Arctic temperatures and the long-tailed ducks shot in eastern North America

Author: Boyd, Hugh

Source: Wildlife Biology, 2(2) : 113-117

Published By: Nordic Board for Wildlife Research

URL: https://doi.org/10.2981/wlb.1996.040

Arctic temperatures and the long-tailed ducks shot in eastern North America

Hugh Boyd

Boyd, H. 1996: Arctic temperatures and the long-tailed ducks shot in eastern North America. - Wildl. Biol. 2: 113-117.

The numbers of adult females and first-winter long-tailed ducks *Clangula hyemalis* shot in eastern North America between 1972 and 1994 have fallen, though the kill of adult males shows no trend. Most of these ducks are likely to have originated in the Arctic Tundra climatic region of Canada. Although summer and autumn temperatures in that region have shown no trends since 1972, their annual variations can account for 19-53% of the variations in the breeding success of eastern-wintering long-tailed ducks, as reflected by the numbers of first-winter birds in the kill.

Key words: Clangula hyemalis, long-tailed duck, oldsquaw, Arctic temperatures

Hugh Boyd, National Wildlife Research Centre, Canadian Wildlife Service, Environment Canada, Ottawa, Ontario, Canada K1A 0H3

Received 17 April 1996, accepted 14 May 1996

Associate Editor: Johan Elmberg

The long-tailed duck *Clangula hyemalis* has a circumpolar distribution and breeds widely across the Canadian Arctic (Ouellet 1990). Alison (1975) made an intensive study of a group breeding near Churchill, Manitoba (58°N, 93°W), near the southern limit of the Canadian range, and Pattie (1990) recorded changes in numbers over 20 years on the Truelove Lowland, Devon Island, NWT (75°N, 84°W), near the northern limit, but it is impracticable to make direct observations of breeding numbers and performance across the entire Canadian range. This note explores the use of the annual waterfowl harvest surveys in Canada and the USA to provide indirect measures of the breeding success of long-tailed ducks in the Canadian Arctic. These are used, in conjunction with measures of seasonal temperatures, to test whether variations in warmth in the breeding range have affected breeding success.

The national harvest surveys ask selected groups of waterfowl hunters in both Canada and the USA to report on their activities. From their responses, estimates of the retrieved kills of all species of ducks and geese can be made each year. Cooch et al. (1978) and Caswell & Dickson (in press) describe the rationale for the two Canadian mail questionnaire surveys and give details of the procedures. The American survey, which began in the 1960s and on which the Canadian ones were modelled, uses a different sampling frame from the Canadian, but the two national surveys produce closely analogous results. In each country, the national harvest survey (NHS) yields estimates of the numbers of active hunters and hunter days' and of the numbers of waterfowl taken. A second survey (the species composition survey, or SCS), sent to a different group of hunters, provides samples of duck wings, which are used to partition the estimated total kill of ducks to yield estimates for each species. The wings also show the relative abundance of adults and first-winter birds, and of males and females in the kill.

It is easy to identify the wings of adult female and adult male long-tailed ducks but in the US surveys the first-winter birds have not been classed by sex, and attempts to sex first-winter wings in Canada have been sporadic. All first-winter birds are therefore treated here as a single, unsexed class.

Though sea-duck hunting used to be of major importance in eastern North America, today relatively few hunters shoot long-tailed ducks, most of which are usually found offshore, both along the Atlantic coast of North America, from Labrador to North Carolina, and on the Great Lakes, where the reported kill has decreased greatly. In recent years, long-tailed ducks have formed only about 0.7% of the duck kill in eastern Canada and 1.6% in the US Atlantic Flyway. Thus the annual wing samples are small, even when those from both countries are pooled (Table 1), because few of the hunters selected to take part in the SCS are in a position to take long-tailed or other sea-ducks, so that the efficiency of the survey for dealing with these species is low and variable.

Annual age- and sex-composition of the long-tailed duck kill

Table 1 summarizes the size of the annual kill in eastern Canada (including Ontario) and the US Atlantic Flyway. Very few long-tailed ducks are taken in western North America. Some are taken in the US Mississippi Flyway (annual average in 1971-1980: 1,383 (Carney et al. 1983) and 522 in 1981-1990 (E.M. Martin, unpubl. data) and they have been included in the Atlantic Flyway totals (see Table 1).

The mean size of the combined eastern Canadian and American kill was 29,600 (s.d. 10,400), ranging from 16,800 in 1989-90 to 58,900 in 1984-85. There has been a downward trend in the total kill [r(total kill.years) = -0.449, $P < 0.05$], due to a substantial reduction in Canada, at a mean annual rate of -4.4%, with no clear trend in the American kill. The reduction in kill has been confined to adult females and first-winter birds, at mean annual rates of -5.1% and -2.1%, respectively (Table 2). Though the kill of adult males has varied as much as that of first winter birds, it has shown no trend. The composition of the Canadian wing samples, taken further north in the wintering range than the American ones, has not differed from them in any consistent way.

Table 1. Estimates of retrieved kill of long-tailed ducks (x1000) in eastern North America, 1972-1994 (N = 23); and numbers of long-tailed duck wings contributed to species composition surveys in those years.

				Wings sent in to SCS		
Year	Canadian kill	American kill	Total kill	Canada	America	Total
1972	16.6	14.5	31.1	138	105	243
1973	24.8	17.2	42.0	161	93	254
1974	19.3	14.0	33.3	126	54	180
1975	22.7	25.1	47.8	61	107	168
1976	19.4	17.7	37.1	75	56	131
1977	9.9	9.0	18.9	50	78	128
1978	10.9	7.0	17.9	51	61	112
1979	21.0	18.3	39.3	149	115	264
1980	16.9	7.4	24.3	96	33	129
1981	14.4	18.9	33.3	65	52	117
1982	17.6	9.9	27.5	98	80	178
1983	20.8	7.2	28.0	97	69	166
1984	27.1	31.8	58.9	158	80	238
1985	11.9	15.0	26.9	90	68	158
1986	20.6	14.9	35.5	114	52	166
1987	13.9	13.8	27.7	79	42	121
1988	10.7	16.1	26.8	63	72	135
1989	9.3	7.5	16.8	47	63	109
1990	6.3	19.7	26.0	43	103	146
1991	4.8	12.7	17.5	54	59	113
1992	4.1	19.4	23.5	42	78	120
1993	8.4	13.7	22.1	65	148	213
1994	7.6	11.9	19.5	109	152	261
Mean	14.7	14.9	29.6	88	79	167
s.d.	6.6	6.0	10.4	38	31	52
r(years)	-0.664	-0.051	-0.449	-0.422	0.215	-0.179
P	<0.001	NS	<0.05	<0.05	NS	NS
% annual change	-4.4	-2.3	-2.7			

There is little independent information about the autumn and winter distribution of birds in the different age- and sex-categories. After reviewing the literature, Bellrose (1976) suggested that adult males were usually last to move south. Many long-tailed ducks winter in the open water area, off south-west Greenland, and others in unfrozen parts of Hudson Bay (where the extent of ice may vary widely from one winter to the next). Recoveries of long-tailed ducks ringed in Canada, Greenland and Iceland (Boertmann 1994, and unpublished records in Canadian Wildlife Service files) show that most of the long-tailed ducks marked in Greenland and Iceland have been recovered in northern waters, while those marked in Arctic Canada have been recovered around the Great Lakes and along the Atlantic coast. Changes in the size of the kill in different regions within eastern North America do not seem to have had significant influences on the composition of the combined wing sample (Boyd, unpubl. data).

The ratio of first-winter birds to adult females (mean 2.96, s.d. 1.55), which is often used as an index of production, has tended to increase [r(years) = 0.468, $P < 0.05$]. This suggests that a drop in the number of adult females wintering in eastern North America may have had more to do with their disappearance from the kill than changes in their breeding success.

Seasonal temperatures in the probable breeding range

The Canadian breeding range of the long-tailed duck nearly coincides with the Arctic Tundra climatic region (as defined by Gullett & Skinner 1992). Some breed in the Arctic Mountains and Fjords region of eastern Baffin Island, but their numbers must be relatively small, and climatic variations in that region in summer and autumn have been so similar to those in the eastern part of the Arctic Tundra region that it is reasonable to use seasonal variations in that region alone to represent climatic changes in the breeding range.

Table 2. Estimated numbers of adult and first-winter long-tailed ducks killed annually in eastern Canada and the US Atlantic Flyway in 1972-1994 (N = 23); and Canadian Arctic Tundra temperatures (°C) in the preceding summer and autumn.

	Estimated kill (x1000)				Arctic Tundra temperatures (°C)			
Year	Ad. ♀	Ad. ♂	1st w.	Total	June	July-August	Autumn	June-November
1972	9.0	7.9	14.2	31.1	-2.3	6.7	-11.0	-1.2
1973	7.3	4.8	29.9	42.0	4.1	8.9	-5.2	0.4
1974	4.7	9.6	10.1	24.4	2.9	8.0	-10.0	-0.6
1975	10.7	12.4	25.4	48.5	6.4	7.3	-8.9	-0.3
1976	10.5	5.0	21.6	37.1	1.6	7.2	-8.6	-0.6
1977	4.1	3.9	11.0	19.0	3.5	7.6	-6.9	-0.1
1978	5.7	7.9	4.8	18.4	-1.2	4.5	-11.4	-1.5
1979	9.4	14.2	15.8	39.4	1.0	7.0	-8.9	-0.6
1980	4.0	7.0	13.3	24.3	2.4	7.8	-8.5	-0.4
1981	7.9	6.6	18.8	33.3	3.3	7.2	-6.2	-0.0
1982	4.0	10.2	13.3	27.5	2.1	7.6	-9.2	-0.6
1983	3.6	9.9	13.5	27.5	2.1	7.4	-9.2	-0.6
1984	10.9	20.9	24.6	56.4	3.7	7.6	-8.1	-0.3
1985	6.8	7.4	12.7	26.9	4.7	7.2	-7.6	-0.2
1986	7.1	16.0	12.4	35.5	0.5	7.0	-11.0	-1.0
1987	3.2	9.8	14.7	27.7	1.4	7.4	-7.8	-0.4
1988	6.0	11.7	9.0	26.7	2.4	8.4	-7.5	-0.2
1989	2.4	5.2	9.2	16.8	7.4	7.4	-9.2	-0.5
1990	3.4	9.9	12.5	25.8	2.3	7.4	-9.1	-0.6
1991	1.4	8.9	7.2	17.5	4.0	7.8	-8.3	-0.3
1992	2.7	16.2	4.6	23.5	-0.5	7.3	-8.6	-0.6
1993	2.8	9.5	9.8	22.1	3.9	8.1	-8.9	-0.4
1994	1.6	5.2	12.7	19.5	3.9	7.5	-7.9	-0.3
Mean	5.6	9.6	14.0	29.2	2.5	7.4	-8.5	-0.5
s.d.	3.0	4.2	6.4	10.2	2.0	0.8	1.5	0.4
r(years)	-0.642	0.210	-0.497	-0.416	0.138	0.147	0.053	-0.056
P	<0.001	NS	<0.05	<0.05	NS	NS	NS	NS
% annual change		-5.1	-3.4	-2.1				

Table 3. Correlation of estimated annual kill of first-winter long-tailed ducks in eastern North America with Canadian Arctic Tundra temperatures (°C) in the preceding summer and autumn during 1972-1994 (N = 23).

		Temperatures (°C)			
Estimated annual kill		June	July-August	Autumn	June-November
1st winter kill	r	0.391	0.321	0.436	0.520
	P	NS	NS	<0.05	<0.01
After removal of trend	r	0.529	0.455	0.535	0.595
	P	<0.02	<0.05	<0.02	<0.01
Detrended adult female kill partialled out	r	0.439	0.452	0.544	0.729
	P	<0.05	<0.05	<0.01	<0.001

The last four columns of Table 2 show the year-to-year variations in the Arctic Tundra regional temperatures in June, July-August, autumn (September-November) and in the entire period June-November. These series are derived from records at fifteen stations for which long runs of data were available (Atmospheric Environment Service, unpubl. data). None of the seasonal temperatures shows a significant time trend.

Seasonal variations in precipitation were also examined, but yielded nothing of relevant interest. Precipitation shows much more local variation than does temperature, so that a regional mean is less likely to reflect events of importance to the rearing of ducks across the entire region.

Conditions in June are of crucial importance to the nesting success of most Arctic-breeding birds. The onset and speed of snowmelt determine not only when nesting can begin but also whether Arctic foxes *Alopex lagopus* and other predators will find nests easily, when snow-free areas are few and small. Long-tailed ducks nest later than most other species, beginning in the second half of June or early July, so that the timing of snowmelt may be of less importance to them than to most Arctic-nesting birds.

Cold temperatures in July and August may make it harder for long-tailed ducks to hatch and rear their young. In those months, most are living on lakes, ponds and rivers. Temperatures in autumn, when most adult and young ducks have moved to the sea, affect the onset and rate of formation of sea ice, which may help to drive the ducks south, though they remain in the Arctic until October, long after most other summer migrants have left.

The kill and Arctic seasonal temperatures

Table 3 summarizes the correlations between the estimates of kill of first-winter long-tailed ducks and the Arctic Tundra seasonal temperatures. For first-winter ducks and adult females, which have decreased substantially in the kill, second sets of coefficients were calculated, using the deviations from a linear trend line fitted to the kill estimate.

The unadjusted first-winter kills were significantly correlated with the autumn and June-November temperatures. The coefficients were increased by removal of the trend from the kill, and also after partialling out the correlation between the kills of adult females and first-winter birds. These correlations suggest that variation in Arctic Tundra seasonal temperatures could have accounted for at least 19% and perhaps as much as 53%, of the observed variations in the kill of first-winter long-tailed ducks.

The kills of adult males and females showed no significant correlations with the Arctic Tundra seasonal temperatures. The kills of first-winter birds were correlated with those of adult females ($r = 0.869$; $P < 0.001$), but not with those of adult males. The deviations from their trend lines were also correlated ($r = 0.560$, $P < 0.01$).

Discussion

Two major weaknesses underlie this study: 1) the relatively small numbers of wings from long-tailed ducks that have been available from the species composition surveys; and 2) the uncertain nature of the links between the ducks sampled in winter and those breeding in the Canadian Arctic. Neither weakness can be remedied easily. Concern about the present status of all seaducks along the Atlantic coast of North America, and an obvious reduction in the numbers of long-tailed ducks wintering on the Great Lakes (reflected in the declining numbers of wings received), have led to proposals for more intensive surveys of seaduck hunting, involving selection of more hunters from coastal localities to take part in the harvest and SCS surveys. Even if the responses to these increased efforts are successful, it is likely to take many years with larger samples to produce a series that will be much more reliable than the one used here. The importance of adult females in maintaining any breeding population makes their recent scarcity in the wing samples especially unfortunate.

Uncertainty about the linkages between the wing samples and the status and performance of the Canadian breeding population stems chiefly from the likelihood that there are more Canadian long-tailed ducks wintering north of the areas where most permit-buying waterfowl hunters live than there are in the south of the winter range. If the age- and sex-composition of northern-wintering ducks differs substantially from that of the ducks that hunters can reach, the wing samples may be unrepresentative of the breeding population. There seems to be no practicable way of verifying this. Yet the consistency and strength of the correlations between the kill of first-winter ducks and of Arctic temperatures seem unlikely to have occurred if the composition of the sampled population was highly erratic.

Though correlations cannot demonstrate causation, they can suggest associations, which may differ in plausibility. Similar positive correlations between Arctic summer temperatures and the proportions of young birds shot from, or seen in, goose flocks in autumn have been known for many years (e.g. Boyd 1965, Lynch 1972); and Boyd (1992) showed that summer temperatures in the Canadian Arctic seemed to account for much of the variation in the numbers of knots wintering in Britain. Although von Haartman (1945) showed the effects of water temperatures on the timing of nesting of waterbirds in southwest Finland, no other studies of the large-scale effects of summer weather on northern-breeding ducks seem to have been published.

It was noted earlier that the timing and speed of snowmelt affect the efficiency with which predators can find and destroy ducks' nests. Fluctuations in the numbers of Arctic foxes and predatory birds also affect the survival of ducklings. Some authors (e.g. Summers 1986, Underhill et al. 1993) have argued that fluctuations in the numbers of lemmings (*Lemmus* and *Dicrostonyx* spp.) and other small mammals drive the impact of predators on Arctic-nesting birds, particularly in those years when lemming populations have just crashed, so that predators have to switch to birds and their eggs. In northern Canada, the numbers of Arctic foxes, while showing 'cyclic' fluctuations over large areas, seem to have been greatly influenced by seasonal temperatures, which was apparently not the case in that part of Siberia studied by Summers, Underhill and others.

The indication that autumn temperatures in the Arctic may have had as much influence on the rearing of long-tailed ducks as those in summer may reflect both their late stay in the north and the difficulties young diving ducks may encounter when first foraging at sea, without maternal guidance.

The greatest value of this note would be realized if it leads to comparable studies of other Arctic-nesting ducks in western North America and in Eurasia.

Acknowledgements - I am indebted to the Director, U.S. Fish & Wildlife Service for permission to use data from informal administrative reports; and to H. Levesque and K.L. Dickson for unpublished records from the Canadian harvest surveys and for helpful comments. Members of the Atmospheric Environment Service, Environment Canada, provided unpublished climatic records. Referees of an earlier version of the paper made incisive comments on its excesses, but bear no responsibility for this one.

References

Alison, R.M. 1975: Breeding biology and behavior of the oldsquaw (Clangula hyemalis L.). - Ornithological Monograph No. 18, AOU, Washington, DC, pp. 1-52.

Bellrose, F.C. 1976: Ducks, geese and swans of North America. - Stacpole, Harrisburg, PA, 544 pp.

Boertmann, D. 1994: An annotated checklist to the birds of Greenland. - Meddelelser om Grønland, Bioscience 38: 1-63.

Boyd, H. 1965: Breeding success of white-fronted geese from the Nenets National Area. - Wildfowl Trust Annual Report 16: 34-40.

Boyd, H. 1992: Arctic summer conditions and British knot numbers: an exploratory analysis. - In: Piersma, T. & Davidson, N. (eds.); The migrations of knots. Wader study Group Bulletin 64, Supplement: 144-152.

Carney, S.M., Sorensen, M.F. & Martin, E.M. 1983: Distribution of waterfowl species harvested in states and counties during 1971-80 hunting seasons. US Fish and Wildlife Service Special Scientific Report. - Wildlife No. 254: 1-114.

Caswell, F.D. & Dickson, K.L. in press: Evaluating the status of waterfowl populations in Canada. - In: Cadman, M., Falls, J.B. & Dunn, E.H. (eds.); Monitoring birds populations: The Canadian experience. Canadian Wildlife Service Occasional Papers.

Cooch, F.G., Wendt, S., Smith, G.E.J. & Butler, G. 1978: The Canada Migratory Game Bird Hunting Permit and associated surveys. - In: Boyd, H. & Finney, G.H. (eds.); Migratory game bird hunters and hunting in Canada. Canadian Wildlife Service Report No. 43, pp. 8-39.

Gullett, D.W. & Skinner, W.R. 1992: The state of Canada's climate: temperature change in Canada 1895-1991. - State of the environment report series no. 92-2. Atmospheric Environment Service, Environment Canada, Ottawa, Ontario, pp. 1-35.

Lynch, J.J. 1972: Productivity and mortality among geese, swans and brant. Part II: Historical records from productivity appraisals, 1950-71. - US Fish & Wildlife Service Research Progress Report, Lafayette, LA, pp. 1-42.

Ouellet, H. 1990: Avian zoogeography in the Canadian Arctic islands. - In: Harrington, C.R. (ed.); Canada's missing dimension. Science and history in the Canadian Arctic islands. Part II. Canadian Museum of Nature, Ottawa, pp. 516-543.

Pattie, D.L. 1990: A 16-year record of summer birds on Truelove Lowland, Devon Island, Northwest Territories, Canada. - Arctic 43: 275-283.

Summers, R.W. 1986: Breeding production of dark-bellied brent geese in relation to lemming cycles. - Bird Study 33: 105-108.

Underhill, L.R., Prŷs-Jones, R.P., Syroechkovski, E.E., Groen, N.M., Karpov, V., Lappo, H.G., van Roomen, M.W.J., Rybkin, A., Schekkerman, H., Spiekman, H. & Summers, R.W. 1993: Breeding of waders (Charadrii) and brent geese Branta bernicla bernicla at Pronchishcheva Lake, northeast Taimyr, Russia, in a peak and a decreasing lemming year. - Ibis 135: 277-292.

von Haartman, L. 1945: Zur Biologie der Wasser- und Ufer-vogel im Scharenmeer Südwest-Finnlands. - Acta Zoologica Fennica 44: 1-120. (In German with English summary).