	34	-	-	-	-	-	-	-	-	-	-	-
Mean	0	-	24	20	19	3	17	-	13	30	77	10	6	0	0
<i>n</i>	1	1	4	4	2	1	1	-	2	1	1	1	1	1	1
SD	-	-	8	11	6	-	-	-	3	-	-	-	-	-	-
First count	13 Jul	2 Jun	20 Jun	2 Jun ^c	14 Jun	25 Jun	6 Aug	-	31 May	5 Jul	5 Jun	22 Jun	20 Jun	5 Aug	3 Aug
Last count	-	-	31 Jul	24 Jul	19 Jun	-	-	-	30 Jun	-	-	-	-	-	-

^aNo birds identified to species in 1980.

^bTwenty red-faced cormorant nests were counted in 1982 but number of adult birds not recorded.

^cDoes not include an additional count on 27 May in which no birds were identified to species.

Table 22. Numbers of red-faced cormorant nests counted during circumnavigation surveys and boat-based productivity monitoring at Kasatochi Island, Alaska. No data exist after 2008.

Replicate	1980	1982	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0 ^a	20	14	14	10	8	10	<i>no count</i>	9	16	28	1	2	0	0
2	-	-	14	6	18	3	9	-	10	16	16	2	0	0	-
3	-	-	14	15	34	4	11	-	22	16	12	2	-	0	-
4	-	-	14	20	-	4	12	-	-	2	-	2	-	0	-
Mean	0	20	14	14	21	5	11	-	14	13	19	2	1	0	0
Overall max. ^b	0	20	14	20	34	9	12	-	22	18	28	2	2	0	0
<i>n</i>	1	1	4	4	3	4	4	-	3	4	3	4	2	4	1
SD	-	-	0	6	12	2	1	-	7	7	8	1	1	0	-
First count	13 Jul	2 Jun	20 Jun	2 Jun	14 Jun	25 Jun	7 Jul	-	31 May	5 Jul	5 Jun	15 Jul	5 Aug	17 Jun	3 Aug
Last count	-	-	31 Jul	8 Aug	10 Jul	2 Sep	5 Sep	-	15 Jul	20 Aug	-	14 Aug	-	5 Aug	-

^aNo birds identified to species in 1980.

^bOverall maximum nest number is the maximum number of nests present at the island each year; when counts were conducted (1980-1998, 2008), maximum nest number is the highest count, whereas when nests were marked and individually monitored (1999-2007), maximum nest number is the total cumulative number of nests present during the season.

Table 23. Numbers of pelagic cormorants counted during circumnavigation surveys at Kasatochi Island, Alaska. Counts of adult birds come from full island circumnavigation surveys and do not include additional visits to the cormorant colony for productivity monitoring in some years that are used to determine number of nests. No data exist after 2008.

Replicate	1980	1982	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0 ^a	0	9	6	31	7	46	<i>no count</i>	46	25	62	6	12	16	40
2	-	-	9	0	17	-	-	-	42	-	-	-	-	-	-
3	-	-	16	14	-	-	-	-	-	-	-	-	-	-	-
4	-	-	32	55	-	-	-	-	-	-	-	-	-	-	-
Mean	0	0	17	19	24	7	46	-	44	25	62	6	12	16	40
<i>n</i>	1	1	4	4	2	1	1	-	2	1	1	1	1	1	1
SD	-	-	11	25	10	-	-	-	3	-	-	-	-	-	-
First count	13 Jul	2 Jun	20 Jun	2 Jun ^b	14 Jun	25 Jun	6 Aug	-	31 May	5 Jul	5 Jun	22 Jun	20 Jun	5 Aug	3 Aug
Last count	-	-	31 Jul	24 Jul	19 Jun	-	-	-	30 Jun	-	-	-	-	-	-

^aNo birds identified to species in 1980.

^bDoes not include an additional count on 27 May in which no birds were identified to species.

Table 24. Numbers of pelagic cormorant nests counted during circumnavigation surveys and boat-based productivity monitoring at Kasatochi Island, Alaska. No data exist after 2008.

Replicate	1980	1982	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0	0	3	2	8	2	15	<i>no count</i>	2	17	20	0	9	6	15
2	-	-	7	0	5	19	13	-	16	27	2	2	7	6	-
3	-	-	11	9	37	20	14	-	13	29	8	2	-	8	-
4	-	-	21	17	-	15	14	-	-	12	-	-	-	8	-
Mean	0	0	11	7	17	14	14	-	10	21	10	1	8	7	15
Overall max. ^a	0	0	21	17	37	22	15	-	13	31	20	2	9	8	15
<i>n</i>	1	1	4	4	3	4	4	-	3	4	3	3	2	4	1
SD	-	-	8	8	18	8	1	-	7	8	9	1	1	1	-
First count	13 Jul	2 Jun	20 Jun	2 Jun	14 Jun	25 Jun	7 Jul	-	31 May	5 Jul	5 Jun	15 Jul	20 Jun	17 Jun	3 Aug
Last count	-	-	31 Jul	8 Aug	10 Jul	2 Sep	5 Sep	-	15 Jul	20 Aug	29 Jul	14 Aug	6 Aug	5 Aug	-

^aOverall maximum nest number is the maximum number of nests present at the island each year; when counts were conducted (1980-1998, 2008), maximum nest number is the highest count, whereas when nests were marked and individually monitored (1999-2007), maximum nest number is the total cumulative number of nests present during the season.

Table 25. Numbers of all cormorants (includes red-faced, pelagic, and unknown species) counted during circumnavigation surveys at Kasatochi Island, Alaska. Counts of adult birds come from full island circumnavigation surveys and do not include additional visits to the cormorant colony for productivity monitoring in some years that are used to determine number of nests. No data exist after 2008.

Replicate	1980	1982	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	85	NC ^a	90	104	98	57	95	<i>no count</i>	57	55	173	39	18	36	40
2	-	-	55	73	143	-	-	-	75	-	-	-	-	-	-
3	-	-	41	56	-	-	-	-	-	-	-	-	-	-	-
4	-	-	52	93	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	89	-	-	-	-	-	-	-	-	-	-	-
Mean	85	-	60	83	121	57	95	-	66	55	173	39	18	36	40
<i>n</i>	1	1	4	4	2	1	1	-	2	1	1	1	1	1	1
SD	-	-	21	19	32	-	-	-	32	-	-	-	-	-	-
First count	13 Jul	2 Jun	20 Jun	2 Jun	14 Jun	25 Jun	6 Aug	-	31 May	5 Jul	5 Jun	22 Jun	20 Jun	5 Aug	3 Aug
Last count	-	-	31 Jul	24 Jul	19 Jun	-	-	-	30 Jun	-	-	-	-	-	-

^aTwenty red-faced cormorant nests were counted in 1982 but number of adult birds not recorded.

Table 26. Numbers of all cormorant nests (includes red-faced, pelagic, and unknown species) counted during circumnavigation surveys and boat-based productivity monitoring at Kasatochi Island, Alaska. No data exist after 2008.

Replicate	1980	1982	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	19	20	30	18	30	10	25	<i>no count</i>	11	37	89	9	12	7	15
2	-	-	30	21	36	22	22	-	26	48	87	-	7	6	-
3	-	-	32	49	71	24	25	-	45	55	83	-	-	8	-
4	-	-	41	50	-	19	26	-	-	20	-	-	-	8	-
Mean	19	20	33	35	46	19	25	-	27	40	86	9	10	7	15
Overall max. ^a	19	20	41	50	71	31	25	-	44	59	89	9	12	9	15
<i>n</i>	1	1	4	4	3	4	4	-	3	4	3	1	2	4	1
SD	-	-	5	17	22	6	2	-	17	15	3	-	4	1	-
First count	13 Jul	2 Jun	20 Jun	2 Jun	14 Jun	25 Jun	7 Jul	-	31 May	5 Jul	5 Jun	15 Jul ^b	20 Jun	17 Jun	3 Aug
Last count	-	-	31 Jul	8 Aug	10 Jul	2 Sep	5 Sep	-	15 Jul	20 Aug	29 Jul	-	6 Aug	5 Aug	-

^aOverall maximum nest number is the maximum number of nests present at the island each year; when counts were conducted (1980-1998, 2008), maximum nest number is the highest count, whereas when nests were marked and individually monitored (1999-2007), maximum nest number is the total cumulative number of nests present during the season.

^bRed-faced, pelagic and unknown cormorant nests were counted on different days; counts for all cormorant nests presented here include only days when all were counted.

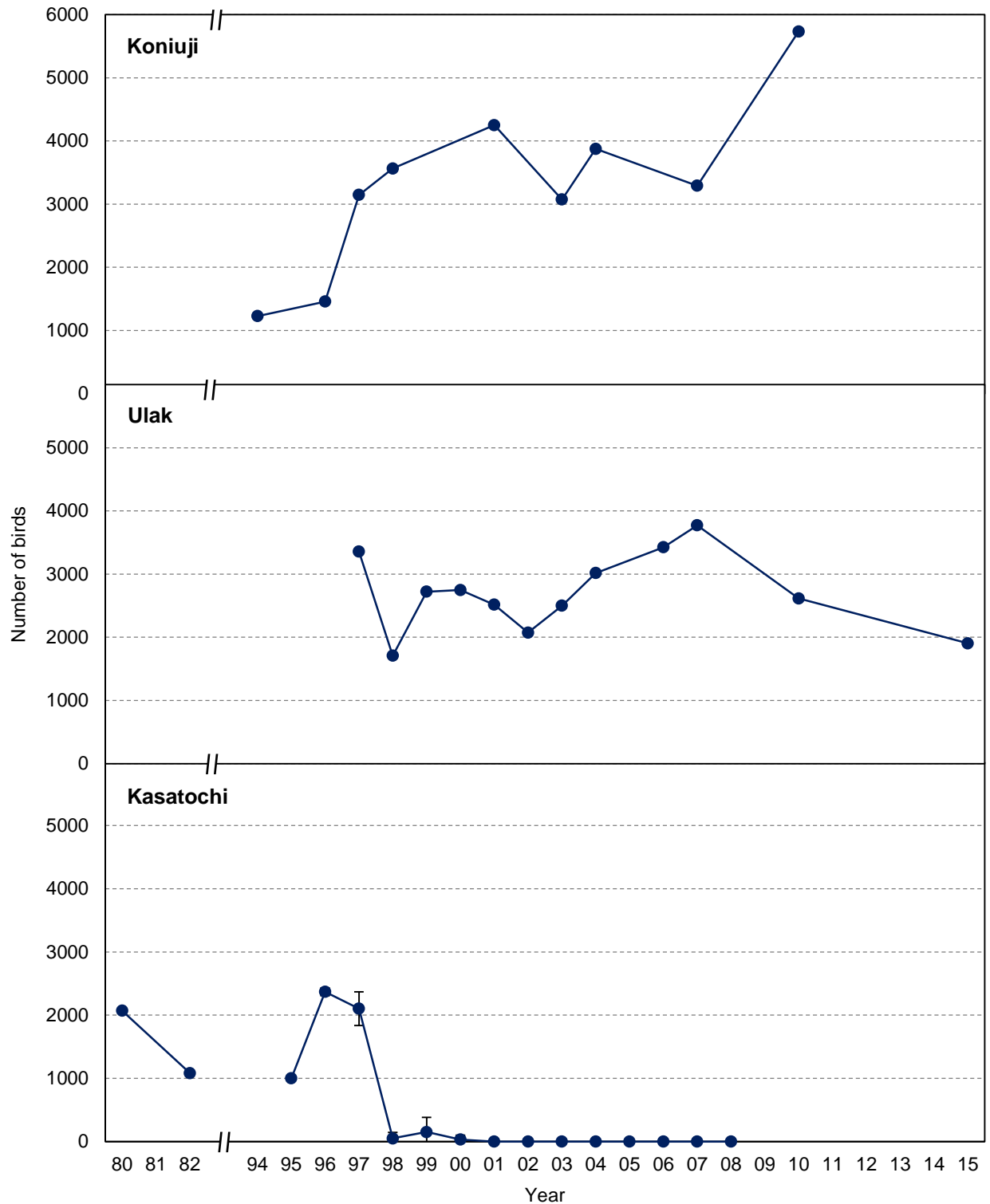


Figure 18. Numbers of murre (includes common, thick-billed, and unknown murre) counted on index plots at Koniuji, Ulak, and Kasatochi islands, Alaska. Values from Koniuji and Ulak are from single surveys, values from Kasatochi represent single counts or the mean of replicate counts (error bars represent standard deviation). At Koniuji, data from 1995 and 2000 are excluded because not all plots were counted. At Kasatochi, no murre attempted to breed 2001-2008; no monitoring data has been collected at Kasatochi since 2008.

Table 27. Numbers of murre (includes common, thick-billed, and unknown murre) counted on index plots at Koniuji Island, Alaska. Data are based on single counts each year except in 2010 when count occurred over two days. Historical data are from Byrd and Williams (1994) and Byrd (1995). No counts were conducted after 2011; data were lost in 2011.

Plot	1994 ^a	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	-	-	145	312	2	<i>no count</i>	270	249	<i>no count</i>	224	410	<i>no count</i>	<i>no count</i>	963	<i>no count</i>	<i>no count</i>	909	<i>data lost</i>
2a	-	-	2	117	80	-	39	67	-	12	30	-	-	24	-	-	3	-
2b	-	-	151	0	0	-	0	0	-	13	0	-	-	0	-	-	0	-
3	-	-	18	11	5	-	5	0	-	0	0	-	-	1	-	-	0	-
4	-	-	20	38	19	-	25	14	-	4	16	-	-	9	-	-	24	-
East side (plots 1-4)	774	276	336	478	108	-	339	330	-	253	456	-	-	997	-	-	936	-
5	-	-	28	586	483	-	429	596	-	530	661	-	-	1207	-	-	2619	-
6	-	-	39	53	3	-	74	504	-	108	96	-	-	42	-	-	0	-
7	-	-	0	419	293	-	NC ^b	0	-	398	147	-	-	0	-	-	455	-
South side (plots 5-7)	-	936	67	1058	779	-	≥503	1100	-	1036	904	-	-	1249	-	-	3074	-
8	-	-	0	5	0	-	-	0	-	0	1	-	-	0	-	-	0	-
9	-	-	11	57	52	-	-	41	-	34	0	-	-	61	-	-	0	-
10	-	-	982	1288	1935	-	-	1677	-	1084	1560	-	-	836	-	-	1034	-
11a	-	-	18	3	16	-	-	0	-	0	9	-	-	0	-	-	0	-
11b	-	-	0	0	0	-	-	6	-	5	0	-	-	0	-	-	0	-
11c	-	-	0	0	0	-	-	0	-	0	0	-	-	0	-	-	0	-
West side (plots 8-11)	454	1112	1011	1353	2003	-	NC	1724	-	1123	1570	-	-	897	-	-	1034	-
12	-	-	12	12	0	-	-	0	-	0	0	-	-	0	-	-	0	-
13	-	-	31	179	22	-	-	1096	-	658	57	-	-	0	-	-	0	-
14	-	-	0	65	653	-	-	0	-	3	888	-	-	148	-	-	688	-
North side (plots 12-14)	-	NC	43	256	675	-	NC	1096	-	661	945	-	-	148	-	-	388	-
Total	1228	≥2323	1457	3145	3563	-	≥842	4250	-	3073	3875	-	-	3291	-	-	5732	-
Survey date(s)	7 Aug	13 Aug	2 Aug	4 Aug	5 Aug	-	1 Aug	6 Aug	-	28 Jul	22 Jul	-	-	22 Jul	-	-	21+22 Jul	-

^aDuring the 1994 survey, all areas were counted but the island was divided into just 2 sections (east and west).

^bNC = section not counted.

Table 28. Numbers of murres (includes common, thick-billed, and unknown murres) counted on index plots at Ulak Island, Alaska. Data are based on a single count except in 2010 when count occurred over two days.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
East end	<i>no count</i>	15	49	30	54	71	31	44	107	<i>no count</i>	39	92	<i>no count</i>	<i>no count</i>	60	<i>data lost</i>	<i>no count</i>	<i>no count</i>	<i>no count</i>	0
A	-	261	109	232	288	208	66	113	855	-	198	255	-	-	221	-	-	-	-	435
B	-	1693	444	772	601	547	476	604	106	-	695	621	-	-	618	-	-	-	-	1443
C	-	6	251	75	109	130	158	84	0	-	119	58	-	-	0	-	-	-	-	25
D	-	1371	725	1417	1671	1527	1266	1575	1841	-	1976	2139	-	-	1528	-	-	-	-	0
E	-	10	129	195	25	32	76	79	107	-	398	606	-	-	214	-	-	-	-	0
Total	-	3356	1707	2721	2748	2515	2073	2499	3016	-	3425	3771	-	-	2614	-	-	-	-	1903
Count date	-	10 Aug	22 Jul	13 Aug	4 Aug	7 Aug	4 Aug	4 Aug	23 Jul		7 Aug	21 Jul	-	-	21+22 Jul	-	-	-	-	1 Aug

Table 29. Numbers of murres (includes common, thick-billed, and unknown murres) counted on index plots at Kasatochi Island, Alaska. No counts were conducted 1983-1994. Murres abandoned index plots 2001-2008; no monitoring data has been collected at Kasatochi since 2008.

Replicate	1980	1981	1982	1995	1996	1997	1998	1999	2000
1	2071	<i>no count</i>	1083	~1000 ^a	2284	1620	~200	~450	~150
2	-	-	-	-	2362	2088	~200	~450	6
3	-	-	-	-	2447	2174	0	0	0
4	-	-	-	-	2309	2417	0	0	0
5	-	-	-	-	2363	2345	0	0	0
6	-	-	-	-	2382	1813	0	0	-
7	-	-	-	-	2435	2203	0	-	-
8	-	-	-	-	-	2166	0	-	-
Mean	2071	-	1083	~1000	2369	2103	~50	~150	~31
<i>n</i>	1	-	1	1	7	8	8	6	5
SD	-	-	-	-	60	266	93	232	67
First count	13 Jul	-	17 Jul	13 Aug	18 Jul	17 Jul	17 Jun	2 Jul	22 Jun
Last count	-	-	-	-	14 Aug	19 Aug	16 Aug	13 Aug	6 Aug

^aThe “~” sign indicates count is an estimate calculated by roughly counting birds in groups, instead of counting every individual bird.

Table 30. Numbers of common and thick-billed murres on index plots at Kasatochi Island, Alaska. No counts identifying birds to species were conducted 1998-2000. Murres abandoned index plots 2001-2008; no monitoring data has been collected at Kasatochi since 2008.

Replicate	Common murres		Thick-billed murres	
	1996	1997	1996	1997
1	264	258	1931	1295
2	307	292	1977	1741
3	320	313	2059	1823
4	282	389	1954	1963
5	307	385	1996	1911
6	291	205	2047	1584
7	324	378	2033	1800
8	-	329	-	1810
Mean	299	319	2000	1741
<i>n</i>	7	8	7	8
SD	22	66	49	213
First count	18 Jul	17 Jul	18 Jul	17 Jul
Last count	14 Aug	19 Aug	14 Aug	19 Aug

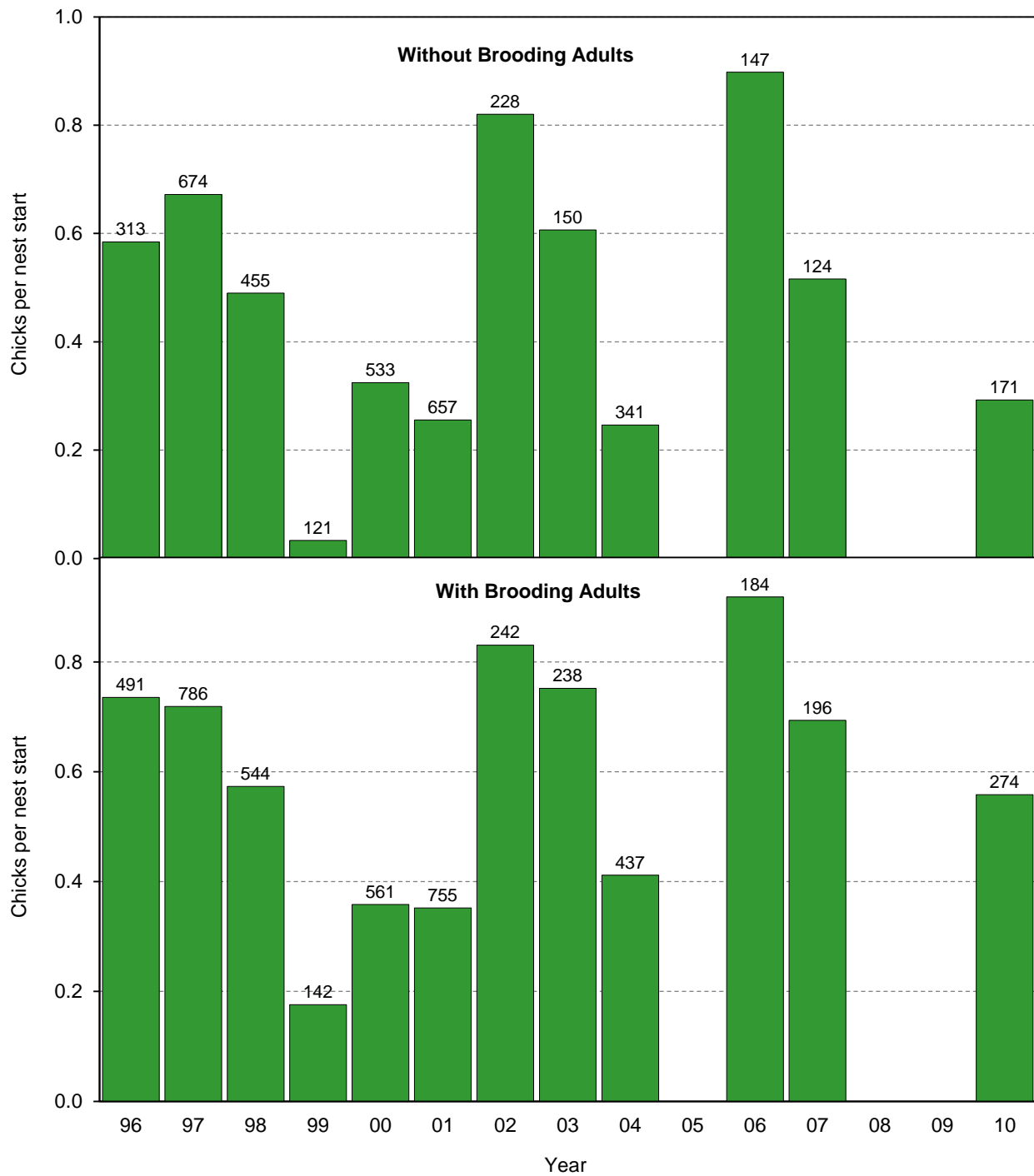


Figure 19. Reproductive performance of black-legged kittiwakes at Konijui Island, Alaska, as determined by a Boom or Bust methodology. Success is measured by the number of chicks per nest start (E/A), where E =total chicks and A =total nest starts (including those without chicks). Numbers above columns indicate sample sizes (A). Data are presented both with and without nests containing brooding adults (calculations with brooding adults assume those nests contained at least one chick; calculations without brooding adults omit those nests from analyses). No data were collected after 2011; data were lost in 2011.

Table 31. Reproductive performance of black-legged kittiwakes on index plots at Koniuji Island, Alaska, as determined by a Boom or Bust methodology. Measures of success are based on a single count of nests and large chicks conducted late in the nesting period. Data are presented both with and without nests containing brooding adults (calculations with brooding adults assume those nests contained at least one chick; calculations without brooding adults omit those nests from analyses). No data were collected after 2011; data were lost in 2011.

Year	Birds included	Total nest starts	Nest sites w/ chicks	Total chicks	Prop. nest sites w/ chicks	Chicks/nest start	Date of count
		(A)	(D)	(E)	(D/A) ^a	(E/A) ^a	
1996	w/o brooders	313	158	183	0.50	0.58	2 Aug
	w/ brooders	491	336	361	0.68	0.74	-
1997	w/o brooders	674	372	453	0.55	0.67	4 Aug
	w/ brooders	786	484	565	0.62	0.72	-
1998	w/o brooders	455	193	223	0.42	0.49	5 Aug
	w/ brooders	544	282	312	0.52	0.57	-
1999	w/o brooders	121	4	4	0.03	0.03	13 Aug
	w/ brooders	142	25	25	0.18	0.18	-
2000	w/o brooders	533	147	173	0.28	0.32	1 Aug
	w/ brooders	561	175	201	0.31	0.36	-
2001	w/o brooders	657	146	168	0.22	0.26	6 Aug
	w/ brooders	755	244	266	0.32	0.35	-
2002	w/o brooders	228	151	187	0.66	0.82	5 Aug
	w/ brooders	242	165	201	0.68	0.83	-
2003	w/o brooders	150	82	91	0.55	0.61	28 Jul
	w/ brooders	238	170	179	0.71	0.75	-
2004	w/o brooders	341	82	84	0.24	0.25	22 Jul
	w/ brooders	437	178	180	0.41	0.41	-
2005	w/o brooders	<i>no data</i>	-	-	-	-	-
	w/ brooders	<i>no data</i>	-	-	-	-	-
2006	w/o brooders	147	112	132	0.76	0.90	8 Aug
	w/ brooders	184	149	169	0.81	0.92	-
2007	w/o brooders	124	62	64	0.50	0.52	22 Jul
	w/ brooders	196	134	136	0.68	0.69	-
2008	w/o brooders	<i>no data</i>	-	-	-	-	-
	w/ brooders	<i>no data</i>	-	-	-	-	-
2009	w/o brooders	<i>no data</i>	-	-	-	-	-
	w/ brooders	<i>no data</i>	-	-	-	-	-
2010	w/o brooders	171	50	50	0.29	0.29	21+22 Jul
	w/ brooders	274	153	153	0.56	0.56	-
2011	w/o brooders	<i>data lost</i>	-	-	-	-	-
	w/ brooders	<i>data lost</i>	-	-	-	-	-

^aProportion of nest sites with chicks (D/A) and chicks/nest start (E/A) may be considered maximum potential values of productivity (F/A) and fledglings/nest start (G/A), respectively, based on the assumption that all chicks counted eventually fledge.

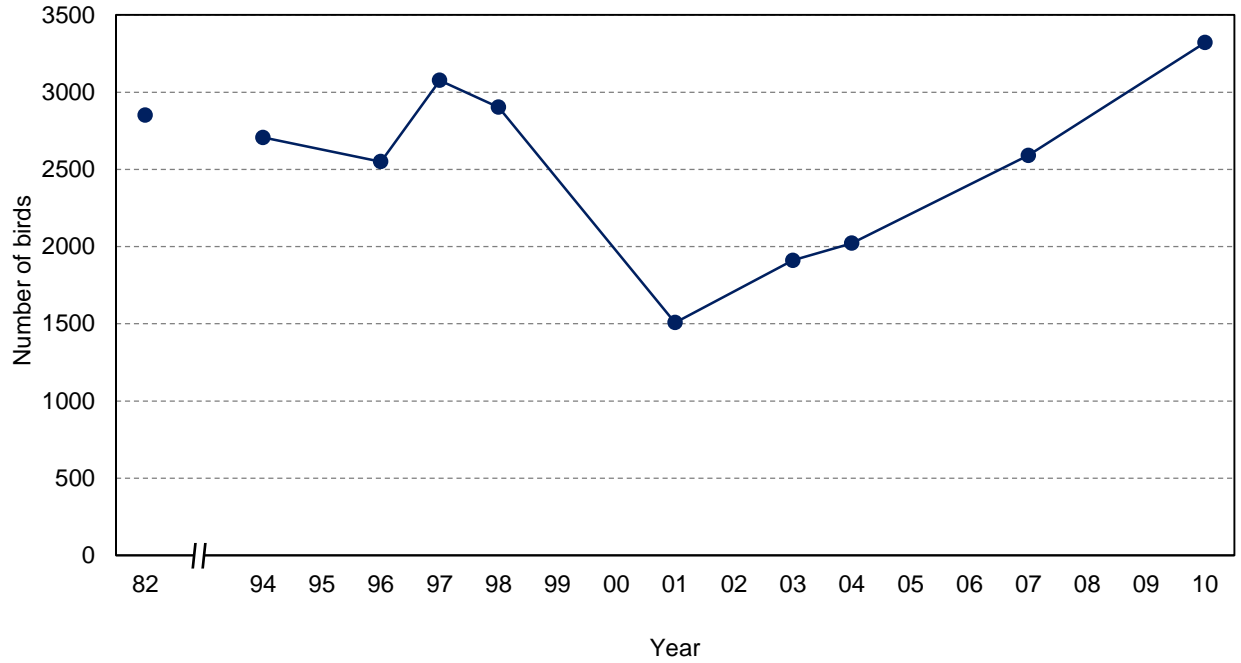


Figure 20. Numbers of black-legged kittiwakes counted on index plots at Koniuji Island, Alaska. Data from 1995, 1999 and 2000 are excluded because not all plots were counted. No counts were conducted after 2011; data were lost in 2011.



Figure 21. Numbers of black-legged kittiwake nests counted on index plots at Koniuji Island, Alaska. Data from 1995, 1999 and 2000 are excluded because not all plots were counted. No counts were conducted after 2011; data were lost in 2011.

Table 32. Numbers of black-legged kittiwakes counted on index plots at Koniuji Island, Alaska. Data are based on single counts each year except in 1996 and 2010 when count occurred over two days. Historical data are from Bailey and Trapp (1986), Byrd and Williams (1994), and Byrd (1995). No counts were conducted 1983-1993 or after 2011; data were lost in 2011.

Plot	1982	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	-	-	-	174	89	73	-	16	9	<i>no count</i>	7	10	<i>no count</i>	<i>no count</i>	75	<i>no count</i>	<i>no count</i>	226	<i>data lost</i>
2a	-	-	-	123	144	237	-	25	12	-	2	0	-	-	0	-	-	0	-
2b	-	-	-	71	83	75	-	34	17	-	5	0	-	-	0	-	-	0	-
3	-	-	-	128	111	86	-	53	36	-	65	45	-	-	19	-	-	71	-
4	-	-	-	113	122	123	-	56	38	-	43	117	-	-	33	-	-	81	-
East side (plots 1-4)	-	-	510	609	549	594	NC^a	184	112	-	122	172	-	-	127	-	-	378	-
5	-	-	-	294	285	310	-	166	221	-	229	315	-	-	348	-	-	703	-
6	-	-	-	274	185	154	-	240	245	-	105	340	-	-	168	-	-	0	-
7	-	-	-	0	13	9	-	NC	58	-	191	181	-	-	795	-	-	1254	-
South side (plots 5-7)	-	-	825	568	483	473	NC	≥406	524	-	525	836	-	-	1311	-	-	1957	-
8	-	-	-	322	324	281	118	NC	263	-	690	511	-	-	430	-	-	257	-
9	-	-	-	65	46	49	24	NC	70	-	45	10	-	-	42	-	-	0	-
10	-	-	-	282	96	211	0	NC	94	-	329	217	-	-	34	-	-	21	-
11a	-	-	-	190	527	672	189	399	14	-	0	31	-	-	0	-	-	112	-
11b	-	-	-	173	162	168	52	136	213	-	64	25	-	-	82	-	-	71	-
11c	-	-	-	180	719	283	12	239	104	-	39	103	-	-	0	-	-	0	-
West side (plots 8-11)	-	-	1220	1212	1874	1664	395	≥774	758	-	1167	897	-	-	588	-	-	461	-
12	-	-	-	134	163	171	52	62	79	-	51	64	-	-	78	-	-	130	-
13	-	-	-	20	7	0	NC	NC	34	-	46	36	-	-	58	-	-	58	-
14	-	-	-	7	1	0	NC	NC	0	-	0	16	-	-	428	-	-	337	-
North side (plots 12-14)	-	-	NC	161	171	171	52	≥62	113	-	97	116	-	-	564	-	-	525	-
Total	2852	2707	≥2555	2550	3077	2902	≥447	≥1426	1507	-	1911	2021	-	-	2590	-	-	3321	-
Survey date(s)	19 Jul	7 Aug	17 Aug	9+11 Jun	4 Aug	5 Aug	13 Aug	1 Aug	6 Aug	-	28 Jul	22 Jul	-	-	22 Jul	-	-	21+22 Jul	-

^aNC = section not counted.

Table 33. Numbers of black-legged kittiwake nests counted on index plots at Koniuji Island, Alaska. Data are based on single counts each year except in 1996 and 2010 when count occurred over two days. Historical data are from Bailey and Trapp (1986), Byrd and Williams (1994), and Byrd (1995). No counts were conducted 1983-1993 or after 2011; data were lost in 2011.

Plot	1982	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	-	-	-	58	41	24	-	14	0	<i>no count</i>	4	4	<i>no count</i>	<i>no count</i>	32	<i>no count</i>	<i>no count</i>	86	<i>data lost</i>
2a	-	-	-	69	95	45	-	28	0	-	2	0	-	-	0	-	-	0	-
2b	-	-	-	46	41	21	-	30	7	-	4	0	-	-	0	-	-	0	-
3	-	-	-	48	68	29	-	30	16	-	10	6	-	-	10	-	-	1	-
4	-	-	-	72	55	47	-	21	5	-	10	9	-	-	17	-	-	7	-
East side (plots 1-4)	-	-	510	293	300	166	NC^a	123	28	-	30	29	-	-	59	-	-	94	-
5	-	-	-	206	165	106	-	92	86	-	121	117	-	-	210	-	-	161	-
6	-	-	-	167	133	68	-	104	87	-	62	132	-	-	66	-	-	0	-
7	-	-	-	0	11	5	-	NC	23	-	102	71	-	-	370	-	-	280	-
South side (plots 5-7)	-	-	825	373	309	179	NC	≥196	196	-	285	320	-	-	646	-	-	441	-
8	-	-	-	199	202	118	1	NC	117	-	218	171	-	-	177	-	-	32	-
9	-	-	-	38	28	20	5	NC	22	-	27	4	-	-	17	-	-	0	-
10	-	-	-	95	56	63	0	NC	143	-	153	78	-	-	17	-	-	0	-
11a	-	-	-	125	289	369	112	161	42	-	0	14	-	-	0	-	-	27	-
11b	-	-	-	153	130	88	20	83	119	-	56	4	-	-	64	-	-	38	-
11c	-	-	-	35	73	65	9	93	59	-	42	11	-	-	0	-	-	0	-
West side (plots 8-11)	-	-	291	645	778	723	147	≥337	502	-	496	282	-	-	275	-	-	97	-
12	-	-	-	85	93	55	0	35	35	-	20	13	-	-	70	-	-	38	-
13	-	-	-	13	4	0	NC	NC	15	-	43	9	-	-	25	-	-	0	-
14	-	-	-	4	0	0	NC	NC	0	-	0	7	-	-	143	-	-	89	-
North side (plots 12-14)	-	-	NC	102	97	55	0	≥35	50	-	63	29	-	-	238	-	-	127	-
Total	~570	1165	≥1626	1413	1484	1123	≥147	≥691	776	-	874	660	-	-	1218	-	-	759	-
Survey date(s)	19 Jul	7 Aug	17 Aug	9+11 Jun ^b	4 Aug	5 Aug	13 Aug	1 Aug	6 Aug	-	28 Jul	22 Jul	-	-	22 Jul	-	-	21+22 Jul ^b	-

^aNC = section not counted.
^bDifferent plots counted on different days.

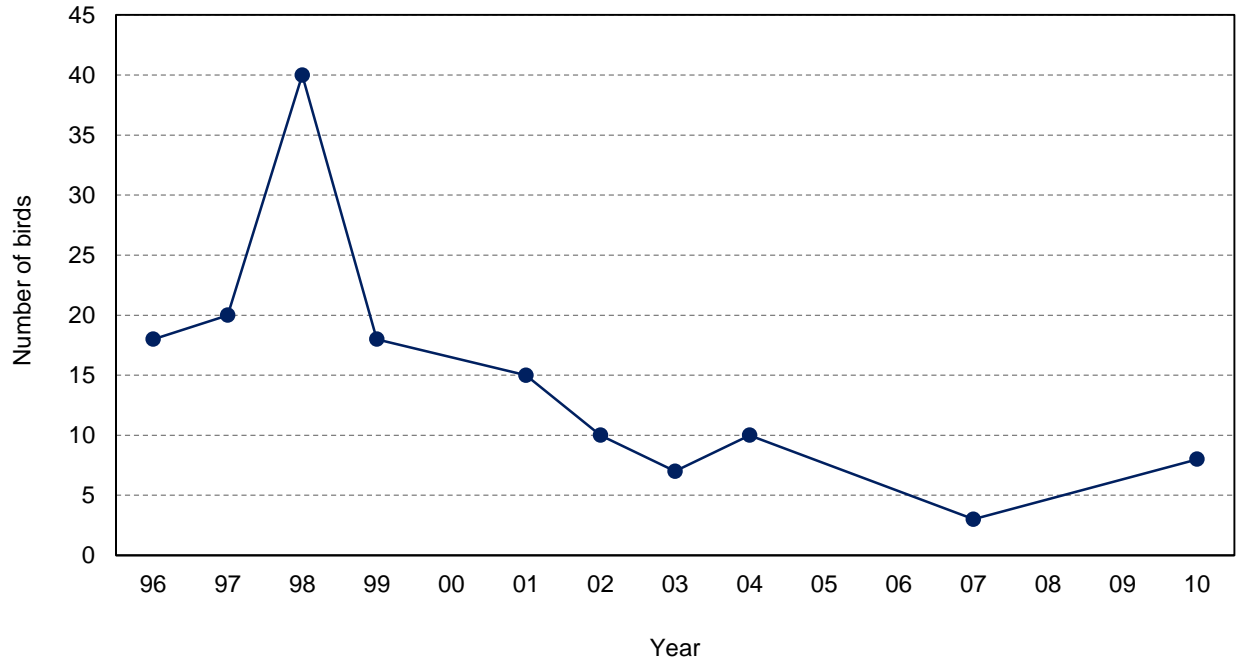


Figure 22. Numbers of red-legged kittiwakes counted on index plots at Koniuji Island, Alaska. Data from 2000 are excluded because not all plots were counted. No counts were conducted after 2011; data were lost in 2011.

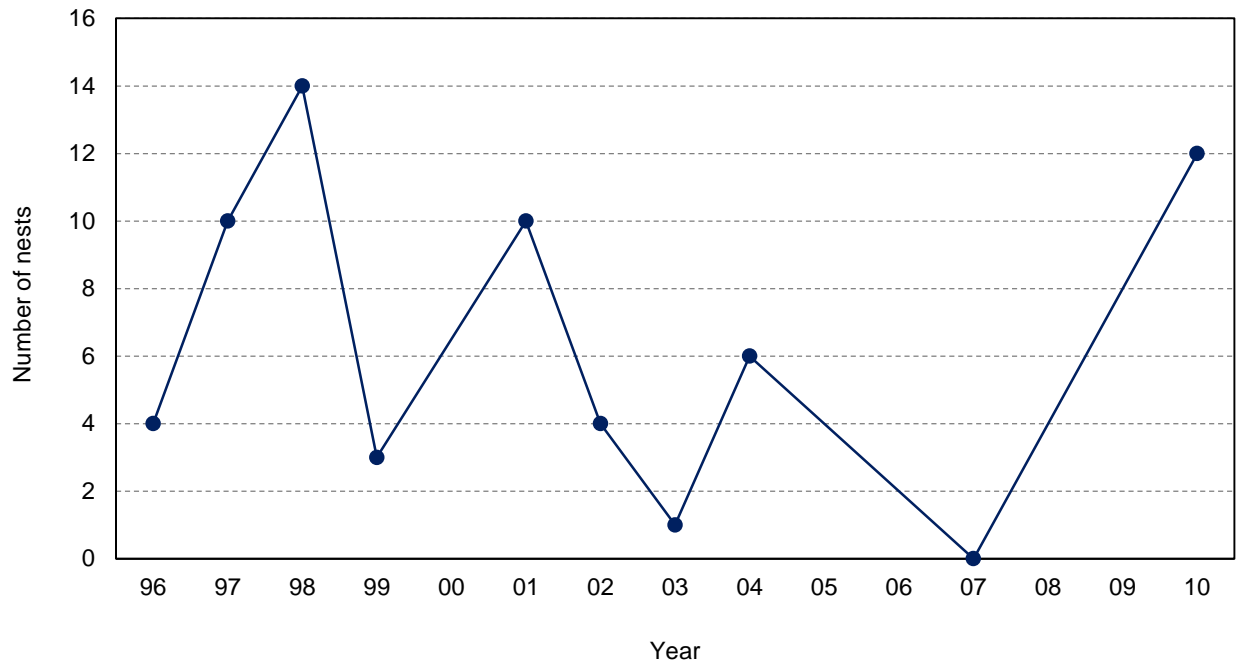


Figure 23. Numbers of red-legged kittiwake nests counted on index plots at Koniuji Island, Alaska. Data from 2000 are excluded because not all plots were counted. No counts were conducted after 2011; data were lost in 2011.

Table 34. Numbers of red-legged kittiwakes counted on index plots at Koniuji Island, Alaska. Only plots on which red-legged kittiwakes have ever been observed are shown. Data are based on single counts each year except in 1996, 1997, and 2010 when counts occurred over multiple days (adult count represents the maximum count). No counts were conducted after 2011; data were lost in 2011.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
3	11 / 0 ^a	0 / 0	1	NC ^b	0	0	0	0	0	<i>no count</i>	<i>no count</i>	0	<i>no count</i>	<i>no count</i>	0	<i>data lost</i>
5	0 / 0	0 / 0	0	0	0	0	0	0	0	-	-	0	-	-	3	-
7	0 / 0	0 / 0	0	0	0	0	0	0	0	-	-	3	-	-	5	-
8	0 / 0	0 / 0	0	0	0	0	9	7	10	-	-	0	-	-	0	-
11	0 / 18	8 / 20	39	18	17	15	1	0	0	-	-	0	-	-	0	-
Total	18 ^a	20	40	≥18	17	15	10	7	10	-	-	3	-	-	8	-
Survey date(s)	9+11 Jun, 4 Aug	14 Jun+ 4 Aug	5 Aug	13 Aug	1 Aug	6 Aug	5 Aug	28 Jul	22 Jul	-	-	22 Jul	-	-	21+ 22 Jul	-

^aWhen more than one count of each plot occurred, slashes separate counts conducted on different dates; total number of birds equals the highest daily count.

^bNC = section not counted.

Table 35. Numbers of red-legged kittiwake nests counted on index plots at Koniuji Island, Alaska. Only plots on which red-legged kittiwake nests have ever been observed are shown. Data are based on single counts each year except in 1996, 1997, and 2010 when counts occurred over multiple days. No counts were conducted after 2011; data were lost in 2011.

Plot	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	0 / 0	0 / 0	0	0	0	0	0	0	0	<i>no count</i>	<i>no count</i>	0	<i>no count</i>	<i>no count</i>	11	<i>data lost</i>
3	2 / 0 ^a	0 / 0	1	NC ^b	0	0	0	0	0	-	-	0	-	-	0	-
7	0 / 0	0 / 0	0	0	0	0	0	0	0	-	-	0	-	-	1	-
8	0 / 0	0 / 0	0	0	0	0	4	1	6	-	-	0	-	-	0	-
11	1 / 2	6 / 10	13	3	6	10	0	0	0	-	-	0	-	-	0	-
Total	4	10	14	≥3	6	10	4	1	6	-	-	0	-	-	12	-
Survey date(s)	9+11 Jun, 4 Aug	14 Jun+ 4 Aug	5 Aug	13 Aug	1 Aug	6 Aug	5 Aug	28 Jul	22 Jul	-	-	22 Jul	-	-	21+ 22 Jul	-

^aWhen more than one count of each plot occurred, slashes separate counts conducted on different dates; total number of nests equals the sum of maximum counts on each plot (even if occurring on different days).

^bNC = section not counted.