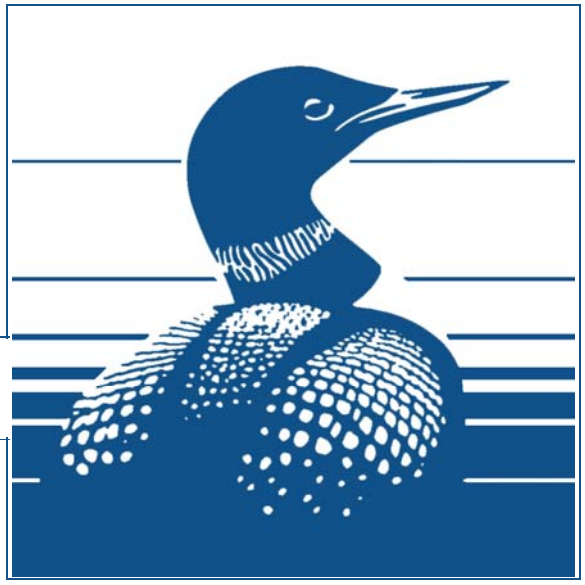
Limnology and Aquatic Birds: Abstracts and Selected Papers from the Fourth Conference of Societas Internationalis Limnologiae (SIL) Aquatic Birds Working Group

Alan Hanson, Joseph Kerekes and Julie Paquet (Editors)

Atlantic Region



Technical Report Series Number 474

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Limnology and Aquatic Birds:

Abstracts and Selected Papers from the 4th Conference of the Societas Internationalis Limnologiae (SIL) Aquatic Birds Working Group

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Canadian Wildlife Service Technical Report Series No. 474

This report may be cited as:
Hanson, A., J. Kerekes and J. Paquet. 2006. Limnology and Aquatic Birds: Abstracts and Selected Papers from the Fourth Conference of the Societas Internationalis Limnologiae (SIL) Aquatic Birds Working Group. Canadian Wildlife Service Technical Report Series No. 474 Atlantic Region. xii + 203 pp.

Published by authority of the
Minister of the Environment
Canadian Wildlife Service

Catalogue No.: CW69-5/474E-MRC
ISBN: 0-662-45053-5

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Characterization of breeding habitats for black and surf scoters in the eastern boreal forest and subarctic regions of Canada

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This paper can be cited as Perry, M. C., D. M. Kidwell, A. M. Wells, E. J. R. Lohnes, P. C. Osenton and S. H. Altmann. 2006. Characterization of breeding habitats for black and surf scoters in the eastern boreal forest and subarctic regions of Canada. Pp. 80–89 *in* A. Hanson, J. Kerekes and J. Paquet. 2006. Limnology and Waterbirds 2003. The 4th Conference of the Aquatic Birds Working Group of the Societas Internationalis Limnologiae (SIL). Canadian Wildlife Service Technical Report Series No. 474. Atlantic Region. xii + 202 pp.

Abstract

We analyzed characteristics of wetland habitats used by breeding black scoters (*Melanitta nigra*) and surf scoters (*M. perspicillata*) in the eastern boreal forest and subarctic regions of Canada based on satellite telemetry data collected in the spring and summer. During 2002 and 2004, nine black scoters (four males, five females) were tracked to breeding areas in Quebec, Manitoba, and Northwest Territories. In addition, in 2001–04, seven surf scoters (three males, four females) were tracked to breeding areas in Labrador, Quebec, Northwest Territories, and Nunavut. Based on satellite telemetry data, locations of black and surf scoters in breeding areas were not significantly different in regard to latitude and longitude. Presumed breeding areas were manually plotted on topographic maps and percent cover type and water were estimated. Breeding habitat of black scoters was significantly different than that for surf scoters, with black scoters mainly using open (tundra) areas (44%) and surf scoters using mainly forest areas (66%). Surf scoters presumed breeding areas were at significantly higher elevations than areas used by black scoters. Some breeding areas were associated with islands, but the role of islands for breeding areas is equivocal. These results aid in the identification of potentially critical breeding areas and provide a baseline classification of breeding habitats used by these two species.

Introduction

Little is known about the location or habitat characteristics of breeding areas for black scoters (*Melanitta nigra*) or surf scoters (*M. perspicillata*) in the eastern boreal forest and subarctic regions of Canada. Habitat loss of breeding areas from logging, mining, and hydro-electric power production (Elliot 1997), may be possible explanations for population declines for black and surf scoters that winter in the Chesapeake Bay area (Perry and Deller 1995) and other areas of the Atlantic Flyway (Caithamer et al. 2000). Additional information is needed about the location of the breeding areas of scoters so managers can determine, if possible, threats that impact recruitment. Black and surf scoters are of special concern as they are the least studied among the waterfowl (Godfrey 1986, Bordage and

Savard 1995). Additionally, the black scoter is the least numerous of the three scoter species (Kehoe 1994).

The breeding habitat of these two species in eastern Canada has received little study due to the remote and large breeding areas they use (Bordage and Savard 1995, Savard et al. 1998). Early naturalists and researchers were restricted to lower latitudes and to the actual size of the area they could study, due to accessibility restrictions that prevailed until the advent of aircraft use for field studies.

The main objective of this study was to delineate breeding populations of black and surf scoters randomly selected in wintering and staging areas for instrumentation with satellite transmitters. A secondary objective of this study was to determine the habitat conditions in the breeding areas using satellite telemetry combined with mapping techniques.

Methods

Telemetry

We captured surf scoters on the Chesapeake Bay with a net gun, shot from the bow of a fast moving boat. On the Restigouche River, we captured black scoters with standard night-lighting procedures, which use hand-held dip nets from the bow of a slowly moving boat with the aid of bright lights. Males and females were used for the telemetry aspect of this study as both sexes go to the breeding areas, although males move to molting areas shortly after initiation of incubation, providing additional data.

Captured ducks were surgically implanted with a 39 g PTT-100 satellite transmitter, manufactured by Microwave, Inc., Columbia, Maryland. Surgery followed general procedures outlined in other telemetry studies (Korschgen et al. 1984, Korschgen et al. 1996). Duty cycle of the transmitter varied slightly each year, but was in the range of 6–8 hours transmitting and 48–60 hours not transmitting. Each duck was held post-surgery for 1–3 days and then released at the site of capture.

All data from transmitters implanted in black and surf scoters were collected from the Argos System, which is carried aboard the NOAA Polar-orbiting Operational Environmental Satellites (POES), through Service Argos, Inc. in Landover, Maryland. The data were analyzed and filtered at Patuxent Wildlife Research Center by staff using Statistical Analyses Software (SAS; SAS Institute, Inc. 1990) and a software program designed to process telemetry data (Dave Douglas, pers. comm.). The filtering process (User Manual, Argos, Inc., Landover, MD) removes data with no estimation of location accuracy (level 0) and data deemed invalid by Argos (level Z). Filtered data (levels 3, 2, and 1) were then plotted using Geographic Information Systems (ArcGIS 8.2; ESRI, Redlands, CA) maps maintained on the Atlantic Seaduck Project website of Patuxent Wildlife Research Center. Satellite telemetry was used to delineate the breeding populations, because it is the optimum technique to determine movements and locations of long-distance migrating birds going to remote areas of large inaccessible northern habitats.

Habitat mapping

Telemetry data from 2001 to 2004 with the highest spatial accuracy (level 3 <150 m) were selected and their locations plotted on a digital NIMA (National Imagery and Mapping Agency) Arc Digitized Raster Graphics (ADRG) of Canada using ArcGIS 8.2. Clusters of points associated with the breeding period were identified as presumed breeding locations and analyzed to determine the length of stay at the different locations. For males, which remain at the breeding area during courtship, time periods greater than 2 weeks were used to select ducks for study. For females, which remain at the breeding lake for several months, length of stay greater than a month was used.

Topographical maps were used in conjunction with ADRG to characterize the breeding habitat, and habitat types were manually accessed from the maps. Digital acquisition of habitat data would have been preferred as a faster and more accurate process, but was not available for the areas of interest in this study. In addition, the NIMA ADRG maps did not provide adequate resolution to discern specific breeding habitats. Therefore, we evaluated the habitat characteristics of breeding areas by transferring the location of the centroid for each cluster of location points to a 1:50,000 topographic maps (National Topographic System, Natural Resource, Canada) and establishing a 4-km square plot centered over the presumed breeding area.

These areas were examined to estimate percent land and water cover for each habitat type. Various icons described in the legends of the maps represented habitat type, including open (tundra), forest, marsh, swamp (wooded wetland), and lake. We had hoped to classify wetlands in detail using descriptions given by the National Wetlands Working Group (1988), but the maps used were not at that level of description. We determined percentages by using a grid (0.25 km) over the map and recording the habitat type at each intersection of the horizontal and vertical lines (n = 256). Size and configuration of lakes, origin of water, presence of islands, and the number of lakes within the square plot were also determined. Elevation and topography (major changes in elevation) of the surrounding area were also determined. Obviously, these data would be more accurately measured in the field, but due to the inaccessibility of the northern area and the high cost to travel there, we attempted to use this less direct approach. All data were analyzed using multi-way analysis of variance (ANOVAs) in SAS (Proc Mixed; SAS Institute, Inc. 1990). All analyses were considered significant at the 5% level.

Results

Telemetry coordinates

Sixteen scoters instrumented with satellite transmitters were tracked to presumed breeding areas in Labrador, Quebec, Manitoba, Nunavut, and the Northwest Territories (Figure 1). Fifteen of the scoters were located in the taiga shield, with three of these located near the taiga shield/tundra line. Nine scoters (4 black and 5 surf scoters) were located east of Hudson Bay and six (4 black and 2 surf scoters) were located west of Hudson Bay. One female black scoter was located in tundra habitat in Northwest Territory.

It was not possible to confirm breeding activity or determine the exact location of any breeding areas, as funds were not available for ground inspections. The mean latitude of breeding areas for the nine black scoters was 59˚27' N, which was not significantly different ($F_{1,14}$ = 3.85, P = 0.069) from the mean latitude of 56˚44' N for the breeding areas for the seven surf scoters (Table 1). The mean longitude for the breeding areas for the nine black scoters was 89˚26' W. This was not significantly farther west than the surf scoters ($F_{1,14}$ = 2.39, P = 0.144), which had a mean longitude of 76˚08' W. The duck that nested the farthest west was also located farthest north and was a female black scoter in the Northwest Territories at 64˚34' N/111˚36' W.

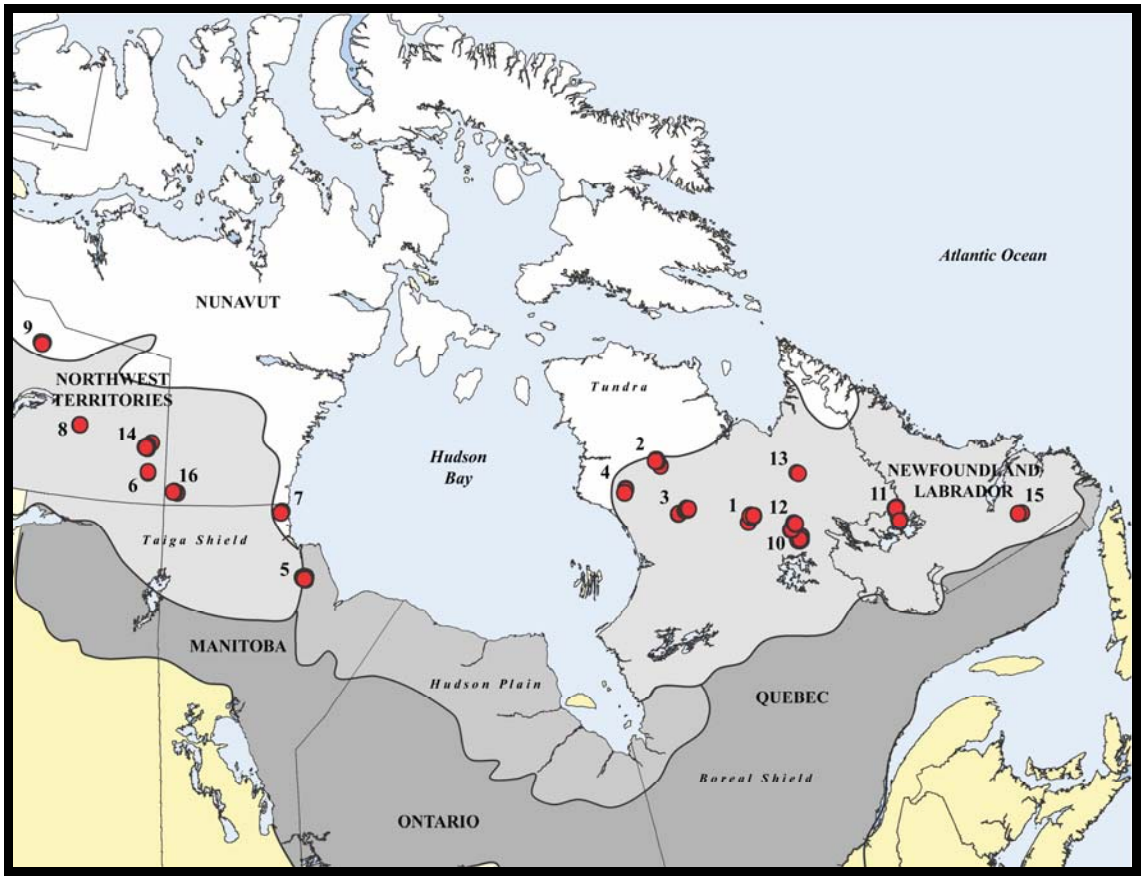

Figure 1. Location of sixteen scoters instrumented with satellite transmitters and tracked to presumed breeding areas in Labrador, Quebec, Manitoba, Nunavut, and the Northwest Territories.

Hydro-Morphology

The hydrology at the presumed breeding areas identified by satellite telemetry was evaluated with map analyses as part of the scoter habitat assessment. The nine breeding areas used by black scoters were all associated with ponds and small lakes that varied in shape from circular to elongate. The mean size of the presumed breeding lake for black

Table 1. Breeding habitat types used in Labrador, Quebec, Manitoba, Nunavut, and Northwest Territories by black and surf scoters during spring and summer 2001–04, based on locations determined by satellite telemetry.

Scoter Species	No.	Sex	PTT No.	Year	Location	Latitude/Longitude	Elev. (m)	Percent Cover				
								Open[1]	Forest	Marsh	Swamp	Lake
Black	1	M	36024	2002	Quebec	56˚20' N / 70˚17' W	400	10	77	2	7	4
	2	M	36198	2002	Quebec	58˚52' N / 73˚51' W	220	70	0	0	0	30
	3	M	36200	2002	Quebec	57˚16' N / 73˚20' W	325	80	0	0	0	20
	4	M	36201	2002	Quebec	58˚23' N / 75˚59' W	180	72	0	0	0	28
	5	F	36366	2002	Manitoba	57˚50' N / 94˚13' W	80	0	5	60	15	20
	6	F	49435	2004	NW Terr.	60˚55' N / 103˚3' W	400	8	42	2	24	24
	7	F	49437	2004	Manitoba	59˚45' N / 95˚13' W	60	59	13	0	1	27
	8	F	49440	2004	NW Terr.	62˚6' N / 107˚24' W	400	16	40	0	18	26
	9	F	49441	2004	NW Terr.	64˚34' N / 111˚36' W	450	81	0	1	0	18
					Mean:	59˚27' N / 89˚26' W	279	44	20	7	7	22
Surf	10	M	20658	2001	Quebec	55˚11' N / 68˚45' W	580	0	77	0	0	23
	11	M	20660	2002	Quebec	54˚43' N / 63˚56' W	510	15	60	0	5	20
	12	M	20668	2002	Quebec	55˚32' N / 68˚51' W	450	0	90	0	0	10
	13	F	40761	2003	Quebec	56˚50' N / 67˚8' W	300	0	92	0	0	8
	14	F	40762	2003	NW Terr.	61˚38' N / 103˚18' W	320	60	5	5	0	30
	15	F	40772	2004	Labrador.	52˚52' N / 59˚34' W	400	0	69	25	0	6
	16	F	49434	2004	Nunavut	60˚24' N / 101˚26' W	410	4	70	0	0	26
					Mean:	56˚44' N / 76˚08' W	424	11	66	4	1	18

[1]Open habitat is considered tundra

scoters was 87 ha with a range of 1–305 ha. All lakes were associated with small rivers. There were five lakes of the same or equal size varying from 0.1–1.3 km in distance from the lake where black scoters were presumed to be breeding.

The seven presumed breeding areas used by surf scoters were also associated with ponds and small lakes that varied in shape from circular to elongate. The mean size of the breeding wetland for surf scoters was 22 ha with a range of 5–69 ha, which was not significantly different than the mean size of lakes used by black scoters ($F_{1,14} = 3.32$, $P = 0.090$). All lakes presumed to be used by surf scoter for breeding were associated with small rivers. There were 22 lakes of the same or equal size varying from 0.1–1.1 km in distance from the presumed breeding lake used by the instrumented surf scoters.

Topographic Data

Analyses of data obtained from topographic maps based on the telemetry locations showed differences between the two scoter species for composition of the landscape (Table 1). The average elevation of habitat used by the nine black scoters (279 m) was significantly less ($F_{1,14} = 4.91$, $P = 0.044$) than the average elevation of habitat used by the seven surf scoters (424 m).

Open (tundra) habitat was the predominant cover type that black scoters selected for breeding areas and comprised 44% compared to 11% open habitat for surf scoters ($F_{1,14} = 4.72$, $P = 0.047$). Forest habitat was the predominant cover type for surf scoter breeding areas and comprised 66% compared to 20% for black scoters ($F_{1,14} = 10.66$, $P = 0.006$). Lakes accounted for the third highest cover type overall with a mean of 22% for black scoters and comprised 18% for surf scoters ($F_{1,14} = 1.03$, $P = 0.327$). Marsh habitat comprised 7% of the cover for black scoters and 4% for surf scoters ($F_{1,14} = 0.13$, $P = 0.722$). Habitat classified as swamp (forested wetland) made up 7% of the habitat for black scoters and 1% for surf scoters ($F_{1,14} = 3.21$, $P = 0.095$). The four largest lakes associated with black scoters had islands, but the three smaller lakes did not.

Discussion

This project, which used satellite telemetry to locate breeding areas of two species of scoters and then applied mapping techniques to determine habitat conditions, has potential for future waterfowl studies, especially with species that reside in remote locations such as scoters.

The nesting data for black and surf scoters provided by early naturalists (Audubon 1838, Thompson 1891, Preble 1902, Bent 1925, Austin 1932) provide information about areas that were accessible to these investigators. Other reports (Manning 1952, Harper 1958, Gillespie and Wetmore 1974, Ross 1983, Goudie and Whitman 1987) increased the information on scoters, but observations were still restricted to the lower latitudes or limited in the size of the area they could study. With aircraft support, scientists were able to study areas that were in northern latitudes and were larger in size. Research conducted by Savard and Lamothe (1991) with helicopter support found the highest densities of black and surf scoters reported in North America in the Lac Bienville area of Quebec at 55˚N, and that densities of scoters increased with higher latitudes.

The lack of digital mapping data in this study made determination of the habitats in these remote areas very time consuming. Based on data derived from satellite telemetry and NTS maps, both species of scoter appear to be associated with the Taiga Shield ecozone, a patchwork of lakes, wetlands, open (tundra), forests, shrublands, and meadows marking the transition from the boreal forest in the south and the open (tundra) to the north (Environment Canada website, http://www.ec.gc.ca, 2004). However, specific local habitats used by the two scoters were different, with black scoters preferring open (tundra) environments and surf scoters preferring forest environments. This difference is further supported by the southern extreme known surf scoter breeding areas located within the boreal forest, at Lac Malbaie, near Quebec City (Reed et al. 1994), and the northern extreme female black scoter that presumably nested within the tundra in this study. Both species appear to nest in habitats with a similar land/water ratio, which is expected considering the large area affected by the glacial history of Canada, but in areas that differ in the amount of surrounding woody vegetation.

The size of lakes used by the two species of scoters as presumed breeding habitat based on our telemetry data were similar to the very limited data previously reported. In Quebec, black scoters were reported to use shallow lakes (<5 m) for breeding in the size range of 10–30 ha and that large deep lakes were avoided (Consortium Gauthier and Guillemette – GREBE 1993). Surf scoters in Quebec also used shallow lakes less than 10 ha in size and avoided large deep lakes (Decarie et al. 1995). Large fish that prey on ducklings may not be able to survive in shallow lakes during winter due to ice cover, whereas, the non-predatory brook trout (*Salvelinus fontinalis*), which are common in shallow lakes such as Lac Malbaie, can overwinter in rivers adjoining the lakes. The role of fish, especially predatory fish, in breeding lakes may be an important limiting factor in the size and depth of lakes selected by scoters as breeding areas (Eriksson 1983, McNicol and Wayland 1992 Mallory et al. 1994). Unfortunately, our data, without ground investigation, were unable to substantially clarify this issue.

Some of the presumed breeding areas in this study were in areas where islands existed within the selected lake habitat. However, there was no indication from the telemetry data that scoters were actually selecting lakes that had islands or that they were nesting on islands. The possibility exists that this is an important factor for northern breeding ducks exposed to several species of mammalian predators. Several well-known breeding areas of scoters do have prominent islands. Lac Malbaie is the southernmost known nesting area for surf scoters and this area has two prominent islands where most of the nesting is believed to occur (Reed et al. 1994, Savard et al. 1998). Highest density of nesting for white-winged scoters has been reported on islands (Brown and Fredrickson 1997) and Redberry Lake in Saskatchewan is a notable example with nesting islands (Brown and Brown 1981).

Islands and the presence of ducks were recorded in the extensive waterfowl surveys conducted in Fennoscandia (northern Finland, Norway, and Sweden) in 1972–76, but not reported (Haapanen and Nilsson 1979). Analysis of these data (L. Nilsson, pers. comm.) showed that there was not a significant difference ($F_{3,28} = 0.87$, $P = 0.47$) in the number of breeding pairs of the European black scoter recorded on lakes with no islands and those that had one, two, or three islands. The telemetry/mapping techniques used with our study are considered adequate to detect large islands; however, ground inspection may be necessary to detect small islands. With more data and more detailed maps, researchers will be in a better position to describe the role of islands as a habitat characteristic that could be

influencing nest site selection by scoters.

This investigation of the breeding habitat of black and surf scoters is preliminary, but we feel the techniques and habitat issues for further study include the ones we examined. More research is necessary to determine the importance biotic and abiotic characteristics such as islands, water depth, predatory fish, and food resources that could be influencing nest site selection. More accurate assessment of scoter breeding habitat in the northeast, similar to that done with lesser scaup (*Aythya affinis*; Fast et al. 2004), will only be possible with a much greater funding effort to provide aircraft to support ground activities. The breeding areas are especially important to study due to their value in scoter population recruitment. The use of satellite radio telemetry tracking in association with a series of mapping techniques will be helpful in future studies of inaccessible and remote areas such as the scoter breeding grounds. Once waterfowl managers have a better understanding of the habitat requirements of scoter populations, they will have a greater awareness of the problems confronting these species.

Acknowledgements

The staff of the Canadian Wildlife Service provided guidance and personnel for most aspects of the study conducted in Canada, especially Daniel Bordage, Alan Hanson, Keith McAloney, and Jean-Pierre Savard. Glenn Olsen (USGS-PWRC) conducted all surgery to instrument the scoters with internal transmitters. Tim Bowman, George Haas, Keith McAloney, and Scott Phillips were very influential in providing funding and encouragement. Technical advice and encouragement were provided by Tony Chubbs (NATO Training, Labrador), Paul Howey (Microwave Telemetry, Inc.), Pierre Lamothe (Hydro-Québec), Austin Reed (CWS, Retired), and Steve Shubert (National Security Agency). Field assistance was obtained from William Barrow, Thomas Berlin, Caroline Bond, Leanne Elson, Scott Gilliland, and Dawn Laing. Dixie Birch, George Haas, Alan Hanson, Lynda Garrett, Emily Teate, and several anonymous persons provided review of and technical assistance with the manuscript. The assistance of all these persons is greatly appreciated.

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