Molting Pacific Steller's Eider Survey in Southwest Alaska, 2015

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Abstract

This report presents the results of the fourth consecutive year of molting Steller's eider surveys along the north side of the Alaska Peninsula. We used a fixed-wing aircraft to conduct a photographic survey of molting Steller's eiders at major lagoons along the Alaska Peninsula from King Salmon to Cold Bay between 29 August and 1 September, 2015. We conducted replicate surveys to examine sampling variation and improve accuracy. We estimated 69,048 Steller's eiders within the survey area, with an average of 15,520 birds at Seal Islands, 43,053 birds at Nelson Lagoon, 7,155 birds at Izembek Lagoon, and 3,320 birds at Port Heiden. These estimates are similar to the 2014 results, but the limited time series is insufficient to examine population trends at this point. We suggest continuation of replicate surveys to help identify sources of variation in photographic counts of molting Steller's eiders.

Key Words: Alaska, Steller's eider, *Polysticta stelleri*, population index, aerial, photographic, survey, molt.

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Introduction

From 1992 to 2011, the U.S. Fish and Wildlife Service's (USFWS) Migratory Bird Management Program conducted spring migration aerial surveys in southwest Alaska to monitor trends in the Pacific population of Steller's eiders (*Polysticta stelleri*) and to improve understanding of habitat use and timing of spring migration (Larned 2012). Because of inclement spring weather, variable migration timing, and unmeasured bias in flock estimation, inter-annual spring counts were highly variable. To improve annual monitoring of this species, Migratory Bird Management tested the feasibility of photographic methods in 2012 (Wilson et al. 2013). This effort was successful in obtaining images of sufficient quality to identify and enumerate Steller's eiders from altitudes that did not cause flocks to dive, thereby reducing bias associated with flock estimation and availability. In addition, molting surveys occur during a period when the population is nonmigratory; thus bias associated with roll up (double counting individuals that are pushed ahead of the aircraft) is avoided. Different cameras, lenses, and crew resource management styles were tested in 2013 and 2014 resulting in improved survey efficiencies (Anderson et al. 2016). The 2015 survey, reported here, is a continuation of these earlier efforts and documents photographic surveys of molting Steller's eiders within the primary molting areas on the Alaska Peninsula including lagoons, and bays between King Salmon and Cold Bay.

Lagoons along the north side of the Alaska Peninsula comprise a series of shallow estuaries protected by long, narrow, and partially vegetated barrier islands, or spits, which have historically been used by Steller's eiders for spring and fall staging, as well as fall molt (Dau et al. 2000). The primary molting areas for Steller's eiders on the Alaska Peninsula are Port Heiden, Seal Islands, Port Moller, and Nelson and Izembek lagoons. Photographic surveys in 2012, 2013 and 2014 established the feasibility of monitoring molting Steller's eiders using oblique aerial photography. However, large differences in some annual estimates

suggested replicate surveys might provide insight into sampling errors and temporal variability associated with timing of molt.

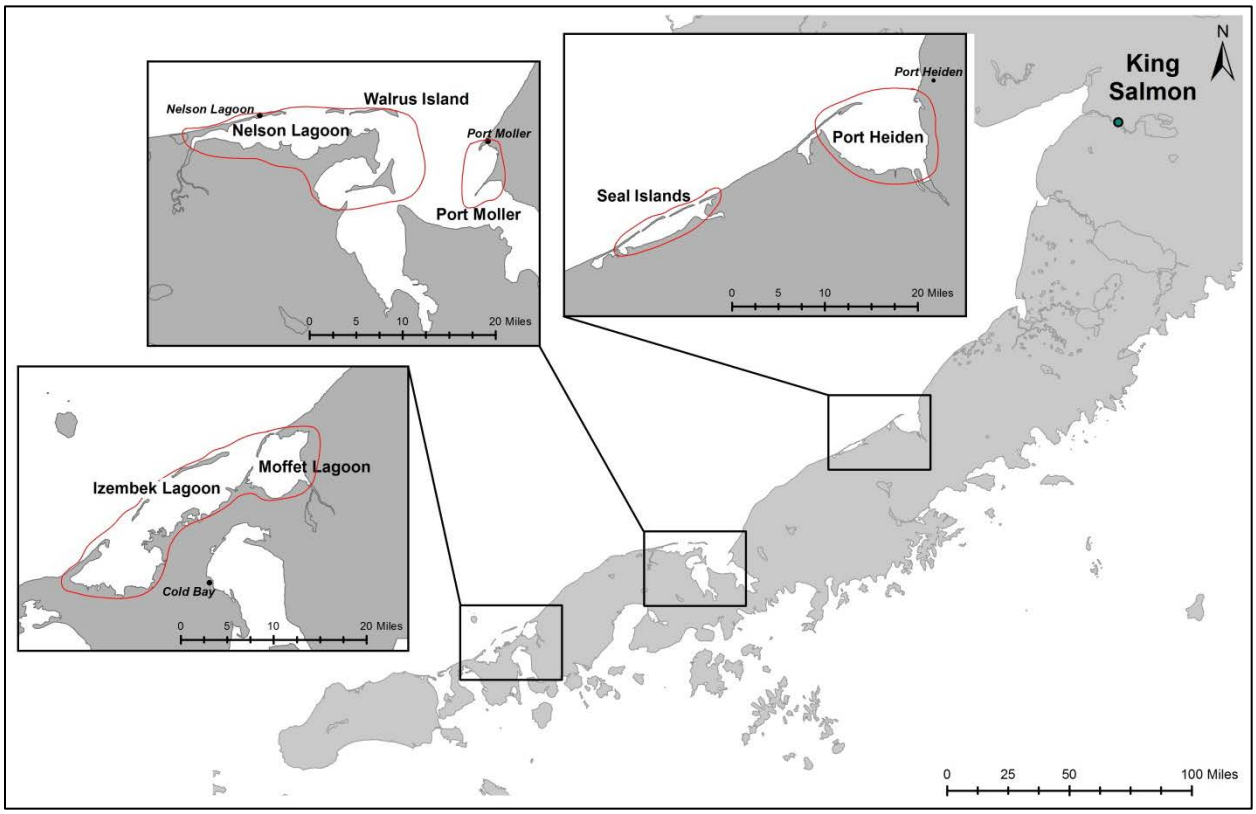

Figure 1. Map of survey area, with inset maps providing detail of primary search zones. Red lines define the boundaries of the areas to be searched annually, as determined by historic distributions of molting eiders. Locations of flocks within these boundaries are typically influenced by tidal stage.

Methods

The 2015 photographic survey of molting Steller's eiders was flown using a USFWS Cessna 206 on Wipline 3450 amphibious floats. The survey was conducted at major lagoons along the Alaska Peninsula from King Salmon to Cold Bay, with replicate surveys at the Seal Islands, Port Heiden and Nelson lagoon. The survey was flown from 29 August to 1 September, 2015. The survey crew consisted of pilot (Anna Anderson), right front observer (Dennis Marks), and left rear-seat photographer (Tim Bowman) (see Appendix 1: Trip itinerary).

We timed flights at Nelson Lagoon and Seal Islands to be at or near low tide, when Steller's eiders were more concentrated in channels. At Izembek Lagoon, photographic flights were timed for high tide and calm winds which, based on previous experience, improved visibility of molting flocks from greater distances. Before attempting to photograph Nelson Lagoon and Seal Islands, we flew a reconnaissance survey of each area at approximately 1,500ft above ground level (AGL) to determine the distribution of the birds within the lagoons and to formulate an efficient strategy for photographing the flocks. We learned during previous surveys that molting Steller's eiders rarely dove on our first overflight, but were more likely

to dive on successive overflights. We strove to photograph all flocks on the first low level overflight, before birds began diving in response to aircraft. During the photographic surveys we flew with ~10° of flaps, between 700-900 feet AGL, with groundspeeds that ranged from 80 to 100 knots, depending on wind direction and wind speed. The front-right seat crew member spotted flocks of Steller's eiders and communicated their location to the pilot. The pilot used a GPS that displayed the aircraft track to ensure full survey area coverage.

Oblique photographs were taken through the rear passenger window on the pilot side of the aircraft. We used a Canon 5D SR SLR® digital still camera, with a 50 megapixel sensor, and an auto-focusing, image-stabilized Canon 70-200 mm f4 lens. We photographed using shutter priority mode, with shutter speeds between 1/1000 and 1/1600 seconds, and an ISO of 800. To avoid image distortion we had Plexiglas window ports installed in the left and right rear passenger seats that opened during flight. Shooting through the open window, the photographer captured images of the long linear flocks with a series of overlapping photographs in a single pass. Small, distinct flocks were sampled with a single photograph.

Steller's eiders typically form distinct, dense, single species flocks, making identification of flocks straightforward. If species identity was questionable, we made a low pass after photographing the flock to confirm species. We periodically encountered mixed-species flocks containing Pacific common eiders (*Somateria mollisima v. nigrum*), Steller's eiders, and black scoters (*Melanitta nigra*). While in the aircraft, the photographer made an initial review of the photos to assess quality, then dictated to the right front observer the frame numbers and any specific notes about photos while the survey details were still easy to recall (e.g., flock location, flock shape, or other information including whether or not to count the flock). These steps helped to ensure photo quality, facilitated efficient compiling of photos, and ensured that adequate photo coverage was achieved.

To process the photographs, we first created a database of photos taken and corresponding notes. We then delineated photos to be further processed, deleting duplicate shots and those that did not include Steller's eiders. Species other than Steller's eiders were identified based on relative size, plumage, and comparison to reference photos, but were not counted. During photo-processing, we used a paper copy of our spreadsheet and wrote in final counts for each photo as a backup to an Excel spreadsheet. We used Adobe Photoshop CS-6 Extended to draw lines delineating which birds should be counted within each individual photo, considering adjacent photo overlap and image quality. To avoid undercounting or double-counting in overlapping serial images, we simultaneously displayed adjacent images on two computer screens and drew lines on each image, indicating the side not to be counted with an 'X' (Figure 2).

Figure 2. Typical photo from a series used to count a long, linear flock of molting Steller's eiders at Nelson Lagoon. The red line and "X" delineate the portion of the photo that overlapped with the next photo indicating that it had already been counted.

We hand-counted the birds in the photos using the Adobe Photoshop CS-6 Extended count feature. With this tool, we positioned the cursor over each bird to be counted and clicked the mouse, leaving a marker and an incremental number over each bird in the flock (Wilson et al. 2013). After counting the photo, we recorded the total on the bottom right hand corner of the photo and saved the photo to a folder for each lagoon system. We entered photo counts of Steller's eiders into an Excel spreadsheet and totaled counts for each major lagoon system. In locations where we had replicate surveys, we used the average number from replicates. We derived the index for the 2015 Pacific Steller's Eider population by summing average counts from each lagoon.

Results and Discussion

Total flight time for the 2015 survey was 20.8 hours. Approximately 15.8 hours were needed to search for and photograph flocks. The remaining 5 hours were used to transition the aircraft between King Salmon and Anchorage. We processed 1,301 photographs during a two-month period interspersed with other assignments.

We estimated a total of 69,048 Steller's eiders for all surveyed areas along the Alaska Peninsula in fall 2015. Seal Islands and Nelson Lagoon comprised 85% of the molting birds surveyed. Proportionally, 62% were in the Nelson Lagoon complex and 23% were at Seal Islands (Table 1). Most of the molting Steller's eiders at Nelson Lagoon were within the lagoon (south) side of Walrus and Kudobin Islands (Figure 3).

Consolidation of birds within flocks was the most important factor for effective photography. Large scattered groups, particularly in open water, were difficult to locate and photograph because the lack of shoreline reference made it difficult to determine what had been photographed and, later, which sections of photos should be counted.

Compared to estimates of Steller's eiders derived from aerial surveys that require ocular counts, this photographic survey should more accurately document abundance of Pacific Steller's eiders because flock estimation bias is eliminated. Also, unlike low level aerial surveys, this photographic survey is conducted at an altitude that does not result in a dive

response from eiders, thereby significantly reducing availability bias. Moreover, the Steller's eider molt survey is conducted when the population is non-migratory, further reducing bias due to undercounting or double counting previously counted birds.

Table 1. Numbers and relative proportions of molting Steller's eiders at surveyed locations along the Alaska Peninsula in the fall of 2015, as counted from aerial photographs.

Location	Date(s)	Replicate 1	Replicate 2	Mean	Proportion of Total
Port Heiden	8/30/15 9/1/15	3,387	3,252	3,320	5%
Seal Islands	8/30/15 9/1/15	4,369	15,520	9,945	16%
Port Moller	8/30/15	0		0	0%
Nelson Lagoon	8/30/15 8/31/15	39,090	47,016	43,053	68%
Izembek Lagoon	8/31/15	7,155		7,155	11%
Total				**63,473**	100%

Figure 3: Satellite image of Nelson Lagoon and Port Moller survey areas.

However, despite the many benefits of a photographic molting survey index, variation in fall counts may be confounded with variation in production (i.e., more adult females may be present in poor breeding years). Molt migration in sea ducks generally involves early arrival of breeding adult males, non-breeders, and failed breeders (Salomonsen 1968, Hohman et al. 1992) with later arrival of successful breeding females and their broods. Successful breeding females do not depart Arctic breeding grounds until the very end of August or early

September (Fredrickson 2001), thus are excluded from the survey. In years when breeding success is low, however, failed breeding females would accompany males and nonbreeding eiders to molting grounds. Thus, abundance estimates derived from molt surveys represent a combination of population size and current breeding conditions, and separation of the two can be difficult. While this adds unpredictable variation to annual estimates, we believe that the effect is relatively small due to the predictably low productivity of Steller's eiders, and the consistently low presence of any females within the study area in early September. For example, during banding drives at Nelson Lagoon, September 6-16, 2006-2008, adult female Steller's eiders accounted for just 10-14% of all molting birds captured (T. Bowman, USFWS unpubl. data). That proportion would have been even lower earlier during late August molt survey, when the molt survey is flown.

The 2015 estimates of molting Steller's eiders were relatively similar to the previous year's estimates (Table 2). However, we do not know the relative contribution of sampling variation due to detection, or survey timing) versus process variation (true population change) in the overall variability (or lack thereof) we observed among annual counts.

Table 2. Estimates of molting Steller's eiders along the Alaska Peninsula based on photographic surveys from 2012-2015.

Date	Port Heiden		Seal Islands		Port Moller		Nelson Lagoon		Izembek Lagoon		Total
8/27/2012	--		8136		602		35218		5375		
8/28/2012	--		--		--		--		2921		
8/30/2012	341		11392		--		35879		--		
2012 Mean		**341**		**9764**		**602**		**35549**		**4148**	**50404**
8/26/2013	0		6990		--		--		--		
8/27/2013	--		--		--		20832		2585		
2013 Mean		**0**		**6990**		--		**20832**		**2585**	**30407**
8/28/2014	--		--		--		47286		--		
8/29/2014	--		17226		--		--		3543		
8/29/2014	--		--		--		--		2967		
9/4/2014	1716		20029		--		--		--		
9/4/2014	2265		--		--		--		--		
9/5/2014	--		--		--		46286		4469		
9/5/2014	--		--		--		--		4448		
9/6/2014	--		15508		99		--		--		
2014 Mean		**1991**		**17588**		**99**		**46786**		**3857**	**70320**
8/30/2015	3387		--		0		39090		--		
8/31/2015	--		--		--		47016		7155		
9/1/2015	3252		15520		--		--		--		
2015 Mean		**3320**		**15520**		**0**		**43053**		**7155**	**69048**

Daily survey conditions in 2015 were relatively uniform, with the exception of daily variation in sun-glare. Although we were reasonably confident we covered all areas where Steller's eiders were molting within the study area, we omitted replicates from analysis if there was difficulty in reconciling photos or problems with image quality. We noted that using a geo-referencing flight and photographic tracking program would be useful to ensure coverage.

Suggestions and recommendations for the future

- We suggest boundaries as defined in Figure 1 for a permanent survey area to help standardize coverage among annual surveys and within-year replicates. Boundaries are large enough to include the full extent of previously observed distribution, plus a peripheral buffer area to accommodate potential future distribution shifts. The primary survey areas include Port Heiden, Seal Islands, Port Moller, Nelson Lagoon, and Izembek

Lagoon.

- We propose an every 5-year expanded search of areas outside of the northern Alaska Peninsula, where molting Steller's eiders have been documented in the past (e.g., Kuskokwim Shoals, Lower Cook Inlet). This would help improve understanding and documentation of the overall distribution of molting Steller's eiders.

- We recommend that a minimum of 2 replicate surveys be attempted at each area within each year.

- The same crew should be scheduled and committed to participate in the entire survey each year in order to ensure consistency and comparability among surveys and replicates.

- A checklist should be developed to ensure all batteries are charged, memory cards are cleared and camera settings are appropriate for the specific survey conditions.

- The pilot should be responsible for keeping track of which flock was previously photographed and communicate clearly to the crew if they fly back over an area that was previously photographed.

- The photographer needs to be able to immediately review photos and determine if they are acceptable. If photos are not acceptable, then the area with the flock in question should be re-flown and re-photographed and unambiguous notes taken to indicate the frames that should be discounted.

- The crew should identify and agree upon clear landmarks as reference points will help the crew clearly communicate and document what flocks have and have not been photographed.

- We recommend that the photographer records notes using a hand held recorder with microphone taped to the camera. This will improve understanding of the photograph sequence and thought process, and avoid misinterpretations that can happen when verbally dictated notes are imprecisely recorded by a note-taker.

- It is essential to have a photographer that has experience with the camera and in taking aerial photos.

- As opportunities arise, the photographer should train the observer in camera operation so there is an alternate experienced photographer if needed.

- All photos should be reviewed and documented the day of the survey to ensure adequate photo quality and accurate notes that are easily interpreted for photo processing.

- Initial processing (drawing lines on photos delineating parts of flock to be counted) and counting should be done immediately after the survey when memory of photos and notes are still fresh.

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Appendix 1. Trip itinerary.

Dates: August 29th, 2015- September 1st , 2015

Pilot: Anna Anderson

Photographer: Tim Bowman

Recorder: Dennis Marks

8/29/2015:	Departed Anchorage for King Salmon. Re-fueled and overnighted at the Becharof NWR bunkhouse in King Salmon.
8/30/2015:	Surveyed from King Salmon to Nelson Lagoon, photographing at Port Heiden, Seal Islands and Nelson Lagoon. Overnighted in Nelson Lagoon.
8/31/2015	Flew to Cold Bay and surveyed Izembek Lagoon in the morning. Re-fueled in Cold Bay, then departed for Nelson Lagoon. Surveyed Nelson Lagoon in evening at low tide. Overnighted in Nelson Lagoon.
9/1/2015:	Refueled in Nelson Lagoon then surveyed Seal Islands and Port Heiden while enroute to King Salmon. Refueled in King Salmon and then departed for Anchorage. Landed Anchorage, end of survey.

Appendix 2. Inclusive dates, flight hours, and personnel, Molting Pacific Steller's Eider Survey in Southwest Alaska.

Year	Date	Hours	Pilot	Photographer	Recorder
2012	8/27-30	16.6	H. Wilson	T. Bowman	W. Larned
2013	8/26-27	15.4	H. Wilson	T. Bowman	W. Larned
2014	8/26-30	19	A. Anderson	T. Bowman	C. Dau
	9/3-6	18.8	H. Wilson	D. Marks	A. Anderson
2015	8/29-9/1	20.8	A. Anderson	T. Bowman	D. Marks