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**AERIAL SURVEYS OF BRANT COLONIES ON YUKON DELTA NWR IN 2004**



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Aerial surveys at five black brant colonies on the Yukon-Kuskokwim Delta--Kokechik Bay (KB), Tutakoke River (TR), Kigigak Island (KI), Baird Inlet Island (BI), and a peninsula northwest of Baird Inlet Island (BP) were conducted on 2 June. Timing of surveys was the earliest ever due to an extremely early break-up. A vertically mounted Kodak 14n Pro digital still camera replaced the dual digital video cameras used in previous surveys. This camera, which has a photo sensor equivalent to the area of 35 mm film, sampled non-overlapping 0.26-hectare quadrats through a hole in the floor of a Cessna-206 aircraft. With the exception of the camera used, sampling protocol was similar to that of recent years and systematically spaced flight lines were established along the long axis of all colonies as in 2003. An external Global Positioning System (GPS) receiver was interfaced with a laptop computer via the serial ports to

record the location of transects and the moving aircraft on the computer monitor. A second GPS receiver was interfaced with the digital camera to record the latitude and longitude of each image. These data along with GPS altitude, time-date, and photographic information were stored internally with each image (Table 1). Surveys were conducted under high overcast to bright sun at all colonies, which provided mostly favorable lighting conditions. Transects were spaced at 150-350 m intervals depending on the size of the colony. We flew at 122 m AGL, which produced images about 63 m wide and 41 m high. Flight speed was 133-177 km/hr over all colonies. KB, TR, KI, BI, and BP required 0:34 (hours:minutes), 0:40, 0:29, 1:04, and 0:31, respectively, from start of first transect to end of last transect. The extra time spent at BI was due to a computer failure that required landing the aircraft and troubleshooting the problem. Ground-truthing searches were conducted at KB, KI, and TR.

GPS locations, which were stored with images created by the camera in exchangeable image file (Exif) format, were plotted on digitized topographic maps with MIPS (Map and Image Processing System) geographical information system. Total area in each colony was determined with the planimeter function in MIPS from GPS locations recorded during flight. Area sampled by each transect was computed from the GPS altitude extracted from Exif files and the focal length of the lens used.

Image files were first converted from Kodak's proprietary format (.dcr) to a compressed format (.jpg) for viewing on a computer with a MATLAB image-processing program on a 43-cm monitor. Digitized images of known nests from previous years and nests from the current year were displayed as background on the computer monitor as a reference to image scale and appearance of different postures of birds in the video images. Because the images recorded with

the digital still camera (4500 x 3000 pixels) covered about 44 times the area of video images (640 x 480 pixels), the images were viewed in sub-areas that were approximately equivalent to 2.2 times that of a video image. This additional viewing area was judged to be better for interpreting image content and had the added advantage of reducing processing time. Transect number, image file name, sub-area being viewed, and observation codes were recorded automatically to file whenever an observer manually entered a two-digit observation code. In addition to recording observations of brant, cackling Canada geese, emperor geese, white-fronted geese, and eiders, boot tracks at BI and KB, as well as motorized vehicle tracks at KB, were noted. All image files with nests of brant, cackling Canada geese, emperor geese, white-fronted geese, and eiders were saved on compact disk. Processing time of imagery was less than in previous years because, unlike videotape that required manual digitization, the images recorded by the digital still camera were converted to a viewable format automatically by the computer. As previously mentioned, the ability to view sub-areas larger than video images also contributed to less processing time. Other efficiencies in processing survey data resulted from the easily retrieved information stored in Exif format with each image (e.g., file name, time, latitude-longitude, altitude).

Nest predation by arctic foxes was greatly reduced throughout the coastal region this year compared to 2003. Numbers of unoccupied nests and nests with strewn down seen in images were reduced from last year. The nest estimate at KB was again low this year (Table 2) and the number of nests found on ground-truthed transects confirmed the decline in number of nests. Only 14 active nests and 5 destroyed nests (apparently flooded by an extremely high tide) were found in 3.5 hectares intensively searched during ground-truthing at KB in an area with

historically high densities of nests. Counts of ATV and boot tracks indicated an increase in human activity in the brant colony. Boot counts have increased from 30 in 2001 to 34, 160, and 166 in 2002-2004, respectively. First observation of the use of motorized vehicles was recorded by video cameras in 2002 outside the survey area. In 2003 15 snow machine tracks and 1 ATV track were observed in video images and in 2004 ATV tracks were observed 88 times in sub-areas equivalent to video images. Extrapolated to the total area of the colony, estimated length of ATV tracks in the colony in 2004 is about 18 km. Coincidental with the apparent increase in human activity in the KB area estimates of the number of nesting brant has declined.

Consistently the colony with the most nests among five colonies surveyed annually since 1992, KB had the fewest nests in 2003 (655 nests), which was a year of high fox predation. By comparison, KB had the largest nest population among all colonies in 2001, also a year of very high fox predation but with less evidence of human activity. Estimated number of nests in 2004 is  $1996 \pm 116$  nests, compared to an average of  $6893 \pm 902$  nests from 1995-2000. Although other factors influence fluctuations in productivity (fox predation, nesting conditions due to climatic factors, physical condition of females arriving from wintering areas) the dramatic decline in total nesting effort (i.e., evidence of failed nests as well as active nests) causes concern for the effect of disturbance by humans in this colony. Estimates of nests at TR and BI also were relatively low compared to previous years without high fox predation. Most nests (67%) counted in images from TR were located between Tutakoke River and Kashunuk River even though this area is about 20% of the total area surveyed. Human activity on BI appeared to be high this year. Boot prints were observed 176 times in sub-areas equivalent to video images, compared to 144 observations of boot prints in video images in 2001, 138 in 2002, and 70 in 2003. BP, which is

about 5 km northwest of BI, had more “normal” number of nests. KI had the greatest number of nests among all colonies for the first time since the survey began.

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Table 1. An example of information saved in exchangeable image file format (Exif) in a compressed image file (bran\_0716.jpg) recorded by the Kodak digital camera at Tuatkoke River. This information for all image files was automatically recorded in a spreadsheet for each colony.

FileName, bran_0716.jpg
JFIF_APP1, Exif
Software, KODAK PROFESSIONAL DCS Photo Desk
GPS: Good fix (08 sats)
UTC Time: 01:51:12
Lat: 61 15.320,N
Lon: 165 38.199,W
Alt: 122.4,M
ISO Speed: 200
Shutter: 1/2000
Focal Length: 70
Shooting Mode: Single
White balance: Auto
DateTimeOriginal, 2004:06:02 17:53:32
DateTimeDigitized, 2004:06:02 17:53:32
ExifImageWidth, 4500 pixels
ExifImageHeight, 3000 pixels

Table 2. Estimates from photographic aerial surveys of brant nests at five colonies--Tutakoke River (TR), Kokechik Bay (KB), Baird Island (BI), Kigigak Island (KI), and Baird Peninsula (BP)--on Yukon Delta National Wildlife Refuge from 1997 to 2004.

COLONY	ANNUAL ESTIMATE								S.E.							
	1997 <sup>2</sup>	1998 <sup>2</sup>	1999 <sup>1</sup>	2000	2001 <sup>2</sup>	2002 <sup>2</sup>	2003 <sup>2</sup>	2004 <sup>2</sup>	1997	1998	1999	2000	2001	2002	2003	2004
TR	4,588	3,448	4,100	7,437 <sup>2</sup>	1,212	4,524	1,622	2,704	554	292	96	584	73	314	79	153
KB	9,144	5,655	4,072	8,021 <sup>2</sup>	3,677	4,634	655	1,996	1092	471	74	866	215	362	52	116
BI	1,944	2,747	1,777	4,088 <sup>1</sup>	3,604	3,052	3,202	2,759	242	264	80	324	198	199	135	160
KI	4,776	3,105	3,962	4,286 <sup>1</sup>	1,721	4,380	2,474	3,284	595	238	402	647	107	255	118	208
BP	2,259	1,431	448	1,962 <sup>1</sup>	421	2,708	547	1,687	282	169	81	142	36	147	46	76
TOTAL	22,711	16,386	14,359	25,749	10,635	19,298	8,500	12,430								

<sup>1</sup> Estimates based on Lincoln-Petersen analysis of counts by two observers.

<sup>2</sup> Estimates based on correction factors from ground-truthed transects.





Figure 1. All-terrain vehicle (ATV) tracks in a digital image recorded during the aerial survey of the brant colony at Kokechik Bay in 2004.