

BIOLOGICAL MONITORING AT CAPE LISBURNE, ALASKA IN 2017



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Key Words: Alaska, black-legged kittiwake, breeding chronology, Cape Lisburne, Chukchi Sea, COASST, common murre, marine mammals, plants, populations, productivity, quarry, *Rissa tridactyla*, seabirds, sea surface temperature, thick-billed murre, *Uria aalge*, *Uria lomvia*, wildlife

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INTRODUCTION

The Alaska Maritime National Wildlife Refuge (AMNWR) conducts annual ecological monitoring at eight 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.

Studies of the Cape Lisburne colony were first conducted under the National Oceanic and Atmospheric Administration Outer Continental Shelf Environmental Assessment Program (NOAA-OCSEAP) during 1976-1983 (Springer and Roseneau 1978; Springer et al. 1979, 1984; Murphy et al. 1980; Roseneau et al. 1985; Springer et al. 1985a, 1985b, 1985c, 1985d). Subsequent to these research projects, AMNWR funded smaller scale studies at Cape Lisburne in 1984-1986 under its seabird monitoring program (Byrd 1986). During 1987-1993, AMNWR and the Minerals Management Service (MMS) supported additional work at the colony (Springer and Roseneau 1989; Roseneau et al. 1992; Denlinger et al. 1994), and the U. S. Geological Survey – Biological Resources Division (USGS-BRD) and the MMS funded full-season studies there in 1995-1998 (e.g., see Roseneau et al. 2000). All of the visits made to Cape Lisburne after 1998 (1999-2017) were part of the AMNWR's seabird monitoring program. All seabird monitoring plots are located within refuge boundaries.

The primary objectives of the 2017 monitoring work were to collect data on population numbers and/or productivity on three indicator species representing two major feeding guilds: 1) diving piscivores (common and thick-billed murres [*Uria aalge* and *U. lomvia*, respectively]), and 2) surface-feeding piscivores (black-legged kittiwakes [*Rissa tridactyla*]). Other objectives included collecting data on nesting chronology for one or more of the above species, as well as information on other species of wildlife and plants. Sea surface temperature data also were collected.

Results of the 2017 monitoring study are reported here in the figures and tables, and archived at AMNWR headquarters in Homer, Alaska. Data summaries also will be included in the annual Alaska seabird monitoring summary report (e.g., see Dragoo et al. 2017). Because data occasionally are re-analyzed, some values listed in this report may differ from those reported in previous or subsequent years. Data presented here include the most up-to-date values available at the time of this report and supersede previous reports (e.g., Roseneau et al. 2000; Dragoo et al. 2010, 2011, 2012, 2013, Dragoo and Balland 2014, Dragoo and Ebbert 2016).

STUDY AREA

The Cape Lisburne seabird colony is located in the Ann Stevens-Cape Lisburne Subunit, Chukchi Sea Unit of the Alaska Maritime National Wildlife Refuge at about 68° 52' N, 166° 05' W; 62 km northeast of Point Hope, Alaska (Figure 1). Local physical and climatic conditions have been described in previous reports (e.g., see Springer et al. 1979, 1985b; Denlinger et al. 1994; Roseneau et al. 1992, 2000). Nesting habitat consists of about 7 km of precipitous, nearly continuous 15-200 m-high sedimentary limestone and shale sea-cliffs that begin about 1 km south of Kay Creek and end approximately 1 km west of the Cape Lisburne U. S. Air Force Long Range Radar Site (LRRS) runway (Figure 2). The LRRS

was established in 1952 and is still active today. Land Plots (LP) 1-8 and A/B are located on First Beach (see Roseneau et al. 2000).

Currently, the seabird colony is estimated to number about 400,000-500,000 murre (comprising about 25-30% common murre and 70-75% thick-billed murre), 20,000-30,000 black-legged kittiwakes, and a total of a few thousand pelagic cormorants (*Phalacrocorax pelagicus*), glaucous gulls (*Larus hyperboreus*), black guillemots (*Cephus grylle*), parakeet auklets (*Aethia psittacula*), and horned and tufted puffins (*Fratercula corniculata* and *F. cirrhata*, respectively; see Roseneau 2010). Subsistence hunters from Point Hope traditionally gather murre eggs at several places in the western and northern sectors of the colony during late June-early July (e.g., D. G. Roseneau, A. M. Springer and A. L. Sows, unpubl. data).

METHODS

Personnel: The 2017 U. S. Fish and Wildlife Service (USFWS) field team consisted of Don Dragoo, Chukchi Sea Unit Biologist, Greg Thomson, Biological Technician (both 21 July - 11 August), and Marc Romano, Bering Sea Unit Biologist (24 July – 4 August).

Data Collection and Analyses: The methods used to collect and analyze seabird-related data followed the procedures described in Roseneau et al. (2000) and AMNWR (2017).

- Adult murre (species combined) were counted from land on previously established plots (Land Plots A, B, 1-3, and 8) on First Beach (Figure 2). Land Plots 4, 5, 6, and 7 were not counted in 2017 due to access limitations caused by excessive beach erosion.
- A Coastal Observation and Seabird Survey Team (COASST) survey was conducted on 1 August 2017 using standard COASST protocols.
- A NOAA Marine Debris Shoreline Survey was conducted on 31 July 2017 using standard NOAA protocols.

INTERESTING OBSERVATIONS

- The day we arrived at Cape Lisburne we learned that a large polar bear was resting on a hill near the western end of the runway. It was seen swimming ashore on 21 July and promptly lay down, apparently exhausted from a long swim. This is where a lot of activity was currently underway by Orion (quarry and seawall contractor), and their bear guards monitored the animal continuously until it left the beach and swam out to sea at 0135 hours on 22 July. We saw what we assumed was the same bear again near the Arch on First Beach, as well as on a ridge above Dave's Rock on Kittiwake beach.
- Walrus were seen in greater numbers and earlier in the season than has been the case in recent years.

QUARRY OPERATIONS

Blasting for rock first occurred on the Refuge in 1987, when the contractor unknowingly crossed the Air Force-Refuge boundary in search of suitable rock. Since then, rock for use in the runway seawall has been intermittently quarried on the Refuge, most recently in the 1990s.

Work on rebuilding the seawall and adjacent runway began again in 2016 and continued this summer. Orion Marine Group, Inc. has the contract and began mining rock from the quarry located on Refuge lands (see photograph below), at the eastern end of First Beach. They also began the task of rebuilding the seawall that protects the runway.

We did not observe any disturbance to the birds on the nearby colony that could be attributed to activity at the quarry. Blasting operations occurred at night and could sometimes be heard at the crew quarters, but appeared to not disturb the nesting birds.



ACKNOWLEDGEMENTS

We would like to thank Sandi Smith and all of the other ARCTEC Alaska personnel at the Cape Lisburne LRRS, as well as the Pacific Air Forces and the 611th ASUS/LGA and CES/CEVP squadrons. We also would like to express our gratitude to the entire Orion Marine crew for their assistance and patience. We

could not have conducted our work without their support. We particularly enjoyed the camaraderie and fine food provided by the ARCTEC staff during our stay. We also would like to thank Susan Georgette, David Zabriskie, and Brittany Sweeney at the Selawik National Wildlife Refuge for graciously providing logistical support and bunkhouse space in Kotzebue. Finally, we would like to express our gratitude to the staff of the Alaska Maritime National Wildlife Refuge for their continued help and support. Cover photo was taken by Greg Thomson.

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Figure 1. Map of northwestern Alaska showing the location of the Ann Stevens-Cape Lisburne subunit study area of the Alaska Maritime National Wildlife Refuge (red arrow).

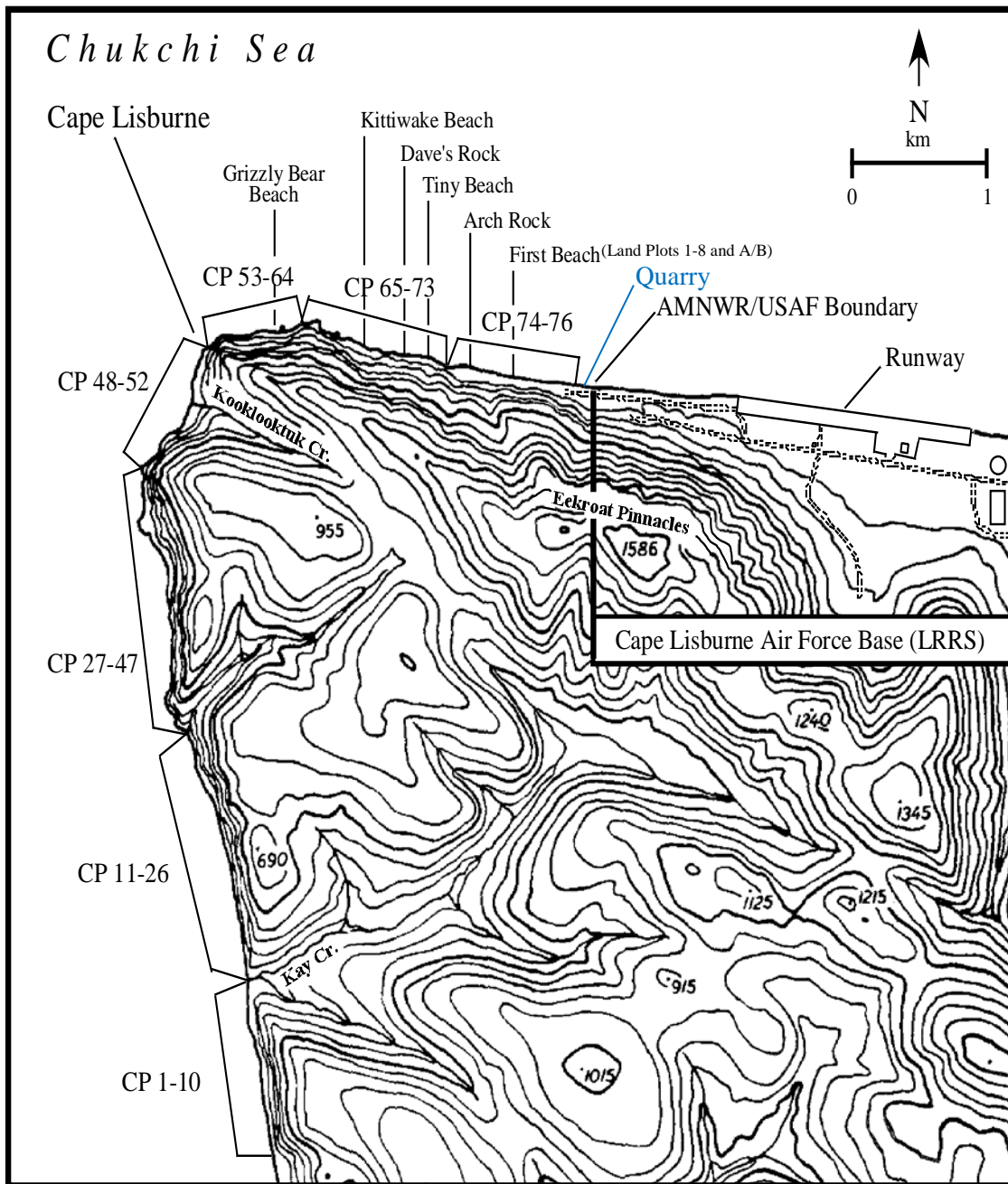


Figure 2. Map of seabird monitoring plots and quarry at Cape Lisburne, Alaska.

FIGURES AND TABLES

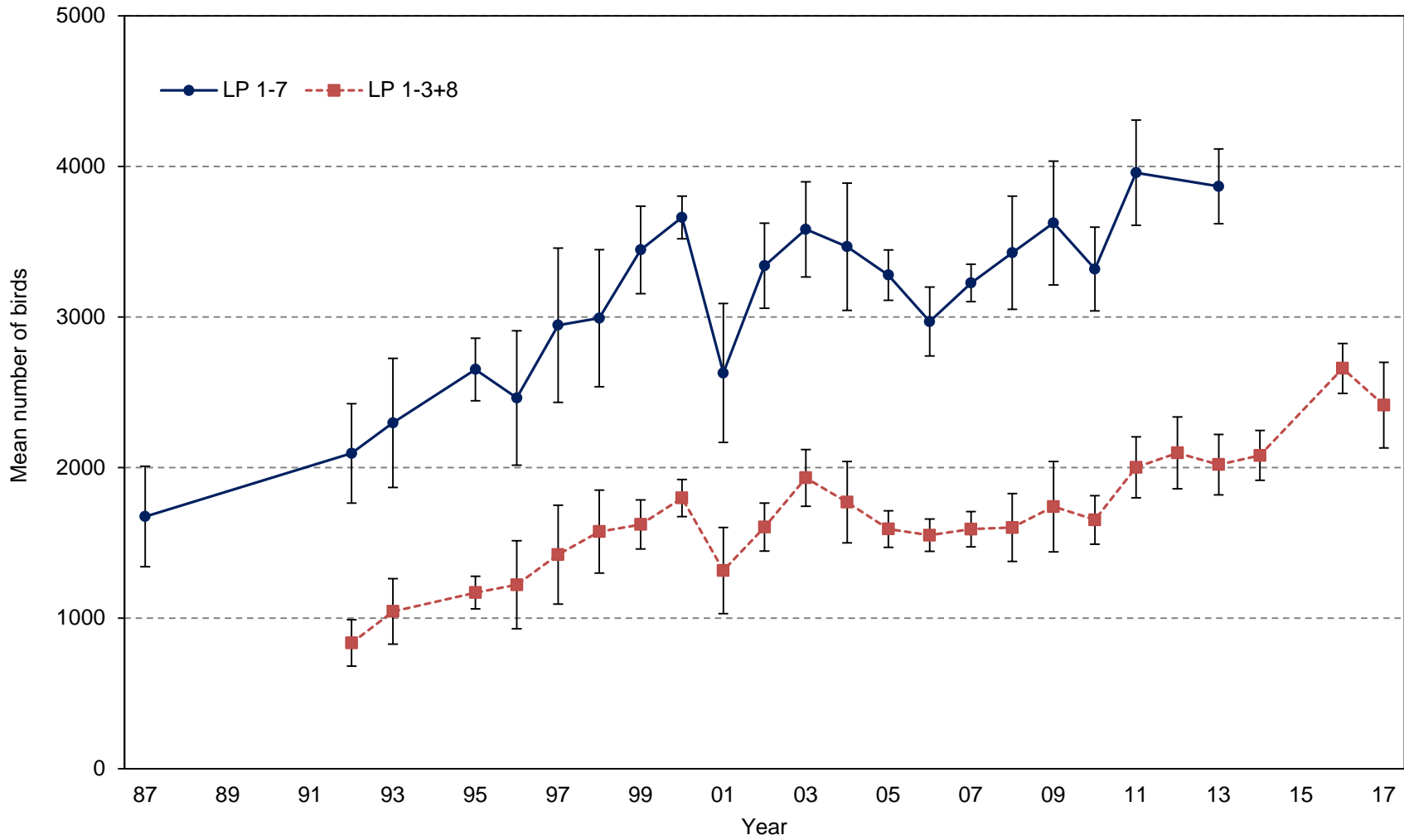


Figure 3. Mean numbers of murre (common and thick-billed murre combined) counted on Land Plots 1-7 (solid line) and Land Plots 1-3+8 (dashed line) at Cape Lisburne, Alaska. Error bars represent one standard deviation. No counts were conducted in 1988-1991, 1994, or 2015; data are excluded for Land Plots 1-3+8 in 1987 and Land Plots 1-7 in 2012, 2014, and 2016-2017 because not all plots were counted.

Table 1. Numbers of murre (common and thick-billed murre combined) counted on Land Plots 1-7 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015; data are excluded in 2012, 2014, and 2016-2017 because not all plots were counted ^{a, b}.

Replicate	1987	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013
1	1399	2091	2102	2260	2589	3103	2005	3591	3767	2127	3154	3820	3300	3365	2804	3377	4076	3219	3271	3584	3737
2	1408	2401	1915	2747	1954	2801	2801	3340	3553	2182	3284	3687	3890	3348	3062	3292	3504	3725	3523	4048	4116
3	1488	1540	2965	2675	2483	2826	2652	3103	3527	2970	2925	3027	3458	3493	2612	3219	2923	3578	3255	3971	3949
4	1278	2147	2468	2424	2498	3439	2960	3397	3520	2542	3100	3705	3781	3293	3029	3142	3669	3346	3027	4855	3386
5	1723	2094	2028	2557	2168	2641	2855	3289	3831	3327	3404	3673	3041	3266	2856	3132	3328	3186	3070	3939	4071
6	2205	1922	-	2658	1930	3268	2842	3942	3768	2619	3473	-	3935	3390	3111	3052	3119	4110	3775	3829	3965
7	2025	1927	-	2926	2834	2219	3225	-	-	-	3793	-	2859	3075	3306	3363	3361	4201	-	3690	3842
8	1868	1997	-	2786	3243	2747	3744	-	-	-	3590	-	-	2993	-	-	-	-	-	4324	-
9	-	2725	-	2826	-	2441	3383	-	-	-	-	-	-	-	-	-	-	-	-	3763	-
10	-	-	-	-	-	3966	3325	-	-	-	-	-	-	-	-	-	-	-	-	4036	-
11	-	-	-	-	-	-	3115	-	-	-	-	-	-	-	-	-	-	-	-	3641	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3810	-
Mean	1674	2094	2296	2651	2462	2945	2992	3444	3661	2628	3340	3582	3466	3278	2969	3225	3426	3624	3316	3957	3866
n ^c	8	9	5	9	8	10	11	6	6	6	8	5	7	8	7	7	7	7	6	12	7
SD ^d	334	330	428	208	446	512	455	291	142	461	282	316	423	167	229	124	376	411	278	349	248
First count	14 Jul	17 Jul	21 Jul	17 Jul	10 Jul	11 Jul	17 Jul	3 Aug	16 Jul	3 Aug	28 Jul	31 Jul	25 Jul	23 Jul	29 Jul	24 Jul	18 Jul	20 Jul	25 Jul	22 Jul	25 Jul
Last count	4 Aug	10 Aug	2 Aug	13 Aug	10 Aug	5 Aug	6 Aug	9 Aug	23 Jul	10 Aug	8 Aug	8 Aug	4 Aug	3 Aug	8 Aug	31 Jul	5 Aug	31 Jul	4 Aug	13 Aug	13 Aug

^aLand Plots 6 and 7 were not counted in 2012 due to access limitations caused by excessive beach erosion.

^bLand Plots 4, 5, 6, and 7 were not counted in 2014 or 2017, and were counted only once in 2016, due to access limitations caused by excessive beach erosion.

^cn = number of counts

^dSD = standard deviation.

Table 2. Numbers of murre (common and thick-billed murre combined) counted on Land Plots 1-3+8 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015; data are excluded in 1987 because not all plots were counted.

Replicate	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	851	970	968	1279	1399	927	1751	1842	1010	1537	2216	1674
2	898	751	1177	787	1379	1521	1489	1691	1049	1576	1966	2118
3	536	1324	1185	1242	1169	1385	1484	1736	1489	1344	1708	1655
4	799	1180	1047	1258	1639	1516	1665	1648	1201	1484	1932	1811
5	839	996	1145	1019	1181	1557	1476	1932	1759	1634	1834	1510
6	804	-	1163	980	1617	1471	1858	1931	1389	1631	-	2140
7	830	-	1269	1504	1118	1640	-	-	-	1790	-	1474
8	812	-	1264	1699	1345	1967	-	-	-	1837	-	-
9	1139	-	1302	-	1171	1855	-	-	-	-	-	-
10	-	-	-	-	2196	1759	-	-	-	-	-	-
11	-	-	-	-	-	1717	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
Mean	834	1044	1169	1221	1421	1574	1621	1797	1316	1604	1931	1769
n ^a	9	5	9	8	10	11	6	6	6	8	5	7
SD ^b	154	218	108	293	328	276	163	123	286	159	188	270
First count	17 Jul	21 Jul	17 Jul	10 Jul	11 Jul	17 Jul	3 Aug	16 Jul	3 Aug	28 Jul	31 Jul	25 Jul
Last count	10 Aug	2 Aug	13 Aug	10 Aug	5 Aug	6 Aug	9 Aug	23 Jul	10 Aug	8 Aug	8 Aug	4 Aug

Table 2 (continued). Numbers of murre (common and thick-billed murre combined) counted on Land Plots 1-3+8 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015; data are excluded in 1987 because not all plots were counted.

Replicate	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2016	2017
1	1551	1525	1685	1856	1523	1511	1727	1636	1734	2042	2626	2142
2	1619	1609	1723	1752	1745	1776	1929	1948	2181	1980	2954	2899
3	1798	1391	1545	1279	1587	1692	1954	2116	1978	1991	2640	2420
4	1635	1618	1513	1866	1609	1588	2381	2141	1759	2014	2707	2555
5	1590	1438	1435	1495	1417	1462	1937	2068	2221	2374	2543	2166
6	1638	1572	1510	1451	2078	1881	1895	2193	2153	-	2480	2303
7	1529	1698	1720	1510	2222	-	1843	2203	2107	-	-	-
8	1367	-	-	-	-	-	2365	2473	-	-	-	-
9	-	-	-	-	-	-	2013	-	-	-	-	-
10	-	-	-	-	-	-	2176	-	-	-	-	-
11	-	-	-	-	-	-	1889	-	-	-	-	-
12	-	-	-	-	-	-	1899	-	-	-	-	-
Mean	1591	1550	1590	1601	1740	1652	2001	2097	2019	2080	2658	2414
n ^a	8	7	7	7	7	6	12	8	7	5	6	6
SD ^b	122	107	117	225	300	161	203	239	201	166	165	284
First count	23 Jul	29 Jul	24 Jul	18 Jul	20 Jul	25 Jul	22 Jul	28 Jul	25 Jul	25 Jul	28 Jul	28 Jul
Last count	3 Aug	8 Aug	31 Jul	5 Aug	31 Jul	4 Aug	13 Aug	6 Aug	13 Aug	2 Aug	7 Aug	7 Aug

^an = number of counts

^bSD = standard deviation.

Table 3. Numbers^a of murre (common and thick-billed murre combined) counted on land-based index plots at Cape Lisburne, Alaska in 2017 (n=6 counts). Land Plots 4, 5, 6, and 7 were not counted in 2017 due to access limitations caused by excessive beach erosion.

Plot	Date					
	28 Jul	30 Jul	2 Aug	3 Aug	4 Aug	7 Aug
LP1	166	153	151	159	127	157
LP2	1147	1609	1444	1488	1261	1313
LP3	595	866	575	627	554	596
LP4	NC ^b	NC	NC	NC	NC	NC
LP5	NC	NC	NC	NC	NC	NC
LP6	NC	NC	NC	NC	NC	NC
LP7	NC	NC	NC	NC	NC	NC
LP8	234	271	250	281	224	237
LPA ^c	53	46	76	56	42	47
LPB ^c	83	90	81	78	38	68

^aBirds were counted by ones from land.

^bNC = Plot not counted

^cPlot LPA, previously called 1a, was created in 1999 and Plot LPB was created in 2010, when murre were first observed occupying them.

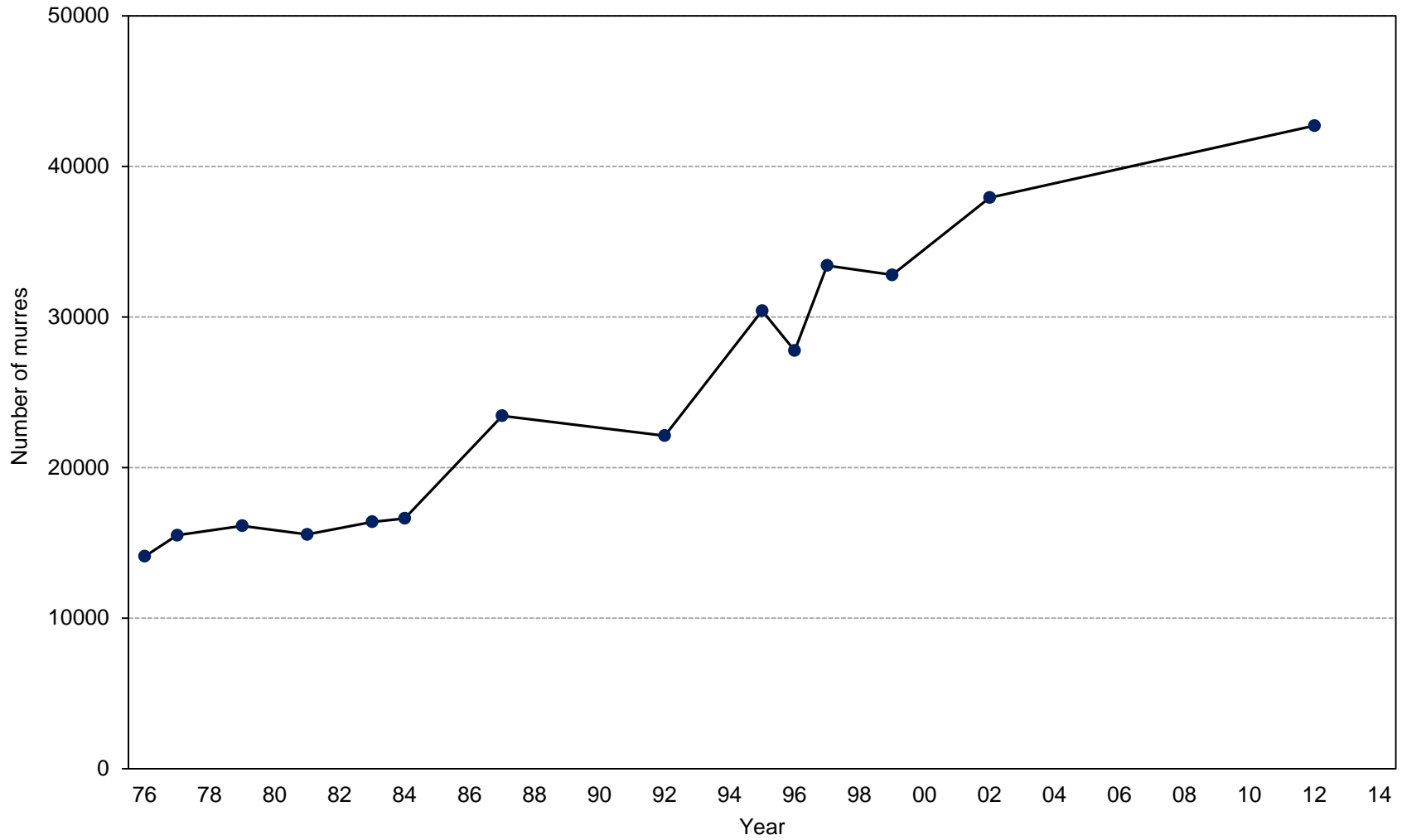


Figure 4. Numbers of murre (common and thick-billed murre combined) counted on boat-based index plots (plots 11, 12, 25, 26, 30, 32, 65, 66, 70 and 72) at Cape Lisburne, Alaska. No counts were conducted in years not shown.

Table 4. Numbers of murres (common and thick-billed murres combined) counted on boat-based index plots (plots 11, 12, 25, 26, 30, 32, 65, 66, 70, 72, 73, and 74) at Cape Lisburne, Alaska. No counts were conducted in years not listed; plots 73 and 74 were counted only in 1976, 1977, and 2012.

Plot	1976	1977	1979	1981	1983	1984	1987	1992	1995	1996	1997	1999	2002	2012
11	750	928	910	1072	1170	1115	1765	1335	1640	1620	1850	1895	2420	2200
12	1300	1545	1480	1776	1500	2175	2960	2055	3203	3075	4640	3945	5130	4300
25	825	1085	790	928	755	780	1228	860	1120	1020	1220	1700	1860	2650
26	600	1225	1140	1033	925	1113	1135	929	1620	1245	1485	1705	2230	2200
30	4250	3585	4065	3588	3140	4180	5645	5142	7670	6530	7568	5710	8170	9800
32	2200	1738	2005	1716	1910	1865	2875	5124	6035	5685	8223	7335	8070	9950
65	1275	2010	1915	2208	2232	2130	2575	2264	2800	3060	2410	3340	3740	4350
66	1250	1335	1568	1450	1820	1325	2260	2098	2865	2170	2660	2895	2010	1850
70	900	1205	1290	1135	1953	1240	1805	1531	2140	2223	2295	2820	3090	3275
72	750	845	960	642	985	690	1180	774	1320	1138	1065	1440	1200	2125
Total (part)	14,100	15,501	16,123	15,548	16,390	16,613	23,428	22,112	30,413	27,766	33,416	32,785	37,920	42,700
73	950	1035	-	-	-	-	-	-	-	-	-	-	-	825
74	625	1340	-	-	-	-	-	-	-	-	-	-	-	5498
Total (all)	15,675	17,876	-	-	-	-	-	-	-	-	-	-	-	49,023
Date(s) of count(s)	25 Aug-28 Aug	21 Jul-26 Jul	15 Aug	25 Jul & 2 Aug	21 Jul-19 Aug	4 Aug	4 Aug	25 Jul-6 Aug	9 Aug	28 Jul	31 Jul	6 Aug	4 Aug	11 Aug

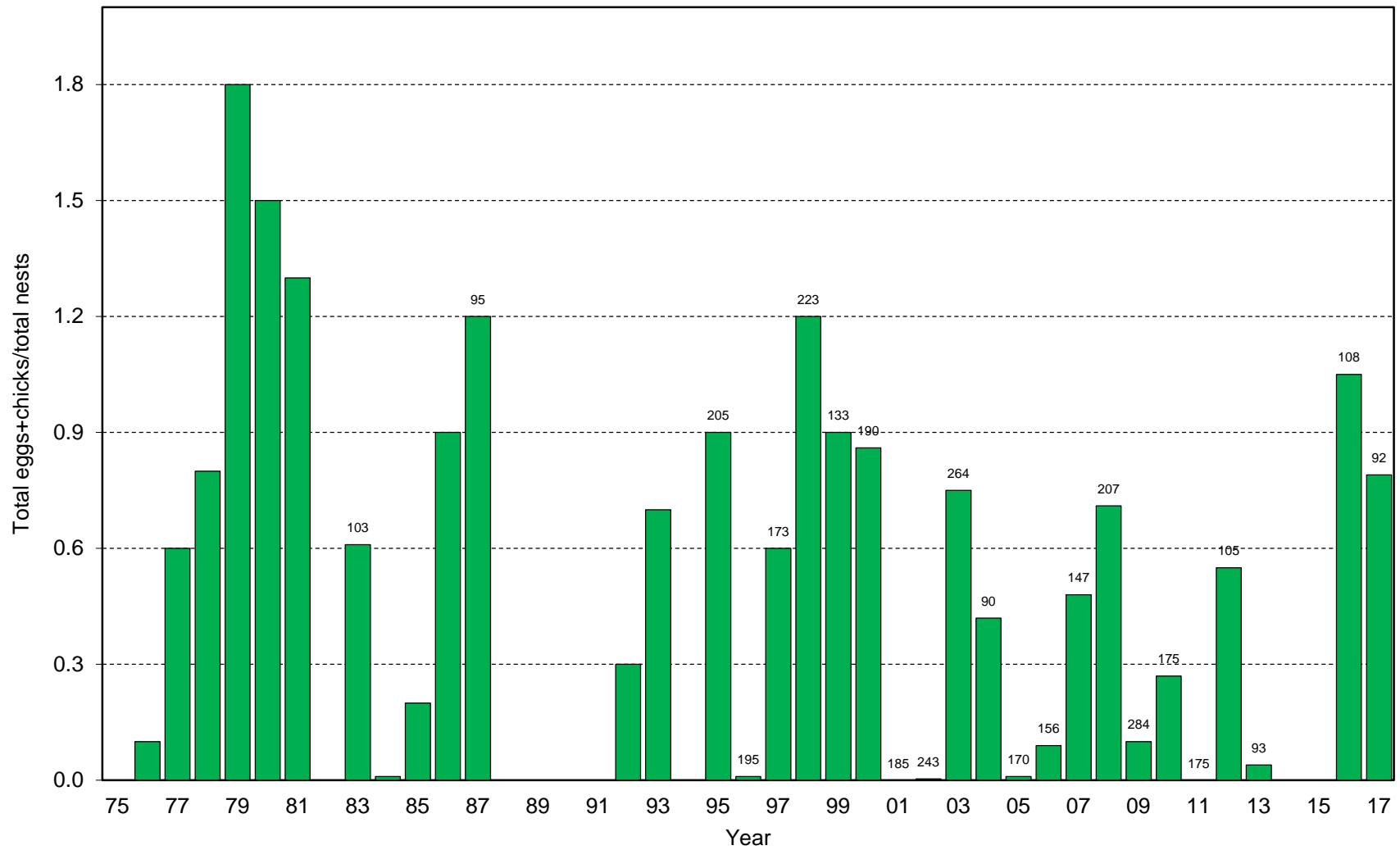


Figure 5. Reproductive performance of black-legged kittiwakes at Cape Lisburne, Alaska. Numbers above columns indicate total number of nests sampled each year. No data were collected in 1982, 1988-1991, 1994, or 2014-2015.

Table 5. Reproductive performance of black-legged kittiwakes at Cape Lisburne, Alaska. No data were collected in 1982, 1988-1991, 1994, or 2014-2015.

Year	Total nests	Total eggs+chicks	Productivity ^a
1976	-	-	0.10
1977	-	-	0.60
1978	-	-	0.80
1979	-	-	1.80
1980	-	-	1.50
1981	-	-	1.30
1983	103	63	0.61
1984	-	-	0.01
1985	-	-	0.20
1986	-	-	0.90
1987	95	115	1.21
1992	-	-	0.30
1993	-	-	0.70
1995	205	181	0.88
1996	195	2	0.01
1997	173	97	0.56
1998	223	-	1.20
1999	133	118	0.89
2000	190	163	0.86
2001	185	0	0.00
2002	243	1	0.004
2003	264	197	0.75
2004	90	35	0.39
2005	170	1	0.006
2006	156	14	0.09
2007	147	71	0.48
2008	207	147	0.71
2009	284	-	0.10
2010	175	47	0.27
2011	175	0	0.00
2012	105	58	0.55
2013	93	4	0.04
2016	108	113	1.05
2017	92	73	0.79

^aTotal eggs+chicks/total nests.

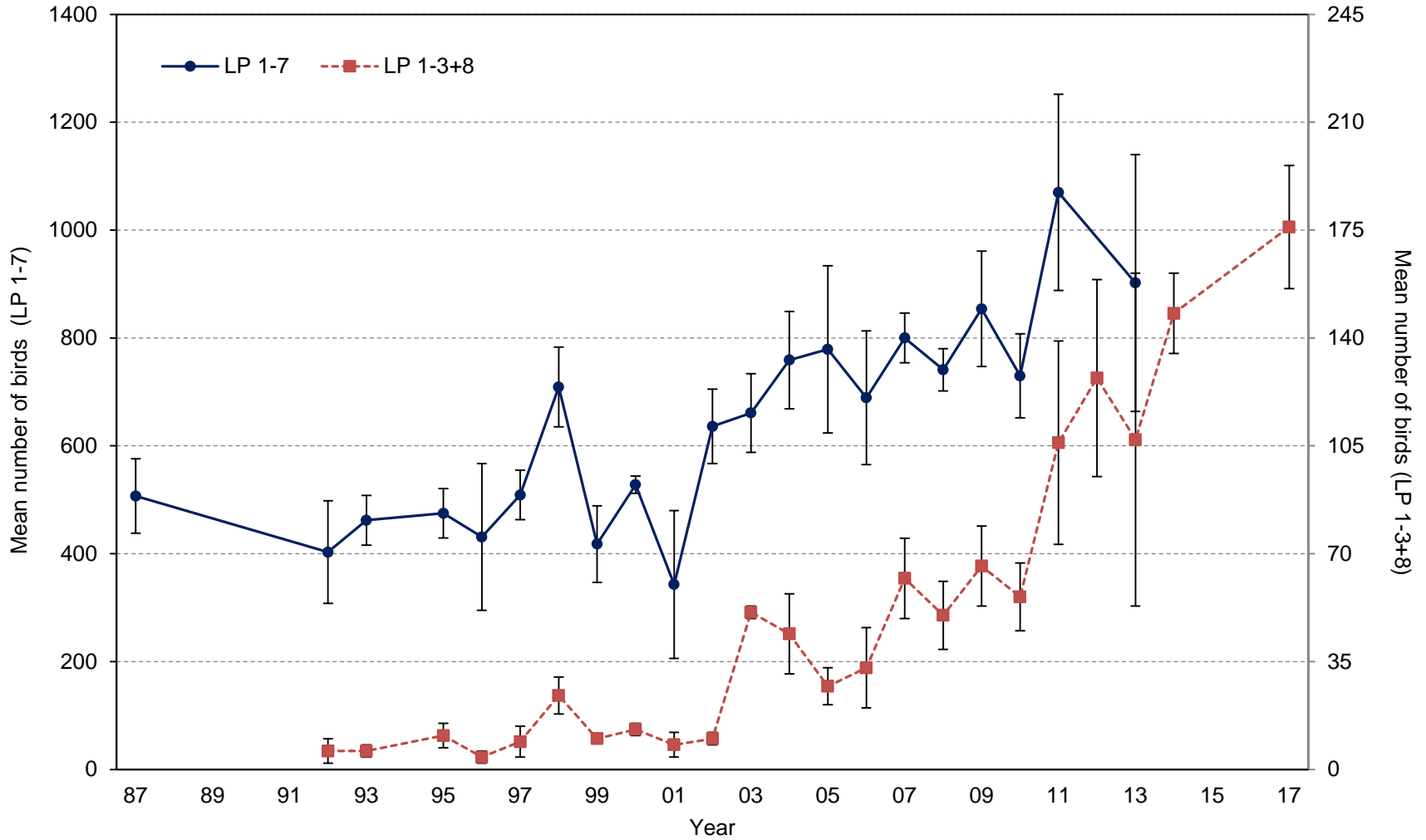


Figure 6. Mean numbers of black-legged kittiwakes counted on Land Plots 1-7 (solid line) and Land Plots 1-3+8 (dashed line) at Cape Lisburne, Alaska. Note the different axis scales for the two data sets. Error bars represent one standard deviation. No counts were conducted in 1988-1991, 1994, or 2015-2016; data are excluded for Land Plots 1-3+8 in 1987 and Land Plots 1-7 in 2012, 2014, and 2017 because not all plots were counted.

Table 6. Numbers of black-legged kittiwakes counted on Land Plots 1-7 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015-2016; data are excluded in 2012, 2014, and 2017 because not all plots were counted ^{a, b}.

Replicate	1987	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013
1	458	361	427	390	260	539	666	543	498	134	613	719	744	651	458	808	803	748	686	810	565
2	556	312	411	519	310	425	620	401	532	237	599	699	629	702	752	841	735	899	659	764	795
3	-	331	510	484	414	531	805	382	551	385	545	695	848	775	502	780	698	884	702	1105	791
4	-	358	508	538	522	494	763	396	527	349	642	657	733	686	761	773	780	938	690	1302	760
5	-	366	454	491	449	515	693	364	522	511	710	536	841	712	672	731	706	677	750	959	1221
6	-	391	-	480	631	551	-	-	527	439	603	-	-	1070	759	792	748	854	729	1127	1002
7	-	569	-	440	-	-	-	-	539	-	743	-	-	968	645	872	716	981	894	1281	1168
8	-	532	-	458	-	-	-	-	-	-	-	-	-	668	775	-	-	-	-	988	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	718	-	-	-	-	1258	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	849	-	-	-	-	1255	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	975	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1008	-
Mean	507	403	462	475	431	509	709	417	528	343	636	661	759	779	689	800	741	854	730	1069	900
n ^c	2	8	5	8	6	6	5	5	7	6	7	5	5	8	10	7	7	7	7	12	7
SD ^d	69	95	46	46	136	46	74	72	16	137	69	74	90	155	124	46	39	107	78	182	238
First count	18 Jul	17 Jul	21 Jul	24 Jul	7 Jul	11 Jul	19 Jul	3 Aug	17 Jul	3 Aug	28 Jul	31 Jul	25 Jul	23 Jul	24 Jul	24 Jul	18 Jul	20 Jul	25 Jul	22 Jul	25 July
Last count	1 Aug	10 Aug	2 Aug	19 Aug	10 Aug	2 Aug	6 Aug	9 Aug	24 Jul	10 Aug	8 Aug	8 Aug	3 Aug	4 Aug	8 Aug	31 Jul	5 Aug	31 Jul	4 Aug	13 Aug	13 Aug

^aLand Plots 6 and 7 were not counted in 2012 due to access limitations caused by excessive beach erosion.

^bLand Plots 4, 5, 6, and 7 were not counted in 2014 or 2017 due to access limitations caused by excessive beach erosion.

^cn = number of counts.

^dSD = standard deviation.

Table 7. Numbers of black-legged kittiwakes counted on Land Plots 1-3+8 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015-2016; data are excluded in 1987 because not all plots were counted.

Replicate	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	5	5	10	1	9	15	8	15	4	12	53	38
2	2	5	11	1	5	24	9	14	4	6	50	25
3	1	4	14	4	8	23	11	14	6	9	51	57
4	10	8	9	6	8	29	11	10	8	10	50	47
5	5	7	5	5	17	28	11	13	12	12	49	52
6	4	-	8	4	4	-	-	12	12	11	-	-
7	4	-	8	-	-	-	-	13	-	12	-	-
8	14	-	19	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
Mean	6	6	11	4	9	24	10	13	8	10	51	44
n ^a	8	5	8	6	6	5	5	7	6	7	5	5
SD ^b	4	2	4	2	5	6	1	2	4	2	2	13
First count	17 Jul	21 Jul	24 Jul	7Jul	11 Jul	19 Jul	3 Aug	17 Jul	3 Aug	28 Jul	31 Jul	25 Jul
Last count	10 Aug	2 Aug	19 Aug	10 Aug	2 Aug	6 Aug	9 Aug	24 Jul	10 Aug	8 Aug	8 Aug	3 Aug

Table 7 (continued). Numbers of black-legged kittiwakes counted on Land Plots 1-3+8 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015-2016; data are excluded in 1987 because not all plots were counted.

Replicate	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2017
1	31	19	57	73	51	48	63	73	34	135	149
2	26	25	67	46	80	49	46	143	86	159	176
3	22	22	66	43	70	60	108	122	80	144	177
4	24	38	60	54	71	45	130	161	66	140	199
5	25	34	43	47	48	64	108	158	172	164	159
6	34	35	56	44	64	51	111	108	146	-	197
7	37	29	86	40	81	76	124	99	167	-	-
8	19	31	-	-	-	-	111	154	-	-	-
9	-	27	-	-	-	-	147	-	-	-	-
10	-	65	-	-	-	-	161	-	-	-	-
11	-	-	-	-	-	-	92	-	-	-	-
12	-	-	-	-	-	-	76	-	-	-	-
Mean	27	33	62	50	66	56	106	127	107	148	176
n ^a	8	10	7	7	7	7	12	8	7	5	6
SD ^b	6	13	13	11	13	11	33	32	54	13	20
First count	23 Jul	24 Jul	24 Jul	18 Jul	20 Jul	25 Jul	22 Jul	28 Jul	25 Jul	23 Jul	28 Jul
Last count	4 Aug	8 Aug	31 Jul	5 Aug	31 Jul	4 Aug	13 Aug	6 Aug	13 Aug	2 Aug	7 Aug

^an = number of counts
^bSD = standard deviation.

Table 8. Numbers^a of black-legged kittiwakes counted on land-based index plots at Cape Lisburne, Alaska in 2017 (n=6 counts). Land Plots 4, 5, 6, and 7 were not counted in 2017 due to access limitations caused by excessive beach erosion.

Plot	Date					
	28 Jul	30 Jul	2 Aug	3 Aug	4 Aug	7 Aug
LP1	0	0	0	0	0	0
LP2	58	64	73	78	50	71
LP3	91	112	104	121	109	126
LP4	NC ^b	NC	NC	NC	NC	NC
LP5	NC	NC	NC	NC	NC	NC
LP6	NC	NC	NC	NC	NC	NC
LP7	NC	NC	NC	NC	NC	NC
LP8	0	0	0	0	0	0
LPA ^c	0	0	0	0	0	0
LPB ^c	0	0	0	0	0	0

^aBirds were counted by ones from land.

^bNC = Plot not counted

^cPlot LPA, previously called 1a, was created in 1999 and Plot LPB was created in 2010, when murrelets were first observed occupying them.

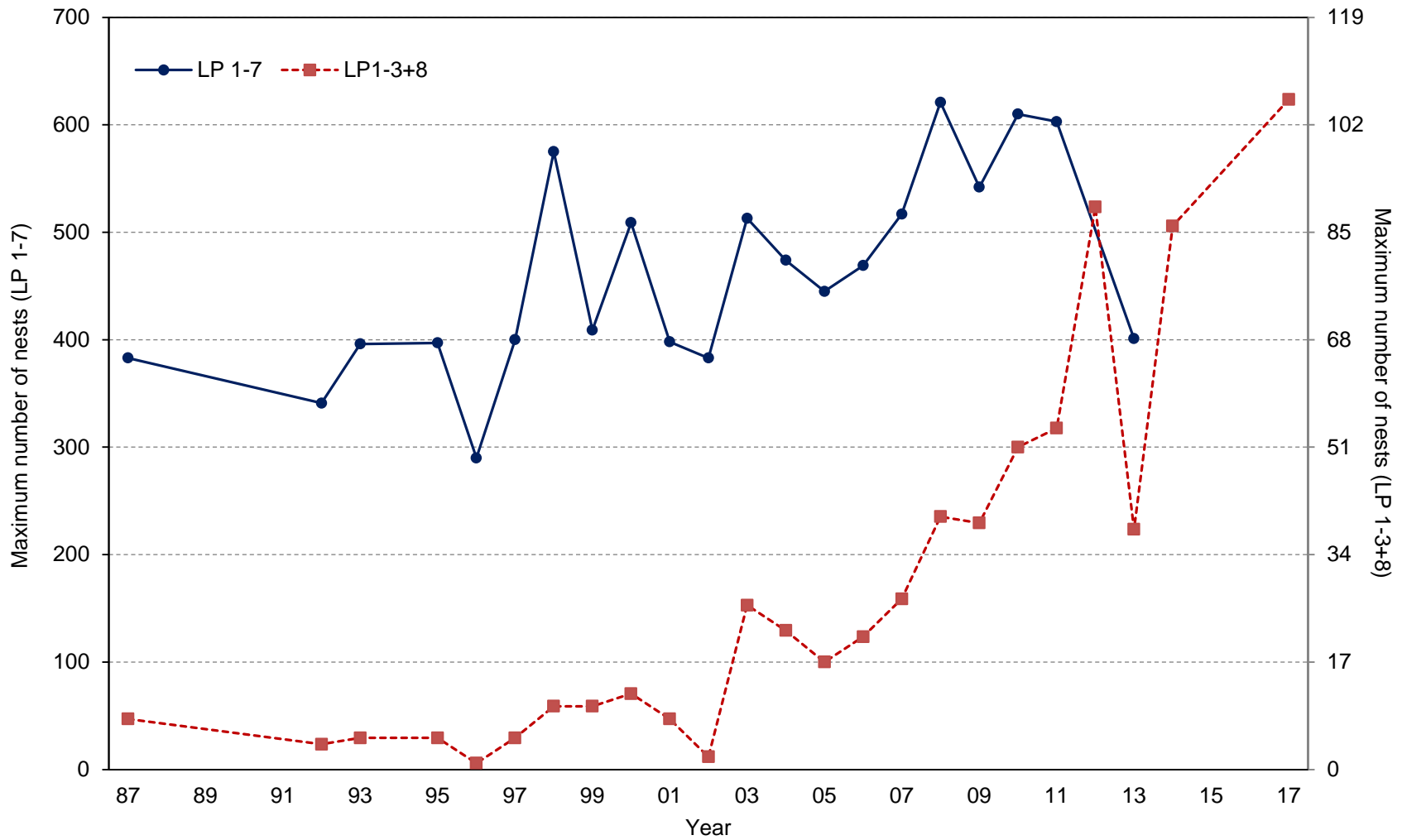


Figure 7. Maximum numbers of black-legged kittiwake nests counted on Land Plots 1-7 (solid line) and Land Plots 1-3+8 (dashed line) at Cape Lisburne, Alaska. Note the different axis scales for the two data sets. No counts were conducted in 1988-1991, 1994, or 2015-2016; data are excluded for Land Plots 1-7 in 2012, 2014, and 2017 because not all plots were counted.

Table 9. Numbers of black-legged kittiwake nests counted on Land Plots 1-7 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015-2016; data are excluded in 2012, 2014, and 2017 because not all plots were counted ^{a, b}.

Replicate	1987	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013
1	361	334	383	397	290	397	575	387	501	342	339	477	411	410	410	452	599	481	574	472	378
2	370	331	393	-	-	394	-	398	489	346	330	497	416	411	443	467	594	463	582	504	395
3	-	-	378	-	-	-	-	-	491	360	326	491	473	415	445	476	601	483	585	529	378
4	-	-	376	-	-	-	-	-	500	386	331	506	461	433	453	488	606	495	595	560	-
5	-	-	-	-	-	-	-	-	493	388	355	499	459	440	441	501	582	502	606	527	-
6	-	-	-	-	-	-	-	-	-	-	353	-	-	-	454	499	596	527	-	575	-
7	-	-	-	-	-	-	-	-	-	-	368	-	-	-	456	511	598	495	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	459	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	453	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	448	-	-	-	-	-	-
Mean	366	333	383	397	290	396	575	393	495	364	343	494	444	422	446	485	597	492	588	528	384
Max. ^c	383	341	396	397	290	400	575	408	509	398	383	513	474	445	469	517	621	542	610	602	401
n ^d	2	2	4	1	1	2	1	2	5	5	7	5	5	5	10	7	7	7	5	6	3
SD ^e	6	2	8	-	-	2	-	8	5	22	16	11	28	14	14	21	7	20	12	37	10
First count	18 Jul	17 Jul	21 Jul	16 Jul	7 Jul	11 Jul	19 Jul	3 Aug	19 Jul	4 Aug	28 Jul	31 Jul	25 Jul	25 Jul	24 Jul	24 Jul	18 Jul	20 Jul	25 Jul	22 Jul	25 Jul
Last count	1 Aug	20 Jul	1 Aug	N/A	N/A	12 Jul	N/A	4 Aug	24 Jul	10 Aug	8 Aug	8 Aug	3 Aug	1 Aug	8 Aug	31 Jul	5 Aug	31 Jul	29 Jul	1 Aug	31 Jul

^aLand Plots 6 and 7 were not counted in 2012 due to access limitations caused by excessive beach erosion.

^bLand Plots 4, 5, 6, and 7 were not counted in 2014 or 2017 due to access limitations caused by excessive beach erosion.

^cMax. = Maximum nest count, used for comparisons.

^dn = number of counts.

^eSD = standard deviation.

Table 10. Numbers of black-legged kittiwake nests counted on Land Plots 1-3+8 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015-2016.

Replicate	1987	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	8	4	3	5	1	5	10	9	10	8	1	25
2	4	4	3	-	-	5	-	10	10	8	2	26
3	-	-	4	-	-	-	-	-	12	8	2	25
4	-	-	5	-	-	-	-	-	12	8	2	22
5	-	-	-	-	-	-	-	-	12	8	2	22
6	-	-	-	-	-	-	-	-	-	-	2	-
7	-	-	-	-	-	-	-	-	-	-	2	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
Mean	6	4	4	5	1	5	10	10	11	8	2	24
Max. ^a	8	4	5	5	1	5	10	10	12	8	2	26
n ^b	2	2	4	1	1	2	1	2	5	5	7	5
SD ^c	3	0	1	-	-	0	-	1	1	0	0	2
First count	18 Jul	17 Jul	21 Jul	16 Jul	7 Jul	11 Jul	19 Jul	3 Aug	19 Jul	4 Aug	28 Jul	31 Jul
Last count	1 Aug	20 Jul	1 Aug	N/A	N/A	12 Jul	N/A	4 Aug	24 Jul	10 Aug	8 Aug	8 Aug

Table 10 (continued). Numbers of black-legged kittiwake nests counted on Land Plots 1-3+8 at Cape Lisburne, Alaska. No counts were conducted in 1988-1991, 1994, or 2015-2016.

Replicate	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2017
1	12	17	16	26	34	21	45	27	68	32	85	104
2	14	17	21	25	37	27	47	25	87	38	83	103
3	22	16	21	26	34	31	51	44	79	24	-	106
4	18	17	21	26	39	30	50	44	89	-	-	-
5	20	17	21	26	38	30	50	53	-	-	-	-
6	-	-	21	27	39	39	-	49	-	-	-	-
7	-	-	21	27	38	38	-	-	-	-	-	-
8	-	-	21	-	-	-	-	-	-	-	-	-
9	-	-	21	-	-	-	-	-	-	-	-	-
10	-	-	21	-	-	-	-	-	-	-	-	-
Mean	17	17	21	26	37	31	49	40	81	31	84	104
Max. ^a	22	17	21	27	40	39	51	54	89	38	86	106
n ^b	5	5	10	7	7	7	5	6	4	3	2	3
SD ^c	4	0	2	1	2	6	3	12	10	7	1	2
First count	25 Jul	25 Jul	24 Jul	24 Jul	18 Jul	20 Jul	25 Jul	22 Jul	28 Jul	25 Jul	25 Jul	28 Jul
Last count	3 Aug	1 Aug	8 Aug	31 Jul	5 Aug	31 Jul	29 Jul	1 Aug	1 Aug	31 Jul	26 Jul	2 Aug

^aMax. = Maximum nest count, used for comparisons.

^bn = number of counts.

^cSD = standard deviation.

Table 11. Counts^a of black-legged kittiwake nests on land-based index plots at Cape Lisburne, Alaska in 2017 (n=3 counts). Land Plots 4, 5, 6, and 7 were not counted in 2017 due to access limitations caused by excessive beach erosion.

Plot	Date		
	28 Jul	30 Jul	2 Aug
LP1	0	0	0
LP2	45	43	45
LP3	59	60	61
LP4	NC ^b	NC	NC
LP5	NC	NC	NC
LP6	NC	NC	NC
LP7	NC	NC	NC
LP8	0	0	0
LPA ^c	0	0	0
LPB ^c	0	0	0

^aNests were counted by ones from land.

^bNC = Plot not counted

^cPlot LPA, previously called 1a, was created in 1999 and Plot LPB was created in 2010, when murre were first observed occupying them.

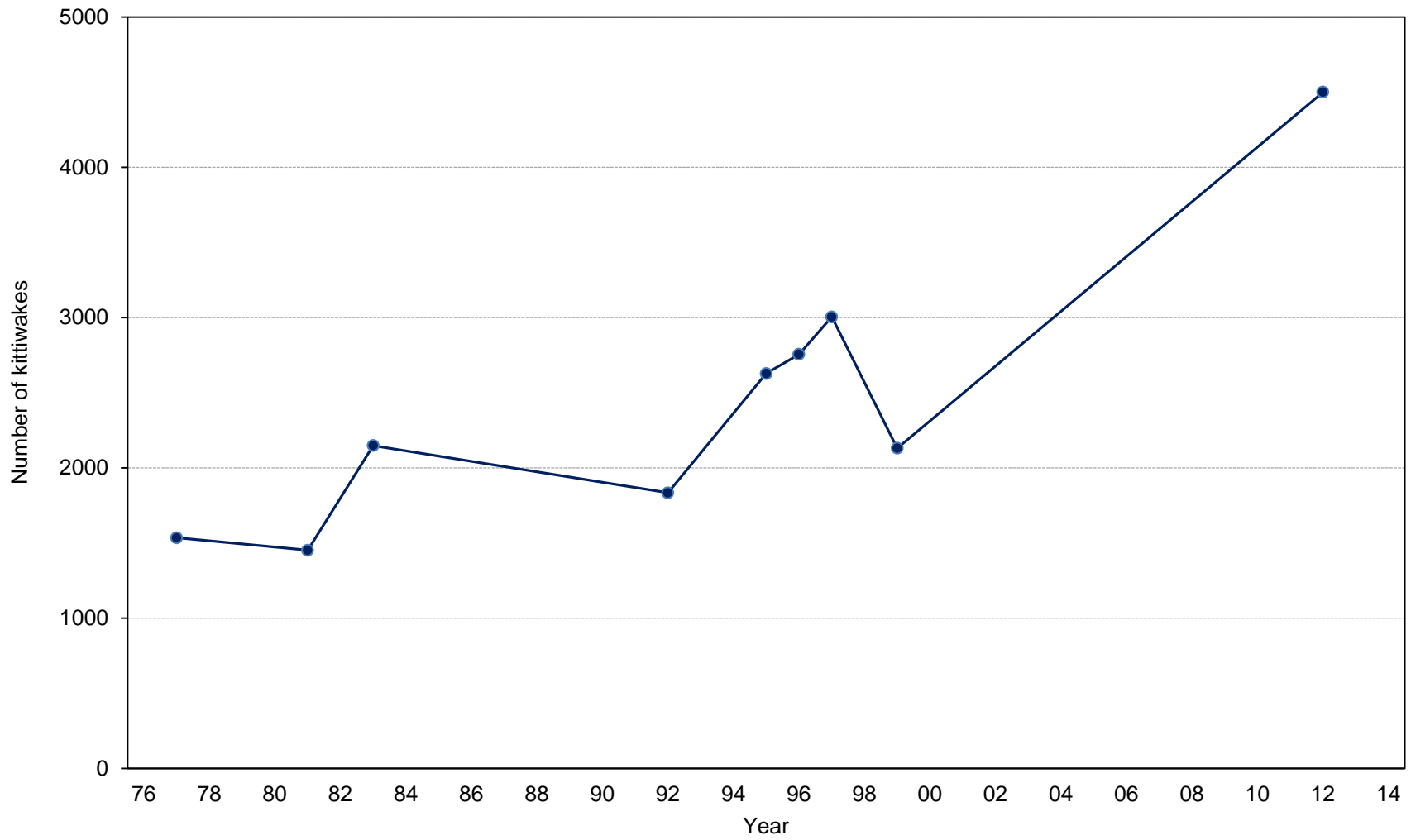


Figure 8. Numbers of black-legged kittiwakes counted on boat-based index plots (plots 11, 12, 25, 26, 30, 32, 65, 66, 70 and 72) at Cape Lisburne, Alaska. No counts were conducted in years not shown.

Table 12. Counts of black-legged kittiwakes on boat-based index plots (plots 11, 12, 25, 26, 30, 32, 65, 66, 70, 72, 73, and 74) at Cape Lisburne, Alaska. No counts were conducted in years not listed; plot 73 was counted only in 1977 and 2012, and plot 74 was counted only in 2012.

Plot	1977	1981	1983	1992	1995	1996	1997	1999	2012
11	114	202	260	259	387	409	494	361	1000
12	75	179	207	128	395	422	457	311	570
25	54	45	77	58	93	107	110	85	420
26	265	246	322	230	321	325	368	285	200
30	126	139	216	201	158	197	206	215	495
32	33	43	22	173	286	375	272	264	555
65	247	310	460	338	332	342	397	44	450
66	50	43	50	44	45	29	77	181	70
70	296	116	324	262	370	332	406	246	440
72	274	128	210	140	240	217	217	138	300
Total (part)	1534	1451	2148	1833	2627	2755	3004	2130	4500
73	349	-	-	-	-	-	-	-	580
74	-	-	-	-	-	-	-	-	624
Total (all)	-	-	-	-	-	-	-	-	5704
Date(s) of count(s)	11 Aug- 27 Aug	25 Jul & 2 Aug	21 Jul & 11 Aug	25 Jul- 6 Aug	9 Aug	18 Aug	10 Aug	6 Aug	11 Aug

Table 13. Mean numbers of individuals found and encounter rates during COASST surveys at Cape Lisburne, Alaska. The surveys were conducted on Cape Lisburne Beach, located between the mouths of "Fossil Creek" (68° 52.27' N, 166° 02.60' W, WGS 84) and Selin Creek (68° 52.42' N, 166° 05.08' W, WGS 84). Mean number of individuals comprises the average number of new birds found per survey and does not include birds still present from previous surveys and re-encountered. Encounter rate is defined as the number of all birds (including new individuals and re-encountered birds) found per kilometer of beach surveyed (1.8 km) divided by the number of surveys. No surveys were conducted in 2015.

Species	2012		2013		2014		2016		2017 ^a	
	Mean # indiv.	Encounter rate	Mean # indiv.	Encounter rate	Mean # indiv.	Encounter rate	Mean # indiv.	Encounter rate	Mean # indiv.	Encounter rate
Common eider	-	-	-	-	-	-	3.0	1.7	-	-
Thick-billed murre	-	-	0.5	0.3	-	-	1.0	0.6	-	-
Unidentified murre	2.0	1.1	0.5	0.3	-	-	-	-	-	-
Black-legged kittiwake	2.0	1.1	1.0	0.6	2.0	1.1	-	-	-	-
Glaucous gull	1.0	0.6	1.0	0.6	5.0	2.8	-	-	-	-
Sooty shearwater	-	-	1.0	0.6	-	-	-	-	-	-
Common raven	-	-	-	-	1.0	0.6	-	-	-	-
All species	5.0	2.8	4.0	2.2	8.0	4.4	4.0	2.2	-	-
n ^b	1		2		1		1		1	
First survey	17 Aug		27 Jul		31 Jul		1 Aug		1 Aug	
Last survey	-		19 Aug		-		-		-	

^aNo bird carcasses were encountered during the 2017 COASST survey.

^bn = Number of surveys.

Annotated list of wildlife observed at Cape Lisburne, Alaska in 2017 (21 July-11 August).

BIRDS

Greater white-fronted goose (*Anser albifrons*). One bird was seen at 6-mile Beach on 27 July. At least 7 birds were observed at 8-mile Lake on 2 August.

Canada goose (*Branta canadensis*). Approximately 300 were seen on 6-mile Lake on 26 and 27 July. Approximately 40 molting birds were seen between 6- and 8-mile beaches. At least 25 were observed on the shore of 8-mile Lake. Approximately 85 were seen at 6-mile Lake on 2 August.

Spectacled eider (*Somateria fischeri*). A male in eclipse plumage was seen on First Beach below the seabird colony on 28 July. A lone male was observed on the beach adjacent to our land plots on 2 August.

King eider (*Somateria spectabilis*). A male and female were seen in nearshore waters near 6-mile Lake on 27 July.

Common eider (*Somateria mollissima*). This species was observed daily. At least one bird in eclipse plumage was seen offshore of the facility on 26 July. Two pairs, including a male in breeding plumage, were seen in nearshore waters adjacent to the beach below the Igrarok Hills on 27 July. A male and female flew from the beach below our First Beach land plots on 30 July. Hundreds of common eiders were seen offshore, flying to the west, throughout the day on 6 August; including a flock of more than 200 near the cape. Approximately 8 to 10 birds were observed on shore at the Arch on First Beach on 6 August.

Surf scoter (*Melanitta perspicillata*). One was seen on the beach below our First Beach land plots, before swimming out to sea, on 30 July.

Long-tailed duck (*Clangula hyemalis*). One bird was seen on 6-mile Lake on 26 July. Two birds were observed near shore off the beach below the Igrarok Hills on 2 August.

Bufflehead (*Bucephala albeola*). A lone female was seen on 6-mile Lake on 26 July.

Willow ptarmigan (*Lagopus lagopus*). One bird was spotted along Fossil Creek on 27 July.

Semipalmated plover (*Charadrius semipalmatus*). Two adults and one fledgling were seen at the mouth of Selin Creek on 25 July. An adult and 3 fledglings were observed on the beach near Selin Creek on 1 August. Three plovers were seen at 6-mile Lake on 2 August.

Whimbrel (*Numenius phaeopus*). One bird was seen on the beach near Fossil Creek on 27 July.

Dunlin (*Calidris alpina*). At least 3 birds were observed with a large flock of western sandpipers at 8-mile Lake on 2 August.

Western sandpiper (*Calidris mauri*). Hundreds, in flocks of 25 to 50, were seen in the wrack line of the beach adjacent to 6-mile Lake on 27 July. Similar numbers were observed there on 2 August.

Short-billed dowitcher (*Limnodromus griseus*). One bird was seen at 8-mile Lake on 2 August.

Red-necked phalarope (*Phalaropus lobatus*). At least 4 young-of-the-year birds were seen swimming in an eddy of Fossil Creek on 26 July. One bird was observed a couple meters from shore near the Arch on First Beach on 6 August.

Pomarine jaeger (*Stercorarius pomarinus*). Two birds, a light phase and a dark phase, were seen on the ground near Fossil Creek on 26 July.

Parasitic jaeger (*Stercorarius parasiticus*). At least one bird was seen at 8-mile Lake on 27 July.

Common murre (*Uria aalge*). Seen daily at the large Cape Lisburne breeding colony and adjacent nearshore waters.

Thick-billed murre (*Uria lomvia*). Seen daily at the large Cape Lisburne breeding colony and adjacent nearshore waters.

Black guillemot (*Cephus grylle*). One guillemot was seen from the boat, and another was observed swimming nearshore from the beach below the Igrarok Hills, on 27 July. Two birds were seen just off the beach at the Arch on First Beach on 30 July. A lone bird was observed nearshore near the Arch on 2 and 6 August.

Parakeet auklet (*Aethia psittacula*). Two were seen from the boat off of Cape Lisburne on 27 July. Several more were observed on 5 August just offshore of the First Beach land plots.

Horned puffin (*Fratercula corniculata*). Seen daily at First Beach land plots and in nearshore waters.

Tufted puffin (*Fratercula cirrhata*). Seen daily in singles and small numbers at First Beach land plots and in nearshore waters.

Black-legged kittiwake (*Rissa tridactyla*). Seen daily at the large Cape Lisburne breeding colony and adjacent nearshore waters. Feeding melees were observed frequently in 2017. Kittiwakes also frequented the fresh- and brackish-water ponds in the area.

Slaty-backed gull (*Larus schistisagus*). One bird was observed among a flock of glaucous-winged gulls on the beach near Fossil Creek on 30 July.

Glaucous-winged gull (*Larus glaucescens*). This species was not as numerous as the glaucous gull, but was often observed in low numbers. One or two were regularly seen on the First Beach land plots.

Glaucous gull (*Larus hyperboreus*). Adults and immatures were seen daily, usually in small numbers (tens). A few chicks were produced in nests on or near the First Beach land plots in 2017. Gulls occasionally took part in nearshore feeding melees and probably took murre eggs from the cliffs (as evidenced by the shells of depredated murre eggs we found on the beach below the plots). Gulls also frequented the fresh- and brackish-water ponds in the area. Flocks of 30 to 50 were routinely seen on the beach east of the runway.

Arctic tern (*Sterna paradisaea*). A breeding colony of at least 20 adults was observed on the beach at 6-mile Lake on 26 and 27 July. At least 3 large downy chicks were seen. Two large chicks and 7 adults were observed at the colony site on 2 August.

Pacific loon (*Gavia pacifica*). One bird was seen flying over 8-mile Lake on 2 August.

Loon sp. (*Gavia sp.*). Three birds were observed resting on the beach below the Igrarok Hills on 27 July, before flying out to sea. About a half dozen unidentified loons were seen at 8-mile Lake on 2 August.

Sooty shearwater (*Ardenna grisea*). A carcass was found on the beach below the Igrarok Hills on 26 July. On 3 August a single bird was seen just offshore of the First Beach land plots.

Pelagic cormorant (*Phalacrocorax pelagicus*). Seen daily at the First Beach land plots and in nearshore waters. Cormorants sometimes participated in nearshore feeding melees along with kittiwakes, murrelets, and puffins.

Golden eagle (*Aquila chrysaetos*). One bird was seen flying low along the Igrarok Hills on 26 July.

Peregrine falcon (*Falco peregrinus*). A bird was observed feeding on a freshly killed black-legged kittiwake near our land plots at First Beach. There was a pair, and probably a nest in the area.

Common raven (*Corvus corax*). Two birds were seen near the site pond on 27 July, 30 July, and 2 August.

Northern wheatear (*Oenanthe oenanthe*). At least 3 non-breeding females were observed on the fringes of the quarry on 8 August.

Eastern yellow wagtail (*Motacilla tschutschensis*). At least two birds of this species were seen at the First Beach land plots on 2, 3, 4, and 6 August. Some of the sightings occurred just as we entered the area and set up to do plot work. They would land a few meters from us and just sit for a couple of minutes.

American pipit (*Anthus rubescens*). A single bird was seen along Selin Creek on 1 August. A pipit also was observed near the Minister's grave on 8 August.

Lapland longspur (*Calcarius lapponicus*). Several birds were seen along Fossil Creek on 30 July.

Snow bunting (*Plectrophenax nivalis*). This species was routinely seen at the Arch on First Beach and the road to Top Camp. Two birds were observed below Igrarok Hills on 26 and 27 July. Eight to 10 birds, including two adult breeding males, were seen flying near the Arch and adjacent cliffs on 3 August.

Savannah sparrow (*Passerculus sandwichensis*). This species was routinely seen around the facility, at Fossil Creek, and at 6-mile Lake.

MAMMALS

North American porcupine (*Erethizon dorsatum*). One was seen at Fossil Creek on 27 July.

Alaska marmot (*Marmota broweri*). One was seen near the road to Top Camp on 26 July.

Arctic ground squirrel (*Urocitellus parryii*). Seen frequently in ones and twos at the facility, on the roads and beaches, and at Top Camp.

Gray wolf (*Canus lupus*). Wolf tracks were seen at 6-mile Beach on 27 July.

Red fox (*Vulpes vulpes*). One animal was seen on the beach near the runway on 27 July.

Pacific walrus (*Odobenus rosmarus*). A walrus carcass was found on the beach below the Igrarok Hills on 26 July. No wounds were evident. Six walrus somehow crammed themselves onto a small nearshore rock below Cape Lisburne, seen from the boat on 27 July. A group of three walrus were observed swimming about 200 meters offshore near Fossil Creek on 1 August. At least 11 were seen swimming offshore between the camp and 6-mile Lake on 2 August. A small group was seen offshore of First Beach on 4 August. At least 11 animals were observed at sea below the cliffs off the cape on 6 August.

Grizzly bear (*Ursus arctos*). A large individual was seen at the east end of the beach below the Igrarok Hills on 26 July. We also saw a bear on the beach just east of 6-mile Lake on August 2. One animal was seen on the beach below the quarry on 4 August.

Polar bear (*Ursus maritimus*). The day we arrived at Cape Lisburne we learned that a large polar bear was resting on a hill near the western end of the runway. It was seen swimming ashore on 21 July and promptly lay down, apparently exhausted from a long swim. This is where a lot of activity was currently underway by Orion (quarry and seawall contractor), and their bear guards monitored the animal continuously until it left the beach and swam out to sea at 0135 hours on 22 July. We saw what we assumed was the same bear again near the Arch on First Beach on 25 July, as well as on a ridge above Dave's Rock on Kittiwake beach on 27 July.

Caribou (*Rangifer tarandus*). Two were seen walking through the compound on 21 July. Three individuals were observed near 6-mile Lake on 26 July. We saw 6 to 8 animals at 8-mile Beach on 27 July.

Table 14. Observations of birds and mammals at Cape Lisburne, Alaska. Dashes indicate species not recorded that year but may not necessarily indicate absence from the area during the time period (e.g., species not observed although present, or species not recorded although observed). Data are from annotated lists in annual refuge monitoring reports. No data were collected in 2015; data may have been recorded prior to 2010 but have not yet been summarized from historic sources.

Species	2010	2011	2012	2013	2014	2016	2017
Greater white-fronted goose	-	-	-	-	-	X	X
Snow goose	-	-	-	-	-	X	-
Canada goose	-	X	X	X	X	X	X
Northern pintail	X	X	X	X	X	X	-
Canvasback	-	-	-	-	-	X	-
Steller's eider	X	-	-	-	-	X	-
Spectacled eider	X	X	-	X	-	X	X
King eider	X	X	-	X	-	X	X
Common eider	X	X	X	X	X	X	X
Harlequin duck	-	-	-	X	X	X	-
Surf scoter	X	X	-	-	-	-	X
White-winged scoter	-	-	-	X	-	X	-
Long-tailed duck	X	X	X	X	X	X	X
Bufflehead	-	-	-	-	-	-	X
Red-breasted merganser	-	-	-	-	X	-	-
Willow ptarmigan	-	-	-	-	-	-	X
Sandhill Crane	-	-	-	-	X	X	-
Semipalmated plover	X	X	-	X	X	X	X
Whimbrel	-	-	-	-	-	-	X
Dunlin	-	-	-	X	-	X	X
Western sandpiper	X	X	X	X	X	X	X
Short-billed dowitcher	-	-	-	-	-	-	X
Wilson's snipe	-	-	-	-	-	X	-
Wandering tattler	-	X	-	-	-	-	-
Red-necked phalarope	X	X	-	X	-	X	X
Pomarine jaeger	-	-	X	X	-	-	X
Parasitic jaeger	X	X	X	X	X	X	X
Long-tailed jaeger	X	-	X	X	-	X	-
Common murre	X	X	X	X	X	X	X
Thick-billed murre	X	X	X	X	X	X	X
Black guillemot	X	X	X	X	X	X	X
Parakeet auklet	-	-	X	-	-	-	X
Horned puffin	X	X	X	X	X	X	X

Table 14 (continued). Observations of birds and mammals at Cape Lisburne, Alaska. Dashes indicate species not recorded that year but may not necessarily indicate absence from the area during the time period (e.g., species not observed although present, or species not recorded although observed). Data are from annotated lists in annual refuge monitoring reports. No data were collected in 2015; data may have been recorded prior to 2010 but have not yet been summarized from historic sources.

Species	2010	2011	2012	2013	2014	2016	2017
Tufted puffin	X	X	X	X	X	X	X
Black-legged kittiwake	X	X	X	X	X	X	X
Ross's gull	X	-	-	-	-	-	-
Herring gull	X	-	-	-	-	-	-
Slaty-backed gull	-	-	-	-	-	-	X
Glaucous-winged gull	-	-	-	-	-	-	X
Glaucous gull	X	X	X	X	X	X	X
Arctic tern	X	X	X	-	-	X	X
Red-throated loon	X	X	-	X	-	-	-
Pacific loon	-	-	-	-	-	-	X
Yellow-billed loon	X	-	-	-	-	-	-
Short-tailed shearwater	-	-	-	X	-	-	-
Sooty shearwater	-	-	-	-	-	-	X
Pelagic cormorant	X	X	X	X	X	X	X
Northern harrier	-	-	X	-	-	-	-
Golden eagle	X	X	-	X	X	X	X
Snowy owl	X	-	-	X	-	-	-
Peregrine falcon	X	X	X	X	X	-	X
Gray jay	-	X	-	-	-	-	-
Common raven	X	X	X	X	X	X	X
Horned lark	X	-	-	-	-	-	-
Cliff swallow	-	-	-	X	-	-	-
Northern wheatear	X	X	X	X	-	X	X
Eastern yellow wagtail	-	-	-	-	-	X	X
White wagtail	X	-	-	-	-	-	-
American pipit	-	X	-	X	X	X	X
Redpoll sp.	-	-	-	X	-	-	-
Lapland longspur	X	X	X	X	X	X	X
Snow bunting	X	X	X	X	X	X	X
American tree sparrow	X	-	-	-	-	-	-
Savannah sparrow	X	-	-	X	-	X	X
White-crowned sparrow	-	-	-	X	-	X	-
Red-winged blackbird	X	-	-	-	-	-	-

Table 14 (continued). Observations of birds and mammals at Cape Lisburne, Alaska. Dashes indicate species not recorded that year but may not necessarily indicate absence from the area during the time period (e.g., species not observed although present, or species not recorded although observed). Data are from annotated lists in annual refuge monitoring reports. No data were collected in 2015; data may have been recorded prior to 2010 but have not yet been summarized from historic sources.

Species	2010	2011	2012	2013	2014	2016	2017
North American porcupine	-	-	-	-	-	-	X
Alaska marmot	X	X	X	X	X	X	X
Arctic ground squirrel	X	X	X	X	X	X	X
Gray wolf	-	-	X	X ^a	-	X ^a	X ^a
Red fox	-	X	X	X	X	X	X
Weasel spp.	-	-	-	-	-	X	-
Pacific walrus	X	X	X	X	-	-	X
Spotted (largha) seal	X	X	X	-	-	-	-
Ringed seal	-	-	-	X	-	-	-
Grizzly bear	X	X	X	X	X	X	X
Polar bear	-	-	-	X	-	-	X
Musk ox	-	X	X	-	-	-	-
Dall's sheep	X	X	X	-	-	-	-
Caribou	X	X	X	-	X	X	X
Bowhead whale	X	-	-	-	-	-	-
Minke whale	X	-	-	-	-	-	-
Gray whale	-	X	X	X	-	-	-
Beluga whale	-	-	-	X	-	-	-
Observation dates	19 Jul- 20 Aug	15 Jul- 19 Aug	23 Jul- 27 Aug	23 Jul- 26 Aug	21 Jul- 4 Aug	25 Jul- 12 Aug	21 Jul- 11 Aug

^aTracks only.

Table 15. Plants identified by Greg Thomson at Cape Lisburne, Alaska in 2013 (from Hultén 1968).

Family	Scientific name	Common name
Gramineae	<i>Elymus arenarius</i> subsp. <i>mollis</i>	Lyme grass
Salicaceae	<i>Salix reticulata</i> subsp. <i>reticulata</i>	Netted willow
Polygonaceae	<i>Rumex arcticus</i>	Sorrel, Dock
Polygonaceae	<i>Polygonum bistorta</i> subsp. <i>plumosum</i>	Meadow bistort
Polygonaceae	<i>Polygonum viviparum</i>	Alpine bistort
Caryophyllaceae	<i>Stellaria crassifolia</i>	Chickweed
Caryophyllaceae	<i>Stellaria laeta</i>	Chickweed
Caryophyllaceae	<i>Stellaria longipes</i>	Chickweed
Caryophyllaceae	<i>Cerastium Beeringianum</i> var. <i>grandiflorum</i>	Mouse-eared chickweed
Caryophyllaceae	<i>Minuartia arctica</i>	Arctic sandwort
Caryophyllaceae	<i>Honckenya peploides</i> subsp. <i>peploides</i>	Seabeach sandwort
Ranunculaceae	<i>Delphinium brachycentrum</i>	Larkspur
Ranunculaceae	<i>Aconitum delphinifolium</i> subsp. <i>delphinifolium</i>	Big monkshood
Ranunculaceae	<i>Aconitum delphinifolium</i> subsp. <i>paradoxum</i>	Little monkshood
Papaveraceae	<i>Papaver Walpolei</i>	Walpole's poppy
Papaveraceae	<i>Papaver Hultenii</i>	Poppy
Papaveraceae	<i>Papaver lapponicum</i> subsp. <i>occidentale</i>	Lapland poppy
Brassicaceae	<i>Cochlearia officinalis</i> subsp. <i>arctica</i>	Scurvy grass
Brassicaceae	<i>Draba borealis</i>	Boreal draba
Saxifragaceae	<i>Saxifraga hirculus</i>	Bog saxifrage
Saxifragaceae	<i>Saxifraga bronchialis</i> subsp. <i>Funstonii</i>	Spotted saxifrage
Saxifragaceae	<i>Saxifraga cernua</i>	Bulblet saxifrage
Saxifragaceae	<i>Saxifraga davurica</i> subsp. <i>grandipetala</i>	Saxifrage
Rosaceae	<i>Potentilla villosa</i>	Cinquefoil
Rosaceae	<i>Potentilla Vahliana</i>	Cinquefoil
Onagraceae	<i>Epilobium latifolium</i>	River beauty
Gentianaceae	<i>Gentiana propinqua</i> subsp. <i>arctophila</i>	Gentian
Polemoniaceae	<i>Polemonium acutiflorum</i>	Tall Jacob's ladder
Boraginaceae	<i>Myosotis alpestris</i> subsp. <i>asiatica</i>	Forget-me-not
Boraginaceae	<i>Mertensia maritima</i> subsp. <i>maritima</i>	Beach bluebells
Scrophulariaceae	<i>Castilleja caudata</i>	Indian paintbrush
Scrophulariaceae	<i>Castilleja elegans</i>	Indian paintbrush
Valerianaceae	<i>Valeriana capitata</i>	Capitate valerian
Asteraceae	<i>Artemesia titesii</i>	Northern wormwood
Asteraceae	<i>Artemesia Tilesii</i> subsp. <i>elatior</i>	Tilesius' wormwood
Asteraceae	<i>Petasites frigidus</i>	Sweet coltsfoot
Asteraceae	<i>Senecio atropurpureus</i> subsp. <i>atropurpureus</i>	Ragwort/Groundsel
Asteraceae	<i>Senecio pseudo-Arnica</i>	Ragwort/Groundsel

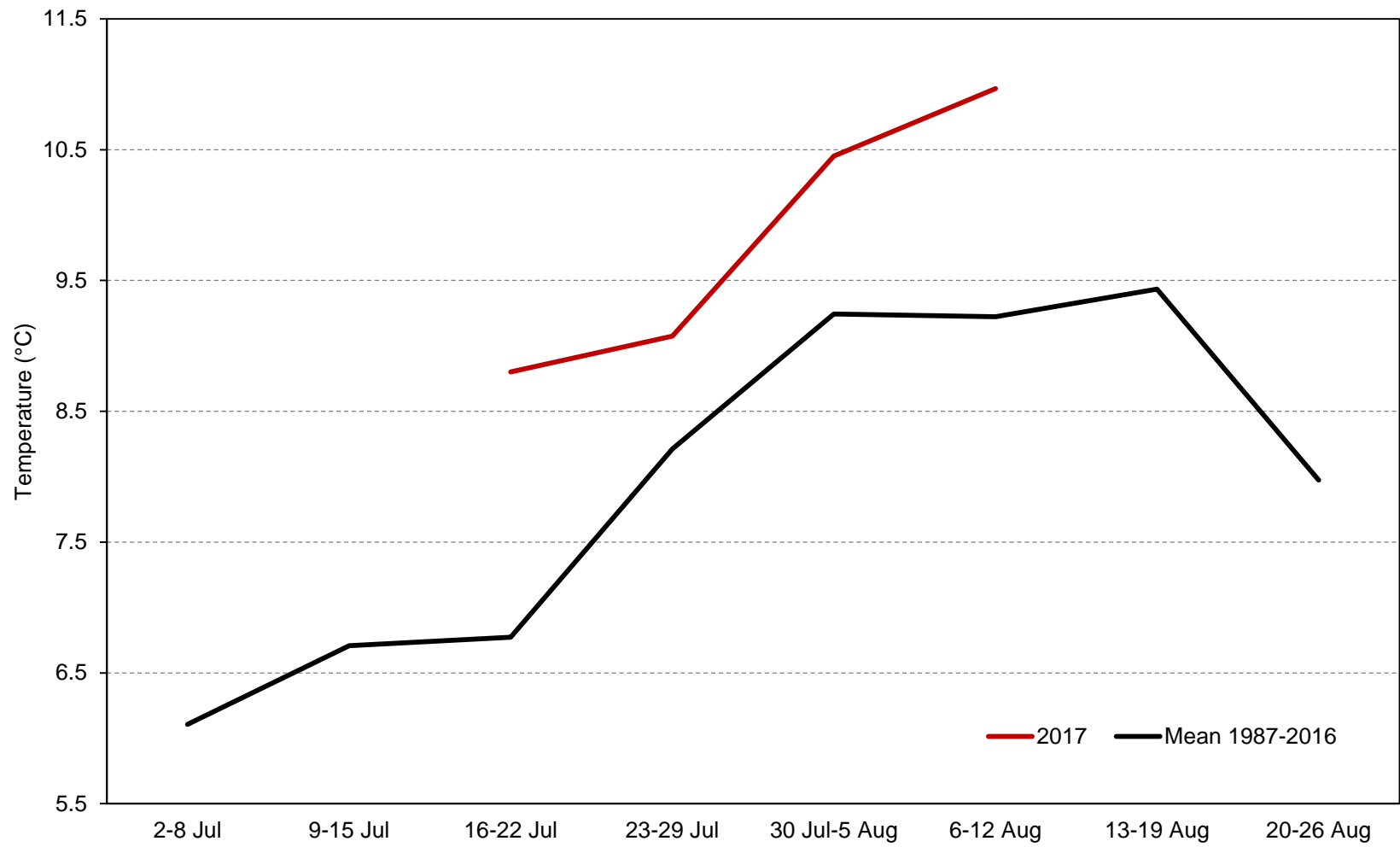


Figure 9. Mean weekly sea surface temperatures (°C) at Cape Lisburne, Alaska.

Table 16. Mean weekly sea surface temperatures (°C)^a at Cape Lisburne, Alaska. No data were collected in 1988-1991, 1994, or 2015.

Week	1987	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003
2-8 Jul	-	-	-	-	-	6.6	-	-	-	-	5.6	-
9-15 Jul	-	-	-	-	-	5.9	-	-	-	-	7.5	-
16-22 Jul	7.0	3.0	-	-	-	6.9	-	-	4.8	-	-	-
23-29 Jul	8.7	6.2	10.0	5.8	7.5	8.3	1.4	-	4.9	-	-	7.8
30 Jul-5 Aug	7.0	-	-	-	-	7.9	5.0	8.7	-	-	9.9	7.9
6-12 Aug	-	-	-	-	-	10.0	5.8	9.3	-	8.5	9.1	8.7
13-19 Aug	-	-	-	-	-	10.3	7.9	-	-	8.3	8.9	8.5
20-26 Aug	-	-	-	-	-	9.9	8.0	-	6.0	-	-	-
27 Aug-2 Sep ^b	-	-	-	-	-	-	8.0	-	-	-	-	-

Table 16 (continued). Mean weekly sea surface temperatures (°C)^a at Cape Lisburne, Alaska. No data were collected in 1988-1991, 1994, or 2015.

Week	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2016	2017
2-8 Jul	-	-	-	-	-	-	-	-	-	-	-	-	-
9-15 Jul	-	-	-	-	6.7	-	-	-	-	-	-	-	-
16-22 Jul	-	-	4.6	9.9	7.2	9.6	4.7	8.9	-	-	7.9	-	8.8
23-29 Jul	12.2	11.3	7.5	11.1	7.4	8.9	7.9	9.6	8.8	9.0	7.8	10.3	9.1
30 Jul-5 Aug	11.6	12.0	8.3	12.8	7.5	9.9	10.4	10.1	9.2	9.7	9.2	9.4	10.5
6-12 Aug	11.7	11.7	8.3	12.7	6.7	10.6	9.8	9.6	9.8	8.8	-	9.9	11.0
13-19 Aug	11.5	11.4	8.2	12.6	7.0	-	10.3	9.4	9.2	8.6	-	-	-
20-26 Aug	-	-	-	-	6.9	-	-	-	9.4	7.7	-	-	-
27 Aug-2 Sep ^b	-	-	-	-	-	-	-	-	-	-	-	-	-

^aTemperatures were measured using a digital thermometer and a bucket filled with water collected in the surf, except in 1997 and 1998 when data loggers were used.

^bWeeks with <2 data points (e.g., 27 Aug-2 Sep) were not used in calculations of weekly means for the graph.

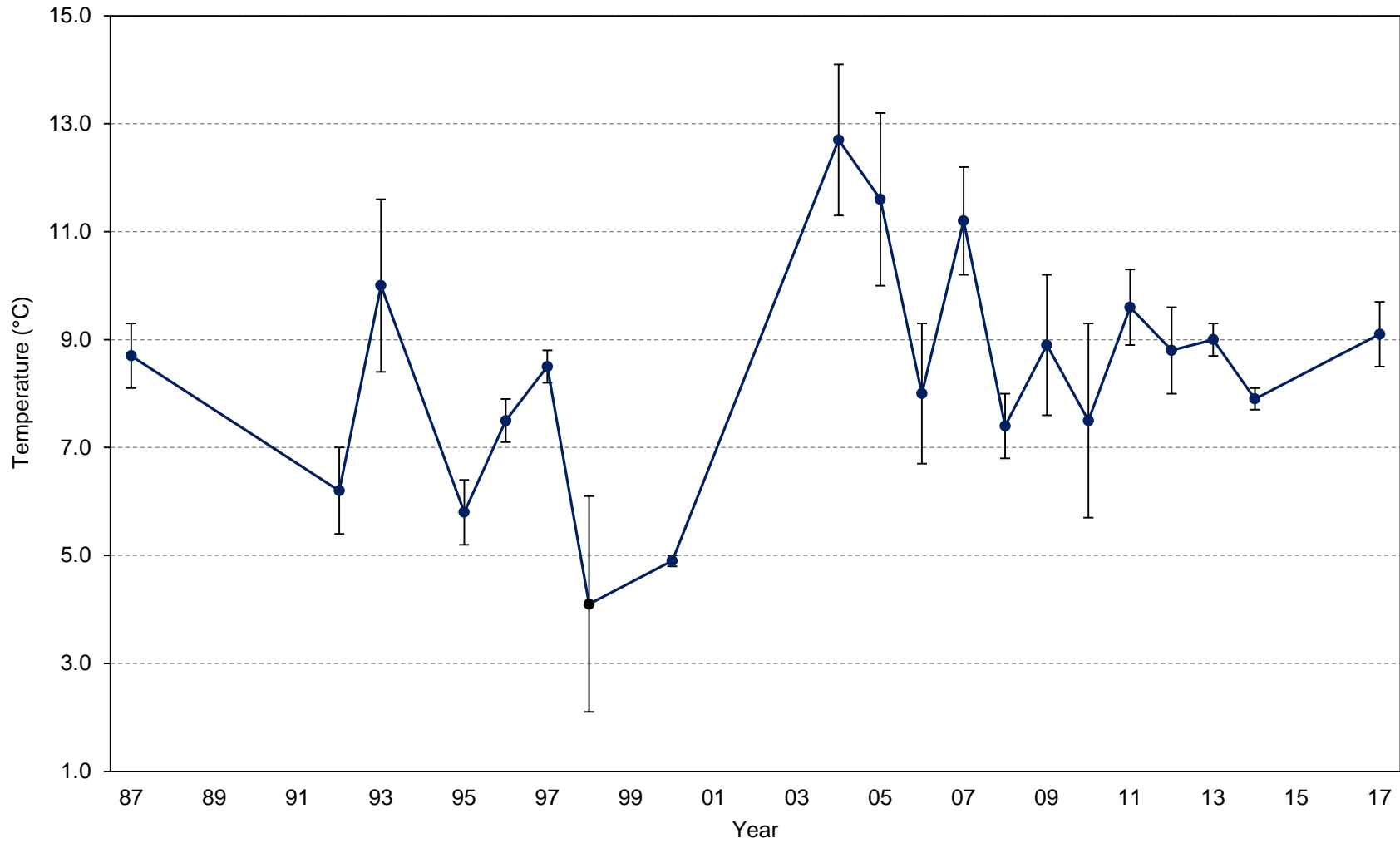


Figure 10. Mean sea surface temperatures (°C) for 23-28 July at Cape Lisburne, Alaska. Error bars represent one standard deviation. No data were collected in 1988-1991, 1994, 1999, 2001-2003, or 2015-2016.

Table 17. Sea surface temperatures^a (°C) for 23-28 July at Cape Lisburne, Alaska. No data were collected in 1988-1991, 1994, 1999, 2001-2003, or 2015-2016.

Year	Mean temperature	SD ^b	n ^c
1987	8.7	0.6	3
1992	6.2	0.8	4
1993	10.0	1.6	5
1995	5.8	0.6	6
1996	7.5	0.4	6
1997	8.5	0.3	6
1998	4.1	2.0	6
2000	4.9	0.1	3
2004	12.7	1.4	5
2005	11.6	1.6	6
2006	8.0	1.3	6
2007	11.2	1.0	6
2008	7.4	0.6	6
2009	8.9	1.3	5
2010	7.5	1.8	6
2011	9.6	0.7	6
2012	8.8	0.8	5
2013	9.0	0.3	5
2014	7.9	0.2	6
2017	9.1	0.6	4

^aTemperatures were measured using a digital thermometer in a bucket filled with water collected in the surf.

^bSD = Standard deviation

^cn = number of measurement days during 23-28 July.

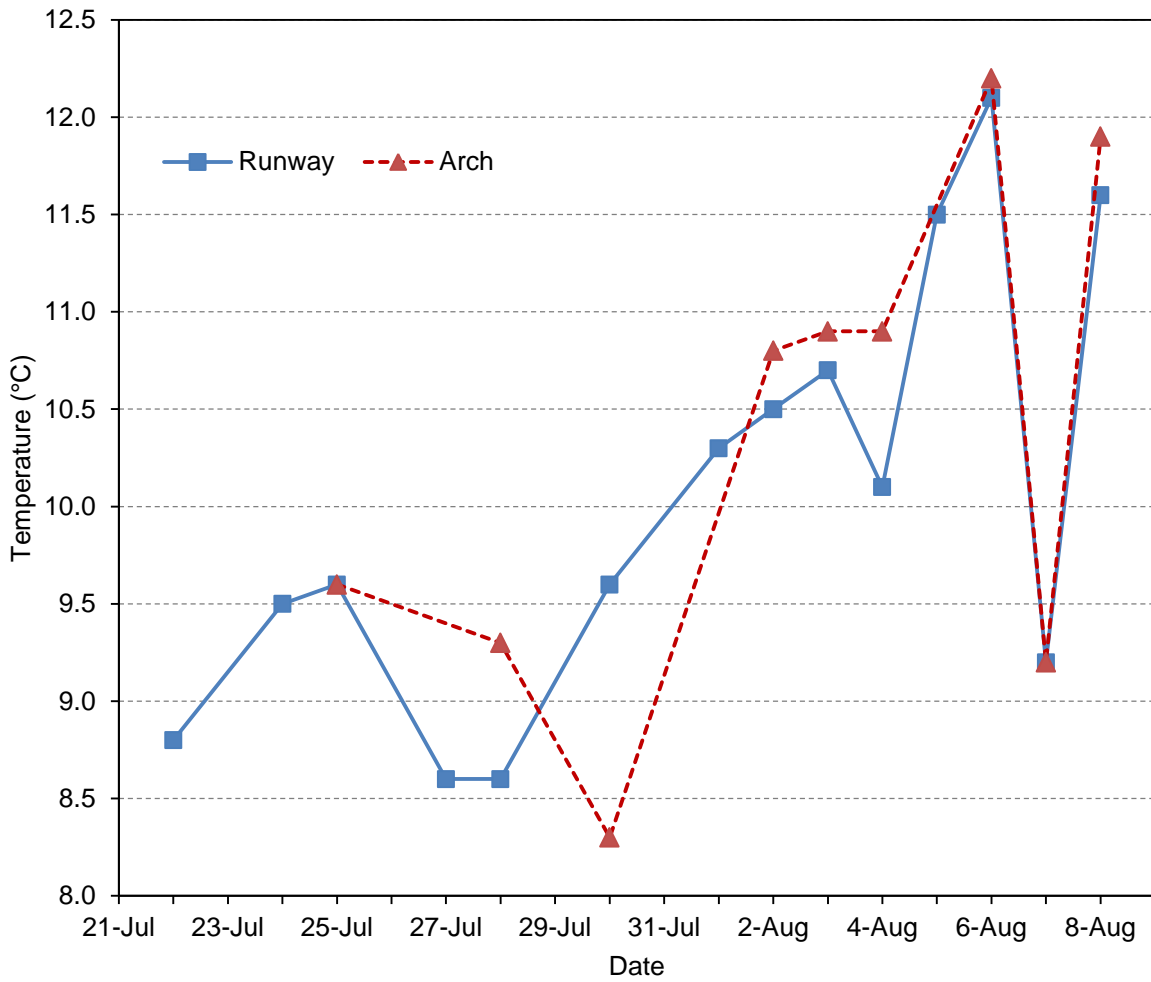


Figure 11. Daily sea surface temperatures (°C) at Cape Lisburne, Alaska in 2017. Temperatures were measured using a digital thermometer and a bucket filled with water collected in the surf.

Table 18. Sea surface temperatures (°C)^a at Cape Lisburne, Alaska in 2017.

Date	Runway	Arch
22 Jul	8.8	-
23 Jul	-	-
24 Jul	9.5	-
25 Jul	9.6	9.6
26 Jul	-	-
27 Jul	8.6	-
28 Jul	8.6	9.3
29 Jul	-	-
30 Jul	9.6	8.3
31 Jul	-	-
1 Aug	10.3	-
2 Aug	10.5	10.8
3 Aug	10.7	10.9
4 Aug	10.1	10.9
5 Aug	11.5	-
6 Aug	12.1	12.2
7 Aug	9.2	9.2
8 Aug	11.6	11.9
Mean	10.1	10.3
SD ^b	1.1	1.3
Range	8.6-12.1	8.3-12.2
n ^c	14	9

^aTemperatures were measured using a digital thermometer and a bucket filled with water collected in the surf.

^bSD = standard deviation

^cn = number of measurement days.