

Incidence of lead shot in Canada Geese taken during the spring subsistence hunt on the eastern shore of James BayJean Rodrigue^a and Austin Reed^a**Introduction**

Poisoning of waterfowl by lead shot has been the subject of a number of studies in North America (Sanderson and Bellrose 1986). Shifts to alternative cartridge types were motivated in part by the risks of lead poisoning in waterfowl that ingest spent shot. This change is the logical corollary to the action taken by governments for several years past to reduce releases of lead into the environment (e.g., banning lead additives in gasoline, setting industry standards).

In 1991, certain areas in Canada were designated non-toxic zones; i.e., the use of lead shot for the hunting of migratory birds was banned there. In 1997, Canada implemented a nation-wide ban on the use of lead shot for hunting waterfowl within 200 m of a watercourse, though lead pellets were still allowed in cartridges used to hunt in farm fields until 1 September 1999. After that date non-toxic shot is required nationally for migratory game birds, except for American Woodcock *Scolopax minor*, Band-tailed Pigeons *Columba fasciata*, and Mourning Doves *Zenaida macroura*.

Though a number of studies on lead shot have been undertaken, there is still little information on the springtime prevalence of shot in waterfowl. We hope that this contribution will add some knowledge of the incidence of lead shot in a species hunted by aboriginal people in spring, namely the Canada Goose *Branta canadensis*. Dickson (1996) reports that this species' numbers have declined in eastern North America in recent years, though an increase of the Atlantic population of Canada Geese has been observed since recreational hunting was closed in 1995 (Harvey and Rodrigue 1998).

Material and methods

As part of a study of the diet of Canada Geese in James Bay, lead shot was counted during identification of food intake (Reed et al. 1996). The oesophagi and gizzards of Canada Geese were collected through the co-operation of the Chisasibi Cree community. The birds came from six hunting camps located along the eastern shore of James Bay between the La Grande River and Point Louis XIV (Fig. 1), having been taken during the spring subsistence hunt in May 1990. Altogether, 309 specimens were examined. Visual inspection of the pellets and the gizzard linings distinguished between shot lodged by gunfire and that ingested.

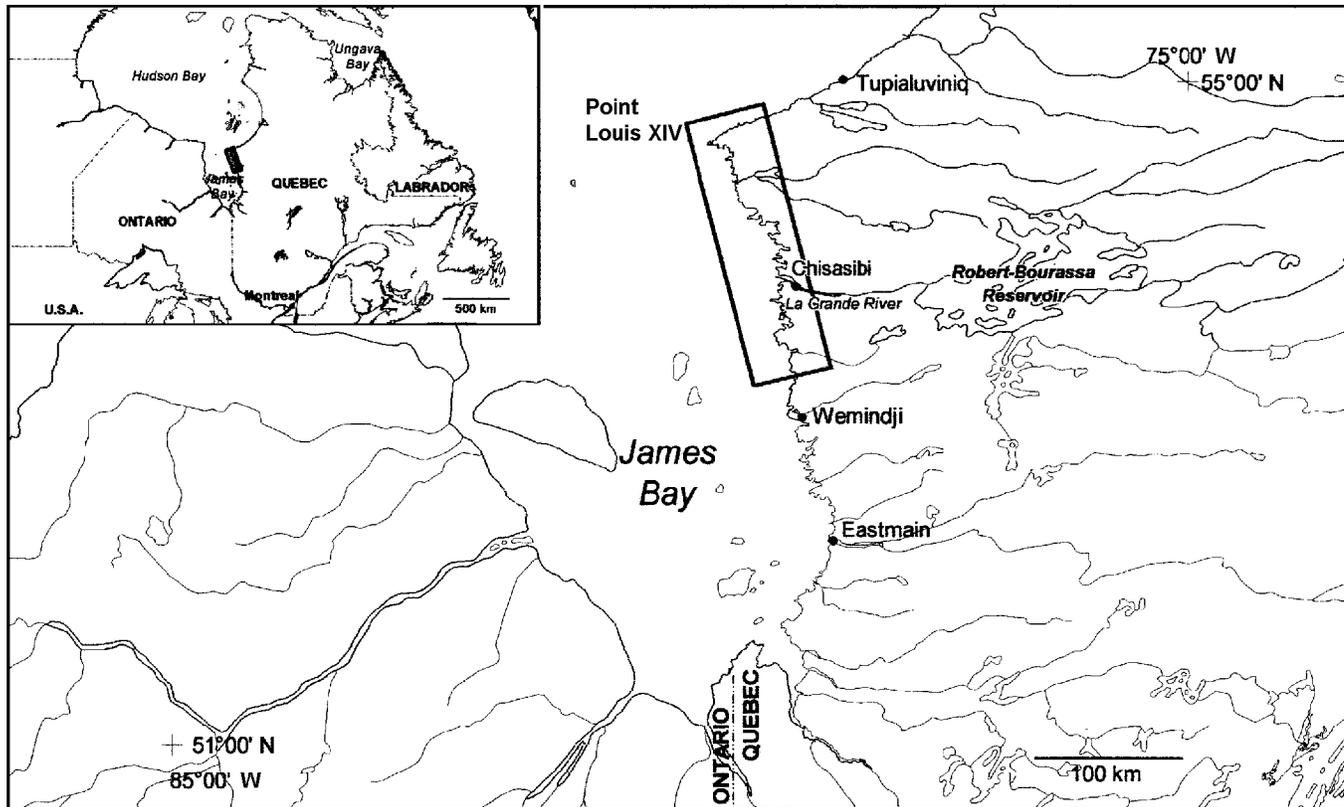
^a CWS, P.O. Box 10100, Ste-Foy, Quebec G1V 4H5.**Results and discussion**

Shot was found in 27 gizzards (8.7%); only one contained more than one pellet (two). This proportion is lower than that reported for Canada Geese in British Columbia in 1988 and 1989 (12.8%; n = 39), but similar to that for Manitoba between 1979 and 1985 (8.0% ; n = 132) (Hochbaum 1993). It is higher than the values reported for Quebec in 1987 and 1988 (1%; n = 289) (Lemay et al. 1989), the Atlantic Provinces in 1988 and 1989 (1.2%; n = 82) (Hanson 1989 and Daury 1991 in Kennedy and Nadeau 1993) and in 1993 (<1%; n = 1760) (Barrow 1994), Manitoba in 1986 and 1987 (2.5%; n = 1029) (DeStefano et al. 1991), Ontario from 1980 to 1983 (0% ; n = 30) (Dennis and North 1987) and from 1994 to 1996 (6.4% ; n = 109) (Tsuji et al. 1998) and the United States (maximum 5.9% ; n = 284) in 1974 and 1975 (White and Stendell 1977) and in 1986 and 1987 (maximum 2.5% ; n = 1 006) (DeStefano et al. 1991). Occurrence of lead shot in Canada Geese taken in the fall hunt of 1990 in the Bay of Many Islands on the eastern shore of James Bay was high: 15.8% (n = 19) (CWS, unpublished data). According to U.S. Fish and Wildlife Service criteria (1986), an area or region is considered contaminated when over 5% of gizzards contain lead shot. In the view of the Canadian Wildlife Service (1990), an ingestion rate of 5% is the trigger level for concern. Beyond this level, research is recommended to determine whether there is a lead poisoning problem. However, because this limit was set on the basis of data from dabbling ducks, the situation may be different for Canada Geese. As part of their springtime diet consists of roots and rhizomes (Reed et al. 1996), they may be ingesting shot buried deeper in the sediment.

Gizzard analysis provides visual confirmation of ingestion of lead shot, but it should be pointed out that the pellets erode quickly; 66% by volume of the shot ingested is lost in the first three days, and the rest is fully eliminated in 45 days (Cook and Trainer 1966). Thus, many geese may have no shot in their gizzards, the pellets having dissolved, with the lead assimilated by the organism, or passed in faeces. In addition, Sanderson and Bellrose (1986) estimate that 24% of gizzards containing hunting shot went undetected by three observers, and Whitehead (1989 in Kennedy and Nadeau 1993) reports that up to 20–30% of lead shot may escape notice in visual examination of gizzards. This is due mainly to erosion and to the small size of hunting shot, which may be hidden among seeds and grit (Sanderson and Bellrose 1986). It can therefore be assumed that the results of our study constitute a minimum level and that actual consumption is underestimated.

Generally speaking, ingestion of shot is a localized phenomenon. In migratory birds, the main cause is the fact that the sites where they feed heavily are the very places where hunting pressure is greatest (Lemay et al. 1989). It is therefore likely that most of the shot consumed is ingested there. Goose hunting is intense around James Bay; this

Figure 1
Location of the study area



reflects the great economic and cultural significance of this species for the Cree (Reed 1991). Lead density may be higher at specific sites along the James Bay coast where an early thaw tends to concentrate activity during the spring hunt. Geese may also pick up shot while migrating, especially in Quebec's farming areas, where hunting has grown in popularity in recent years (A. Bourget and P. Dupuis, pers. commun.).

According to Cook and Trainer (1966), two lead pellets in the gizzard would increase lead concentrations in the blood only slightly and would not jeopardize the bird's survival. The lethal dose for geese kept in captivity is four or five pellets of No. 4 shot (Cook and Trainer 1966). In the Western James Bay region, Tsuji et al. (1998) also report that birds showed symptoms that could be linked to lead poisoning. In Ontario, Canada Geese found dead of lead poisoning had more than 13 lead pellets in their gizzards (Brojer et al. 1998). However, shot may be embedded in the birds' flesh as well as ingested with food, and the effects of embedded shot vary according to species and age (Perry and Artmann 1979; Perry and Geissler 1980).

In 1977, 23% of the Brant Geese *Branta bernicla* that died of starvation in New Jersey had shot embedded in their flesh (Kirby et al. 1983). In 1993, in the Maritimes, 35.1% (n = 111) of the live Canada Geese examined with a fluoroscope had lead shot embedded in their flesh, with an average of 2.3 pellets per bird (P. Hicklin, pers. commun.).

In Prince Edward Island, although 24% (n = 722) of Canada Goose gizzards contained shot, only 0.8% had been

ingested, as opposed to 17% embedded in the gizzard wall and 6.9% having pierced it (Barrow 1994).

Canada Geese were collected on spring migration, shortly before nesting. The energy demands generated by these two activities, together with the lead lodged in their gizzards and/or flesh, may affect breeding in some individuals. Sex and age, which affect the response to lead in Canada Geese (DeStefano et al. 1992) were not noted, thus precluding any conclusions.

Lead poisoning remains a problem 10 years after the establishment of non-toxic areas in Missouri (DeStefano et al. 1991). In Canadian farming areas, there is still potential for ingestion of lead in spring (Barrow 1994). Depending on when ploughing is done, in fall or in spring, and the birds' migration dates, there is a risk that waterfowl may pick up shot. Esslinger and Klimstra (1983) estimated that ploughing reduces the quantity of shot in the surface soil of fields where hunting pressure is high by 85%, but they point out, too, that because fields are ploughed yearly, shot buried deeper may be brought back to the surface. This factor is compounded by the increasing popularity of waterfowl hunting on farmland in recent years and by use of lead shot in agricultural areas in Canada until the recent ban in September 1999. Barrow (1994) has already recognized the potential for exposure in farm fields in spring and proposed that geese banded in spring be examined by fluoroscope to determine the extent of this risk.

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