Emperor Goose (*Chen canagica*) Photographic Age-Ratio Survey, Alaska Peninsula, 2014

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ABSTRACT *Emperor geese (Chen canagica) were photographed between 26 September and 4 October 2014 along the shorelines of seven lagoons on the north side of the Alaska Peninsula to estimate the annual proportion of hatching-year (HY) birds. Age classification of HY vs. adult geese was based on the gray/black head and neck plumage evident on juvenile geese. In 2014, we classified 19,619 geese from 570 photographs. We counted 2,839 HY birds resulting in a self-weighted ratio estimate of 0.145 (SE = 0.008). The lagoon-stratified, count-weighted proportion of young was 0.151 (SE = 0.008).*

KEY WORDS aerial survey, Alaska, emperor goose, *Chen canagica*, age-ratio, photography, Alaska Peninsula

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INTRODUCTION

From mid-September through October, most of the Emperor goose (*Chen canagica*) population congregates in 7 lagoons on the north side of the Alaska Peninsula (Petersen and Gill 1982; Fig. 1). These staging geese provide an opportunity to sample the population to determine an index of annual productivity because hatching year (HY) Emperor geese retain gray/black plumage on their head and neck that contrasts with the complete white head plumage of adult geese (Fig. 2). This plumage difference is used to age classify geese (i.e. HY vs. adult) in aerial photographs.

The primary objective of this study was to calculate an annual estimate of the proportion of HY Emperor geese in the fall staging population. These data provide an index to annual production that is defined as the number of hatched young that survive until October and is expressed as a proportion of the total birds classified. In combination with a fall population abundance survey to weight our lagoon-specific age-ratio estimates, these data are necessary to measure the progress towards meeting the management objective of a fall juvenile age ratio ≥ 20% as specified in the Pacific Flyway Management Plan for the Emperor Goose (Pacific Flyway Council 2006) . Age ratio of emperor geese has been monitored with this survey since 1985.

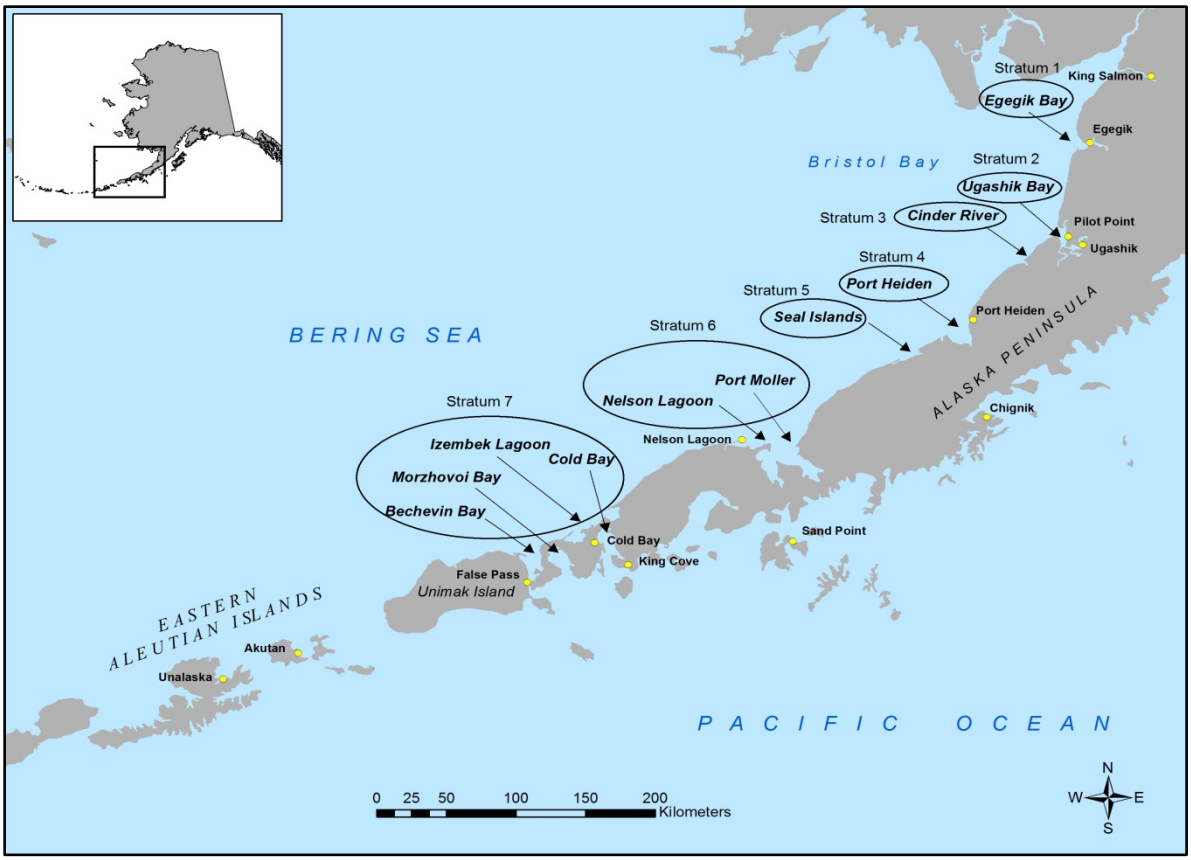

Figure 1. Seven primary fall staging areas for Emperor geese along the north side of the Alaska Peninsula.

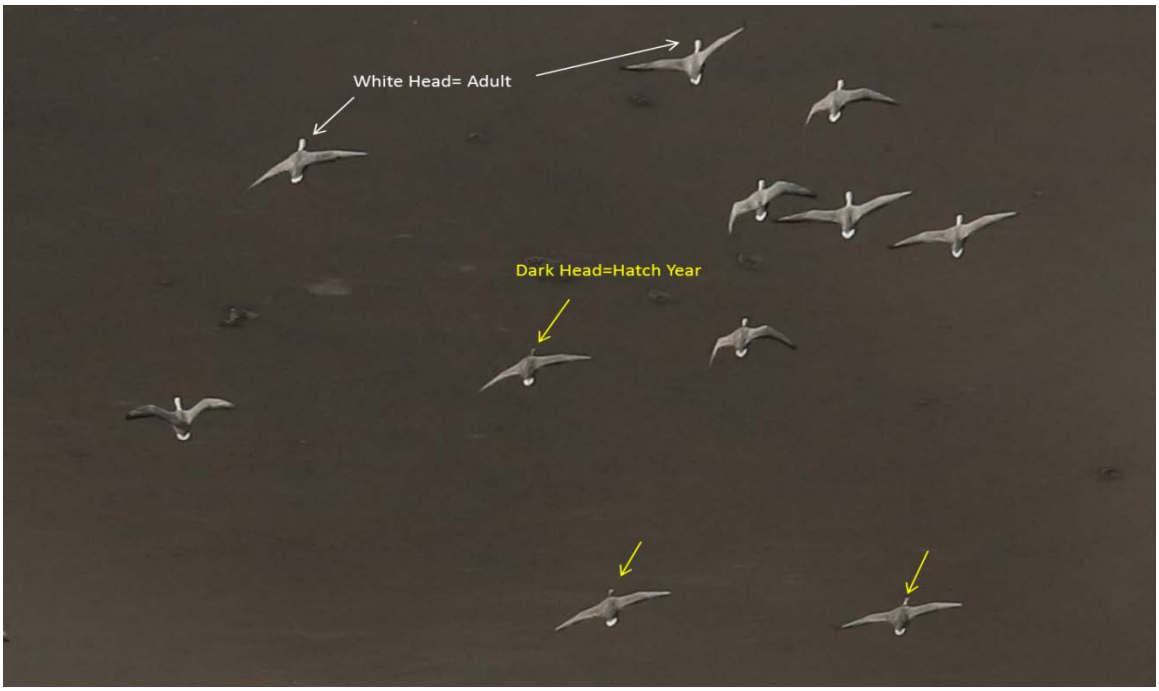

Figure 2. Head plumage characteristics of hatch year and adult Emperor geese.

METHODS

We conducted the photographic age-ratio survey in seven primary sites along the north side of the Alaska Peninsula including Egegik Bay, Ugashik Bay, Cinder River, Port Heiden, Seal Islands, Nelson Lagoon, and Izembek Lagoon (Fig. 1). We attempted to fly the aerial photographic survey when HY geese were approximately 100 days of age to ensure that we could differentiate between the age classes before the juveniles acquire their adult plumage. In 2014 the survey was flown in an amphibious-equipped Cessna 206 (N77554). The aircraft was flown at approximately 500-1000 feet above the ground to locate geese. After spotting groups of Emperor geese on beaches or flying ahead of the aircraft, the pilot positioned the aircraft to arc around the flock while attempting to provide the best possible distance, angle, and light for the photographer who was located directly behind the pilot. Aircraft maneuvering decisions were made when a flock was first spotted and verbally coordinated with the photographer to maximize photographic opportunities. Once found, we typically descended to 300-400 feet AGL to photograph flocks. The photographer captured digital images of geese through the aircraft's window port with a hand-held digital SLR camera. Taking photographs from the left rear-seat made it easier for the pilot (also in a left seat) to appropriately position the aircraft relative to the flock.

Camera Settings

We used a Canon EOS 5D Mark II camera with an image-stabilized 70-200 mm lens. The LCD display allowed for a rapid assessment of image quality. Image size was 5616 x 3744 pixels, and file size ranged from 5-12 megabytes. The photographer recorded the: Date, Time, Start Photograph #, End Photograph # , and Location (e.g., 9/27/11, 16:25 4927-4970, Egegik Bay). Camera settings for the Canon 5D were:

1. Camera set to take the highest quality JPG image
2. AF mode set to A1 Servo
3. Focus set to autofocus
4. Mode set to *shutter priority* (TV) and shutter speed set to 1250.
5. Metering mode set to *Evaluative Metering*.
6. ISO set at 800.

Photo Analysis

We viewed digital images in *Adobe Photoshop©* on a computer with dual 19-inch LCD monitors set at 1280 x 1024 resolution. We used a grid overlay for each photograph and magnified the image as needed to adequately distinguish the age class of each goose. We used the *Count Tool* to mark each counted goose as adult, juvenile, or unknown (Fig. 3). We did not classify geese on any photographs where the majority of bird images were too small or excessively blurred to reliably determine age class.

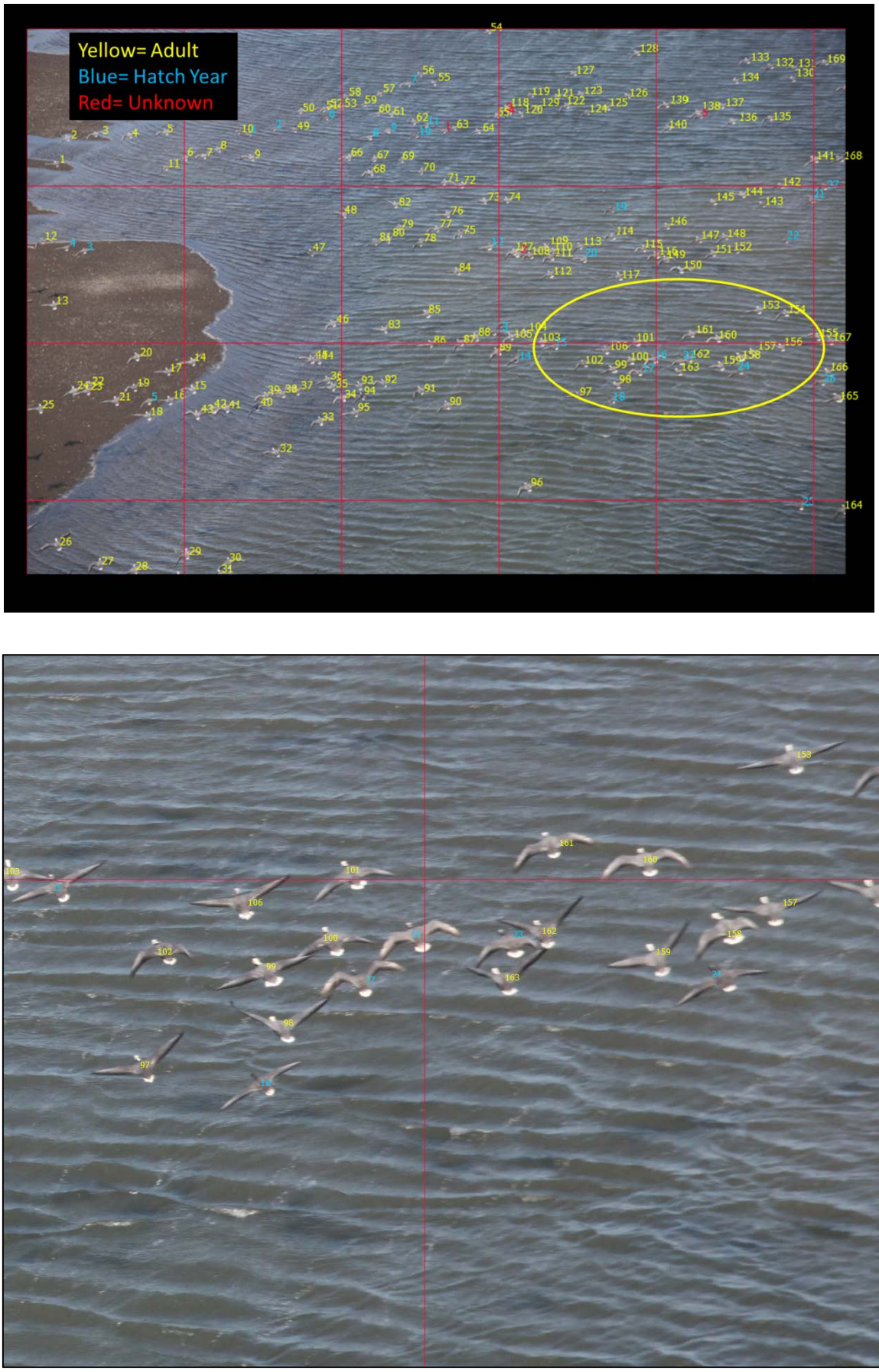

Figure 3. Typical photograph with grid overlay (top) and count tool labels (bottom).

Statistical Analyses

We calculated two estimates as described by Stehn and Wilson (2014)(i.e., count-weighted and self-weighted.

Count-Weighted Estimate

The mean ratio of juveniles/adults for each stratum was calculated from all photos in each stratum (i.e., each of seven lagoons). The resulting seven strata ratios were then weighted by the proportion of the total fall population observed in each stratum from the similarly timed, independent aerial survey count (USFWS unpubl. data). The resulting weighted stratum estimates were then summed to yield the estimate. Variances of the mean age ratio per stratum were weighted in proportion to squared population counts.

Self-Weighted Estimate

The self-weighted estimate is simply the ratio of total HY to total adults counted across all strata and is appropriate when the sampling intensity or total birds counted in photographs within each stratum is proportional to the population size estimated within each stratum from the independent, fall aerial population survey. In short, photographic survey effort should be allocated proportionally to each stratum based on the fall distribution of birds among the 7 strata.

RESULTS

Flights were conducted 26-28 September and 4 October with pilot B. Shults and photographer W. Larned (Table 1). Survey timing was approximately 105 days after the average hatch date for emperor geese on the Yukon-Kuskokwim delta (Fischer and Stehn 2015). Total flight time to complete the survey including transit between King Salmon and Cold Bay was 15 hrs.

We classified 19,619 geese on 570 photographs. We counted an average of 34.4 birds/photograph. We identified 2,839 juvenile geese resulting in juvenile : adult ratios of 0.1509 and 0.1447 for the count-weighted and self-weighted estimates, respectively (Fig. 4). Ratio estimates calculated for each lagoon varied between 0.059 and 0.177 (Table 2).

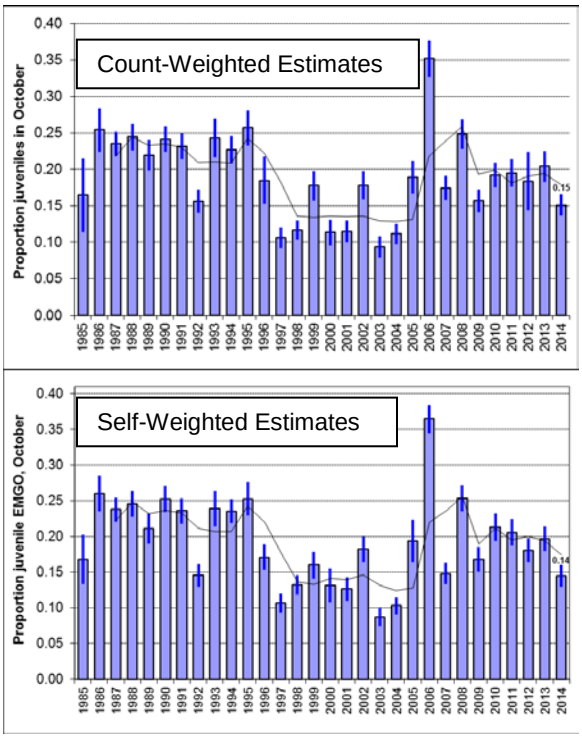

Figure 4. Estimates and standard errors of the proportion of juveniles for each year, 1985-2014.

CONCLUSION

Both the count-weighted and self-weighted estimates were lower in 2014 compared to 2013 and were lower than the previous 29 year mean of 0.192 (Fig. 4) and below the Pacific Flyway goal of 0.20 (Pacific Flyway Council 2006). Although the count-weighted and self-weighted estimates are similar, we favor the count-weighted estimator when fall count data are available because the proportion of total birds classified from photographs was not guaranteed to be in proportion to abundance of geese in each lagoon (Fig. 5). For example, at 5 of 7 lagoons, we photographed a higher proportion of birds than were counted at those locations during the fall survey. Survey timing was conducive to confidently distinguish between juvenile and adult head plumage.

Nonetheless, annual estimates from the two methods are nearly identical; indicating that unless photographic sampling of geese among lagoons is grossly disproportionate to the actual distribution of geese, then either estimator reliably tracks annual production of emperor geese.

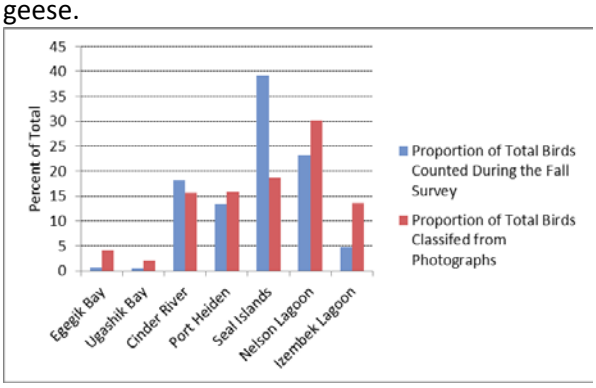

Figure 5. Proportions of birds counted during the fall survey and those classified from photographs in each stratum, 2014

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The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

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Table 1. Survey timing, sample size, and average proportion of juvenile Emperor geese counted in photographs, 1985-2014, Alaska Peninsula.

Year	Dates of photographs	Pilot	Photographer	No. of Photos (n)	Mean DOY of Survey	Mean DOY of hatch	Avg. age (days) of young	Total Juveniles	Total geese Classified	Count-weighted Estimate	*SE*	Self-weighted Estimate	*SE*
1985	24 Sep, 2,3,6,10 Oct	W.I. Butler, Jr.	M.R. Petersen	155	277.4	182.2	95.2	536	3,193	0.1646	*0.0258*	0.1679	*0.0175*
1986	30 Sep, 1,2,4,5,11,13,15 Oct	W.I. Butler, Jr.	M.R. Petersen	311	278.3	177.8	100.5	1,659	6,380	0.2538	*0.0151*	0.2600	*0.0126*
1987	16,24,26 Sep, 6,7,8,10 Oct	W.I. Butler, Jr.	M.R. Petersen	703	273.8	178.8	95.1	2,417	10,177	0.2350	*0.0084*	0.2375	*0.0084*
1988	7,21,25,26,27,30 Sep, 3 Oct	W.I. Butler, Jr.	M.R. Petersen	483	269.2	173.8	95.3	2,747	11,180	0.2443	*0.0092*	0.2457	*0.0095*
1989	23,25,28 Sep, 3 Oct	W.I. Butler, Jr.	M.R. Petersen	390	269.3	181.0	88.3	2,684	12,718	0.2190	*0.0105*	0.2110	*0.0107*
1990	28,29,30 Sep, 2,4 Oct	W.I. Butler, Jr.	M.R. Petersen	474	272.7	172.0	100.8	3,418	13,541	0.2410	*0.0089*	0.2524	*0.0094*
1991	28, 29 Sep, 1,3,4 Oct	W.I. Butler, Jr.	M.R. Petersen	412	272.6	170.7	101.8	3,433	14,569	0.2315	*0.0090*	0.2356	*0.0093*
1992	26,27,30 Sep, 3,4 Oct	W.I. Butler, Jr.	M.R. Petersen	403	273.6	180.5	93.0	2,154	14,832	0.1560	*0.0082*	0.1452	*0.0079*
1993	1, 2, 3 Oct	W.I. Butler, Jr.	G.R. Balogh	255	274.9	172.5	102.4	1,372	5,735	0.2425	*0.0135*	0.2392	*0.0128*
1994	26 Sep	W.W. Larned	G.R. Balogh	479	270.5	170.0	100.5	3,974	16,881	0.2266	*0.0096*	0.2354	*0.0086*
1995	26-29 Sep	W.W. Larned	G.R. Balogh	361	269.0	169.2	99.8	2,947	11,664	0.2566	*0.0122*	0.2527	*0.0119*
1996	23, 25, 26 Sep	W.W. Larned	T.J. Tiplady	182	268.1	167.7	100.4	1,847	10,793	0.1848	*0.0165*	0.1711	*0.0089*
1997	30 Sep,1 Oct	W.W. Larned	T.J. Tiplady	205	273.0	165.9	107.2	1,183	11,138	0.1066	*0.0072*	0.1062	*0.0068*
1998	29 Sep,1 Oct	W.W. Larned	T.J. Tiplady	336	272.2	175.0	97.2	2,185	16,544	0.1171	*0.0067*	0.1321	*0.0069*
1999	28 Sep,1 Oct	W.W. Larned	T.J. Tiplady	392	272.1	178.1	94.1	2,155	13,489	0.1777	*0.0103*	0.1598	*0.0095*
2000	25, 28, 29 Sep	W.W. Larned	P.A. Anderson	263	272.4	175.0	97.4	1,016	7,748	0.1136	*0.0089*	0.1311	*0.0123*
2001	26 Sep, 1 Oct	W.W. Larned	P.A. Anderson	365	270.8	177.6	93.2	1,410	11,186	0.1150	*0.0077*	0.1261	*0.0085*
2002	1, 2, 4 Oct	W.W. Larned	P.A. Anderson	402	275.4	168.6	106.8	1,174	6,458	0.1784	*0.0096*	0.1818	*0.0090*
2003	24-25, 27 Sep	W.W. Larned	P.A. Anderson	421	268.1	165.9	102.2	760	8,686	0.0940	*0.0075*	0.0875	*0.0065*
2004	4, 6 Oct	W.W. Larned	P.A. Anderson	370	278.3	163.9	114.4	642	6,237	0.1118	*0.0070*	0.1029	*0.0063*
2005	2, 3, 6 Oct	W.W. Larned	P.A. Anderson	500	275.7	168.2	107.5	1,274	6,563	0.1889	*0.0115*	0.1941	*0.0152*
2006	28, 29 Sep, 2, 3 Oct	K.S. Bollinger	C.P. Dau	469	272.5	175.2	97.3	3,561	9,773	0.3516	*0.0127*	0.3644	*0.0102*
2007	27, 29 Sep, 2, 3 Oct	W.W. Larned	P.A. Anderson	398	272.6	169.8	102.9	1,796	12,134	0.1744	*0.0083*	0.1480	*0.0077*
2008	27,28, 29 Sep	W.W. Larned	P.A. Anderson	625	270.5	173.1	97.4	2,587	10,207	0.2484	*0.0103*	0.2535	*0.0095*
2009	2, 3, 4, 6, 8 Oct	W.W. Larned	H.M. Wilson	607	275.9	174.6	101.3	2,081	12,404	0.1571	*0.0079*	0.1678	*0.0086*
2010	25, 26 Sep	W.W. Larned	H.M. Wilson	436	268.8	171.4	97.4	4,439	20,876	0.1921	*0.0087*	0.2126	*0.0098*
2011	27, 28, 29 Sep	W.W. Larned	H.M. Wilson	441	270.8	171.5	99.3	3,996	19,432	0.1951	*0.0097*	0.2056	*0.0097*
2012	28, 29 Sep	W.W. Larned	H.M. Wilson	378	272.3	182.3	90.0	2,367	13,109	0.1840	*0.0205*	0.1806	*0.0086*
2013	20 Oct	H.M. Wilson	C.P. Dau	224	293.0	180.7	112.3	2,216	11,269	0.2040	*0.0107*	0.1966	*0.0089*
2014	26-28 Sep, 4 Oct	B.S. Shults	W.W. Larned	570	270.8	166.0	104.8	2,839	19,619	0.1509	*0.0075*	0.1447	*0.0080*

Table 2. Estimates of the proportion of juveniles (i.e., ∑ juveniles/∑adults) at each staging area along the Alaska Peninsula, 1985-2014.

	Egegik	Ugashik	Cinder River	Port Heiden	Seal Islands	Nelson Lagoon[1]	Izembek[2]
YEAR							
1985	0.0000	0.0000	0.0868	0.2179	0.2354	0.1528	0.1747
1986	0.1740	0.2684	0.2772	0.1563	0.1642	0.3371	0.3175
1987	0.0000	0.0459	0.2506	0.1952	0.2204	0.2607	0.2303
1988	0.2530	0.1667	0.2734	0.2387	0.1982	0.2538	0.2319
1989	0.0000	0.0925	0.1959	0.1909	0.1295	0.2822	0.2215
1990	0.1556	0.1708	0.3393	0.2237	0.2322	0.2468	0.1659
1991	0.1988	0.1056	0.3018	0.2373	0.2070	0.2246	0.2135
1992	0.0761	0.0885	0.1805	0.1222	0.0686	0.1765	0.2331
1993	0.0940	0.2109	0.2306	0.1709	0.1481	0.2958	0.2977
1994	0.2364	0.1923	0.2351	0.2480	0.2614	0.2195	0.1661
1995	0.2556	0.1278	0.2895	0.2348	0.2165	0.2562	0.2592
1996	0.2695	0.0000	0.1497	0.1649	0.1774	0.2255	0.1557
1997	0.1479	0.0368	0.1034	0.1422	0.1021	0.0915	0.0826
1998	0.1918	0.0000	0.1411	0.1138	0.1505	0.0665	0.1030
1999	0.5544	0.0000	0.0705	0.1574	0.0931	0.2015	0.1704
2000	0.0945	0.0551	0.1893	0.1125	0.0873	0.0614	0.2542
2001	0.1787	0.1443	0.1493	0.0375	0.1128	0.1043	0.1429
2002	0.1889	0.2708	0.1761	0.1785	0.1917	0.1704	0.1722
2003	0.0667	0.0512	0.1205	0.0484	0.1359	0.0691	0.0507
2004	0.1250	0.1157	0.1017	0.0623	0.1481	0.1168	0.0814
2005	0.0909	0.1687	0.1201	0.1383	0.2336	0.1983	0.3784
2006	0.2595	0.4308	0.3702	0.2973	0.3000	0.3917	0.3767
2007	0.2165	0.0956	0.1641	0.0843	0.2504	0.1568	0.2429
2008	0.2544	0.2237	0.3155	0.3026	0.2074	0.2442	0.2667
2009	0.2971	0.0739	0.2378	0.1371	0.1335	0.1268	0.1717
2010	0.2973	0.0609	0.2506	0.1996	0.1385	0.2070	0.1632
2011	0.2602	0.1692	0.2292	0.1908	0.1844	0.1922	0.1208
2012	0.1848	0.2372	0.1354	0.2307	0.1799	0.1896	0.1833
2013	0.0000	0.0000	0.0996	0.2154	0.1864	0.2539	0.0937
2014	0.1589	0.0587	0.1772	0.0765	0.1688	0.1408	0.1709
Mean	**0.176**	**0.122**	**0.199**	**0.171**	**0.175**	**0.197**	**0.196**
SD	*0.116*	*0.101*	*0.081*	*0.069*	*0.056*	*0.080*	*0.082*
SE	*0.021*	*0.018*	*0.015*	*0.013*	*0.010*	*0.015*	*0.015*

[1] Nelson Lagoon includes geese counted at Port Moller.
[2] Izembek estimate includes geese counted at Izembek Lagoon, Morzhovoi Bay, Bechevin Bay, and Cold Bay