Sea Duck Joint Venture
Annual Project Summary
FY 2016 - (1 April 2016 - 31 March 2017)
Cooperative Agreement F12AC01228

Project Title: Sea Duck Research and Monitoring in the Atlantic Flyway: Development of a monitoring program for the American Common Eider. Part II: Assessing the use High Resolution Imagery for counting males (SDJV Project #134)

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Project Description: In our last report (SDJV 134: Part I), we found that the repeatability of population estimates using aerial counts of male Common Eiders in spring was very low, and comparisons with nest counts suggested that visual counts of males may underestimate colony size by 2.5 to 3.8 times. Bird surveys conducted using aerial images are not prone to observer errors counting which can be problematic when the encounter rates or group sizes are high. Here we report some preliminary work to assess the use of very high spatial resolution image data for counting male Common Eiders.

Objectives:

1. Assess the feasibility of using high spatial resolution image data for counting male Common Eiders.

Methods:

Discussions with Leading Edge Geomatics Ltd suggested it might be possible to collect very high resolution, ~3 cm Ground Sample Distance (GSD), digital imagery using an UltraCam Vexcel Sensor. To evaluate the potential of 3 cm GSD imagery to capture male Common Eiders we took an overhead photograph of a taxidermist mount of an adult male American Common Eider to measure the dorsal footprint of the bird. This image was imported into the open source software ImageJ (Rasband, W.S., ImageJ, U. S. National Institutes of Health, Bethesda, Maryland, USA, http://imagej.nih.gov/ij/, 1997-2016) and scaled to the size of the bird (Table 1; A.). ImageJ's Threshold tool was used to select the white and black areas of the plumage as viewed from above, and these areas were measured using the ImageJ's measurement tool. We estimated the dorsal footprint of the white plumage of an adult male Common Eider was ~420 cm^2 and the

black area was ~220 cm^2 (Table 1; B&C). Assuming a GSD of ~3 cm, we estimated that we might expect that an adult male Common Eider would cover about 45 white and 25 black pixels on the high resolution image. The digital values of the pixels along the boundaries of the white and black plumages, and the plumage with the background, would be averaged. To estimate the number of white or black pixels, and the number of transitional pixels between the plumages, or with the plumages and the background, we overlaid a 3 cm grid over the image and we counted the number white/black pixels and the number of transitional pixels (Table 1; D). Overall, we estimate that we could expect an adult male Common Eider might be captured on ~100 pixels at a GSD of 3 cm.

Survey Area: We proposed to run the pilot study in the Mingan Archepelago, Québec during mid-February 2016. This area was surveyed for eiders in February 2003, 2006, 2009, 2012 and 2015 (Lepage and Gilliland CWS files). During these surveys we estimated the size (number of white males and proportion of brown eiders) and recorded the location (latitude and longitude) of each flock. Using this information we were able to define a reasonable sized study area that was used by a large number of eiders in each year. However, the study area was shifted to New Brunswick in March because of a change in aircraft type (see Sensor and Aircraft below). With shift in aircraft type, we were limited to working in areas within 2.8 km from the shoreline. To determine the location of the new study area we used similar data from eider winter surveys conducted in 2006, 2012 and 2016 in the Maritimes. We selected 2 areas: 1) Letete Passage, near Dear Island, NB (Fig. 1 A.) and the northeast coast of Grand Manan Island (Fig. 1 B.).

Sensor & Aircraft: The preferred sensor for the assessment was the UltraCam Falcon Prime (I-K. Peterson pers. comm) this system has very large frames (17310 x 11310 pixels) that capture color (RGB), Panchromatic (PAN) and near infrared (NIFR) at a very high acquisition frame rate. However, this sensor was not available at the time, and Leading Edge offered use of a upgraded UltraCam Vexcel sensor. This sensor also takes large frames (11704x7920 pixels) and captures RGB and NIFR data; however the frame acquisition rate is slower than the UltraCam Falcon. Leading Edge made several calculations and determined that it was possible to collect 3cm GSD imagery with the Vexcel Camera with minimal risk of pixel blur, although coverage may not be complete due to the lower frame acquisition rate. Given a large portion of the area to be surveyed was over-water they proposed to use a Piper Navajo flying at ~335 m ASL to collect the data.

The Piper Navajo ended up weather bound on a job in Puerto Rico for February and most March which required a last minute change in aircraft to a Cessna 206. For safety, the Cessna 206 was limited to working at distances no further than 2.8 km from the shoreline at a minimum working altitude of 475 m ASL when work over water. This required a last minute change in study site as most of the study area in the Mingan Archipelago was outside the working range of the aircraft, and we switched to a location in New Brunswick where the birds were located closer to shore. The working altitude of the Cessna was slightly higher which had implications for

resolution of the imagery. Locations of flocks of eiders detected within the new study area in February 2006, 2012 and 2016 are shown in Figures 1 and 2.

Preliminary Results:

Aircraft availability and weather constraints restricted the days the survey could be conducted. On 24 and 30 March 2016, we collected a total of 1116 images. Images were collected at an altitude of 477 m which resulted in a GSD of 4.47 by 5.08 cm resulting in an image size of about 520 by 400m (Table 2). The centroids of each image are shown in Figures 1 and 2.

To date, we have only done a cursory preview of some of the images. Figure 3 shows about 120 Herring Gulls around a salmon farm. Figure 4 shows a detection of a loose flock of eiders. Figure 5 A is a closer view of a portion of the flock in Figure 4 using the NIFR band which shows 18 adult male 15 brown eiders. Three of the brown eiders show some white in the breast area suggesting they maybe immature males. Figure 5 B and C are close-ups of a single male eider and of a herring gull in flight. The close up of the eider in Figure 5 A suggests the bird is about 47 cm long which is close to the total body length measurement of the mounted eider (44.3 cm). The difference in length may result from transitional pixels being included in the estimate of body length. Figure 6 shows a herd of harbour seals detected on one of the images.

Recommendations:

A cursory analysis of the imagery suggests that very high resolution spatial imagery maybe used to estimate number of adult male Common Eiders. Within the image set we located examples of eiders, and Herring and Black-backed Gulls and it seems relatively easy to discriminate between the male eiders and gulls based on shape and colour patterns on the birds' backs. However, a more detailed treatment of the data is required.

An advantage of the very high resolution spatial imagery over the aerial oblique photos collected in the last part of the study (SDJV 134: Part I) is that every pixel in the image is geo-referenced which simplifies the task of merging overlapping images. An enormous amount time and effort was spent sorting, merging and counting the eiders on the aerial oblique imagery collected in 2012. The task of merging and colour balancing and geo-rectifying the high resolution spatial imagery is mostly automated. But processing the imagery requires specialized software, hardware skills.

We also recommend collecting a small amount of additional imagery to be used in future assessments. Issues with aircraft availability and local weather conditions restricted image collect to the last week of March in 2016. Eiders initiate their spring migration from the wintering areas to breeding sites in late March and we expect many of the birds that use this area had left by the time the imagery was collected.

Rasband, W.S., ImageJ, U. S. National Institutes of Health, Bethesda, Maryland, USA, http://imagej.nih.gov/ij/, 1997-2016.

Table 1. Estimating the area of white and black plumage on the dorsal side of an American Common Eider.-1

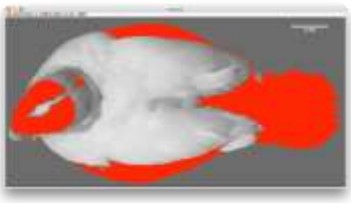
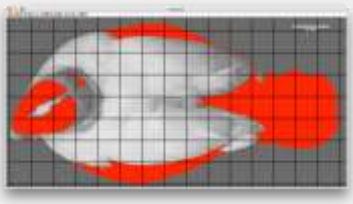
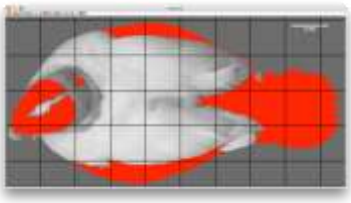
Selection	Image	Measurement
A). Image scaled to size of bird		645 cm^2
B). White area		424 cm^2
C). Black area		221 cm^2
D). 3 cm by 3 cm grid		• 33 white • 21 white transitional • 8 black • 36 black transitional
E). 4.5 cm by 5 cm grid		• 17 white • 10 white transitional • 2 black • 23 black transitional

Table 2. Dimensions of the high resolution images collected March 2016.-1

Image	x	y	Area
pixel size (cm GSD)	4.47	5.08	22.71

Table 2. Dimensions of the high resolution images collected March 2016.-1

Image	x	y	Area
No. Pixels	11704	7920	92695680
image size (m)	523	403	210525

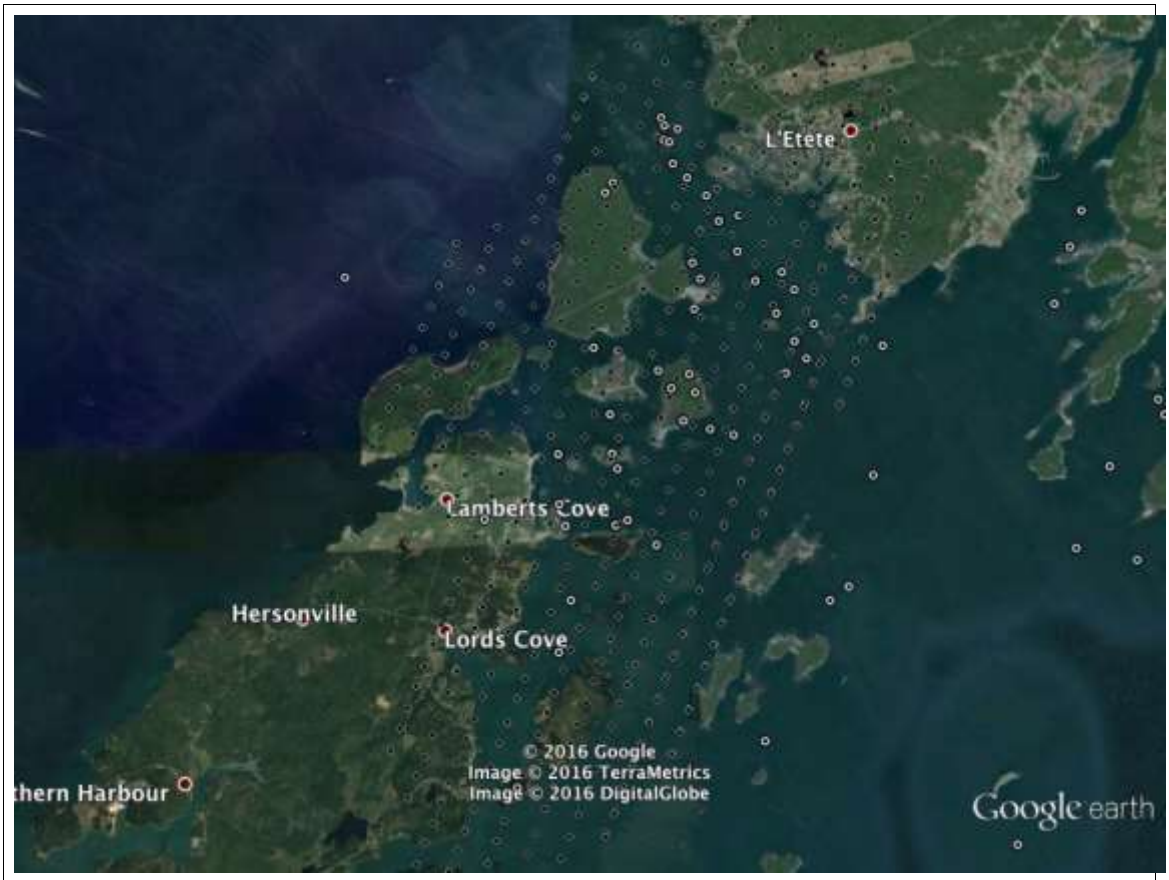


Figure 1. Locations of flocks of common eiders observed on in February 2006, 2012 and 2016 (black dots with bold white halos) and centroids of images (black dots with white halos) collected on 24 and 30 March 2016, Letete Passage, NB.

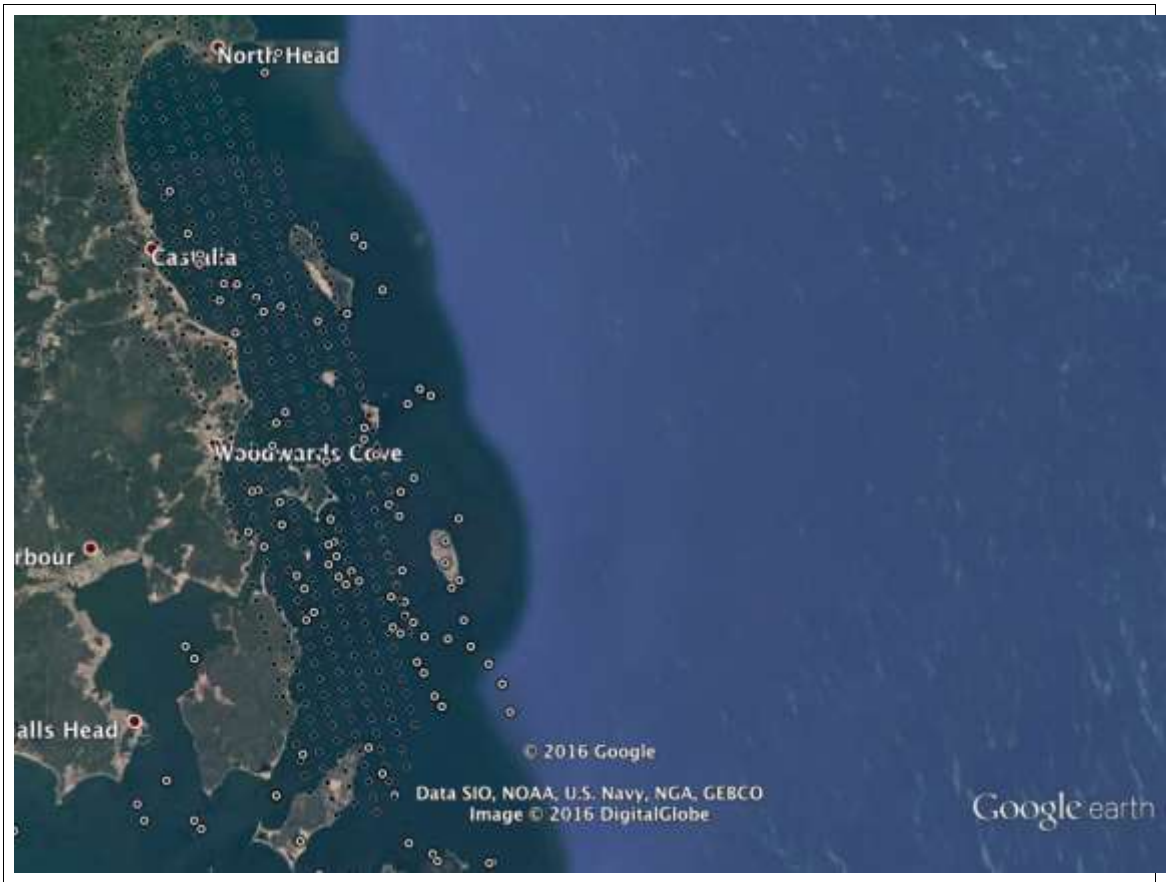


Figure 2. Locations of flocks of common eiders observed on in February 2006, 2012 and 2016 (black dots with bold white halos) and centroids of images (black dots with white halos) collected on 24 and 30 March 2016, North East Grand Manan, NB.

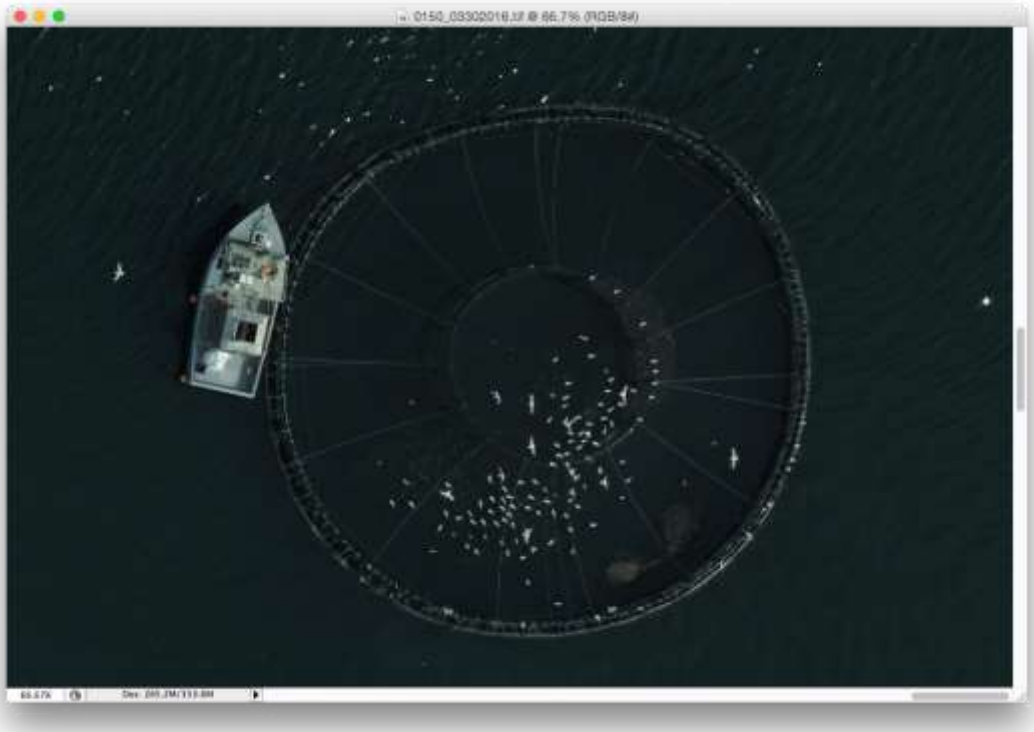


Figure 3. Example of Herring Gulls captured in at an atlantic salmon farm near Deer Island, NB .

Figure 4. Example of a flock of eiders near Letete Passage near Deer Island, NB .

A).

B).

C).

Figure 5. Example of close up the flock of eiders in Figure 4 (a), close up of a male eider (b), and a closeup of a herring gull captured in flight (c).

Figure 6. Example of Harbour Seals captured in an image near Deer Island, NB .