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Waterbirds around the world

A global overview of the conservation, management and research of the world's waterbird flyways

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Cover photography: Whooper Swans *Cygnus cygnus* arriving at Martin Mere, England. Photo: Paul Marshall. (www.paulmarshallphotography.com)

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Estimating waterfowl harvest in North America

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ABSTRACT

Most of the waterfowl harvested in North America are taken by sport hunters. The United States and Canada monitor the sport harvest through annual surveys of those hunters. Both countries employ sport harvest survey systems that consist of two major mail surveys: a questionnaire survey that asks a large sample of hunters to report their total harvest of ducks and geese for the year, and a parts collection survey that asks a smaller, separate sample of hunters to send in a wing from every duck and the tail feathers from every goose they harvest. The questionnaire survey gives estimates of total duck and goose harvest, whereas the parts collection survey provides estimates of the species, age and sex composition of the waterfowl harvest. These data are used to examine long-term trends in species-specific harvest and demographics that can yield vital information on the status of North American waterfowl populations. Subsistence harvest in Canada is estimated using indirect methods, but in Alaska an intensive specialized survey is used to estimate subsistence harvest.

INTRODUCTION

Regulating the harvest of waterfowl to ensure that it is commensurate with population status is an important component of waterfowl management in North America. In order to establish appropriate waterfowl hunting regulations each year, both harvest and population size must be monitored (Geis *et al*. 1969, Smith *et al*. 1989). Most of the waterfowl harvest is monitored through surveys of hunters that are conducted annually.

The primary sources of waterfowl harvest in North America are sport hunting in Canada, the United States and Mexico, and subsistence hunting in Alaska and northern Canada. In this paper, we summarize the various methods used in North America to estimate the number of ducks and geese harvested by sport and subsistence hunters. We describe the sample frames of the various surveys, how those sample frames are obtained, and the survey methodologies and estimation procedures that are employed. Then we present the results of those efforts, and discuss how harvest estimates are used to help ensure that the harvest is sustainable.

METHODS

Estimating sport harvest in the United States

In the United States, sport hunters are required to purchase hunting licenses annually. Those hunting licenses are issued by the individual state governments, not by the federal government. The cooperative state-federal Migratory Bird Harvest Information Program uses the states' licensing systems to provide the sample frame for the federal migratory bird harvest survey system. Under this program, state wildlife agencies collect the name and address of each migratory bird hunter who purchases a hunting license. They also ask each of those migratory bird hunters a series of general questions about the species they hunted and their hunting success the previous year. The state wildlife agencies then send those names and addresses to the U.S. Fish and Wildlife Service. Participation in this program is mandatory for migratory bird hunters; thus, the sample frame includes all licensed sport hunters who are legally authorized to hunt migratory game birds. This totals about 3 500 000 sport hunters each year.

The U.S. Fish and Wildlife Service selects samples of hunters from the name and address data that the state wildlife agencies provide. Hunters are stratified by state and by hunting activity and success in the previous year, and stratum-specific sampling rates are selected to increase precision and maximize sampling efficiency. For example, the small group of duck hunters who were very successful in the previous year is sampled at a high rate, the larger group of moderately successful duck hunters is sampled at a lower rate, and the very large group of hunters who rarely if ever hunt ducks is sampled at a very low rate.

At the beginning of the hunting season, each sampled hunter is mailed a hunting diary form and asked to record the date, location and number of ducks and geese taken for each day of waterfowl hunting. After the end of the hunting season, the U.S. Fish and Wildlife Service sends the sample hunters a postcard reminder asking them to complete and mail back their hunting diaries. This mailing is followed by two additional reminders to all sample hunters who still have not responded. Both of those reminder mailings include replacement diary forms.

Hunters' responses are used to estimate the mean number of ducks and geese harvested per hunter for each stratum, and the total harvests of ducks and geese are estimated by expanding the means by the number of active hunters in each stratum. About 60 000 hunters are selected annually for the waterfowl hunting diary survey. Participation is voluntary, and the response rate is 55-60%.

Some hunters are unable to identify to species all of the birds they harvest. Thus the survey described above does not ask participants to report their harvest by species. To obtain species-specific harvest estimates, the U.S. Fish and Wildlife Service selects another sample of waterfowl hunters annually, and asks those hunters to participate in the Waterfowl Parts Collection Survey. Hunters who agree to participate are given special postage-paid "wing envelopes", and are asked to send back a wing from every duck they shoot and the tail feathers of every goose they shoot throughout the hunting season.

Biologists identify the species, age and sex of each duck wing sample and the species and age of each goose tail sample. Thus, the survey yields estimates of the species composition of the duck and goose harvest. Results of this survey are combined with the results of the hunting diary survey to provide species-specific harvest estimates, as well as estimates of age and sex

ratios (Martin & Carney 1977, Geissler 1990). The annual sample size for the Waterfowl Parts Collection Survey is about 90 000 duck wings and 20 000 goose tails (Padding *et al*. 2003).

Estimating sport harvest in Canada

The Canadian waterfowl harvest survey system was established in 1967 (Cooch *et al*. 1978). All sport hunters who wish to hunt waterfowl in Canada must purchase the Canada Migratory Game Bird Hunting Permit, which was introduced in 1966. This is a national permit that is issued by the federal government, primarily at post offices throughout the country. The permit includes a stub on which the postmaster records the person's name and address, and whether or not that person purchased a permit and hunted the previous year. The postmaster then detaches the completed stub and sends it to the Canadian Wildlife Service. Thus, the sample frame for Canada's harvest survey system consists of all sport hunters who are legally authorized by the Canadian government to hunt migratory game birds. In recent years, this amounts to about 200 000 sport hunters each year.

The Canadian Wildlife Service selects samples of permit buyers, stratified by geographic survey zone, permit renewal status, past hunting success and county of residence (Cooch *et al*. 1978). The permit includes a hunting diary on which hunters are asked to note the date, location, and harvest for each of their hunts. Near the end of the migratory bird hunting season, each sampled hunter is mailed the Harvest Questionnaire Survey, which is a more detailed survey form. Hunters are asked to use their permit diaries to help them report their hunting activity and harvest accurately on the survey form. About two months after the first mailing, the Canadian Wildlife Service sends a second survey form to those who have not responded.

Estimates of mean and total duck and goose harvest are derived in much the same way as they are in the United States (Cooch *et al*. 1978). The Canadian Wildlife Service selects about 45 000 hunters annually for the Harvest Questionnaire Survey. Participation in the survey is voluntary, and the response rate is about 40%.

The Canadian Wildlife Service selects another sample of waterfowl hunters annually and asks those hunters to participate in the Species Composition Survey. This survey is conducted for the same purpose as the Waterfowl Parts Collection Survey in the United States, and employs similar methods. Likewise, Canada's analyses are similar to those used by the United States. The results of the Harvest Questionnaire Survey and the Species Composition Survey are combined to produce species-specific harvest estimates (Cooch *et al*. 1978). The annual sample size for Canada's Species Composition Survey is about 20 000 duck wings and 8 000 goose tails.

Estimating subsistence harvest in Alaska

The sample frame for the Alaska Subsistence Harvest Survey consists of all households in the parts of Alaska in which subsistence harvesting of birds and eggs is a legal activity. There are about 26 000 such households. The sample frame is stratified by geographic region, by communities within regions, and by previous history of hunting activity for each household. About two thirds of the communities in each region are selected for sampling. In those communities, about 40% of the high-harvest households, 15% of the low-harvest households, and 10% of the no-harvest households are selected to participate in the survey.

The survey covers the subsistence harvest period, April-October, in three increments. Survey workers hand-deliver the first survey forms to sampled households in April, at which time the workers explain how the forms should be filled out. The survey form shows pictures of the various species of birds, and participants are asked to record how many birds and eggs of each species they take. Three months later, the survey workers visit the households again to retrieve the first survey forms and deliver the forms for the second period. Two months after that, the survey workers visit again to pick up forms and deliver the forms for the last period, and at the end of the final period they visit once more to collect the last survey forms.

The analyses used to estimate the harvest are similar to those used to estimate sport harvest in the United States and Canada, except that species-specific estimates are derived directly from household reports rather than from a wing survey. Participation in the survey is voluntary, and the response rate is about 66%.

Sport harvest in Mexico

There are no annual estimates available for sport harvest in Mexico. However, a study by Kramer *et al*. (1995) gives a good indication of the magnitude and species composition of the annual waterfowl harvest in Mexico. From 1987 to 1992, Kramer *et al*. conducted a census of harvest in all the traditional waterfowl hunting areas of Mexico, visiting each major area in a different year. Then they applied area-specific correction factors to adjust for under-reporting by hunters. Finally, they summed the results for each area across years to obtain estimates of average annual harvest for all of Mexico.

Subsistence harvest in Canada

The most recent comprehensive assessment of subsistence harvest in Canada was undertaken by Wendt & Dickson in 1994 (unpublished report). They reported harvest estimates for all areas where surveys had been conducted at some time during the previous 20 years. For areas where surveys had not been conducted, they derived indirect estimates of harvest. Their report gives estimates of total duck and goose harvest, but no species-specific estimates are available. The Canadian Wildlife Service is expecting to obtain up-to-date, direct estimates of subsistence harvest for most of Canada in the near future.

RESULTS

Sport hunting accounts for by far the greatest proportion of the total duck and goose harvest in North America. Of the approximately 15 000 000 ducks harvested in 2002, about 14 000 000 were taken by sport hunters, primarily in the United States (Fig. 1). Similarly, of about 4 850 000 geese harvested in 2002, nearly 4 300 000 were taken by sport hunters in the United States and Canada (Fig. 2). Most of the waterfowl hunting and harvest in Canada occurs in the south-central part of the country (Quebec, Ontario, Manitoba, Saskatchewan and Alberta), whereas comparatively little sport hunting occurs along the coasts and in the far north (Table 1). Similarly, in the United States, about 70% of the waterfowl hunters are in the middle of the country (Mississippi Flyway and Central Flyway); thus most of the duck and goose harvest also occurs there, compared to the east (Atlantic Flyway) and west (Pacific Flyway) coasts (Table 1). In general, more ducks are harvested in southern states (e.g. Arkansas, Louisiana, Texas), whereas more geese are harvested in northern and mid-latitude states (Table 1).

Table 1. Estimated sport harvest of ducks and geese and number of waterfowl hunters in Canada and the United States during the 2001 hunting season.

State/Province	Duck Harvest	Goose Harvest	Waterfowl Hunters
Canada			
Newfoundland	50 200	5 600	8 700
Prince Edward Island	17 800	25 100	2 700
Nova Scotia	58 500	10 600	4 600
New Brunswick	41 700	5 600	4 700
Quebec	215 800	166 800	22 800
Ontario	364 500	149 900	42 000
Manitoba	168 300	128 000	13 500
Saskatchewan	153 500	323 300	17 600
Alberta	135 400	162 700	16 000
British Columbia	55 600	15 500	5 100
Northwest Territories	1 000	1 000	100
Yukon Territory	400	100	100
United States			
Maine	82 800	9 400	9 400
Vermont	27 000	5 900	3 800
New Hampshire	18 200	4 900	3 800
Massachusetts	31 800	12 200	6 800
Connecticut	17 900	15 139	4 400
Rhode Island	11 000	3 400	1 200
New York	195 900	104 400	31 100
Pennsylvania	129 400	129 700	42 100
West Virginia	6 500	7 300	1 700
New Jersey	82 200	75 600	9 600
Delaware	43 600	40 800	5 300
Maryland	160 200	95 400	24 800
Virginia	101 700	45 800	17 500
North Carolina	205 700	30 200	25 600
South Carolina	255 300	14 600	20 900
Georgia	95 600	11 100	20 400
Florida	145 800	600	14 000
Atlantic Flyway Total	**1 610 500**	**606 400**	**242 400**
Minnesota	648 000	238 900	128 500
Wisconsin	252 700	40 700	63 800
Michigan	281 400	134 900	53 300
Iowa	246 800	48 000	27 700
Illinois	448 700	76 800	47 000
Indiana	147 000	60 300	25 200
Ohio	121 700	78 200	30 400
Missouri	478 800	104 400	37 100
Kentucky	119 600	22 500	17 500
Arkansas	1 114 300	72 800	57 600
Tennessee	282 400	20 700	30 800
Louisiana	2 211 700	141 500	92 800
Mississippi	247 300	18 400	21 700
Alabama	148 100	5 500	15 800
Mississippi Flyway Total	**6 748 400**	**1 063 600**	**648 900**
Montana*	43 700	56 500	6 700
North Dakota	693 400	242 000	29 400
South Dakota	289 200	188 300	28 800
Wyoming*	43 600	51 600	7 800
Nebraska	223 400	64 800	28 100
Colorado*	115 113	104 500	24 000
Kansas	261 000	90 300	24 100
New Mexico*	32 100	5 000	3 600
Oklahoma	259 600	47 500	19 200
Texas	1 440 800	308 900	111 600
Central Flyway Total	**3 401 800**	**1 159 500**	**283 000**
Washington	340 600	59 700	30 000
Oregon	275 900	79 300	25 800
Idaho	198 600	53 200	19 800
Montana*	95 000	36 600	11 400
Wyoming*	5 900	1 900	800
California	948 600	90 800	65 000
Nevada	33 800	800	6 100
Utah	200 900	25 100	26 600
Colorado*	27 100	5 300	3 600
Arizona	42 700	2 800	5 100
New Mexico*	2 600	1 900	500
Pacific Flyway Total	**2 171 700**	**357 400**	**194 800**
Alaska	61 900	8 600	7 800

* Montana, Wyoming, Colorado, and New Mexico are transected by the Central/Pacific Flyway boundary and are therefore listed in both flyways. Estimates are partitioned into their respective flyways.

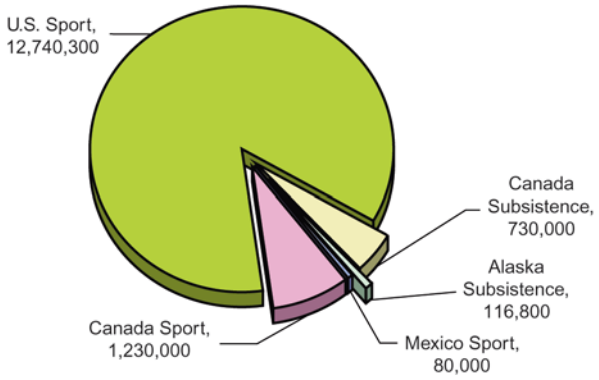

Fig. 1. Distribution of the duck harvest in North America among sport and subsistence hunters during the 2002 waterfowl hunting season.

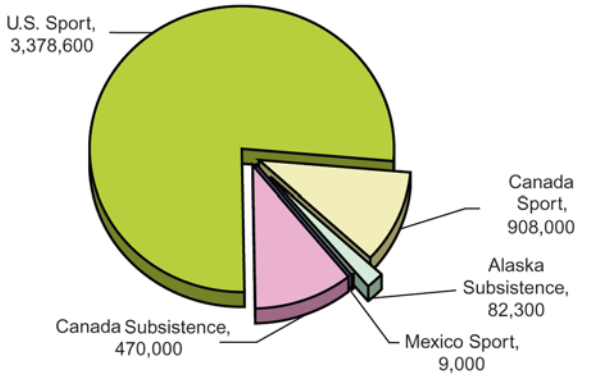

Fig. 2. Distribution of the goose harvest in North America among sport and subsistence hunters during the 2002 waterfowl hunting season.

The annual sport harvest is comprised of 33 species of ducks and five species of geese. The species composition of the duck harvest during the 2002 hunting season was typical of recent years. More than 30% of all ducks harvested were Mallard *Anas platyrhynchos*, followed by Green-winged Teal *A. crecca*, Gadwall *A. strepera* and Wood Duck *Aix sponsa* at about 10% each. Ring-necked Duck *Aythya collaris* and Lesser Scaup *A. affinis* were the most commonly harvested diving-ducks. As with ducks, the species composition of the sport harvest of geese during the 2002 hunting season was typical of recent years. About 70% of all geese taken were Canada Geese *Branta canadensis*, followed by Snow Geese *Chen (Anser) caerulescens* at about 20%.

Although most of the waterfowl harvest in North America is due to sport hunting, there are some cases in which subsistence hunting is an important source of mortality, especially for some species of concern. For example, the Emperor Goose *Chen (Anser) canagicus* population numbers only about 75 000 birds. Sport hunting of this species is not allowed, and therefore the only harvest that occurs is subsistence harvest in Alaska. The estimated harvest is 3 200 birds per year, or about 4% of the population. Another species of concern is the Black Brant *Branta bernicla nigricans*, which has a population of about 120 000 birds. Of a total harvest of about 17 000, more than half are taken by subsistence hunters in Alaska. Only 2 000 are taken by sport hunters in the United States and Canada, whereas 5 000 are taken by sport hunters in Mexico.

DISCUSSION

National sport harvest survey systems have been in place in the United States since 1952 and in Canada since 1967, and subsistence harvest surveys have been conducted in Alaska since 1985. These surveys have provided annual estimates over an extended period of time that enable biologists to evaluate long-term trends in hunter numbers, hunting pressure, harvest, and waterfowl population demographics (e.g. Trost *et al*. 1987). These data in turn help biologists to formulate models of population dynamics that are used to determine harvest management prescriptions for species such as Mallard, Northern Pintail *Anas acuta* and Canvasback *Aythya valisineria*.

Estimates of the annual harvest also help waterfowl managers assess the impacts of hunting regulations on harvest. For example, the results of the harvest surveys described above can be used to predict the effects of changes in season length and bag limits on total duck or goose harvest, or to predict the effects of changes in species-specific bag limits on individual species (Martin & Carney 1977). This helps managers determine the appropriate regulatory actions to take when harvest must be reduced or, if populations are expanding, when it can be allowed to increase.

The estimates of age and sex composition derived from wing surveys can also be valuable, particularly for showing long-term trends in productivity (e.g. Reynolds 1987, Miller 2000). Harvest age ratios can serve as an early warning system that helps identify declining species or populations. For example, age ratios (immature/adult) of Lesser Scaup harvested in the United States have been declining for the last 20 years (Padding *et al*. 2003), suggesting a gradual decline in productivity of the species. During the same period, the North American breeding population of the species has also undergone a significant decrease (U.S. Fish and Wildlife Service 2003). As a result of these findings, several research efforts to determine the causes of the decline in the Lesser Scaup population are currently underway, and these are focusing on adult female survival and productivity.

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