Leech (Hirudinea) Infestations among Waterfowl near Yellowknife, Northwest Territories

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Bartonek, J. C. and D. L. Trauger. 1975. Leech (Hirudinea) infestations among waterfowl near Yellowknife, Northwest Territories. Canadian Field-Naturalist 89: 234-243.

Abstract. Fourteen species of aquatic birds, including 11 species of ducks, were infested with leeches, *Theromyzon rude* and *Placobdella ornata*, near Yellowknife, Northwest Territories. Leeches infested 88% of 41 American Wigeon (*Anas americana*) and 31% of 86 Lesser Scaup (*Aythya affinis*) examined after death. Lesser Scaup captured by drive-trapping contained significantly more leeches than undisturbed ducks. Leeches were attached to the host within the mucosa of the nasal chamber, to the conjunctiva of the eye, and on the skin of the body. Although only two deaths of ducklings were directly attributed to leech infestations, other birds probably died as a result of parasitism by leeches.

Although leech parasitism of waterfowl is apparently widespread in North America (Trauger and Bartonek, *in press*), the incidence and significance of these infestations is poorly understood. Greatest contributions towards knowledge of leech–waterfowl relationships have accrued from studies conducted in Canada. Early work by Moore and Meyer (1951) and Meyer and Moore (1954) clarified the taxonomic relationships of leeches parasitizing waterfowl and identified the principal host species. This information was significantly extended by Moore (1964, 1966). Ecological relationships of leeches and aquatic birds were investigated in studies of the helminth fauna of grebes (Gallimore 1964), coots (Colbo 1965), and ducks (Graham 1966). Recently, Davies (1973) reviewed the geographic distributions and hosts of freshwater leeches in Canada.

We became interested in leech parasitism of waterfowl in 1966 while conducting research on diving ducks near Yellowknife, Northwest Territories (62°28′ N, 114°24′ W). During the summer of 1967 we studied leech infestations among waterfowl to determine the incidence of this parasitism. From 1968 through 1970 we made 206 additional observations in spring and summer to increase our understanding of leech–waterfowl relationships. In this paper we describe the nature and occurrence of leech infestations among a boreal waterfowl population. The distribution and significance of leech parasitism of various species of aquatic birds is reviewed elsewhere (Trauger and Bartonek, *in press*).

Study Area

Field work was conducted in the subarctic taiga north of Great Slave Lake where numerous small wetlands occur between low granitic outcroppings of the Precambrian Shield (Murdy 1964, 1966). These water areas are predominantly bog ponds characterized by floating mats of sedges (*Carex* spp.), buckbean (*Menyanthes trifoliata*), cinquefoil (*Potentilla palustris*), and water arum (*Calla palustris*). Other types of wetlands are numerous shallow pools with emergent vegetation and infrequent large lakes with abrupt ericaceous shores. Many wetlands have bottoms of deep loose muck. Most have aquatic plants such as yellow pondlily (*Nuphar variegatum*), pondweeds (*Potamogeton* spp.), watermilfoils (*Myriophyllum* spp.), bladderworts (*Utricularia* spp.), marestails (*Hippuris* spp.), and muskgrasses (*Chara* spp.). Murdy (1964) considered these waters to be generally "hard" with limited fertility. He found median values for composite surface samples taken in mid-July to be as follows: specific conductance 125 μmhos (25°C); total alkalinity 135 ppm; and pH 7.4. Bartonek and Murdy (1970), Murdy et al. (1970), and Trauger (1971) have described the environmental characteristics of the Yellowknife study area in greater detail.

Breeding populations of waterfowl near Yellowknife ranged from 45.9 to 55.2 pairs per square mile and averaged 51.3 between 1962 and 1965 (Murdy et al. 1970). Four species comprised nearly 90% of the breeding population (Murdy 1964): Lesser Scaup (*Aythya affinis*) 48%, Mallard (*Anas platyrhynchos*) 14%, American Wigeon (*Anas americana*) 14%, Green-winged Teal (*Anas crecca carolinensis*) 11%. Less abundant species were the Pintail (*Anas acuta*) 5%, Northern Shoveler (*Anas clypeata*) 4%, Ring-necked Duck (*Aythya collaris*) 2%, and Bufflehead (*Bucephala albeola*) 1%. The Surf Scoter (*Melanitta perspicillata*), White-winged Scoter (*M. deglandi*), Canvasback (*Aythya valisineria*), and Blue-winged Teal (*Aythya discors*), represented less than 1%. Red-necked Grebes (*Podiceps grisegena*), Horned Grebes (*P. auritus*), and Arctic Loons (*Gavia arctica*) were also common breeding species inhabiting wetlands of the study area.

Nature of Infestations

Leeches infesting ducks and other waterbirds near Yellowknife were *Theromyzon rude* and *Placobdella ornata*. Although more host records exist for *Theromyzon rude* among various species of waterfowl (Meyer and Moore 1954; Moore 1966; McDonald 1969), Moore (1964, 1966) concluded that *Placobdella ornata* also feeds on blood extracted from various aquatic birds. In addition to *Theromyzon rude* and *Placobdella ornata, Glossiphonia complanata, Helobdella stagnalis,* and *Nephelopsis obscura* were collected in benthic samples from bog ponds or among food items in duck gullets during this study (Bartonek and Murdy 1970; Bartonek 1972). Moore (1964) found these species among leech specimens collected in the Yellowknife area; they also are known to occur widely in adjacent areas of Alberta (Moore 1964, 1966) and Saskatchewan (Oliver 1958). Identification of our specimens was aided by Klemm (1972) and confirmed by Roy T. Sawyer and Frederick J. Vande Vusse.

Mann (1962) has described responses of leeches (*Theromyzon* spp.) to a variety of stimuli favoring encounters with ducks. In our study, leech infestations of waterfowl were categorized according to the site of attachment: (1) eyes, (2) nasal chamber, (3) body, and (4) elsewhere.

Eyes

Leeches attached themselves to the conjunctiva at the medial canthus of the eye beneath the nictitating membrane. This attachment protected the leeches from scratching by the bird (Figure 1). Apparently leeches seldom, if ever, attached themselves to the cornea. Although no more than one leech was usually found per eye, its large size would either restrict the vision of the bird or blind it. Engorged adult leeches were readily apparent to observers, even when the bird was viewed from a distance through binoculars or telescopes. Young leeches, often several per eye, were found beneath both the nictitating membrane and the eyelid. These small leeches were often detectable only by detailed post-mortem examination.

We believe that adult leeches gained access to the eyes from the plumage of the head. Young leeches gained access to the eyes by at least three methods: (1) moving from the plumage of the head to the eye in a manner similar to that of adults, (2) being transported by the parent leech entering the eye, and (3) entering the nasal chamber, either independently or on the parent leech, and then moving to the eye via the lacrimal duct.

Leeches were removed from the eyes of captured birds by applying pressure with a fingertip against the medial edge of the nictitating membrane, which slipped back exposing the leech (Figure 1, inset) and then pulling the leech loose from the conjunctiva with a forceps. After the leech was removed, the conjunctiva remained inflamed and swollen for several hours, but blood exuded from the wound for only a few minutes. The eyelid frequently was closed for a period of time because of the irritation of hirudin, an anticoagulant secreted by the leech.

Although several European workers have reported leeches infesting the eyes of ducks and geese (Herter 1929; Christiansen 1939; Roberts 1955), this type of infestation has not been previously reported in North American waterfowl (Trauger and Bartonek, *in press*).

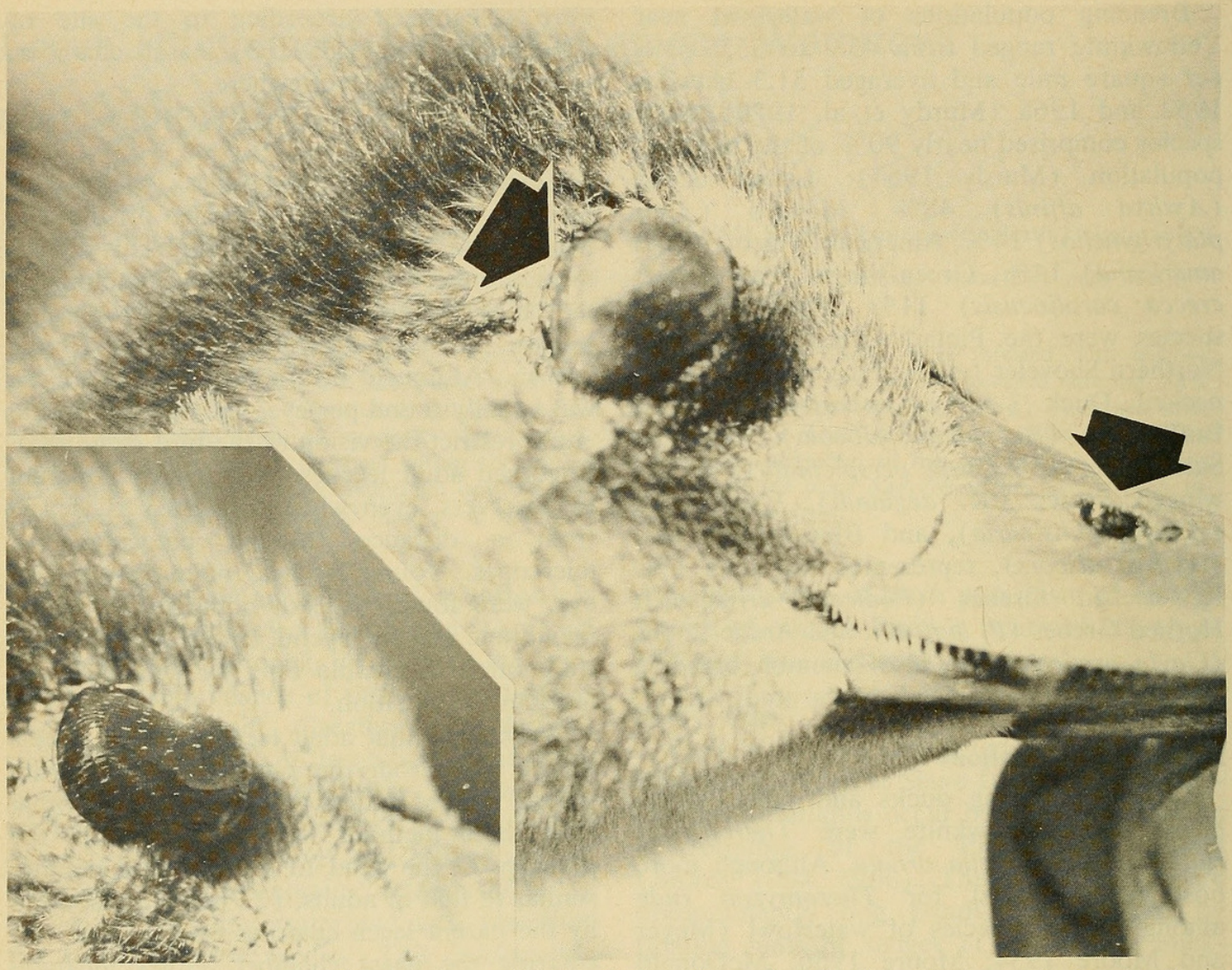

FIGURE 1. An adult leech (*Theromyzon rude*) attached to the conjunctiva beneath the nictitating membrane of this juvenile Lesser Scaup is conspicuous, while another leech is visible through the nare (arrows). The leech still clings to the conjunctiva after the nictitating membrane was slipped over its body (inset).

Kuznetsova (1955) and Roberts (1955) reported that the cornea of waterfowl became opaque after leeches fed at the conjunctiva. Kuznetsova (1955) also observed that sometimes the eye increased in size, even to the extent that it came out of the orbit. We did not observe any such signs of eye injury to any ducks handled in this study.

Nasal Chamber

Leeches attached themselves to the mucosa anywhere within the bird's nasal chamber, but generally posterior from the nares to, and occasionally inside of, the lacrimal ducts (Figure 2). Adult and young leeches that were deep within the nasal chamber were usually detected only after detailed post-mortem examination, but some adult leeches were visible through the nares (Figure 3). Engorged leeches protruding from the nares were swollen on both ends and constricted in the middle where the body passed through the nare. Such leeches were readily observed from a distance with the aid of binoculars or telescopes.

Entrance to the nasal chambers by both adult and young leeches is probably gained more frequently through the nares following attachment to and movement from the bill, and less frequently through the buccal cavity and then the pharynx following ingestion. In addition, the young leeches may be transported into the nasal chamber on adults.

Ducks react to the apparent discomfort caused by leeches in their nasal chambers by scratching with their feet at leeches protruding

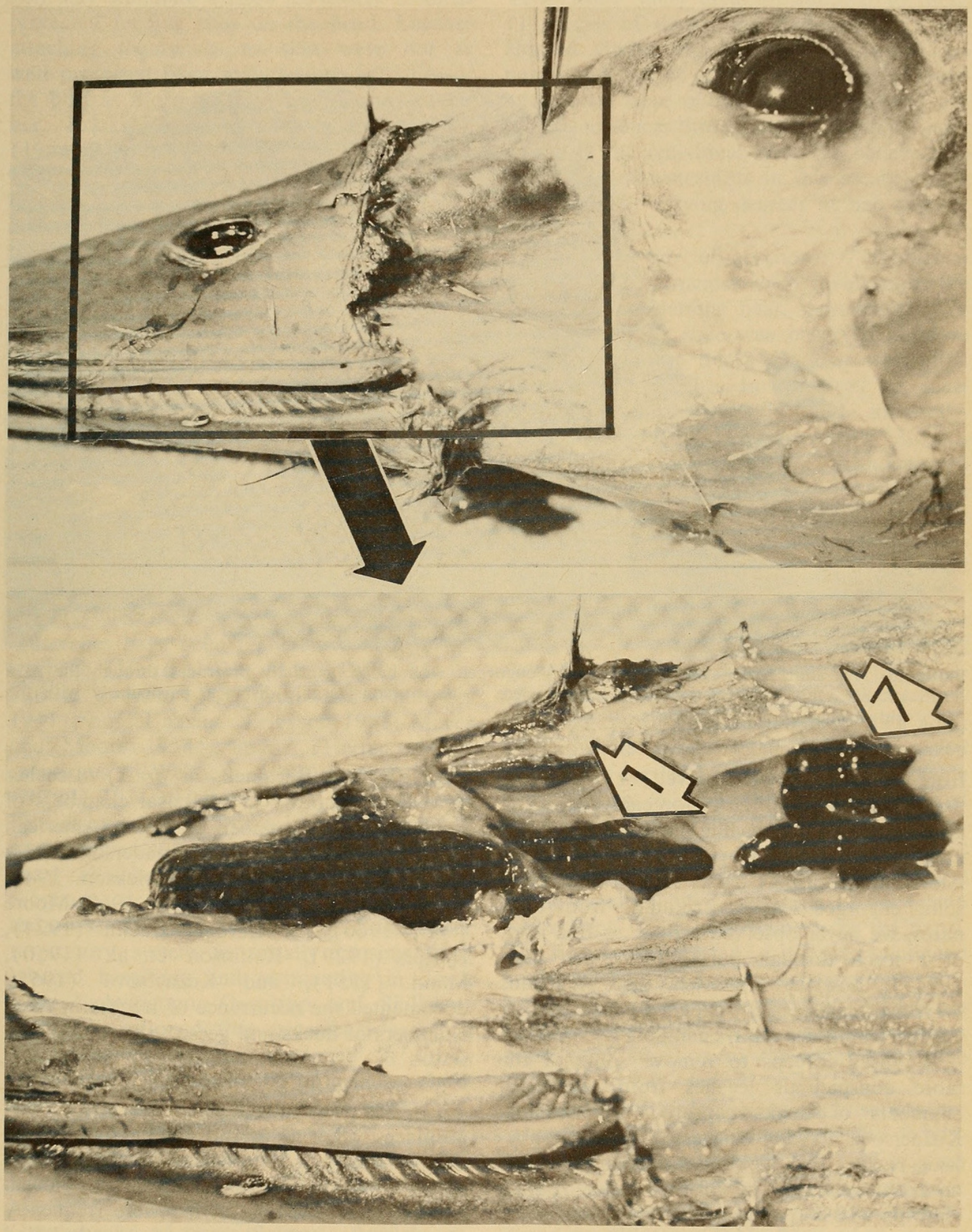

FIGURE 2. Only one adult leech (*Theromyzon rude*) is visible through the nare of this juvenile American Wigeon (above); however, dissection revealed eight leeches in the left nasal chamber (below).

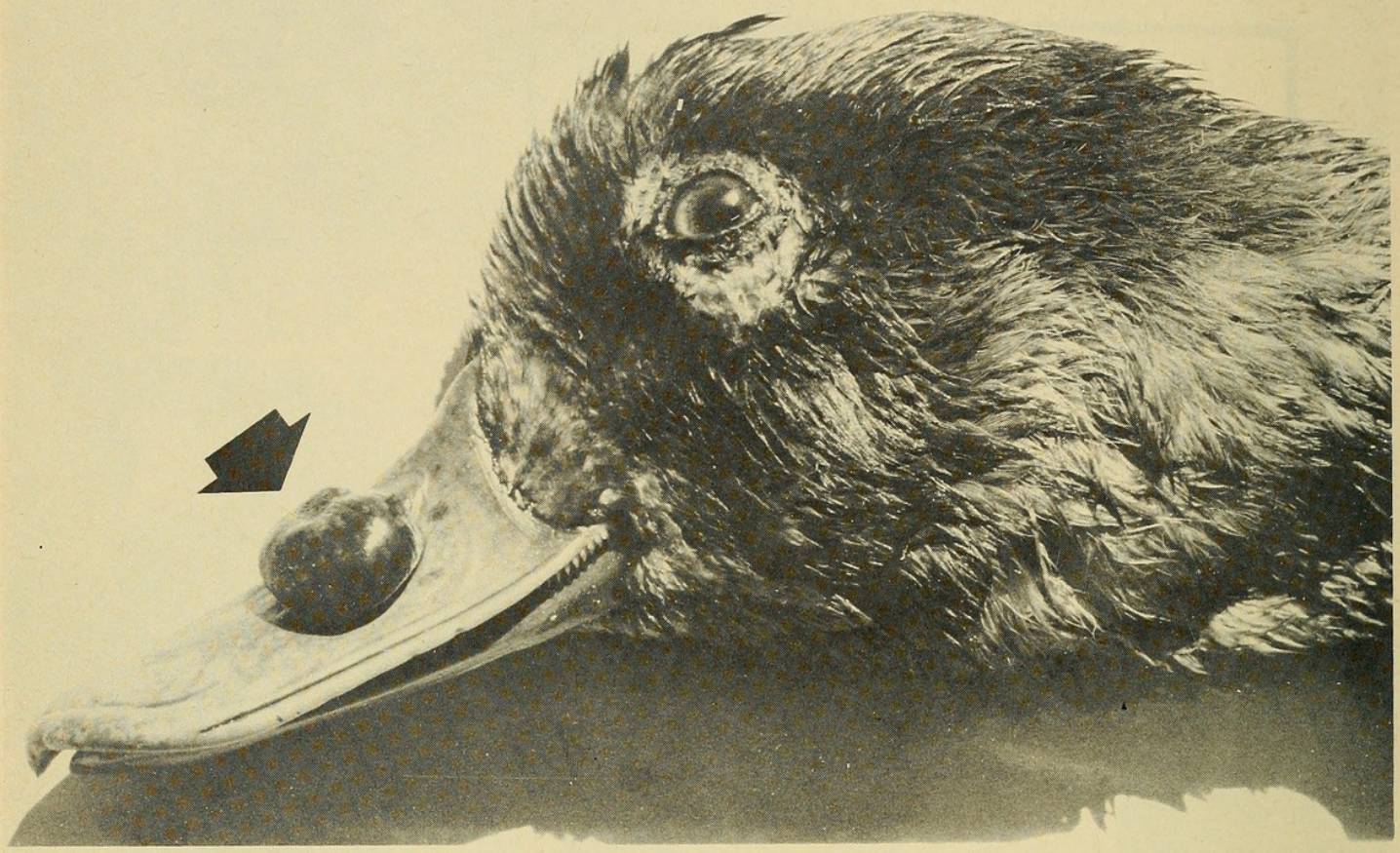

FIGURE 3. An adult leech (*Theromyzon rude*) engorged with blood, partially protrudes through the nare of this adult Lesser Scaup. Such leeches were visible at considerable distance, particularly with the aid of binoculars or telescopes.

from the nares, as we observed, or by shaking their heads and sneezing, forceably expelling air through the nares while the bill is immersed in water, as reported by Kuznetsova (1955). Although we suspect ducks scratch and injure some engorged leeches protuding from their nares, we never observed a duck to free itself of a leech through purposeful effort. Low (1945), however, reported that Redheads (*Aythya americana*) expelled the smaller leeches from their nasal chambers by sneezing.

We used forceps to remove some of the more conspicuous leeches from the nasal chambers of ducks captured for banding. Kuznetsova (1955) suggested as a prophylaxis rinsing the duck's nasal chambers with aqueous solutions of gastric juice, sodium chloride (10%), vinegar, or ammonia.

Apparently the nasal chamber is the most prevalent site of infestation by leeches (Trauger and Bartonek, *in press*). Leeches have been reported in the nasal chambers of waterfowl by a number of North American workers (Kalmbach and Gunderson 1934; Sooter 1937; Low 1945; Erickson 1948; Meyer and Moore 1954; Banko 1960; Moore 1964, 1966). In Europe, Büchli (1924), Herter (1929), Rollinson et al. (1950), Mann (1951), and Kuznetsova (1955) documented the occurrence of leeches in nasal chambers of ducks and geese.

Body

Leeches were attached to the bird's body at places other than the conjunctiva of the eye or the mucosa of the nasal chamber, namely on legs, feet, breast, or cloaca. Leeches that had not yet fed were frequently seen moving on the plumage of recently killed birds. These movements were generally to-

wards the head, suggesting that feather direction may stimulate a taxis movement towards protected feeding sites on the head. Leeches attaching themselves to skin were not as well protected from maintenance activities of the bird as those in the eye and nasal chamber. Erickson (1948), Meyer and Moore (1954), Banko (1960), and Moore (1964, 1966) also reported leeches on the body surfaces of infested waterfowl in North America, but few references have been made to this type of infestation in Europe (Rollinson et al. 1950).

Elsewhere

Leeches were found in the buccal cavity, pharynx, and larynx of autopsied birds; however, we believe that they probably moved from the nasal chamber into these areas after the birds died. In addition, leeches were found in some esophagi, proventriculi, and ventriculi of ducks examined for food habits (Bartonek and Murdy 1970; Bartonek 1972). Although leeches were apparently eaten as food, they also may have been ingested during preening.

Leeches have been reported to occupy the tracheae (Herter 1929; Mann 1951; Moore 1966), bronchi (Quortrup and Shillinger 1941), buccal cavity (Erickson 1948; Meyer and Moore 1954), larynx (Herter 1929), esophagus (Weltner 1887), and brain (Büchli 1924; Herter 1929) of waterfowl. Kuznetsova (1955) found leeches more often in the upper respiratory tracts, especially the nasal chambers, than attached within the esophagus or to the conjunctiva. He characterized severe leech infestations of the upper respiratory system as usually causing short labored breathing and terminating in death from asphyxiation. Quortrup and Shillinger (1941) mentioned that occasional cases of verminous pneumonia developed in ducks infested with leeches in the bronchi.

Incidence of Infestation

Between 1966 and 1970, Mallards, Pintails, Green-winged Teals, American Wigeons, Northern Shovelers, Ring-necked Ducks, Canvasbacks, Lesser Scaups, Buffleheads, White-winged Scoters, and Surf Scoters were found to be infested with leeches on the Yellowknife study area. In addition to these 11 species of ducks, the Red-necked Grebe, Horned Grebe, and Arctic Loon were also parasitized. All of our determinations of leech infestations were of the moment and did not reflect incidences throughout the summer, year, or life of the individual bird. We believe that all species of waterbirds in this locality were parasitized to varying degrees at one time or other by leeches.

Based on our observations, *Theromyzon rude* was the principal leech involved in the waterfowl infestations near Yellowknife. We estimate that *T. rude* was observed in more than 95% of the ducks or other waterbirds infested with leeches in the eyes or nasal chamber, both externally and internally. *Placobdella ornata* was infrequently encountered parasitizing waterfowl. Although *P. ornata* was found in the nasal chamber of a few ducks, this species was usually attached externally to the skin or plumage of the host. We did not discriminate between *T. rude* and *P. ornata* in calculating incidence of infestation. Furthermore, no attempt was made to determine the fate of ducks released following removal of leeches from beneath the nictitating membrane or inside the nasal chamber.

Incidences of infestation among 135 adult and juvenile ducks killed and necropsied specifically for leeches are presented in Table 1. American Wigeon (88%) were infested very significantly ($P < 0.01$) more than the Lesser Scaup (31%). Juveniles were infested slightly more than adults. Of 66 ducks infested in the nasal chamber, only one Lesser Scaup had a leech visibly protruding from the nares. The five ducks infested in the eyes contained young leeches which were apparent only during the post-mortem examination. All leeches on the body were found on the plumage; none were attached to the skin; and none appeared to have fed.

Undisturbed birds were carefully scrutinized at a distance through binoculars and a telescope for leeches in each eye and in each nare. Leeches protruding from the nares were observed in 5 of 130 Lesser Scaup, 2 of 52 American Wigeon (Table 2), and 1 of 102 birds representing seven other species. Leeches

TABLE 1—Incidence of infestation and site of attachment by leeches parasitizing four species of ducks collected and necropsied near Yellowknife, Northwest Territories, summer 1967

Species Age	Number of birds examined	Number of birds infested: Nasal chambers	Eyes	Body[1]	Total	Percent infested	Average number of leeches per infested bird
Lesser Scaup				2	8	24	2.1
Adult	33	7	0				
Juvenile	53	19	1	0	19	36	2.9
American Wigeon							
Adult	11	7	0	3	7	64	3.9
Juvenile	30	28	2	15	29	97	4.1
Mallard							
Juvenile	7	5	2	0	5	71	12.0
Green-winged Teal							
Adult	1	0	0	0	0	0	—
Total	135	66	5	20	68		
Percent infested		49	4	15	50		
Average number of leeches per infested bird		3.4	2.0	2.0	3.9		

1 Leeches were on plumage but not feeding.

were not detected in the eyes of these 284 birds. But young leeches within either the nasal chamber or eye, and adult leeches within the nasal chamber could not be detected by this method of observation.

We superficially examined 485 birds captured by drive-trapping during 1967. Leeches, both protruding from the nares as in Figure 3 and barely visible through the nares as in Figure 1, were found in 36% of 396 Lesser Scaup and 31% of 36 American Wigeon (Table 2). Twelve (23%) of 53 birds of eight other species were infested with leeches: eight birds in the eye, five birds in the nasal chamber, and two birds on the body.

Disturbed ducks were more susceptible to leech infestation than those that were undisturbed. Comparative data on "disturbed" and "undisturbed" Lesser Scaup and American Wigeon were obtained by determining the incidence of infestation using three methods (Table 2), namely: (1) necropsying ducks killed while actively feeding, (2) observing ducks at a distance through either binoculars or telescopes, and (3) examining, in the hand, ducks captured by drive-trapping. The first two methods we regard as causing the least disturbance, or "undisturbed," while drive-trapping caused the most disturbance, or "disturbed."

TABLE 2—Percentage of leech-infested Lesser Scaup and American Wigeon from Yellowknife, Northwest Territories, during the summer of 1967, as determined from three methods: (1) necropsy of ducks collected, (2) examination of birds captured by drive-trapping, and (3) observations of ducks through binoculars and telescopes

Host species site of attachment	Percent of ducks infested by leeches, as determined by: Necroposy	Examination	Observation
Lesser Scaup			
(Sample size)	(86)	(396)	(130)
Nasal chamber	30	28	4
Eye	1	9	0
Body	0	1	0
Total	31	36	4
American Wigeon			
(Sample size)	(41)	(36)	(52)
Nasal chamber	85	19	4
Eye	5	22	0
Body	0	0	0
Total	88	31	4

No ducks examined post-mortem contained adult leeches in their eyes similar to the one shown in Figure 1. One Lesser Scaup and two American Wigeon contained young leeches in their eyes, but these leeches could be detected only during the detailed necropsies. No differences in the incidence of adult leeches infesting the eyes of ducks were found in the two "undisturbed" groups. The incidence of adult leeches infesting the eyes of "disturbed" ducks, however, was greater than observed in the "undisturbed" groups for both the Lesser Scaup ($\chi^2 = 31.1$, $df = 1$, $P < 0.005$) and the American Wigeon ($\chi^2 = 1.78$, $df = 1$, $P < 0.25$). We also believe that the incidence of adult leeches protruding from the nares was greater among the "disturbed" than the "undisturbed" birds. Unfortunately, we did not distinguish between leeches protruding from the nares and those barely visible through the nares, which would be necessary for a test of difference.

During drive-trapping operations, ducks were frequently aware of human intrusion for several hours before the drive was under way. Once ducks entered the trap they usually dived in an effort to escape, which increased their chances of becoming infested by leeches. We believe that birds, when disturbed, are less attentive to normal preening habits, thereby increasing the probability of leeches gaining access to protected feeding sites in the eye and nasal chamber instead of being either preened from or eaten by the intended host. Meyer and Moore (1954) also remarked on the rapidity with which leeches attached themselves to ducks when the birds were chased and forced to dive by humans.

Birds captured by drive-trapping and infested during the disturbance associated with the drive often lost their leeches within an hour after being out of the water. We believe that leeches voluntarily dropped from the ducks after they became satiated or desiccated as a result of the duck's being out of water for prolonged periods, such as being held in pens prior to banding.

The incidence of leech parasitism varied among ponds. Some ponds had more than 40% of the ducklings infested with leeches whereas other ponds had infestation rates less than 20%. Ducklings on a few ponds appeared to be free of leeches. Small sample sizes and possibly inconsistent effort in observing and recording incidence of leech infestations between years and ponds precluded a more detailed analysis. But we believe that differences in infestation rates existed between ponds as well as from year to year. Gallimore (1964) and Colbo (1965) found differences in the infestation rates of *Theromyzon rude* in grebes and coots among pond, slough, and lake habitats in Alberta.

Leeches infested waterfowl throughout their stay in the Yellowknife area. Meyer and Moore (1954) noted that leeches became active prior to the melting of ice in Manitoba. Likewise, our earliest record is that of an adult female Lesser Scaup with a leech protruding from the nostril when collected on 15 May 1968, at a time when most ponds were still frozen. Between 25 and 30 May 1969, a Mallard, a Ring-necked Duck, and three Lesser Scaup were seen with leeches protruding from their nostrils. Infestations of leeches appeared to peak during July and August, coinciding with the peak brooding season for both leeches (Hagadorn 1962) and ducks (Murdy 1964). Gallimore (1964) and Colbo (1965) also reported summer peaks in the *Theromyzon rude* infestations of grebes and coots in Alberta. Ducks were found hosting leeches up to the time of our departure from the study area in early September. We have no reason to assume that ducks did not host the leeches up to and possibly even during migration.

Significance of Infestations

Leech infestations of waterfowl are widespread in North America, but various workers have apparently regarded leeches to be of little consequence to the survival of birds (Trauger and Bartonek, *in press*). Although quantitative data are scarce for evaluating the significance of leeches as a mortality factor, investigators have reported leech parasitism of 17 species of waterfowl.

During five summers we observed the deaths of only two ducks that were directly attributed to leech infestations. During August 1966 we found two emaciated ducklings, a White-

winged Scoter and a Surf Scoter, that were blinded in both eyes by many young leeches. These birds were effortlessly caught and placed in the bottom of our canoe where they died shortly afterwards. Although leeches were thought to be the primary cause of death, necropsies were not conducted to determine the extent of other parasitism or the existence of other diseases. The stress associated with capture was probably a contributing factor.

In August 1968 a Surf Scoter duckling was easily caught by hand as it swam aimlessly beside our canoe. This duck was weak and blinded by five engorged leeches in the eyes, three in the left and two in the right. Although the young Scoter did not die while in our possession, it was near death when released after the leeches were removed. Several days later a juvenile Arctic Loon, blinded by leeches and extremely weak, was also captured by hand. Nine leeches were removed from the eyes and three additional leeches were taken from the nasal cavity. When the bird was released, it made a feeble escape and swam away listlessly. Unfortunately, we were unable to determine the fate of these birds because of other field responsibilities. Nevertheless, we believe that other deaths due to leech infestations may have occurred. Juvenile mortality is difficult to detect except indirectly through a decline in the number of ducklings per brood.

Trauger observed one sequence of events that is highly suggestive of duckling mortality due to leeches. On 29 July 1969 he observed a Ring-necked Duck brood consisting of five ducklings (6 to 10 days old). One duckling had an engorged leech protruding from the nares and was lagging behind the other ducklings as the brood swam away from the shoreline. The next day a Ring-necked Duck brood with only four ducklings (6 to 10 days old) was observed on the same pond. No leeches were observed on any of the ducklings. The stray duckling was not located during a thorough search of the area, and it was presumed that this bird had either died or was killed during the night.

Leech parasitism of Green-winged Teal, Bufflehead, White-winged Scoter, Surf Scoter, and Arctic Loon reported in this study represent new host records for these species. Gallimore (1964) and Moore (1964) reported the first host records for the Red-necked Grebe and Horned Grebe. Host records for other waterfowl species are reviewed by Trauger and Bartonek (*in press*).

Acknowledgments

Harold A. Kantrud, Kenneth F. Higgins, Gary L. Krapu, and the late H. W. Murdy, Northern Prairie Wildlife Research Center, aided us in making observations of leech-infested waterfowl. Robert Bromley and David Bartesko, Yellowknife, Northwest Territories, also assisted with field work. Roy T. Sawyer, Department of Biology, College of Charleston, Charleston, South Carolina and Frederick J. Vande Vusse, Department of Biology, Gustavus Adolphus College, St. Peter, Minnesota, identified the leeches. Vande Vusse also provided us with several pertinent references on leeches parasitizing waterfowl. Gary L. Pearson, George A. Swanson, and Gary L. Krapu, Northern Prairie Wildlife Research Center, provided editorial assistance with the manuscript.

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Received 7 May 1974
Accepted 8 February 1975

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