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Giardiasis in Pinnipeds from Eastern Canada

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ABSTRACT: Cysts of *Giardia* sp. were detected in feces from the rectum of 20 of 74 pinnipeds examined from the eastern coast of Canada in 1997 and 1998 using a monoclonal antibody technique. Infected pinnipeds included 15 adult harp seals (*Phoca groenlandica*), four adult grey seals (*Halichoerus grypus*), and one juvenile harbor seal (*Phoca vitulina*). Cysts were not detected in 15 seal pups <1-yr–old. The highest prevalence (50%) occurred in adult harp seals collected near the Magdalen Islands in the Gulf of St. Lawrence. The overall prevalence of *Giardia* sp. in grey and harbor seals, excluding pups, from the Gulf and St. Lawrence estuary was 23%. Feces from 11 beluga (*Delphinapterus leucas*) and one northern bottle-nosed whale (*Hyperoodon ampullatus*) stranded in the St. Lawrence estuary were negative for *Giardia* sp. cysts. The significance of *Giardia* sp. in marine mammals, shown here for the first time in eastern coastal Canada, is unknown.

Key words: *Giardia* sp., marine mammals, pinnipeds, seals, survey, zoonosis.

Recent mass mortality events have stimulated interest in the health and diseases of free-ranging marine mammal populations. Consumption of marine mammals such as ringed seals (*Phoca hispida*), harp seals (*Phoca groenlandica*), and beluga (*Delphinapterus leucas*) by native and nonnative people can pose certain risks for human health due to zoonotic diseases carried by marine mammals. Biologists and veterinarians working with marine mammals also may be at risk. Parasites of marine mammals, especially gastro-intestinal parasites such as the anisakids, have been studied for a number of years and are well known; albeit their biology and epizootiology are incompletely understood. Microparasites such as protozoa, whether intestinal or extra-intestinal, are poorly studied, largely due to difficulties in obtaining fresh specimens requiring special techniques of preservation or sensitive detection methods.

Giardia spp. have been reported from humans and a wide range of wild and domestic terrestrial vertebrates (Adam, 1991). Recently, *Giardia* sp. has been detected in ringed seals from western arctic Canada (Olson et al., 1997a). In some northern communities in Arctic Canada, giardiasis is a common disease (Eaton and White, 1976; Pugh, 1985; Dean et al., 1990). As part of a program of research on the diseases and pathogens of marine mammals in eastern Canadian waters, feces from marine mammals were collected and examined to determine whether *Giardia* sp. was present.

Seals were shot, with scientific permit issued by Fisheries and Oceans Canada, between Bic (48°23′N, 68°53′W) and Métis-sur-Mer (48°40′N, 68°00′W) in the St. Lawrence estuary, at Amet Island (45°50′N, 63°11′W) and the Magdalen Islands (47°23′N, 61°52′W) in the Gulf of St. Lawrence and off the northeastern coast of Newfoundland (between 49°56′N, 52°59′W and 51°09′N, 54°37′W). Seals were collected from May to November, except those from the Magdalen Islands, which were collected in March 1997 and 1998, and those from Newfoundland, which were collected in April and May 1998. A northern bottle-nosed whale (*Hyperoodon ampullatus*) was stranded alive at Sept-Iles in the St. Lawrence estuary (50°12′N, 66°23′W) on 8 September 1997 and samples were collected 48 hr postmortem. Stranded beluga were found dead between May 1997 and June 1998 in the St. Lawrence estuary. All animals were identified by species and sex, and teeth were collected for age determination. Feces were collected from seals within 1 hr post-mortem, but up to several days postmortem in the case of stranded beluga.

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Fresh feces (5–10 ml) collected from the rectum were placed in small vials containing 5 ml of 5% neutral buffered formalin and kept at 4 C until examined for *Giardia* sp. cysts using a monoclonal antibody technique described in Olson et al. (1997a). In cases where there was little or no feces in the rectum, a scraping of the rectal wall using a clean knife or a clean flat wooden popsicle stick was made and removed mucus and debris were fixed.

The age of beluga whales and seals was determined by cutting longitudinal or transverse sections of teeth and counting the number of growth layer groups (Mansfield and Fisher, 1960; Brodie 1971, 1982; International Whaling Commission 1982; Bowen et al., 1983; Mansfield, 1991; Bernt et al., 1996). Seals were grouped by age as pups (newborn to 1-yr-old), juveniles (>1-yr-old and sexually immature), and adults (sexually mature, 3- to 8-yr-old depending on species). Sexual maturity for grey seals (*Halichoerus grypus*) occurs at 6-yr-old for males and at 4-yr-old for females (Hammill and Gosselin, 1995; McLaren, 1993), for harbor seals (*Phoca vitulina*) at 6-yr-old for males and 3- to 4-yr-old for females (Boulva and McLaren, 1979; McLaren, 1993), for harp seals at 4- to 8-yr-old for males and at 4- to 6-yr-old for females (Sergeant, 1991; Hammill et al., 1995; McLaren, 1993) and for beluga at 7- to 9-yr-old for males and at 5- to 6-yr-old for females (Brodie, 1971, 1982; Stewart and Stewart, 1989).

Feces from the northern bottle-nosed whale (juvenile male, four growth layer groups) and 11 beluga (five females, six males, aged from (<1- to 28.5-yr-old or more) from the St. Lawrence estuary were negative for *Giardia* sp. cysts. *Giardia* sp. cysts were found in feces of 20 of 74 pinnipeds examined including 15 of 30 adult female harp seals from the Magdalen Islands, four grey seals (one juvenile male [5-yr-old] from Amet Island', three adult females (two from Amet Island and one from the St. Lawrence estuary), and one juvenile male harbor seal (1-yr-old) from the St. Lawrence estuary. Seven harp seals from Newfoundland (five adult males, two juvenile males), five harbor seals from the St. Lawrence estuary (one adult female, four juveniles, two males and two females), and 12 grey seals (two juvenile males, two adult males and three adult females from Amet Island and one juvenile female, two adult males and two adult females from the St. Lawrence estuary) were uninfected. Prevalence was highest (50%) in adult harp seals from the Magdalen Islands. The overall prevalence of *Giardia* sp. in grey and harbor seals, excluding pups, from the Gulf and St. Lawrence estuary was 23%. *Giardia* sp. cysts were not found in the feces of two 6- to 7-wk-old old harbor seal pups from the St. Lawrence estuary, three 4- to 7-wk-old old grey seal pups from Amet Island or 10 2-wk-old harp seal pups from the Magdalen Islands. The number of *Giardia* sp. cysts in samples from infected harp seals ranged from 19 to 1,346 (mean ± SD = 297 ± 412) cysts per ml of feces, in infected grey seals from 6 to 3,000 (mean ± SD = 1,752 ± 1348) cysts per ml of feces, and 63,467 cysts per ml of feces in the infected harbor seal.

In the present study *Giardia* sp. cysts were detected in three species of pinnipeds in the St. Lawrence estuary and Gulf of St. Lawrence. Harbor seals are resident in the estuary or Gulf year round where they give birth and breed on islands and reefs during summer (Boulva and McLaren, 1979; V. Lesage, pers. comm.). Grey seals migrate into the estuary in the spring, returning to the Gulf in late fall (Lavigueur and Hammill, 1993; J. F. Gosselin and M. O. Hammill, pers. comm.) where they give birth and breed during January and February on the pack ice or on islands (Stobo et al., 1990; Lavigueur and Hammill, 1993). Harp seals are arctic phocids which undergo a seasonal migration in the fall from eastern arctic Canada to the Gulf of St. Lawrence (some enter the estuary to feed in the fall or spring) or to the northeast coast of Newfoundland where they give birth and breed on the ice

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in winter, returning to the arctic for the summer (Sergeant, 1991).

Two hypotheses may explain the presence of *Giardia* sp. cysts in Canadian pinnipeds. There may be one or more previously unknown species of *Giardia* unique to seals, capable of being maintained in seals via the fecal-oral route when seals haul out on land or ice. Alternatively, seals may acquire *Giardia* sp. from sources contaminated with human feces (untreated municipal wastewater, faulty septic tanks, wastewater from boats) or domestic animal feces (agricultural wastewater) containing *Giardia* sp. cysts. This may occur by seals drinking contaminated estuarine or sea water or feeding on marine organisms contaminated with *Giardia* sp. cysts.

Giardia lamblia is the most common human intestinal parasite worldwide (Adam, 1991) and *Giardia* sp. cysts are common in agricultural animals such as cattle, horses, sheep and pigs (Xiao, 1994; Olson et al., 1997b). *Giardia* sp. cysts have been detected in Canadian raw and treated drinking water (Wallis et al., 1996).

In the St. Lawrence watershed, many riverine and seashore communities, as elsewhere in the world, are sources of anthropogenic contamination. For example, in Quebec, 140 of 339 St. Lawrence riverside municipalities with 1.35 million inhabitants (or 33% of the riverside population) in 1992 discharged untreated municipal wastewater into the St. Lawrence River (St. Lawrence Centre, 1996). In addition, various boats and ships ply the St. Lawrence River, estuary and Gulf (St. Lawrence seaway) year round, and may discharge human sewage into the water. Agricultural wastewater also enters the St. Lawrence watershed (St. Lawrence Centre, 1996).

Giardia sp. cysts have been detected in marine waters (Johnson et al., 1995) and tests indicate that cysts can survive in saline solutions of <2% (Naik et al., 1982). Survival of *Giardia* spp. cysts in fresh water is optimal between 4 C and 8 C (Jakubowski, 1990). The concentration, viability and virulence of cysts in Canadian estuarine and marine waters is unknown.

The absence of *Giardia* sp. in the St. Lawrence beluga, a year-round resident of the estuary, may be related to the fact that samples came from stranded animals which were less fresh than those from shot seals and cysts may have degraded over time. However, beluga from the western Arctic sampled two hours post-mortem were also negative (Olson et al. 1997a). The maintenance of *Giardia* sp. infection within a species may be facilitated by the fecal-oral route of transmission which, in fully aquatic animals such as cetaceans, may be problematic. Alternatively, *Giardia* sp. cysts passed into water from one host species may not be infective to all potential aquatic host species. The zoonotic potential of *Giardia* sp. in seals is unknown but hunters, biologists and veterinarians should take precautions to avoid infection.

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