Parasite Transmission Stages in Feces of Common Eiders Flushed from their Nests

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Abstract - Several species of ducks defecate when flushed from their nests, but it is unclear why. Possibly, this behavior reflects manipulation by parasites to facilitate transmission. We analyzed feces of 32 incubating *Somateria mollissima* (Common Eider) for evidence of parasite transmission stages. We found a total of only 11 parasite transmission stages (identified as digenean and nematode eggs) in feces of 3 different hens, suggesting that defecation around the nest has a low probability of leading to parasite transmission. Other hypotheses for defecation behavior in this and other duck species (repulsion of egg predators, weight loss to increase hen maneuverability to escape predators) appear insufficient to explain its persistence.

Introduction

Females of several duck species defecate on their eggs and nests when flushed (Forbes et al. 1994). The primary hypothesis for this behavior is that defecation deters predators (McDougall and Milne 1978, Swennen 1968). Fecal odors may be offensive to predators, and adaptive because it reduces their attraction to eggs where they may acquire parasites (including viral and bacterial). However, some evidence suggests that feces attract both avian and mammalian predators (Clark and Wobeser 1997, Olson and Rohwer 1998), and furthermore may transmit pathogens to developing embryos (Cox et al. 2000, 2002). Thus, the primary hypothesis is not well-supported. Another hypothesis is that defecation is a form of manipulation of host behavior (Moore 2001) that provides transmission opportunities for parasites to egg predators, intermediate hosts occupying the nest vicinity, or conspecifics in high-density nesting areas.

Somateria mollissima L. (Common Eiders) commonly carry intestinal parasites with fecal transmission stages, including coccidians, trematodes, cestodes, nematodes, and acanthocephalans (Boorgsteede et al. 2005, Goudie et al. 2000, Hollmén et al. 1999, Thieltges et al. 2006). We collected feces from Common Eiders flushed from their nests and looked for parasite stages therein to determine potential for parasite transmission around the nest.

Study Area and Methods

In May and June 2002, we searched for Common Eider nests on Bon Portage Island (Outer Island on some maps; 43.5ºN, 65.8ºW), 3 km off the southwest coast of Nova Scotia, Canada. Open coastal areas with inland areas of coniferous forest, and small areas of freshwater marsh, characterize the

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island. The outer 100 m (at most) above the high-tide line were opportunistically ground-searched by two to four observers. In >10 yr of various research activities on the island (D. Shutler, unpubl. data), no nests have been found beyond this distance. Nests were located when a hen flushed, or when a hen was detected sitting on her nest. When we approached sitting females, they too would flush and defecate. Feces that we syringed, scraped, or washed off eggs, nests, and surrounding vegetation were stored in watertight containers until we returned to the lab. To minimize detectability to predators, down from nests was used to re-cover eggs after we left (Götmark 1992).

Fecal samples were processed within hours of collection to prevent degradation of parasite transmission stages. For most samples, we used fecal flotation (Georgi and Georgi 1990) to find evidence of transmission stages. Samples contained enough water from our collection procedures so that they were immediately ready to be stirred and then poured through a tea strainer; strained fluid was collected in a beaker. Using a plastic pipette, the fluid fraction was distributed into two 1.5-ml centrifuge tubes. Extra fluid fraction was discarded. Tubes were centrifuged at 380 g for 3 min. The top half of the sample in each tube was then discarded, and a saturated sugar solution (45.4 g of sugar dissolved in 35.5 ml of hot water, then cooled to room temperature) was used to top up each tube. Tubes were stirred briefly before they were again centrifuged at 380 g for 5 min. The tubes were allowed to sit for 10–15 min before a bulb pipette was used to collect a sample from the top of the liquid in the tube, where some parasite transmission stages rise to (Georgi and Georgi 1990). One drop was deposited on a microscope slide and covered with a cover slip. Because flotation is effective at extracting only some intestinal parasites, and because few positives were obtained with early samples, we also made some direct smears from unprocessed fecal samples (Table 1). In these cases, a sample of feces was spread directly on a microscope slide.

The area under the cover slip was examined with a light microscope at 100x magnification. Approximately 20 min was spent on each slide. We took digital images of objects we identified as parasite transmission stages, based on Foreyt (1990) and Roberts and Janovy (2000). Digital images were supplied to D. Duszynski (University of New Mexico), R. Evans (Acadia University), and J.D. McLaughlin (Concordia University) to confirm identifications.

Results

Ninety-nine smears were made from 43 fecal samples that came from 32 different female Common Eiders (Table 1). Direct smears were made from 9 samples; of these, 6 were from ducks that were sampled on two different days. Of the remaining 90 smears, we made 2 for each of 15 ducks, 3 for each of 6 ducks, 4 for each of 8 ducks (each sampled on two different days), and 5 from each of 2 ducks (also each sampled on two different days) (Table 1).

In total, 11 parasite transmission stages were isolated from 3 different ducks; no transmission stages were found in direct smears. None of the females sampled twice provided positive samples. Six nematode eggs (possibly *Capillaria*; Fig. 1a) were found; a sample from 1 duck had 1 and a sample from 1 duck had 5 (Table 1). Five digenean eggs were found (Fig. 1b); a sample from 1 duck had 1 (a sample from this same duck had 5 nematode eggs),

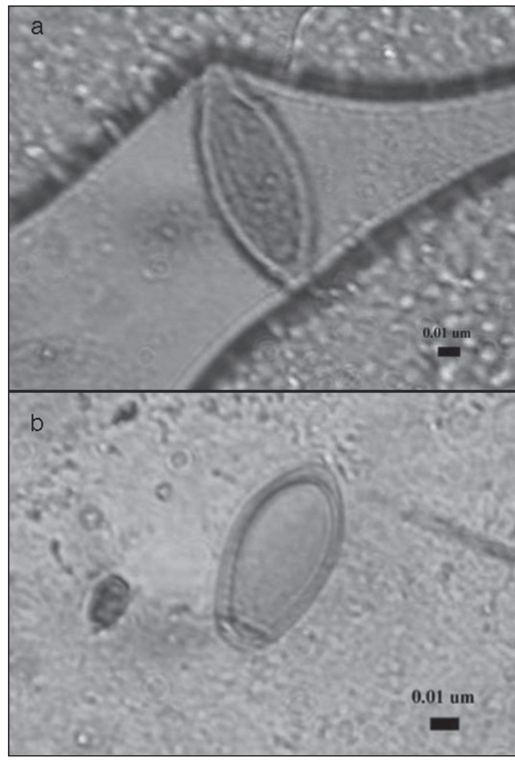

Figure 1. Representative eggs found in feces of Common Eider hens flushed from their nests: a. Nematode egg. b. Digenean egg.

Table 1. Distribution of sampling effort in collection of Common Eider feces. A sample represents the feces of 1 duck on 1 day; these samples were usually converted into 2 smears, but occasionally were converted into 3, and in the last 3 days we also made direct smears from each of the samples. The number of positive samples is also indicated.

				Samples positive for	
Date	Ducks sampled	Flotation smears	Direct smears	Digeneans	Nematodes
21 May	1	3			
22 May	7	16			
23 May	7	15			
24 May	4	8			
27 May	4	8			
29 May	2	4			
30 May	2	4			
31 May	3	6			
5 Jun	4	8			
12 Jun	3	6	3	2	1
13 Jun	2	4	2		1
19 Jun	4	8	4		

and a sample from 1 duck had 4 (Table 1). Thus, in only 3 of 32 ducks did we detect parasite transmission stages in feces, and numbers per sample were low in these ducks (c.f. Hall and Holland 2000, Moss et al. 1990).

Discussion

Parasitism is reportedly common in Common Eiders, and the low numbers of transmission stages we found in feces of incubating Common Eiders have several potential explanations. First, because Common Eiders fast during incubation (Goudie et al. 2000), parasite transmission opportunities may be low, so that parasites have been selected to stay dormant at this time. Second, parasites may not survive fasting, and may only be reacquired when eiders resume eating. Third, if transmission opportunities occur only at drinking and/or bathing sites but not nesting sites, parasites may be less likely to shed transmission stages when their host is flushed than when their host leaves the nest of its own volition; this selectivity would require extreme sensitivity by parasites, but this is not unheard of (Moore 2001). Fourth, parasite populations exhibit significant temporal and spatial variation in densities (e.g., Forbes et al. 1999; Shutler et al. 1995, 1999), and our single-season of data may have coincided with low populations for each of the parasites in which we were interested.

There are several hypotheses for defecation behavior in ducks. The most frequently tested, the protection hypothesis, proposes that feces repel predators; this hypothesis has been supported in two studies on Common Eiders (McDougall and Milne 1978, Swennen 1968). Moreover, several species of birds direct feces at predators that approach their nests (e.g., *Sterna hirundo* L. [Common Tern]; Nisbet 2002), possibly to damage insulatory properties of predators' feathers or fur. In contrast, two studies (Clark and Wobeser 1997, Olson and Rohwer 1998) found that duck feces attracted predators (neither study identified predator species), and additional studies (Hammond and Forward 1956, Keith 1961, Livezey 1980, Townsend 1966) found no effect of feces on rates of predation. Thus, the nest-protection hypothesis has limited support; in fact, feces appear in some circumstances to actually attract predators. In addition, defecation on eggs and nests may spread pathogenic bacteria to developing embryos or young that hatch (e.g., Cox et al. 2000, 2002). Accordingly, many species of birds actually make significant investments to transport feces away from their nests (Lang et al. 2002, Weatherhead 1984), and the principal proposed reasons for this behavior are that it reduces the likelihood of attracting predators and reduces the spread of disease to and among offspring. Because predators and disease are costly to ducks and their progeny, benefits that outweigh these costs of defecation on eggs need to be identified. Perhaps feces divert a predator from a flushed, and potentially vulnerable, hen to her nest. The loss of one season of reproductive investment may be a small price to pay for a long-lived bird. Alternatively, defecation lightens an individual so that it may more readily escape predators. However, adult Common Eiders weigh between 1300 and 2600 g (Goudie et al. 2000), and even if a fecal mass was 20 g, this would only be approximately 1% of a hen's mass.

In sum, we found few transmission stages in feces of incubating Common Eiders, so we have little evidence that defecation behavior, at least around the nest, could lead to parasite transmission. A clear explanation for defecation behavior remains elusive. In the case of Common Eiders, it may be instructive to sample drinking and bathing areas for evidence of parasite transmission stages.

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