

Some observations on *Pseudomenopon pilosum* (Amblycera: Menoponidae), the louse vector of *Pelecitus fulicaeatrae* (Nematoda: Filarioidea) of coots, *Fulica americana* (Aves: Gruiformes)

CHERYL M. BARTLETT AND R. C. ANDERSON

Department of Zoology, College of Biological Science, University of Guelph, Guelph, Ont., Canada N1G 2W1

Received April 18, 1988

BARTLETT, C. M., and ANDERSON, R. C. 1989. Some observations on *Pseudomenopon pilosum* (Amblycera: Menoponidae), the louse vector of *Pelecitus fulicaeatrae* (Nematoda: Filarioidea) of coots, *Fulica americana* (Aves: Gruiformes). *Can. J. Zool.* **67**: 1328–1331.

Breeding populations of *Pseudomenopon pilosum* (Scopoli, 1763) became established on 10 laboratory-reared juvenile American Coots (*Fulica americana* Gmelin) initially infested with 5 adult male and 5 adult female lice. Eggs of *P. pilosum* hatched less than 10 days after deposition and the combined duration of the three nymphal instars was 10–20 days. Nymphs and adults occupied all regions of the body. *Pseudomenopon pilosum* might thus acquire microfilariae of *Pelecitus fulicaeatrae* (Diesing, 1861) by simply randomly moving to and feeding on the legs where, in infected coots, the skin-inhabiting microfilariae of *P. fulicaeatrae* are known mainly to occur. *Pseudomenopon pilosum* occurred on all of 13 adult coots and three 1-week-old coot chicks collected in June in western Canada where *P. fulicaeatrae* is enzootic. Third-stage larvae of *P. fulicaeatrae* were found in adult *P. pilosum* on two of four adult coots harbouring microfilariae, but prevalence in lice was low (5.5% of 18 lice on one coot and 1.1% of 90 on the second) and only one third-stage larva was present in each infected louse. Four other species of lice were present on adult coots but only one other on 1-week-old chicks. Experiments showed that *P. pilosum* could occur as a straggler on chickens (*Gallus gallus* (L.)) and Red-necked Grebes (*Podiceps grisegena* (Boddaert)) although it did not establish on either species.

BARTLETT, C. M., et ANDERSON, R. C. 1989. Some observations on *Pseudomenopon pilosum* (Amblycera: Menoponidae), the louse vector of *Pelecitus fulicaeatrae* (Nematoda: Filarioidea) of coots, *Fulica americana* (Aves: Gruiformes). *Can. J. Zool.* **67** : 1328–1331.

Des populations de *Pseudomenopon pilosum* (Scopoli, 1763) ont réussi à s'établir chez 10 Foulques d'Amérique (*Fulica americana* Gmelin) juvéniles élevées en laboratoire et infectées au départ de 5 ricins mâles et de 5 ricins femelles adultes. Les oeufs de *P. pilosum* ont éclos en moins de 10 jours et les trois stades larvaires ont duré 10–20 jours au total. Les larves et les adultes se sont répartis dans toutes les régions du corps. *Pseudomenopon pilosum* semble donc acquérir des microfilaires de *Pelecitus fulicaeatrae* (Diesing, 1861) simplement en migrant au hasard vers les pattes et en s'y nourrissant, puisque les pattes sont l'endroit où les microfilaires parasites de la peau sont normalement trouvés chez les foulques infectées. Des *P. pilosum* ont été trouvés chez chacune des 13 foulques adultes et chez les 3 oisillons de 1 semaine capturés en juin dans l'ouest du Canada où *P. fulicaeatrae* est endémique. Des larves de troisième stade de *P. fulicaeatrae* ont été trouvées chez des adultes de *P. pilosum* sur deux de quatre foulques parasitées par des microfilaires, mais la prévalence chez les ricins était faible (5,5% des 18 ricins trouvés chez une foulque et 1,1% des 90 ricins trouvés chez la seconde) et une seule larve de troisième stade était présente dans chaque ricin infecté. Quatre autres espèces de ricins étaient présentes chez les foulques adultes, mais une seule chez les oisillons de 1 semaine. Des expériences ont démontré que *P. pilosum* pouvait être un parasite occasionnel des poulets (*Gallus gallus* (L.)) et des Grèbes jougris (*Podiceps grisegena* (Boddaert)), mais ne réussissait à s'établir de façon permanente ni chez l'une ni chez l'autre espèces.

[Traduit par la revue]

Introduction

The amblyceran chewing louse *Pseudomenopon pilosum* (Scopoli, 1763) is the vector of *Pelecitus fulicaeatrae* (Diesing, 1861), a common filarioid nematode parasite of the American Coot (*Fulica americana* Gmelin) (see Bartlett and Anderson 1987). Chewing lice have rarely been reported as vectors of filarioids and, during the course of our work with *P. fulicaeatrae*, opportunities arose to make preliminary observations on the biology of *P. pilosum*. These observations, which pertain to the role of *P. pilosum* as a vector, are reported herein.

Materials and methods

Five live adult male and 5 live adult female *Pseudomenopon pilosum* were placed on the head of each of 10 juvenile (approximately 3 months old) American Coots (*Fulica americana*) which had been hatched and reared in captivity (as per group E coots in Bartlett and Anderson, 1987). Lice were obtained from a juvenile coot that had been housed for 2 months with 13 naturally infested adult coots (the group A coots of Bartlett and Anderson, 1987). The 10 juvenile coots were housed individually in wire cages approximately 1 × 0.5 × 0.5 m in size. Commercial duck chow and drinking water were provided *ad libitum*; swimming water was not provided.

Two juveniles were killed, via an interperitoneal injection of sodium pentobarbital, at each of 10, 20, 30, 40, and 50 d postinfestation. Wings were immediately wrapped in paper towels soaked in chloroform and each was enclosed in a small plastic bag. The remainder of the body was swathed in paper towels soaked in chloroform and the whole carcass was placed in a large plastic bag and frozen. Later, carcasses were thawed and the skin divided into body regions as outlined in Eveleigh and Threlfall (1976), with the following two modifications. It was not practical to separate the long, slender neck into lateral as well as dorsal and ventral portions and, therefore, only the latter two divisions were made. Second, because few lice were found on the crown, auricular region, and gular region, data from these three areas were combined and are referred to as data from the head. Each piece of skin was washed in two changes of soapy water and the water was passed through a 100-mesh Endecott sieve. Lice remaining on the skin or sieve were transferred to 70% alcohol and sorted to nymph, adult male, and adult female.

Eight adult coots were shot near Brooks, Alberta, in the 1st week of June 1987, and five adults and three chicks (approximately 1 week old) were shot near Oak Lake, Manitoba, in the 2nd week of June 1987. Each bird was placed in a plastic bag and frozen. Later, carcasses were thawed and each whole carcass was washed in two changes of soapy water. Lice were collected as above and sorted to species, nymph, adult male, and adult female.

Adult coots shot in the wild were also examined for adults and microfilariae of *Pelecitus fulicaeatrae*. If microfilariae of *P. fulicaeatrae* were present in fluid around adult worms, then all adult *P. pilosum* on that coot were dissected and examined for third-stage larvae of *P. fulicaeatrae*.

Four juvenile (1 month old) domestic chickens (*Gallus gallus* (L.)) were placed in a flight pen (5 × 1 × 3 m) with a juvenile coot harbouring numerous adult and nymphal *P. pilosum*. Thirty days later, the coot was removed and two chickens were killed and their feathers and skin examined grossly for lice. Seven days after the coot was removed, the remaining two chickens were killed and examined for lice.

Adult *P. pilosum* were removed from naturally infested adult coots and approximately 25 males and 25 females transferred to each of two additional juvenile chickens. Chickens were housed together in a wire bottomed cage (2 × 0.5 × 0.5 m) and provided with water and commercial chicken feed *ad libitum*. Feathers and skin were examined grossly for lice 2 d postinfestation. Chickens were killed 10 d postinfestation and feathers and skin were again examined grossly for lice.

Various numbers of *P. pilosum* (depending on their availability) were removed from naturally infested coots and transferred to three juvenile (2.5–3 months old) Red-necked Grebes (*Podiceps grisegena* (Boddaert)) which had been hatched in captivity, fed live fish, and maintained in indoor cages on artificial grass carpeting without access to swimming water. One grebe received approximately 50 lice (including both nymphs and adults) and was examined grossly for lice 2 d later, then killed 10 d postinfestation. Feathers and skin were digested in warm 5% KOH and the digest passed through a 100-mesh Endecott sieve. A second grebe received 10 adult lice and was killed 45 d postinfestation; its feathers and skin were digested as above. A third grebe initially received 17 adult lice. Twelve days postinfestation it received approximately 50 more lice (including both nymphs and adults) and, 6 months after the initial infestation, approximately 50 more lice (mainly adults). This grebe was killed 8 months after the initial infestation and its feathers and skin examined grossly for lice.

Use of the terms prevalence and intensity follows Margolis et al. (1982).

Lice from wild coots were deposited in the United States National Parasite Collection in Beltsville, Maryland (Nos. 80352–80360), the Canadian National Collection at the Biosystematics Research Centre in Ottawa, Ontario (unnumbered), and the British Museum (Natural History) in London, England (No. BM.1988-197).

Results

Nymphal and adult *Pseudomenopon pilosum* were found on all 10 experimentally infested coots; nymphs were usually most numerous (Table 1). Lice were present on most body regions of all coots (Table 1).

TABLE 1. Numbers of *Pseudomenopon pilosum* found on different regions of the body of 10^a experimentally infested American Coots (*Fulica americana*) at specific times postinfestation (p.i.)

Days p.i.	Whole body ^b				Neck									
	♂♂	♀♀	N	T	Head	Dorsal	Ventral	Back	Breast	Abdomen	Wings	Legs	Tail	
Coot 1	10	2	3	14	19	1	1	1	2	3	1	8	2	0
Coot 2	10	2	0	26	28	4	2	3	0	2	1	10	3	3
Coot 3	20	18	26	31	75	0	0	8	20	31	3	8	1	4
Coot 4	20	7	7	9	23	10	0	1	2	3	2	0	2	3
Coot 5	30	5	6	53	64	1	2	4	11	8	7	27	3	1
Coot 6	30	22	18	54	94	0	3	14	13	17	1	23	4	19
Coot 7	40	20	17	53	90	2	5	5	11	30	6	23	6	2
Coot 8	40	32	15	142	189	3	19	16	27	35	9	67	11	2
Coot 9	50	12	13	59	84	2	5	9	20	14	2	21	7	4
Coot 10	50	4	0	8	12	1	2	1	2	0	1	2	2	1
Total		124	105	449	678	24	39	62	108	143	33	189	41	39

^aFive adult male and five adult female lice were initially placed on each coot; two coots were killed every 10 days postinfestation.

^b♂, no. of adult males; ♀, no. of adult females; N, number of nymphs; T, total no. of lice.

Two species of Amblycera (*Pseudomenopon pilosum* (Scopoli, 1763) and *Laemobothrion atrum* (Nitzsch, 1818)) and three species of Ischnocera (*Rallicola advenus* (Kellogg, 1896), *Incidifrons transpositus* (Kellogg, 1896), and *Fulicoffula longiphila* (Kellogg, 1896)) were found on adult coots (Table 2). *Pseudomenopon pilosum* and the three ischnocerans were found on all adult coots. *Pseudomenopon pilosum* and *R. advenus* were the only lice present on coot chicks (Table 2).

Adults of *Pelecitus fulicaeatrae* were found in seven of eight adult coots from Alberta. Five coots contained both male and female worms in the same ankle and microfilariae were present in fluid around worms in three (Nos. 2, 5, and 7). Adult *P. fulicaeatrae* were found in all five adult coots from Manitoba. Three coots contained both male and female worms in the same ankle and microfilariae were present in fluid around adult worms in two (Nos. 1 and 4).

An infective third-stage larva of *P. fulicaeatrae* was found in 1 of the 5 female *P. pilosum* on Alberta coot No. 5 and another was found in 1 of the 43 female *P. pilosum* on Alberta coot No. 7. Infective third-stage larvae were not present in male lice on these two coots or in *P. pilosum* on other coots that harboured microfilariae.

Two adult female *P. pilosum* were found on one of the chickens that had been housed with an infected coot and killed the day the coot was removed. Lice were not present on the other chicken killed the same day or on the two killed 7 d after the coot was removed. Lice were not present on the two chickens that had been experimentally infested with approximately 50 adult *P. pilosum* and examined 2 and 10 d postinfestation.

A few (< 5) *P. pilosum* were observed on the live grebe 2 d postinfestation but none at later times.

Discussion

Breeding populations of *P. pilosum* became established on all experimentally infested coots. The presence of nymphs at 10 d postinfestation indicates that eggs of *P. pilosum* hatch less than 10 days after deposition, an incubation period similar to that of the other two amblyceran lice (*Menacanthus stramineus* (Nitzsch, 1818) and *Ricinus elongatus* (Olfers, 1816)) that have been studied (Marshall 1981). The combined length of

the three nymphal instars of *P. pilosum* is longer than 10 days (as indicated by the presence of fewer than five adult lice of either sex on coots 10 d postinfestation) but less than 20 days (as indicated by the presence of more than five adults of both sexes on coots 20 d postinfestation). The duration of the nymphal period is 9 and 30 days in the other two amblycerans studied (Marshall 1981).

Bartlett and Anderson (1987) found microfilariae of *Pelecitus fulicaeatrae* in both nymphal and adult *P. pilosum* but infective third-stage larvae of *P. fulicaeatrae* only in adult lice. They suggested that third-stage larvae occur only in adult lice either because the combined duration of the three nymphal instars is too short to allow the filarioid to develop to the third stage or because development to the third stage is physiologically dependent on the adult louse stage. Based on the present study, it appears that the duration of the nymphal period of *P. pilosum* is sufficiently long since most filarioids in the subfamily Dirofiliariinae (of which *P. fulicaeatrae* is a member) require only 9–15 days (Bartlett 1984 and references therein). The adult stage of the vector may, therefore, be necessary. With the exception of *P. fulicaeatrae*, all species in Dirofiliariinae that have been studied to date develop in dipterans, and microfilariae are only ingested by the adult stage of the vector.

Pseudomenopon pilosum probably acquires microfilariae of *P. fulicaeatrae* primarily when feeding on the legs of coots because it is in the neck of feather follicles in that region that the microfilariae of *P. fulicaeatrae* mainly occur (Bartlett and Anderson 1987). Lice were present on the legs of all experimentally infested coots in the present study although the low proportion of lice found there (6.0% of 678) suggests that legs were not preferentially occupied. In addition, the low prevalence of infective-stage filarioid larvae in lice on captive (Bartlett and Anderson 1987) and wild (present study) coots suggests that lice do not preferentially feed in regions where microfilariae occur. *Pseudomenopon pilosum* is a highly motile louse (personal observation) and may simply randomly move to and feed in various sites, including the legs. Threlfall and Wheeler (1986) considered *P. pilosum* primarily a body louse.

Pseudomenopon pilosum and three other species of lice were

TABLE 2. Numbers of adult males, adult females, and nymphs of five species of Mallophaga on adults and chicks of American Coots (*Fulica americana*) collected in the first 2 weeks of June 1987, in Alberta and Manitoba, Canada

	<i>Pseudomenopon pilosum</i>			<i>Laemobothrion atrum</i>			<i>Rallicola advenus</i>			<i>Incidifrons transpositus</i>			<i>Fulicoffula longiphila</i>		
	♂♂	♀♀	Nymphs	♂♂	♀♀	Nymphs	♂♂	♀♀	Nymphs	♂♂	♀♀	Nymphs	♂♂	♀♀	Nymphs
Alberta															
Adult 1	41	24	54	1	1	0	94	106	208	5	3	29	40	38	44
Adult 2	26	18	30	0	0	0	40	34	96	4	10	87	16	14	38
Adult 3	8	4	12	0	0	0	46	55	71	2	2	33	22	34	57
Adult 4	44	36	50	1	0	4	67	71	118	6	0	20	25	19	30
Adult 5	13	5	6	0	0	0	54	55	31	0	2	6	9	7	15
Adult 6	17	5	28	0	0	0	94	91	165	9	5	21	13	11	39
Adult 7	37	43	46	0	0	4	132	149	148	2	2	19	26	21	27
Adult 8	23	7	14	0	1	9	78	55	107	1	1	7	7	10	17
Manitoba															
Adult 1	26	22	29	2	1	3	110	110	110	0	1	8	15	14	40
Adult 2	0	0	4	0	3	24	46	34	90	3	1	18	8	13	10
Adult 3	2	1	31	2	0	12	86	71	233	9	5	54	24	15	16
Adult 4	1	0	1	1	1	2	22	26	56	7	3	44	3	6	2
Adult 5	14	7	22	2	2	8	57	63	191	0	3	30	18	13	22
Chick 1	1	0	20	0	0	0	0	0	1	0	0	0	0	0	0
Chick 2	11	8	22	0	0	0	0	0	1	0	0	0	0	0	0
Chick 3	5	4	2	0	0	0	0	0	0	0	0	0	0	0	0

present on all adult coots collected in the wild. *Laemobothrion atrum* was also present on some and has not previously been reported in Canada. The ischnoceran *Rallicola advenus* was the most common louse on all adult coots. Interestingly, *P. pilosum* was the only species that survived on wild-caught adult coots maintained in captivity for up to 9 months (unpublished data for group A coots of Bartlett and Anderson, 1987).

Pseudomenopon pilosum was present on all coot chicks and *P. fulicaeatrae* could, therefore, be transmitted from adult birds to chicks shortly after the latter hatched. The only other louse species harboured by chicks was *R. advenus* but only one nymph was present on each of two chicks whereas intensities of *P. pilosum* were higher. Possibly, down feathers, which alone are present on hatchling coots, do not provide adequate food or shelter for ischnocerans. The latter might generally, therefore, be acquired when chicks are older.

Grebes (*Podiceps* spp.) in western Canada are parasitized by *P. fulicaeatrae* (see Bartlett and Anderson 1987) but reports of *P. pilosum* on them are not considered valid even though the louse is known to lack strict host specificity (Price 1974). In the present study, *P. pilosum* did not establish on Red-necked Grebes but did survive for a few days postinfestation. Thus, in nature, individuals of *P. pilosum* might occur as stragglers on grebes and, if they harbour infective-stage filarioid larvae, could transmit *P. fulicaeatrae*. Similar straggling of *P. pilosum* might result in sporadic infections of *P. fulicaeatrae* in other bird species. Experimental evidence for straggling is provided by the fact that lice transferred to a chicken housed with an infested coot. *Pseudomenopon pilosum* did not, however, establish on chickens.

Acknowledgements

We gratefully acknowledge Professor A. O. Bush of Brandon University who helped collect coots, Karen Higdon of the University of Guelph who provided technical assistance throughout the study, and Terry A. Wheeler of the University of Guelph who identified louse species. Birds were collected under permits issued by Alberta Forestry, Lands and Wildlife and the Canadian Wildlife Service. This study was supported by a Natural Sciences and Engineering Research Council of Canada operating grant to R. C. Anderson.

- BARTLETT, C. M. 1984. Development of *Dirofilaria scapiceps* (Leidy, 1886) (Nematoda: Filarioidea) in *Aedes* spp. and *Mansonia perturbans* (Walker) and responses of mosquitoes to infection. *Can. J. Zool.* **62**: 112–129.
- BARTLETT, C. M., and ANDERSON, R. C. 1987. *Pelecitus fulicaeatrae* (Nematoda: Filarioidea) of coots (Gruiformes) and grebes (Podicipediformes): skin-inhabiting microfilariae and development in Mallophaga. *Can. J. Zool.* **65**: 2803–2812.
- EVELEIGH, E. S., and THRELFALL, W. 1976. Population dynamics of lice (Mallophaga) on auks (Alcidae) from Newfoundland. *Can. J. Zool.* **54**: 1694–1711.
- MARGOLIS, L., ESCH, G. W., HOLMES, J. C., KURIS, A. M., and SCHAD, G. A. 1982. The use of ecological terms in parasitology. (Report of an ad hoc committee of the American Society of Parasitologists.) *J. Parasitol.* **68**: 131–133.
- MARSHALL, A. G. 1981. The ecology of ectoparasitic insects. Academic Press, London.
- PRICE, R. D. 1974. A review of the genus *Pseudomenopon* (Mallophaga: Menoponidae). *Ann. Entomol. Soc. Am.* **67**: 73–84.
- THRELFALL, W., and WHEELER, T. A. 1986. Ectoparasites from birds in Newfoundland. *J. Wildl. Dis.* **22**: 273–275.