Monitoring Emperor geese by age ratio and survey counts, 1985-2013

Robert A. Stehn and Heather M. Wilson

USFWS, Migratory Bird Management, 1011 E. Tudor Road, Anchorage, AK 99503

27 January, 2014

Abstract

During fall migration, most Emperor geese (*Chen canagica)* forage and roost along the shorelines of seven marine estuarine lagoons on the north side of the Alaska Peninsula. For 29 consecutive years, 1985 to 2013, we flew an aerial survey to count all geese observed thereby indexing October population sizes, and we flew a second aerial survey to sample flocks with aerial photographs to estimate the annual proportions of hatching-year birds. Age classification of hatching-year (HY) vs. after hatch-year (AHY) geese was based on the gray head and neck plumage evident on juvenile geese. In 2013, we categorized 2,216 HY birds out of 11,269 Emperor geese aged in 224 photographs giving a self-weighted ratio estimate of the proportion juveniles as 0.197 (SE = 0.009). The lagoon-stratified, count-weighted proportion of young was 0.204 (SE = 0.011), nearly matching the average proportion across all 29 years of 0.192. From 1979 to 2013, the population index of fall-staging Emperor geese has been relatively stationary with approximately 75,000 geese.

Objectives

The primary objective of this monitoring study is to provide an annual estimate of the proportion of juvenile (hatching-year, HY) Emperor geese in the fall staging population. These data provided an index to annual production, defined here as the number of hatched young that survive until October, expressed as a proportion of the total birds. The Emperor Goose Management Plan (Pacific Flyway Council 2006) states a goal of maintaining at least 20% young. In combination with a similar-timed aerial population survey, these data also address the management objectives of estimating trend in population size, production, and average annual survival rate. Documenting the geographic distribution of Emperor geese and associated bird species is also valuable for assessment of possible impacts from development or environmental change affecting waterbird habitats along Bristol Bay.

Methods

Age ratio

Shoreline-based observers with spotting scopes have collected fall age ratio and family group data at Izembek Lagoon since 1966 (Izembek National Wildlife Refuge, unpubl. data, Pacific Flyway Council 2006). In 1976 and 1977, field studies of Emperor geese at Cape Peirce and Nelson Lagoon included additional ground observations of flocks and, in 1978 and 1979, the first aerial photographic sampling for age ratio (Petersen and Gill 1982). Initial population counts of Emperor geese along the Alaska Peninsula were made in spring 1963 (King 1963) and fall 1968 (McKnight 1970-73). These early studies provided the basis for the standardized fall survey that USFWS has flown 1979-2013. Summaries of the fall survey counts by segment have been presented in annual reports (Dau and Wilson 2013, Mallek and

Dau 2011). The age ratio photo survey has been flown for 29 years, 1985-2013. Methods and prior results have been reported (Butler et al. 1995, Anderson et al. 2005, Dau et al. 2006).

Young Emperor geese retain entirely gray juvenile plumage on their head and neck that contrasts with the pure white head plumage of adult geese. By mid-October, juveniles begin to acquire some white plumage and the use of aerial photographic classification becomes less reliable. Scattered gray feathers remain for several more months along with grayish coloration of the bill and feet of juveniles, therefore age classification by ground observers using spotting scopes remains accurate.

We flew the aerial photographic survey near 1 October each year when hatching-year geese average about 100 days of age. The aircraft was flown at approximately 500-1000 ft AGL to locate geese. Once found, we typically descended to 300-400 feet AGL to photograph flocks. A right-seat or rear-seat photographer took aerial photographs through the aircraft's window with a hand-held 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. Panning the camera (i.e., following the moving birds and photographing while moving the lens at roughly the same rate as the birds and keeping the birds centered in the viewfinder while shooting) substantially reduced the blur caused by the moving aircraft and flying geese. Looking forward and capturing the birds in the viewfinder before they are below the plane is critical. This requires alertness by the photographer to anticipate the movement of the flock and get positioned for panning, while the plane is often in a tight turn with relatively strong G pressures.

Specific flight techniques varied somewhat among pilots and aircraft. In general, the pilot spotted groups of Emperor geese loafing or flushing on sandbars well ahead of the aircraft and then positioned the aircraft to arc around the flying flock while attempting to provide the best possible distance, angle, and light for the photographer. Aircraft maneuvering decisions were made when a flock was first spotted and verbally coordinated with the photographer to maximize photographic opportunities. Because Emperor geese roost and forage along lagoon shorelines, the plane was often positioned in a sustained semi-slip to provide the photographer extended opportunity to photograph linear sequences of multiple flocks along barrier islands and spits. The quality of oblique photos substantially improved with proper panning technique and aircraft positioning relative to the flock. Ideal placement of the aircraft would result in tilt, reducing the angle between the camera lens and the plexiglass aircraft window. The ideal angle in this configuration being the camera lens flat against the window, with the aircraft window tilted down towards the birds below. Wind direction and speed usually compromised the pilot's ability to maintain ideal aircraft position and limited any sustained opportunity for photographing flocks. Because the objective was simply to photograph a representative sample of Emperor flocks, missed flocks or less-than-ideal complete images were not a serious problem. The photographic survey can be flown in higher winds than the count survey because detection rate is not as critical and wind disturbance does not appreciably affect the photography of flying birds. However, with higher winds, maneuvering of the aircraft becomes more difficult and flocks fly at significant speed once downwind.

The photographic survey can largely be accomplished on one flight along the Alaska Peninsula. Flying southwest from King Salmon to Cold Bay is preferable with the plane slightly offshore and the left side pilot and photographer scanning the outer edge of the coast and maneuvering inland as needed. Typically, we took most photos on a single flight down the Peninsula, and added photos on the return trip up the Peninsula filling in areas that needed better coverage or that had poor quality photos on the original pass. More photos were taken where birds were more abundant rather than a set number of photos per lagoon. The number of birds per photograph ranged from a few to several hundred.

From 2006-2008, we used a Canon 20D digital camera with a 135mm lens, and since 2009, we used a Canon 5D camera with an image-stabilized 70-200 mm lens. The LCD display allowed for a rapid but crude assessment of image quality. Recent images are 5616 x 3744 pixels and 5-12 megabytes (depending on zoom) in JPG format. This digital equipment replaced earlier Nikon and Canon SLR film cameras using Ektachrome 200 slide film and 105mm or 135mm fixed lenses. The photographer typically records the following variables in a field notebook during the survey: Date, Time, Photo# Start, Photo # End, Location, Notes (e.g., 9/27/11, 16:25 4927-4970, Egegik). Typical camera settings for a Canon 20D or 5D were:

- Set camera to take the highest quality JPG image (TIF or RAW are not needed)
- Set the AF mode to A1 Servo.
- Set the drive mode to Continuous Shooting (4-5 shots/second).
- Set the focus on lens to autofocus. The airplane window does not seem to affect focus.
- Set the ISO to 800. On a bright day, you might try ISO 400 to improve quality
- Set the mode to shutter priority (TV), and adjust shutter speed to 1250. This should give you a good balance between shutter speed and depth of field. On a bright day, try 1600-2000.
- Set the metering mode to Evaluative Metering.
- Use the Canon 70-200mm image-stabilized lens The zoom varied but often good results were obtained at about 135mm focal length with birds 300-500 feet away.

Even with wide variation in distance, angle, lighting, and focus, we were able to use nearly all the photographs taken. Smooth water, dark sand, or vegetation provided contrasting backgrounds making head plumage easier to classify. Whitecaps, surf, and sun glare on water or wet sand were poor backgrounds. With direct sunlight from behind the photographer, the grey heads of juveniles also have high reflectance and they appear very light colored causing juveniles to become harder to distinguish from adults. Overcast conditions result in clearer distinction of head plumage. The heads of geese are less visible when they are flying directly away from the aircraft at nearly the same altitude. Oblique angle shots from above the flocks provided the most useable photos. Any obvious duplicate images of the same birds were not used. In response to the approaching survey aircraft, nearly all geese take flight. Because family groups tend to fly less readily, family groups were often located on the periphery of flocks. Rarely were flocks photographed while still standing on the beach, and non-flying geese were more difficult to age due to mixed orientation, backgrounds, and postures. Selecting representative flocks or portions of flocks to photograph, including small and large flocks and leading, central, and trailing edges of flocks, was an important consideration.

We viewed digital images on a computer 23-inch LCD screen with 1920x1080 pixels. Each bird was classified by age and tallied with a mechanical counter. Viewed using Microsoft Office Picture Manager at 43-100% zoom each photo was subdivided into 4 to 20 panels. With the 35mm color slide film used in earlier years, images were projected on a wall and counted. We skipped any photographs or portions of photographs with birds too distant or excessively blurred. Individual birds with the head hidden beneath wings of other birds were also skipped.

The estimated mean proportion of juveniles per total Emperor geese was calculated as a ratio estimate with each photo considered an independent sample unit within each lagoon stratum. The variance calculations followed cluster-sampling for proportions (Cochran 1963), with no reduction of variance by a finite population correction factor. For each of the seven lagoons (regional strata), the mean ratio of juveniles was calculated from all photos in the region. The seven strata were weighted by the proportion of the total fall population observed in that region from the similarly timed, independent aerial survey count. Variances of the mean age ratio per stratum were weighted in proportion to population counts squared. In addition to this count-weighted stratified estimate, we also calculated a self-weighted proportion of juveniles in the fall population. The self-weighted estimate was appropriate when the sampling intensity (total number of birds in photographs) was proportional to the population size within each region, in other words, more birds were photographed where more birds were present. We preferred the count-weighted method because it used more information and gave a design-based estimate not dependant on the untested assumption of proportionate sampling. Nevertheless, the count-weighted estimate is dependant on the assumption that the population survey counts are timely and accurate. This year, with the age ratio survey occurring 21 days after the count survey, the self-weighted estimate is probably a better choice.

Population index

Aerial surveys of the fall staging population of Emperor geese were flown annually from 1979 to 2013 covering all shorelines and lagoons between King Salmon and Cold Bay, Alaska (Dau and Wilson 2013). Various single-engine, float-equipped USFWS aircraft (Cessna 185, Cessna 206, turbine Beaver, and turbine Quest Kodiak) were flown at a ground speed of approximately 175 km/hr (95 knots) and an altitude of 45m (150 feet). Both left and right seat observers counted birds and voice recorded data into tape recorders or laptop computers. Additional segments along Kuskokwim Bay and the north side of Bristol Bay, and segments along the south side of the Alaska Peninsula, have been flown when time and weather conditions allowed. The maximum survey area included 143 shoreline segments. When segments were not flown, we substituted the average of counts from three prior years with data for that region (Table 1). Coastline segments were usually flown ~100 meters offshore with deviations made to confirm species identification and numbers in flocks seen within 1.6 km (1 mile) of shorelines. For circling and crossing the larger lagoons, we used a meandering flight path. The track of the aircraft was monitored on a computer with a moving map program to help prevent duplication and ensure complete coverage. Whenever possible, flights were conducted with <20 knots of wind and at or near high tide as this concentrated Emperor geese near shorelines.

Results and Discussion

As recorded on fall aerial surveys flown annually for 35 years 1979 to 2013, the number of Emperor geese in the seven lagoon regions along the northern Alaska Peninsula has varied among years (Fig. 1, Table 1). The Port Moller/Nelson Lagoon region held the largest average population at 24,493 geese. This region was followed by Seal Islands, Cinder River, and Port Heiden regions each averaging 10,000-14,000 geese. The northernmost regions around Egegik and Ugashik averaged about 1,000 each and the southernmost Izembek Lagoon averaged about 6,000 geese. The total population in the seven lagoon regions sampled for age ratio averaged 70,202 (SD = 11,115) and was 94% of the total population index of 74,696 (SD = 10,745) (Table 1). The actual population is certainly larger than the indexed number because the flocks seen are typically under-estimated, not all geese present in the lagoons can be detected, and some geese may have already moved to wintering areas beyond the boundaries of the fall staging area surveyed. The total population index growth rate (GR) from 1979 to 2013 in all regions was 1.000 (90% c.i. = 0.996-1.004, n = 35 years).

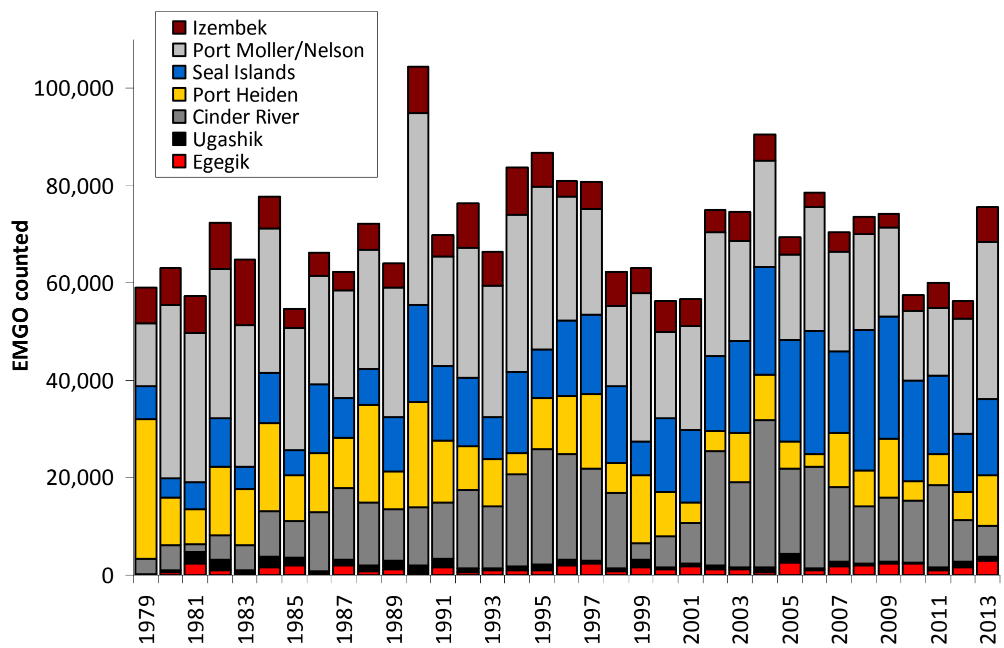

Figure 1. The number of Emperor Geese counted in each of the 7 lagoon regions in each year of the fall aerial survey, 1979-2013.

In 2013, we took 240 photos of Emperor geese. Eight photos were discarded as duplicates shots of the same birds, and another eight were unusable. The remaining 224 photos had 2,216 juveniles (HY) and 9,053 adults (AHY) totaling 11,269 geese classified to age (Table 2). The self-weighted ratio estimate of the proportion of HY birds was 0.197 (SE = 0.010). The stratified count-weighted proportion of juveniles was 0.204 (SE = 0.010) (Fig. 2, Table 2).

Spring warming and breakup was late on the YKD in 2013. Break-up of ice on the Kuskokwim River at Bethel was 30 May, the second latest year since 1960. The latest breakup was on 3 June 1964. Estimated average hatch date for Emperor geese was 180.7 (June 30), 7 days later than the 1985-2013 average date. An index to Emperor nest success was 10th highest among 29 years. Fox or vole sign on plots searched for nests in 2013 was moderate, ranking 16th and 17th below highest activity, respectively, out of 26 years (data J. Fischer, USFWS, MBM, Anchorage). A storm-driven flood tide occurred just a few days before peak hatch that destroyed many nests, eggs, and goslings in the Manokinak area (J. Schmutz, pers. comm.). Despite the late spring and the flood event, production of young Emperor geese was average in 2013.

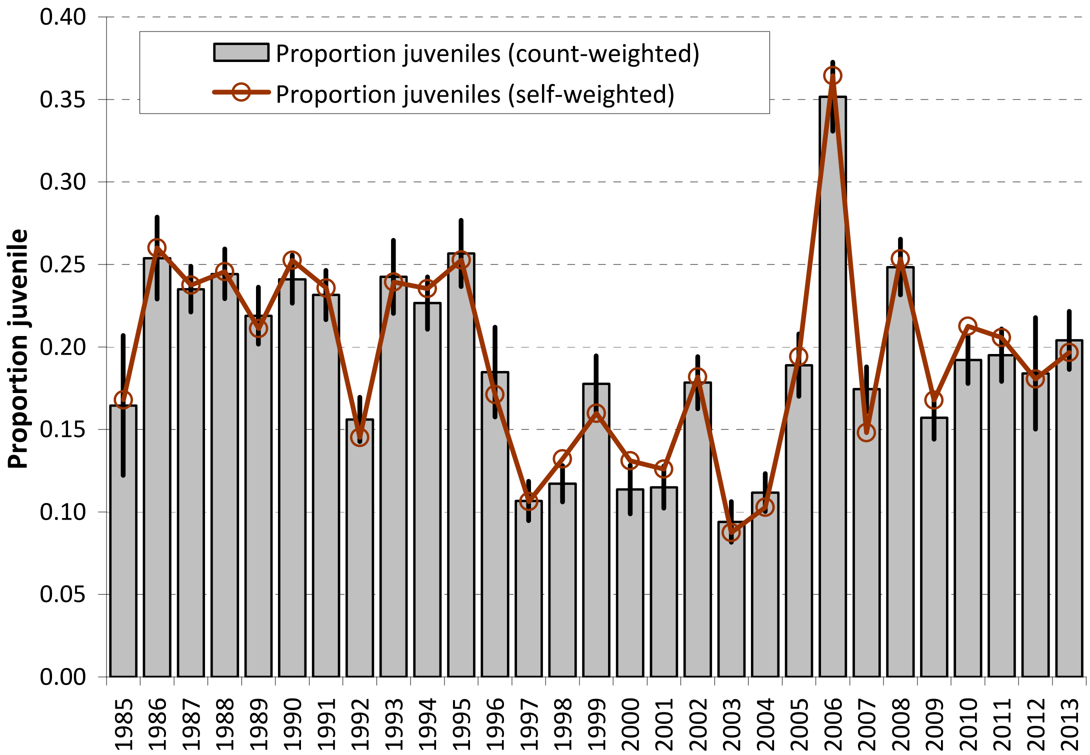

Figure 2. The counted-weighted and self-weighted proportions of juveniles in the October population of Emperor geese based on photographic samples of flocks in seven lagoon regions of the Alaska Peninsula, 1985-2013. Vertical lines at the top of each column indicate a 90% confidence interval around the annual counted-weighted mean proportion.

In spite of problems of accidently incorrect camera settings that caused considerable blur in most of the images (see Fig. 3), and the government furlough that delayed the survey until 20 October (resulting in some HY birds showing partial white head plumage, see Fig. 3), we believe we obtained reliable data. The photographic sampling techniques appeared to be relatively robust even against such problems.

Figure 3. Enlarged portions of photographs showing two problems encountered during the 2013 photographic sampling of Emperor goose flocks to determine October age ratio. The left picture has 13 adults and 4 juveniles, adequately age-classified even though blurred. The right photo has 3 adults and 5 young, identifiable even with partially molted head plumage.

The average count-weighted proportion of juvenile Emperor geese across all 29 years was 0.192 (SD = 0.0582). The average within-year estimate of sampling error of 0.0108 was considerably smaller, only 19% of the estimated between year variation. Given this consistently low sampling error in the annual estimates of proportion juveniles, we considered the differences among years in the age ratio an accurate indication of actual change in the year-specific production of young. The count-weighted proportions of juveniles have ranged from a minimum of 0.094 in 2003 to a maximum of 0.352 in 2006. The age ratio calculated by the two weighting methods showed less than a 0.010 difference in 17 of 29 years. The largest differences between methods were 0.026 in 2007 and -0.021 in 2010. The average difference between weighting methods was -0.0013 (SD = 0.0109).

Instead of following a smooth distribution around a central mean of 0.192, the distribution of the annual estimates of juvenile production tended to be within four ranges of 0.10 to 0.12 (poor), 0.16 to 0.20 (medium), 0.23 to 0.26 (good), with one year having a 0.35 (exceptional) proportion of young in the fall age ratio (Fig. 2).

In addition to our aerial photographic age-ratio survey, refuge personnel conducted ground-based observations of Emperor geese near Izembek NWR throughout the period of fall migration. The accumulated ground-based Izembek age ratio data appeared comparable to the aerial photographic sample that represent only a few days of survey observations but with wide geographic coverage. For the 29 years when both data were available, the simple correlation between the two measures was r = 0.591 documenting significant agreement. On average, there was a difference of 0.017 more juveniles (SD = 0.056) from the Izembek ground counts compared to the count-weighted photo samples. In 16 of 29 years, the difference was less than ± 0.04. In 6 of 29 years, Izembek ground data showed a greater proportion juveniles by 0.09-0.11 and in 2 years, a smaller proportion by 0.08 and 0.11. In 2013, the age ratio from ground-based observations at Izembek was 0.213 (370 juveniles out of 1736 birds aged) compared to 0.204 in the photo sample.

The strong cohort of young produced in 2006 was a remarkable change from a pattern of medium to low age ratios recorded since 1985 (Fig. 2) and was reflected in our aerial photographic survey as well as ground-based observations at Izembek Lagoon (Unpubl. USFWS data). Historic data (Pacific Flyway Council 2006) collected by ground observers at Izembek Lagoon included age ratios above 30% juveniles in 7 of 18 years between 1966 and 1984, before the current Alaska Peninsula photographic sampling began. Since 1985, the age ratio estimate at Izembek been was above 30% juveniles in only 2 of 29 years (1987 at 34%, 2006 at 38%).

Another noticeable deviation in the distribution of fall age ratios was that the lowest six age ratios occurred from 1997 to 2004 (Fig. 2). In the 9 years since this period of poor production, the fall age ratio has been between 0.16 and 0.20, all in the medium range except for highs in 2006 at 0.35 and 2008 at 0.25.

We looked for correlations between the annual proportion of juveniles in the fall population and a variety of other population and environmental variables. Correlations between fall age ratio and survey timing, sample size, or various population count variables were all non-significant ($r < 0.397$, prob > 0.05, df = 27). Typical indices thought to relate to waterfowl productivity such as indicated nest success and clutch size measured during mid-incubation (Fischer and Stehn 2013), showed no relationship to the production of young as measured by fall age ratio. Similarly, the estimated number of nests and total number of eggs (Fischer and Stehn 2013) showed no correlation with the fall age ratio.

The 29-year average proportion of young in the October 1985-2013 population was 0.192. Therefore, if the population is closed, stationary, and stable, the average annual survival rate balancing production without loss or gain in population size would be 0.808 (Skalski et al. 2005). This average survival rate applies to the combined age classes of geese from October to October. The overall growth rate from 1985 to 2013 based on the averaged fall and spring count indices was 1.000 showing the population to be stationary, although with annual cohorts of unequal size, it is not stable. The degree to which deviation from stability may bias the average survival rate has not been demonstrated.

Acknowledgments

The photographic sampling surveys were flown by pilots W.I. Butler, Jr. (1985-1993) and W.W. Larned (1994-2005, 2007-2012) and the fall population count surveys were flown by R.J. King (1981-1998) and E.J. Mallek (1999-2012). The skill and dedication of these four FWS pilots, plus three other pilots that have flown occasionally, is truly remarkable.

Numerous observers, photographers and other biologists have provided their expertise in collecting additional aerial and ground observations. The staffs of the Alaska Peninsula/Becharof and Izembek National Wildlife Refuges have provided essential logistic support. The participation by all project personnel and cooperators is much appreciated.

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

Literature Cited

Anderson, P.D., W.W. Larned, E.J. Mallek, C.P. Dau and R.A. Stehn. 2005. Monitoring Emperor Goose Populations by Aerial Counts and Fall Age Ratio-Fall 2004. Unpubl. report, USFWS, MBM, Anchorage, 5pp.

Butler, W.I., R.A. Stehn, R.J. King, M.R. Petersen, and C.P. Dau. 1995. Monitoring Emperor goose populations by aerial survey counts and fall age ratio. Unpubl. report, U.S. Fish and Wildl. Serv., Anchorage, AK. 28pp.

Dau, C.P., K.S. Bollinger, E.J. Mallek, and R.A. Stehn. 2006. Monitoring the Emperor goose population by aerial counts and fall age ratio - Fall 2006. Unpubl. report, USFWS, MBM, Anchorage, AK. Dec 2006. 10pp.

Dau, C.P., and H.M. Wilson. 2013. Aerial survey of Emperor geese and other waterbirds in southwestern Alaska, Fall 2013. Unpubl. report, USFWS, MBM, Anchorage. 12pp.

Fischer, J.B. and R.A. Stehn. 2013. Nest population size and potential production of geese and spectacled eiders on the Yukon-Kuskokwim Delta, Alaska, 1985-2012. Unpubl. Report, USFWS, MBM, Anchorage, AK. 46pp.

King, J.G. 1963. Refuge narrative report, Jan-Apr 1963. Clarence Rhode NWR, Bethel AK.

Kirby, R.E., T.W. Barry, R.H. Kerbes, and H.H. Obrecht, III. 1986. Population dynamics of North American light bellied brent geese as determined by productivity and harvest surveys. Wildfowl 36:49-52.

Lynch, J.J., and J.R. Singleton. 1964. Winter appraisals of annual productivity in geese and other water birds. Wildfowl Trust Annual. Rept. 15:114-126.

Ogilvie, M.A. 1978. Wild Geese. Buteo Books, Vermillion, South Dakota. 350pp.

Owen, M. 1980. Wild geese of the world. B.T. Batsford, Ltd., London. 236pp.

Mallek, E.J., and C.P. Dau. 2012. Aerial survey of Emperor geese and other waterbirds in southwestern Alaska, Fall 2011. Unpubl. report, USFWS, MBM, Fairbanks. 14pp.

McKnight, D.E. 1970-1973. Wildlife survey and inventory activities. Alaska Dept. Fish & Game reports to Federal Aid in Wildlife Restoration, Projects W-17-2, W-17-3, W-17-4, W-17-5.

Pacific Flyway Council. 2006. Pacific Flyway Management Plan of the Emperor Goose. Emperor Goose Subcommittee, Pacific Flyway Study Committee [c/o USFWS], Portland, OR. Unpubl. Rept. 24pp. + appendix.

Petersen, M.R. and R.E. Gill, Jr. 1982. Population and status of Emperor Geese along the north side of the Alaska Peninsula. Wildfowl 33:31-38.

Table 1. Population counts of Emperor geese observed along shoreline segments on the Alaska Peninsula aerial survey flown about the first week in October each year. Data recording methods, conditions, and results are described in annual reports (e.g. Dau and Wilson 2013). The shaded cells indicate when segments were not flown and the missing value was replaced by the average count of the closest 3 prior years in that region. If prior years were not available, the closest years were used.

Region #	North 8	Egegik 1	Ugashik 2	Cinder River 3	Port Heiden 4	Seal Islands / Ilnik 5	Port Moller / Nelson 6	Izembek 7	South-side 9	Sum regions 1-7	Sum of all regions
1979-91 segment #s		*8-10*	*11*	*12-14*	*15-16*	*17-18*	*19-22*	*23-29, 35-37*			
1992-11 segment #s	*10-34*	*35-37*	*38*	*39-43*	*44-45*	*46-49*	*50-55, 551,552 56-58*	*59-69, 80-85*	*86-137*		
1979	46	60	84	3,255	28,603	6,719	13,067	7,326	7,151	*59,114*	*66,311*
1980	8	588	322	5,284	9,695	4,064	35,481	7,649	7,151	*63,083*	*70,242*
1981	131	2,288	2,405	1,626	7,299	5,552	30,585	7,580	5,690	*57,335*	*63,156*
1982	0	1,056	2,063	5,000	14,097	9,980	30,684	9,580	8,148	*72,460*	*80,608*
1983	19	369	723	5,029	11,642	4,510	29,002	13,642	7,615	*64,917*	*72,551*
1984	0	1,641	2,223	9,351	17,923	10,378	29,689	6,546	5,091	*77,751*	*82,842*
1985	0	2,058	1,474	7,700	9,260	5,081	25,155	3,895	5,161	*54,623*	*59,784*
1986	0	65	693	12,112	12,263	13,960	22,282	4,770	1,288	*66,145*	*67,433*
1987	24	1,920	1,289	14,610	10,362	8,310	22,056	3,716	3,349	*62,263*	*65,636*
1988	12	816	1,188	12,844	20,116	7,440	24,400	5,438	3,911	*72,242*	*76,165*
1989	15	1,195	1,841	10,456	7,769	11,173	26,558	5,133	6,589	*64,125*	*70,729*
1990	3	89	1,833	11,910	21,677	19,990	39,420	9,439	5,133	*104,358*	*109,494*
1991	3	1,644	1,790	11,525	12,711	15,242	22,552	4,324	5,493	*69,788*	*75,284*
1992	41	636	688	16,112	9,108	14,116	26,581	9,119	5,299	*76,360*	*81,700*
1993	16	1,091	233	12,725	9,740	8,548	27,076	6,941	4,690	*66,354*	*71,060*
1994	0	1,002	730	19,046	4,352	16,565	32,376	9,684	2,488	*83,755*	*86,243*
1995	0	923	1,195	23,746	10,467	9,957	33,569	6,796	1,893	*86,653*	*88,546*
1996	14	1,915	1,325	21,529	12,042	15,471	25,536	3,162	3,024	*80,980*	*84,017*
1997	14	2,336	650	18,986	15,282	16,213	21,786	5,456	3,024	*80,709*	*83,746*
1998	14	796	620	15,540	6,213	15,603	16,474	6,966	5,159	*62,212*	*67,385*
1999	14	1,518	1,568	3,494	13,822	7,069	30,367	5,279	3,180	*63,117*	*66,311*
2000	9	1,171	384	6,473	9,146	14,967	17,754	6,303	5,419	*56,198*	*61,626*
2001	5	1,872	594	8,303	4,066	15,014	21,192	5,554	3,387	*56,595*	*59,987*
2002	67	1,214	700	23,483	4,173	15,307	25,505	4,599	3,644	*74,981*	*78,692*
2003	23	1,242	270	17,664	9,986	19,050	20,370	6,027	2,658	*74,609*	*77,290*
2004	8	631	867	30,349	9,263	22,095	22,013	5,308	2,814	*90,526*	*93,348*
2005	33	2,633	1,686	17,540	5,677	20,743	17,533	3,673	3,727	*69,485*	*73,245*
2006	33	951	536	20,798	2,664	25,088	25,510	3,067	3,066	*78,614*	*81,713*
2007	33	1,859	908	15,301	11,238	16,547	20,678	3,934	3,066	*70,465*	*73,564*
2008	0	1,890	398	11,841	7,436	28,766	19,713	3,555	4,602	*73,599*	*78,201*
2009	15	2,292	428	13,140	12,090	25,240	18,177	2,863	5,402	*74,230*	*79,647*

2010	8	2,302	224	12,844	3,848	20,834	14,256	3,196	4,577	*57,504*	*62,089*
2011	21	1,001	616	16,975	6,196	16,100	14,012	5,220	4,577	*60,120*	*64,718*
2012	12	1,600	1,220	8,539	5,689	12,032	23,563	3,552	4,577	*56,195*	*60,784*
2013	12	2,994	711	6,410	10,292	15,832	32,284	7,092	4,577	*75,615*	*80,204*
Average	19	1,362	985	12,901	10,463	14,102	24,493	5,897	4,475	*70,202*	*74,696*
Std Dev	25	750	627	6,636	5,438	6,243	6,330	2,377	1,624	*11,155*	*10,745*

Table 2. Survey timing, sample size, and average proportion juvenile Emperor geese in photographic samples of flocks on the AK Peninsula.

Year	Dates of photographs	Pilot	Photographer	N photos	Avg. DOY (day-of-year) of photos	Avg. DOY of hatch	Avg. age (days) of young	Juvenile	Total geese aged	Count-weighted prop. juveniles	*SE*	Self-weighted prop. juveniles	*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*

The ratio between the number of males and females in a society is referred to as the gender ratio. This ratio is not stable but instead shaped by biological, social, technological, cultural, and economic forces. And in turn the gender ratio itself has an impact on society, demography, and the economy. In this entry we provide an overview of the variation and the changes of the gender ratio across the world. Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years â€" Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2016. Surveillance Summaries / March 27, 2020 / 69(4);1â€"12. Related Pages.Â Description of System: The Autism and Developmental Disabilities Monitoring (ADDM) Network is an active surveillance program that provides estimates of the prevalence of ASD among children aged 8 years whose parents or guardians live in 11 ADDM Network sites in the United States (Arizona, Arkansas, Colorado, Georgia, Maryland, Minnesota, Missouri, New Jersey, North Carolina, Tennessee, and Wisconsin).