Aerial survey of wintering Pacific brant and other species at the Izembek Lagoon Complex and the Sanak Islands, Alaska, January 2017.

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ABSTRACT: This report presents results of the 21-24 January 2017 aerial survey of Pacific brant and other species wintering at the Izembek Complex and the Sanak Islands of Alaska. This survey serves as the Alaska component of the annual Mid-winter Survey for Pacific brant, as outlined in the Pacific Flyway Management Plan. Our estimate for 2017 is 44,899 brant, the fourth highest since the survey started in 1981. The estimate represents the sum of two components: 1) the average (39,471, CV= 0.10) of three replicate counts for Izembek Complex on 21, 23, and 24 January (37,814, 44,137, and 36,462) and 2) a single brant count of the Sanak Islands on 24 January (5,428). Counts of other species, including emperor geese and Steller's eiders are reported. The long-term growth rate of over-wintering brant in Alaska is 1.084 (SE= 0.005; 1981-2017), and currently, Alaska supports ~30% of the Mid-winter population of Pacific brant. The size of the brant population wintering in Alaska appears to have stabilized since 2011, averaging 45,591 birds (SE 0.03); with a growth rate of 1.016 (SE 0.01; 2011-2017).

Key words: Mid-winter survey, Pacific brant, Izembek Complex, Sanak Islands, Alaska.

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INTRODUCTION

Aerial surveys of wintering Pacific brant at the Izembek NWR including refuge coastlines and adjacent marine estuaries (hereafter Izembek Complex) have been conducted annually since the winter of 1980-1981 (Fig. 1, Tables 1-2). In 2010, the survey was expanded to include the Sanak Islands (hereafter Sanak; Figs. 2 and 3, Tables 1, 2 and Appendix 2). This survey serves as the Alaska component of the Pacific Flyway Mid-winter Survey (hereafter PF-MWS) for brant, and documents winter distribution, abundance, population trend, and habitat use by brant and other species. Results from the Alaska survey are combined with mid-winter surveys in British Columbia, Washington, Oregon, California and Mexico, and used by the Pacific Flyway Study committee to recommend changes to harvest strategy as specified in the management plan for Pacific brant (Pacific Flyway Council 2002).

In Alaska, eelgrass beds are the primary foraging areas for brant and occur from Moffet Bay to Bechevin Bay along the north side of the Alaska Peninsula (Bering Sea side), and in Kinzarof Lagoon and Morzhovoi Bay along the south (Pacific Ocean) side of the Alaska Peninsula. Brant also occur at Sanak, 80 km south of Cold Bay. Although

numbers there were not consistently documented prior to 2010 (Jones 1952, 1955; McKnight 1971; Dau and Chase 1995), it appears brant now regularly use this area, with numbers spiking during severe cold weather events. At Sanak, brant utilize eelgrass beds and other shallow intertidal habitats which often remain ice free.

METHODS

The 2017 Mid-winter Survey of Izembek Complex and Sanak was flown from 21-24 January by Migratory Bird Management (MBM) personnel using an amphibious Cessna 206 aircraft (N375F; see Figure in Acknowledgements). Survey ground speed was approximately 160 km/hr (100 mph) and altitude was 45m (150 feet) above sea level (ASL). Georeferenced observations made from both sides of the aircraft were voice recorded into panel-mounted computers for later transcription using custom software packages (RECORD, TRANSCRIBE; J. I. Hodges, USFWS-Migratory Bird Management, Juneau, AK).

Systematic flight paths provided coverage of all near shore and open water areas along shorelines and within estuaries (Fig. 3). For navigation, a combination of panel mounted computers and GPS units providing moving map displays, as well as paper topographic maps (scale 1:63,360) with delineated segment boundaries were used. The crew recorded survey conditions including ice cover, wind speed and direction, temperature, sky condition, visibility, and tide stage during the course of the survey.

The Izembek Complex includes shorelines and estuaries from Moffet Lagoon to Bechevin Bay, along the north (Bering Sea) side of the Alaska Peninsula, and Kinzarof Lagoon and Morzhovoi Bay on the south (Pacific Ocean) side of the Alaska Peninsula broken into a series of survey segments corresponding to distinct landscape features (e.g., lagoons, bays, Figs. 1 and 3). The Sanak Island group includes Sanak and Caton islands and surrounding islets with northern and southern segments in each island group (Figs. 2 and 3).

All of the Izembek Complex (Segments 60-65, 67-68, 80-81, and 84-85; Figs. 1 and 3) was flown on three repeated surveys on 21, 23, and 24 January, 2017, while the Sanak Islands (Segments *Sanak North*, *Sanak Sou*th, *Caton North*, *Caton South*; Figs. 2 and 3) were flown only on 24 January.

SURVEY CONDITIONS

Winter conditions in southwestern Alaska prior to our arrival in Cold Bay appeared consistent with historical, colder winters, with some ice cover and snow on the landscape. The mean temperature for Cold Bay in January 2017 was 26.4^{o}F, compared with a long-term average January temperature for Cold Bay (1950-2017) of 28.5^{o}F. Conditions were variable throughout our repeated surveys of the Izembek Complex, with temperatures ranging from 25-38 ^{o}F and visibility conditions ranging from clear to snowing with fog. Unlike the past 4 winters, we observed continuous lowland snow

cover and all fresh-water bodies frozen. Overall, we estimated ice cover at >50% in the northern estuaries (Bering Sea Lagoons) and 5-30% in the southern estuaries (Pacific Ocean side). There was <1% marine ice cover and ~50% fresh-water ice cover (including skim ice) at the Sanak Islands, and there was no lowland snow cover throughout the Sanak survey area. During surveys, tide levels were high in the Sanak and Caton islands on 24 January and high to mid-level in Bering and Pacific estuaries in the Izembek Complex on 21, 23, and 24 January.

Visibility was excellent in the Izembek Complex on our first survey, 21 January, with broken to overcast skies, relatively little sun glare, and southerly winds of 5 kts. Survey conditions on 23 January were good, with warm temperatures averaging 37^{o}F and 2,500 ft overcast skies, 3-15 kt winds out of the southeast, and light rain. The shore-fast ice in Bering Sea lagoons was significantly rearranged by a 60 kt storm on 22 January, ultimately breaking-up and dispersing some of the ice and presenting more open water. This led to brant flocks becoming much more scattered than on the first day of surveying (21 Jan.). The final survey on 24 January, began with a single survey of the Sanak Islands. Conditions at Sanak, were good, with 2000 ft broken skies, 20 miles visibility, 12 kts of southerly wind, and warm temps (37^{o}F). Later that day, conditions in the Izembek Complex improved to 2,500 ft. broken ceilings, <10 kts of westerly wind, and good visibility, with the exception of the final 30 minutes of the survey at Moffet and Kinzarof Lagoons, where mist, dim light, and light snow, began to diminish survey visibility conditions.

RESULTS

Pacific Brant

We estimated a combined total of 44,899 brant of which, 88% were in the Izembek Complex. We calculated totals of 37,814, 44,137, and 36,462 for the Izembek Complex from surveys conducted on the 21, 23, and 24 January (Appendix 1). We also observed 5,428 brant at Sanak on 24 January (Appendix 2), which we added to our Izembek Complex average (39,471, CV = 0.10) to calculate the Alaska Mid-winter total of 44,899. Marine ice averaged >50% at the Izembek Complex in 2017, moderately restricting the distribution of brant in the lagoon and leading to a larger proportion occurring in the deeper, more marine-influenced Bechevin and Morzhovi bays, Kinzarof Lagoon, and the Sanak Islands (42% in these areas in 2017 vs. an average of <13% in non-ice years). The long-term average of Alaska Mid-winter counts (Izembek Complex: 1981-2017 + Sanak: 2010-2017) is 18,566 $\pm$ 0.06 (SE), and the survey shows an increasing, long-term trend of 8.4% per year (Fig. 4, Table 3) in Alaska. Currently, Alaska supports ~30% of the Mid-winter population of Pacific brant (Fig. 5). The Alaska wintering population appears to have stabilized since 2011 averaging 45,591 birds (SE 0.03) with a growth rate of 1.5% per year. The combined Mid-winter index from Alaska to Mexico was approximately 140,000 brant in 2016, with no significant trend during the prior 10-year period (U.S. Fish and Wildlife Service 2016). The 2017 combined index will be reported later in the year.

Emperor Goose

We estimated a combined total of 7,502 emperor geese (Izembek Complex average [2,911, CV: 0.38] + Sanak [4,591]), with Sanak representing 60% of the combined total. The 2017 total for emperor geese represents the highest count on record (20% higher than the previous year, and 154% higher than the long-term average; Migratory Bird Management unpubl. data). Our repeated surveys of the Izembek Complex resulted in observed totals of 4,013, 1,175, and 2,945 emperor geese on 21, 23, and 24 January (Appendix 1), resulting in the Izembek average of 2,911 (CV: 0.38). In addition, we observed 4,591 emperor geese at the Sanak Islands on 24 January (Appendix 2). Izembek Complex winter counts of emperor geese have been highly variable throughout the history of the survey (1981-2017, range 542 – 7,502, CV: 0.53) likely due to variability in ice cover and habitat availability (long-term average 2,976 $\pm$ 270 [SE], trend 0.2%/year [R^2: 0.02], Migratory Bird Management unpubl. data). Even with moderate levels of ice present in Izembek Lagoon in 2017, emperor goose distribution appeared similar to low ice years. However, unlike brant, the winter range of emperor geese in Alaska spans from Kodiak through the Aleutian Islands; thus, inferences about population change from this survey are not necessarily reflective of the entire species.

Steller's Eider

We estimated a combined total of 12,725 Steller's eiders of which 76% were in the Izembek Complex. We observed totals of 10,953, 10,568, and 7,545 Steller's eiders in the Izembek Complex on 21, 23, and 24 January (CV= 0.19, Appendix 1), resulting in an Izembek Complex average of 9,689. In addition, 3,036 Steller's eiders were observed at the Sanak Islands on 24 January (Appendix 2). The 2017 average Mid-winter count (including Sanak: 2011-present) was 36% lower than the previous long-term average count from 1981-2016 (20,037). As with emperor geese, Mid-winter counts of Steller's eiders have been highly variable (current long-term average: 19,801 $\pm$ 1,840 [SE], trend 0.7%/yr [SE: 0.01, R^2: 0.02]). The winter range of Steller's eiders in Alaska spans from Cook Inlet through the Aleutian Islands; thus, inferences about population change from this survey are not necessarily reflective of the entire species.

DISCUSSION / RECOMMENDATIONS

Pacific Flyway Mid-winter Brant Survey

Winter counts of brant have been conducted at Izembek since 1981 (Table 1) and the Izembek brant index has been used as the Alaska component of the Pacific Flyway Mid-winter survey (PF-MWS) since the winter of 1985-1986. The survey was expanded in winter 2009-2010 to include the Sanak Islands (U.S. Fish and Wildlife Service 2011, Pacific Flyway Data Book). We continue to recommend the Alaska portion of the PF-MWS be calculated as the average of replicate counts from the Izembek Complex and a minimum single count at Sanak. Annual counts for both locations, as well as segments within locations, should also continue to be reported separately (e.g., Table 1, Fig. 4,

Appendix 1). Historical within-winter replicate counts conducted at Izembek had not been consistently reported prior to 2015. We report these counts and information about each historical survey in Tables 1 and 2. We continue to recommend that survey crews strive to complete within-winter replicate counts during January or early February to maintain consistency with the PF-MWS counts conducted elsewhere in the Pacific Flyway. However, we include historical counts conducted between 28 November and 31 March in our long-term record of annual estimates for the Alaska Mid-winter brant survey (Table 1), as monthly surveys at Izembek demonstrated consistent winter population counts during this period (i.e., spring migration effects did not appear to occur until mid-April or later).

Conditions at Izembek

Sea ice averaged 50% within the Izembek Complex survey area during the 2017 survey, and appeared to present moderate restriction to brant distribution in the area. Ice conditions can determine habitat accessibility during winter months and can severely restrict brant distribution (particularly in high ice years) to remaining open-water areas. These remaining open-water areas are typically the central Izembek Lagoon, Kinzarof Lagoon, lagoons in northern Bechevin and Morzhovi Bays, and the Sanak Islands (C. Dau pers. obs.). Unlike the past four winters (2013-2016), weather conditions along the Alaska Peninsula in winter 2017 were more like those of colder, historical winters, with snow covering most of the landscape and solid and shore-fast ice present in all lagoon areas. The average Cold Bay temperature in January 2017 was 26^{o}F, versus January averages of 32, 38, 31, and 33^{o}F, respectively over the past four winters (2013-2016). Despite, a 2017 January temperature closer to the long-term average (28.5^{o}F at Cold Bay 1950-2017; http://www.wrcc.dri.edu/), continued warming throughout the year on northern breeding and wintering grounds has likely been an important factor in increasing numbers of over-wintering brant at Izembek (Ward et al. 2009; Fig. 4). A long-term trend negative trend in ice conditions at Izembek Lagoon (Petrich et al. 2014) may signal improved access to high quality eel grass habitat. Whereas Alaska historically accounted for <5% of the winter brant population (in the 1980's and 90's), over-wintering brant at Izembek currently comprise the second largest geographic component of the 2005-2016 PF-MWS (~30%), with Mexico continuing to represent the largest portion (~60%), and the remaining birds (~10%) occurring in California, Oregon, Washington, and British Colombia (Fig. 5).

Sanak Islands

Brant counts at the Sanak Islands over the last 8 years (2010-2017) have averaged 4,770 $\pm$ 1,140 (SE), representing 11% of the overall Alaska winter count. 2017 presented an opportunity to anecdotally examine the hypothesis that larger proportions of wintering brant utilize Sanak when ice conditions restrict habitat use at Izembek. Ice conditions were variable throughout the window of our repeated surveys; ranging from an estimated 60% to 30% during cold, calm conditions, to a high-wind, blizzard storm event, and subsequent warming. Our qualitative observations produced an average estimate of 50% ice cover in the Izembek Complex during our surveys. More surveys of Sanak during moderate to high ice-years are needed to investigate the hypothesis that Sanak and other marine lagoons outside of Izembek, provide temporary refugia for

brant displaced from preferred foraging grounds in Izembek Lagoon. We found an average of 32% of brant utilized Izembek in 'high' ice years (when ice cover was >50%; Izembek/Sanak surveys 2010, 2012, and 2017), versus >88% when ice was reduced or absent at Izembek (2011, and 2013-2016). If Sanak and other nearby lagoons serve as an adequate refuge for brant temporarily displaced by ice at Izembek, brant may be able to avoid an 'ecological trap' caused by sudden, severe icing events in the Izembek Complex (Ward et al. 2009).

Increasing numbers of brant and considerations for habitat protection

It is unknown to what extent eelgrass habitats are being impacted by concentrated winter foraging in areas that are also heavily utilized during fall. Research on stability and use of Izembek area eelgrass may become increasingly important in light of milder winter conditions and increased grazing. We echo a concern raised by earlier survey crews (see Mallek and Dau 2009), that Morzhovi and Bechevin bays, and Kinzarof Lagoon provide essential, nearby open-water refugia for overwintering brant when ice restrictions limit available habitat in Izembek Lagoon. Some of these areas are state tidelands lacking any special designation or protection. In 2017, as in other high ice years, we observed a higher proportion of brant utilizing Morzhovi and Bechevin Bays and Kinzarof Lagoon, likely due to ice restrictions in preferred Izembek areas (e.g., Moffett, Applegate, and Normal Bay; which are portions of Izembek with high freshwater input and/or low tidal activity). Consistent with previous survey crews, we recommend the Alaska Department of Fish and Game consider State Critical Habitat or State Game Refuge designation for sites known to be especially important when severe ice conditions make other Izembek estuaries inaccessible, including: Kinzarof Lagoon; Big, Middle, and Little Lagoons in Morzhovoi Bay; and Hook Bay and St. Catherine's Cove in Bechevin Bay.

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

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The 2017 Izembek Mid-Winter survey crew; William "Bill" Larned (right-front observer) and Heather Wilson (left-front observer/pilot), with Amphibious Cessna-206 N375F.

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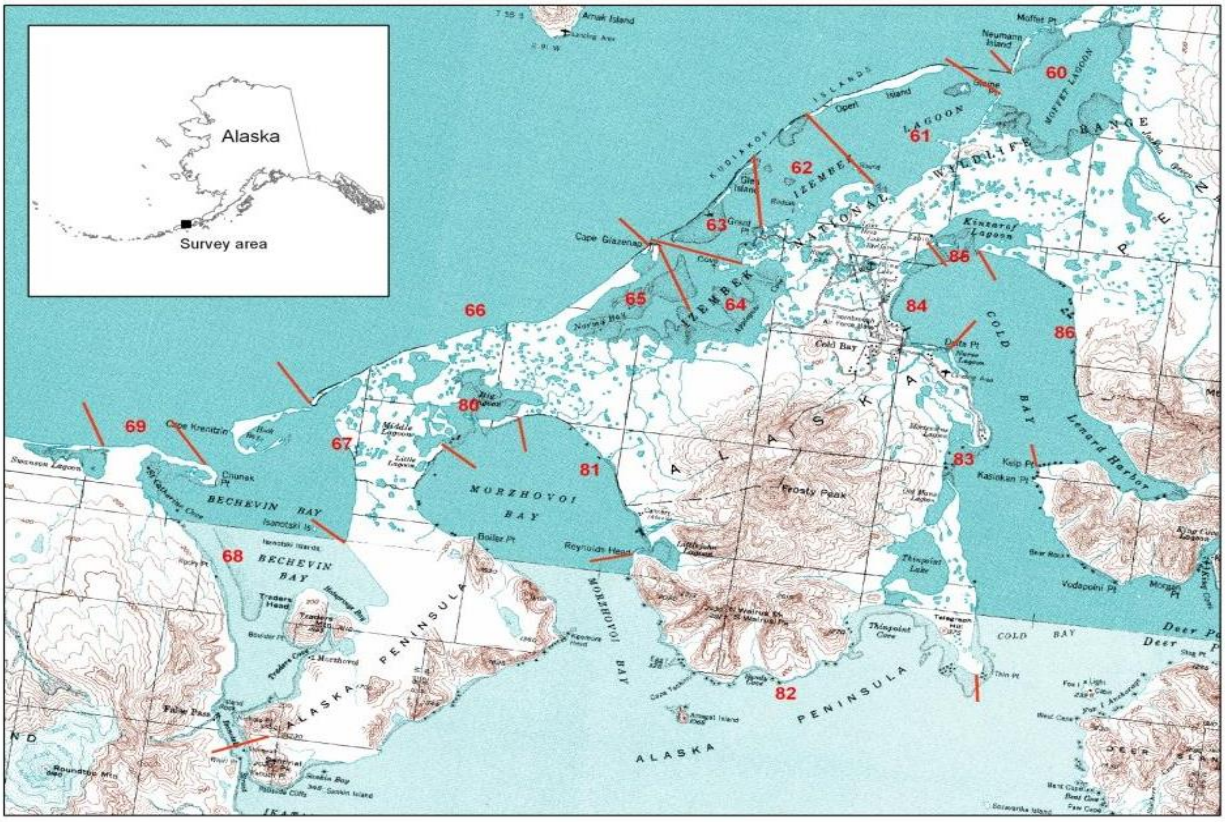

Figure 1. Pacific brant survey area by segment in the Izembek Complex, Alaska.

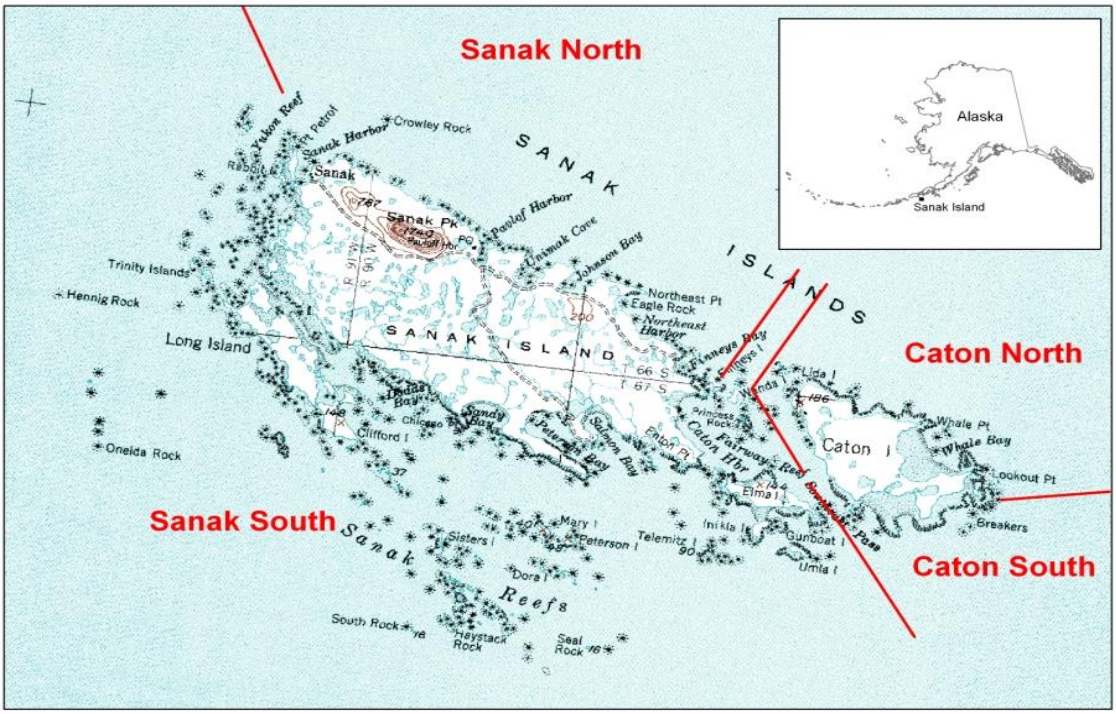

Figure 2. Pacific brant survey area by segment in the Sanak Islands.

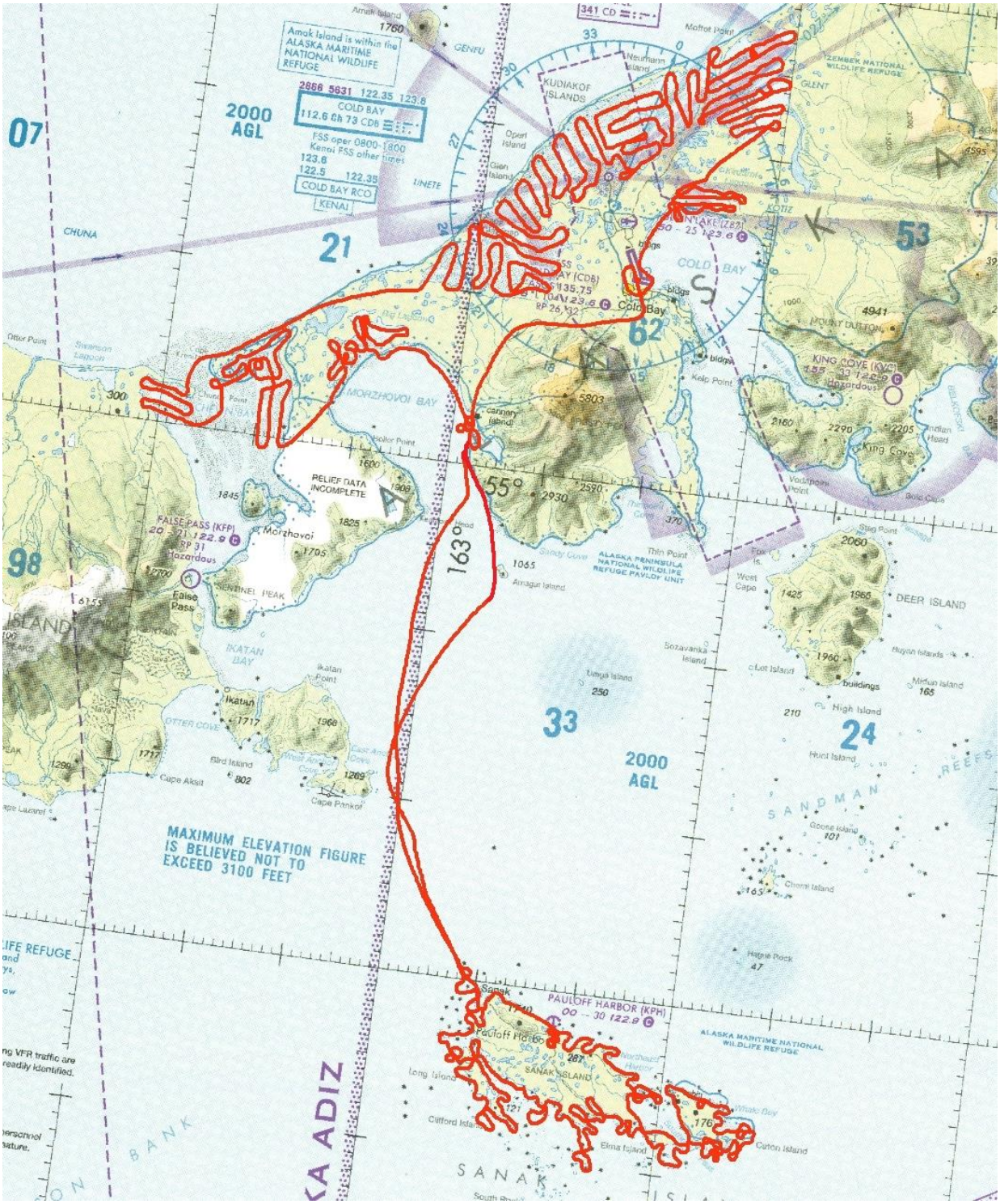

Figure 3. Survey path for Alaska Mid-winter Brant Survey in the Izembek Complex (Izembek Lagoon and Morzhovi and Bechevin Bays) and the Sanak Islands.

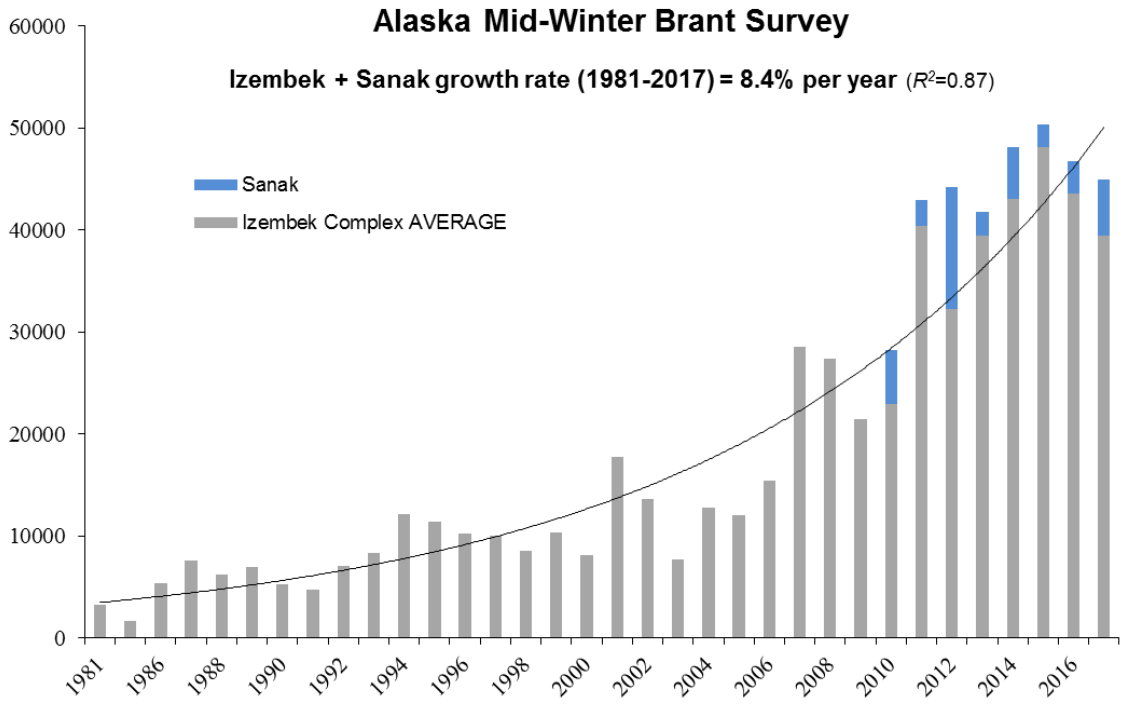

Figure 4. Population trend for the Alaska component of the Pacific Flyway Mid-Winter index for brant (1981-2017). Annual totals represent averages of within-winter replicates at Izembek (grey bars), plus counts at the Sanak Islands, Alaska (blue bars).

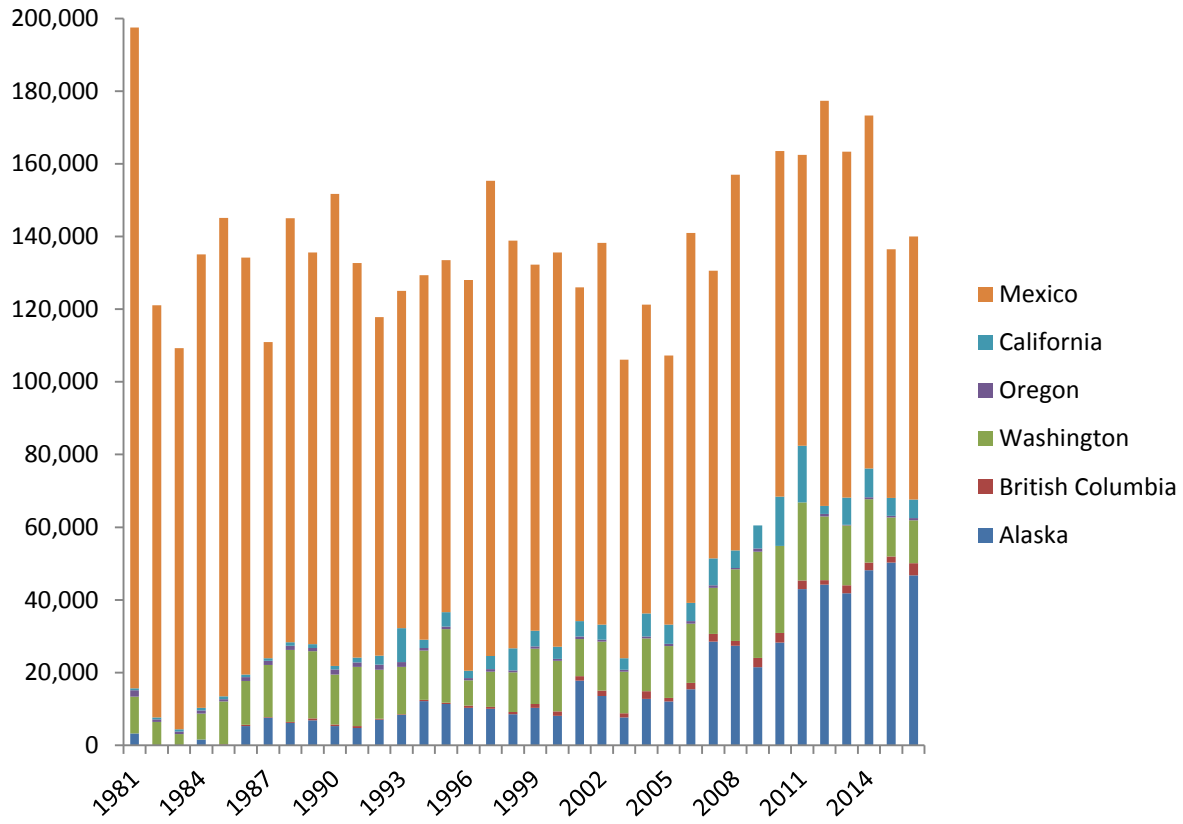

Figure 5. Components of the annual Pacific Flyway Mid-winter index for Pacific brant (1981-2016). The annual Mid-Winter brant index is calculated as the sum of annual indices from Mexico, California, Oregon, Washington, British Columbia, and Alaska (Olsen 2016).

Table 1. Alaska Mid-winter Survey for brant (AK MWS) 1981-2017. YEAR reflects the year in which January, February, and March surveys were flown. Within-year surveys conducted under high ice conditions (e.g., 50%+ of Izembek Complex lagoons iced over) are underlined.

Alaska Mid-Winter Brant Survey

					Izembek Complex Within-Year Counts in Chronological Order[2,3]				
YEAR	**TOTAL[1]**	Sanak	Izembek Complex AVERAGE	Izembek Complex CV	≥ Nov. 27th	December	January	Febuary	March
1981	**3,271**		3271	62%		1602	2670		5540
1984	**1,611**		1611	0%			1611		
1986	**5,338**		5338	62%	7665		3010		
1987	**7,550**		7550	34%	9355			5745	
1988	**6,180**		6180	50%		3975	8385		
1989	**6,918**		6918	43%	9795	7050	3910		
1990	**5,303**		5303	11%	5685		5595		4630
1991	**4,742**	*	4742	7%		4950	4350	4925	
1992	**7,043**		7043	15%		6790	5797	7200	8386
1993	**8,369**		8369	17%			7407 8008	10551	8862 7015
1994	**12,125**		12125	41%	21249		7580 13221	8942	12389 9366
1995	**11,381**		11381	13%	9703		11978	12461	
1996	**10,278**		10278	34%		17218	9795	7534 9735	8730 8658
1997	**10,049**		10049	29%		7460 9451	13237		
1998	**8,562**		8562	3%			8350 8773		
1999	**10,354**		10354	20%		12348	8255	10460	
2000	**8,120**		8120	52%		11917	3610	8833	
2001	**17,790**		17790	0%				17790	
2002	**13,576**		13576	0%			13576		
2003	**7,677**		7677	27%		9168			6185
2004	**12,756**		12756	0%					12756
2005	**12,041**		12041	65%			19303 2638 4563	17238 16463	
2006	**15,404**		15404	33%			10700	11685 21394 17838	
2007	**28,533**		28533	37%				15018 40041 32814 26257	
2008	**27,422**		27422	5%			28329 26515		
2009	**21,482**		21482	0%				21482	
2010	**28,234**	5303	22931	11%			22567 22550	26443 20165	
2011	**42,937**	2517	40420	24%				46383 29145	45733
2012	**44,252**	11996	32256	0%			32256		
2013	**41,821**	2413	39408	0%					39408
2014	**48,140**	5129	43011	24%			50257 35765		
2015	**50,316**	2206	48110	8%			50815 45405		
2016	**46,772**	3165	43607	9%			46532 40682		
2017	**44,899**	5428	39471	10%			37814 44137 36462		
Long-term Average	**18,566**	4770	17444	22%					
10-yr Ave.	**39,628**			9%					
Long-term Growth rate	**8.4%**	-3.5%	8.0%						

[1]Totals represent the average of Izembek Complex replicate survey and, for 2009-present, also include Sanak Islands counts

*An exploratory survey of Sanak was flown on 15 Feburary 1991 (Dau and Chase 1995); 1,189 brant were observed, extrapolated to an estimated 3,052. The Sanak 1991 estimate is not included in the table, due to the substantial departure from later survey methods.

[2]Partial surveys "corrected" for missed segments (i.e., segments flown on other days, in the same year, usually Bechevin/Morzhovi areas, substituted) are as follows: Additions to Izembek Lagoon totals were: 2006-07: (729 and 1,314), 2007-08: (7,815), 2014-15: (4,329)

[3]2012 totals (Sanak and grand total) have been corrected to match those in Mallek and Dau 2012 (11,996 and 44,252, respectively).

Table 2. Annual dates of all surveys, crews, and aircraft for the Alaska Mid-winter Brant Survey 1981-2017. *Asterisks denote surveys in which the Sanak Islands were flown.

YEAR	REPS	DATES	PILOT OBSERVER	OTHER OBSERVER(S)	AIRCRAFT
1980-81	3	12/30, 1/26, 3/9	J.E. Sarvis	K.A. Metzner	PA-18
1983-84	1	1/16	J.E. Sarvis	M.L. Nunn	PA-18
1985-86	2	11/29, 1/24	J.E. Sarvis	M.D. Blenden	PA-18
1986-87	2	11/27, 2/27	J.E. Sarvis	C.P. Dau	PA-18
1987-88	2	12/11, 1/15	J.E. Sarvis	C.P. Dau	PA-18
1988-89	3	11/29, 12/27, 1/17	C.P. Dau	D. Strom/R.L. West	PA-18
1989-90	3	11/29, 1/10, 3/29	C.P. Dau	M.A. Chase/S.S. Simpson/R.L. West	PA-18
1990-91	3	11/30, 1/9, 2/21 *2/15 (Sanak only)	C.P. Dau *Charter Pilot (Sanak)	J. Chase/M.A. Chase *C.P. Dau/M.A.Chase (Sanak)	PA-18, *PA-31 (Sanak)
1991-92	4	12/17, 1/23, 2/10, 3/26	C.P. Dau	C.F. Zeillemaker/M.A. Chase	PA-18
1992-93	5	1/14, 1/16, 2/26, 3/8, 3/24	C.P. Dau	N. Schlicten/C.F. Zeillemaker	PA-18
1993-94	6	11/30, 1/19, 1/26, 2/15, 3/9, 3/28	C.P. Dau	M.A. Chase/R.P. Schulmeister/D.H. Ward/C.F. Zeillemaker	PA-18
1994-95	3	11/30, 1/2, 2/14	C.P. Dau	S.D. Schulmeister/R.P. Schulmeister	PA-18
1995-96	6	12/1, 1/12, 2/16, 2/26, 3/4, 3/18	C.P. Dau	G.E. Siekaniec/R.P. Schulmeister/ S.D. Schulmeister/D.H. Ward	PA-18
1996-97	3	12/19, 12/23, 1/17	C.P. Dau	G.E. Siekaniec/J.E. Sarvis/R.P. Schulmeister	PA-18
1997-98	2	1/2, 1/8	M. Roy	-	PA-18
1998-99	3	12/15, 1/2, 2/10	M. Roy/C.P. Dau	R. Portwood/T.A. Schafer	PA-18
1999-00	3	12/17, 1/16, 2/22	M. Roy	L. Ziemba	PA-18
2000-01	1	2/26	C.P. Dau	D.H. Ward	PA-18
2001-02	1	1/30	C.P. Dau	D.H. Ward	PA-18
2002-03	2	12/21, 3/4	K.B. Fox	K.M. Sowl	PA-18
2003-04	1	3/5	W.W. Larned	K.M. Sowl	PA-18
2004-05	5	1/19, 1/26, 1/27, 2/26, 2/28	J.K. Richardson E.J. Mallek	K.M. Sowl P.D. Anderson/T.F. Donnelly	PA-18
2005-06	4	1/26, 2/15, 2/17 (x2)	J.K. Richardson E.J. Mallek	K.M. Sowl C.P. Dau	PA-18
2006-07	4	2/9, 2/13, 2/14 (x2)	J.K. Richardson	K.M. Sowl	PA-18
2007-08	2	1/25, 1/26	J.K. Richardson	C.P. Dau	PA-18
2008-09	1	2/2	E.J. Mallek	C.P. Dau	PA-18
2009-10	4	1,29, 1/30, 2/1, 2/2	F. Mueller K.S. Bollinger	C.P. Dau	PA-18 C206 Amphib
2010-11	3	*2/27, 2/28, 3/1	K.S. Bollinger	P.D. Anderson	C206 Amphib
2011-12	2	*1/14	E.J. Mallek	C.P. Dau	Kodiak Amphib
2012-13	1	3/28, *3/29	E.J. Mallek	C.P. Dau	Kodiak Amphib
2013-14	2	1/27, *1/28	H.M. Wilson	C.P. Dau	C206 Amphib
2014-15	2	*1/24, 1/25	H.M. Wilson	C.P. Dau	C206 Amphib
2015-16	2	*1/22, 1/23	H.M. Wilson	C.P. Dau	C206 Amphib
2016-17	3	1/21, 1/23, *1/24	H.M. Wilson	W.W. Larned	C206 Amphib

Appendix 1. Waterbird and mammal observations by segment in the Izembek Complex on each of three repeated surveys; 21, 23, and 24 January 2017.

Izembek Complex Survey #1 - 21 January 2017													
SPECIES	SEGMENT NUMBER												TOTAL
	60	61	62	63	64	65	67	68	80	81	84	85	
Bald Eagle	1	2	2	2	5	3	2	1		1		1	20
Black Scoter		15	6	2	26	2	36	49		152	18		306
Brant	**33**	**9105**	**2**	**6**		**11080**	**9705**	**230**	**3350**		**3**	**4300**	**37814**
Bufflehead								2	31		7	20	60
Common Eider							7	41		1202			1250
Common Loon							1						1
Common Murre													0
Common Raven							3			1			4
Emperor Goose	**185**	**89**	**16**		**495**	**892**	**455**	**402**	**1055**	**25**		**399**	**4013**
Goldeneye				64	4		57	159	696			80	1060
Greater Scaup	40					654	2048	2	40				2784
Harbor Seal	1			9	60		40	70					180
Harlequin Duck			1				84	20	37	26	34	5	207
Large gull ssp.	1		1		4	7	32	4	1	12	152		214
Long-tailed Duck	278	176	111	71	78	525	22	181	6	37		72	1557
Mallard						100						10	110
Northern Pintail						65			175			125	365
Pacific Loon		4		2			1	1		14		1	23
Pelagic Cormorant							17			3			20
R-b Merganser		31		341	441	39	292	29	799	3		445	2420
Sea Otter	224	106	51	75	522	361	427	64		10	22	2	1864
Sm. Shorebird ssp.									8				8
Steller's Eider	**480**	**1267**	**25**			**1430**	**5570**	**200**	**1355**			**626**	**10953**
W-w. Scoter							8	3	18	34	6		69

Izembek Complex Survey #2: 23 January 2017													
SEGMENT NUMBER													TOTAL
60	61	62	63	64	65	67	68	80	81	84	85	
	1		2		4		1	3		4		15
	307	64			230	218	169	17	37	11	10	1063
219	**12345**	**1319**	**4711**	**1923**	**5827**	**8903**	**224**	**2829**			**5837**	**44137**
								41				41
						1			5			6
									1			1
								15	9			24
					1			6				7
165		**375**	**353**	**110**	**22**	**7**	**80**	**572**	**19**		**72**	**1775**
						56		77			110	243
			80	720	190	3230		89				4309
28				85	2							115
						12		30	10	6	8	66
1	3	4	4	2		117		38	5	8		182
221	61	16	5		32	774	4	6	3	10		1132
6	1				8	25		8			60	108
					40	15		200				255
						1			1			2
						20			1			21
	96	14	18			129	5	246	4		20	532
196	61	13	75	278	225	189	40	15	1	29		1122
						10					120	130
2096	**1411**	**526**	**181**	**740**	**735**	**3046**	**142**	**725**	**9**		**957**	**10568**
	28					18	6	8	3			63

Izembek Complex Survey #3: 24 January 2017													
SEGMENT NUMBER													TOTAL
60	61	62	63	64	65	67	68	80	81	84	85	
1	4	1	2	2	2	4	4	4			1	25
100	724		40			17	27	43	37		140	1128
623	**12813**		**1836**	**315**	**5277**	**8748**	**222**	**2176**	**52**		**4400**	**36462**
								170				170
							20		1201		10	1231
									2			2
											1	1
								1			1	2
13		**330**	**360**	**314**	**355**	**16**	**76**	**689**	**166**		**626**	**2945**
20					50	70		86			46	272
				630	30	3955		130			1	4746
84	2	20		196	5	32	1					340
						17	7	39	24		4	91
	6	16	1		58	2	2	58	5			148
74	54	44	36	8	22	544		18			7	807
15	20			55	23	72		188				373
56			100			20	10	805				991
									3			3
						1			2			3
	136				23	176	14	117	2		108	576
87	9	10	15	231	36	45	131	1	6	10	18	599
								400				400
105	**660**	**985**	**295**	**1575**	**310**	**2183**	**436**	**393**			**603**	**7545**
	22	10	10			4		27	10	21		104

Appendix 2. Waterbird and mammal observations by segment, Sanak Islands, 24 January 2017.

SPECIES	SEGMENT			TOTAL
	Sanak South	Sanak North	Caton[1]	
Bald Eagle	27	3	16	46
Black Oystercatcher	86		245	331
Black Scoter	591	894	339	1824
Brant	**2746**	**310**	**2372**	**5428**
Bufflehead	2	1	50	53
Cattle	308	43		351
Common Loon		3		3
Common Murre	212	1	50	263
Common Raven	9	1	11	21
Emperor Goose	**2567**	**203**	**1821**	**4591**
Goldeneye		10		10
Greater Scaup	40	8		48
Harbor Seal			1	1
Harlequin Duck	83	90	161	334
Horse	15			15
Large gull ssp.	24	24	23	71
Long-tailed Duck	30	18	3	51
Mallard	105	73	293	471
Northern Pintail	718	113	3016	3847
Pacific Loon	7		1	8
Pelagic Cormorant	3			3
R-b Merganser	18	35	27	80
Sea Otter	38			38
Sm. Shorebird ssp.			600	600
Steller's Eider	**752**	**154**	**2130**	**3036**
Tundra Swan	14			14
W-w. Scoter	144	7	12	163
Surf Scoter	10	24	5	39
Double crested Cormorant	55	77	64	196
Northwest Crow	33	23	130	186
Black-bellied Magpie	2			2
Gyrfalcon			1	1

[1]North and South Caton segments were not delineated while surveying in 2017, thus, a single Caton category is presented representing both segments.