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Brief Communication

Investigations of Waterborne Pathogens in Eurasian Beaver (*Castor fiber*) from Telemark County, Southeast Norway

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The presence of pathogenic bacteria and parasites in drinking water is a well-known cause of human disease outbreaks (*Isaac-Renton & Cordeiro* 1993, *Koenraad et al.* 1997). There is however, a lack of knowledge of the contamination routes to water. In Norway, the supply of drinking water to the public and the food industry is primarily based on chlorinated surface water. Since the Eurasian beaver (*Castor fiber*) has a widespread distribution in southern Norway (*Nolet & Rosell* 1998), and lives in water, it may excrete pathogens into drinking water sources. The present study was carried out to examine whether beaver in Norway might be a reservoir of parasites belonging to the protozoan genera *Giardia* and *Cryprosporidium,* or bacteria of the genera *Campylobacter* and *Salmonella.*

Flagellates of the genus *Giardia* are common intestinal parasites of many mammals and are considered the most common cause of waterborne gastroenteritis in North America (*Erlandsen et al.* 1996). Giardia cysts are frequently found in Norwegian surface water sources (*Gjerde* 2000) and the number of reported human cases of giardiasis is rising here (*Anon.* 1998, 1999). In the USA, the prevalence of Giardia infection in beaver (*C. canadensis*) has been reported to be 7-16% (*Erlandsen et al.* 1990) and the beaver is considered a potential health threat if inhabiting watersheds used as sources of drinking water (*Erlandsen et al.* 1996). The parasite is resistant to chlorination (*Moorehead et al.* 1990).

Cryptosporidium spp. are coccidian parasites causing intestinal infections in a wide range of mammals including man (*O'Donoghue* 1995, *Upton & Current* 1985, *Rose et al.* 1997). *Cryprosporidium* oocysts are frequently isolated from surface water sources in Norway (*Gjerde* 2000) but the number of reported human cases of Cryptosporidiosis is low here (*Anon.* 1998, 1999). The parasite is highly resistant to chlorination (*Fayer et al.* 1997). Cryptosporidium infection in beaver has been reported from Poland (*Bajer et al.* 1997) and the USA (*Isaac-Renton et al.* 1987).

Campylobacter spp. is the most common water and food-borne pathogen causing human enteritis in Norway (*Anon.* 1998, 1999). The bacterium has been demonstrated in the intestinal contents of a wide variety of domestic and wild animal species (*Rosef et al.* 1983) and is regularly isolated from river water in Telemark

Table 1. The number of Eurasian beavers (*Castor fiber*) from Telemark County, Norway, analysed for the presence of the bacterias *Campylobacter* spp. and *Salmonella* spp., and the protozoens *Giardia* spp. and *Cryptosporidium* spp. in faecal contents. Animals are categorized according to capture form, sex, age and the habitat they were taken from.

Category	Campylobacter	Salmonella	Giardia	Cryptosporidium
Live-trapped	83	106	111	103
Shot	50	129	130	79
Total	133	235	241	182
Males	72	126	129	98
Females	61	109	112	84
Juveniles (0-10 kg)	20	38	41	27
Subadults (10-15 kg)	21	46	47	35
Adults (≥15 kg)	92	151	153	120
River (>5 m wide)	105	172	177	142
Stream (<5 m wide)	14	24	24	15
Tarn/lake	14	39	40	25

(*Rosef et al.* 2001). In Norway, human waterborne outbreaks have been traced to faecal contamination from gulls (*Larus* spp.), geese (*Anser brachyrhynchus*) and sheep (*Andreassen* 1981, *Dahl & Melby* 1987, *Varslot et al.* 1996). *Pacha et al.* (1983) reported the absence of *Campylobacter* infection in 75 beavers examined in North America.

Salmonella contamination and salmonellosis in humans and farm animals is an increasing problem in the industrialized countries (*Rodrigue et al.* 1990). In Norway however, *Salmonella* is a limited problem and most of the human clinical cases (80-90%) are infected abroad (*Bredal & Langeland* 1993, *Fossum et al.* 1996). In spite of this, a waterborne outbreak of human *S. typhimurium* infection has been reported here (*Foldal & Vatne Bjørdal* 1999). *Salmonella* may infect a wide range of wild and domestic mammals and birds which may also act as carriers. *Salmonella* spp. have also been isolated from beavers in Germany and Russia (*Romasov* 1992).

Faecal samples were collected from beavers of different sex and age-classes living in the water systems of Bø, Sauherad and Nome municipalities (59° 17´-25´N, 09° 03´-17´E) in Telemark County, southeast Norway during the years 1997-1999 (Table 1). The animals were either live-trapped with landing nets (*Rosell & Hovde* 2001), Hancock or Bailey live-traps, or shot during the hunting season (Table 1). The beavers were sexed by the colour of the anal gland secretion (*Rosell & Sun* 1999) or the presence of the os-penis (*Osborn* 1955) and partitioned into three age-classes based on body weight (*Hartman* 1992): juveniles (≤12 months, <10 kg), subadults (13-24 months, 10-15 kg), and adults (>24 months, ≥15 kg).

Campylobacter was isolated from faecal swab samples brought to the laboratory and streaked out onto a selective blood free agar [CCDA-modified Preston agar, Oxoid CM 739 and SR155 supplement] within 2 hours. The agar plates were incubated at 42ºC in a micro aerobic athmosphere achieved by using the Oxoid, Campy Gen code CN025A and read after 24 and 48 hours.

Salmonella was isolated by examining one gram of fresh or frozen faeces following the procedure described in NMKL 71 (*Anon.* 1991).

Giardia and *Cryptosporidium* detection. The

ProSpectT® microplate assay for in-vitro diagnosis of Giardia and/or Cryptosporidium, Alexon inc., Sunnyvale, CA 94089, USA was used. Preliminary positive samples were followed up by individual assays. For confirmation of *Giardia* the ProSpectT® Giardia EZ microplate assay for in-vitro diagnosis of *Giardia,* Alexon-Trend, Inc Ramsey, MN 55303, USA was used. For confirmation of *Cryptosporidium* the ProSpecT® Cryptosporidium microplate assay, Alexon-Trend, Inc. Ramsey, MN 55303, USA was used.

Neither *Giardia, Cryptosporidium, Campylobacter* nor *Salmonella* were detected in any of the samples examined. We conclude that the beaver does not seem to be involved in drinking water contamination with these pathogens in Telemark County.

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